VERIFY HARD COPY AGAINST WEB SITE IMMEDIATELY PRIOR TO EACH USE

West Valley Demonstration Project

Doc. ID Number WVNS-SAR-001

Revision Number 10

Revision Date 01/23/2006

Engineering Release #1427

SAFETY ANALYSIS REPORT FOR

WASTE PROCESSING AND SUPPORT ACTIVITIES

APPROVED: 12-30-04

L.J. Chilson, Manager, Nuclear Safety and Emergency Management — Date

12-30-04

J.R. Gerber, Chairman, WVNSCO Radiation and Safety Committee — Date

WVNSCO

West Valley Nuclear Services Company

10282 Rock Springs Road
West Valley, NY 14171-9799

WV-1816, Rev. 5

SAR-001

WASTE PROCESSING AND SUPPORT ACTIVITIES

TABLE OF CONTENTS

Section Page

LIST OF TABLES....14

LIST OF FIGURES....16

LIST OF ACRONYMS AND ABBREVIATIONS....18

1.0 INTRODUCTION AND OVERALL DESCRIPTION OF THE FACILITY.... 28
1.1 Introduction.... 28
1.2 Facility Descriptions.... 30
1.2.1 IRTS, Main Plant, and Support Facilities Descriptions.... 30
1.2.2 General Vitrification Facility Description.... 31
1.3 Process and Activity Descriptions.... 31
1.3.1 IRTS Process Description.... 31
1.3.2 Vitrification Process Description.... 32
1.3.3 Overview of Waste Management, Storage, and Disposal.... 32
1.4 Identification of Agents and Contractors.... 33
1.5 Hazard Categorization.... 33
1.6 Structure of this Safety Analysis Report.... 34
REFERENCES FOR CHAPTER 1.0.... 35

2.0 SUMMARY SAFETY ANALYSIS.... 41
2.1 Site Analysis.... 41
2.1.1 Natural Phenomena.... 41
2.1.2 Site Characteristics Affecting the Safety Analysis.... 42
2.1.3 Effect of Nearby Industrial, Transportation, and Military Facilities 42
2.2 Impacts from Normal Operations.... 43
2.3 Impacts from Abnormal Operations.... 43
2.4 Accidents.... 44
2.5 Conclusions.... 44
REFERENCES FOR CHAPTER 2.0.... 46

3.0 SITE CHARACTERISTICS.... 47
3.1 Geography and Demography.... 47
3.1.1 Site Location.... 47
3.1.2 Site Description.... 47
3.1.2.1 Site Boundary.... 48
3.1.2.2 Boundaries for Establishing Effluent Release Limits.... 48
3.1.3 Population Distribution and Trends.... 49
3.1.3.1 Current Population.... 49
3.1.4 Uses of Nearby Land and Waters.... 49
3.1.4.1 Site Vicinity Land Use.... 49
3.1.4.2 Community Facilities and Institutions.... 50
3.1.4.3 Water Use.... 50
3.2 Nearby Industrial, Transportation, and Military Facilities.... 50
3.2.1 Nuclear Facilities.... 50
3.2.2 Industries.... 50
3.2.3 Military Installations.... 51
3.2.4 Transportation Facilities.... 51

TABLE OF CONTENTS
(Continued)

3.3 Meteorology..... 52
3.3.1 Regional Climatology for Western New York..... 52
3.3.2 Local Meteorology for Buffalo, New York..... 54
3.3.3 On-Site Meteorological Program for the WVDP..... 54
3.4 Surface Hydrology..... 55
3.4.1 Hydrologic Description..... 55
3.4.1.1 Site and Facilities..... 57
3.4.1.2 Hydrosphere..... 57
3.4.2 Floods..... 57
3.4.2.1 Flood History..... 57
3.4.2.2 Flood Design Considerations..... 58
3.4.2.3 Effects of Local Intense Precipitation..... 58
3.4.3 Probable Maximum Flood on Streams..... 59
3.4.3.1 Probable Maximum Precipitation..... 59
3.4.4 Potential Dam Failures..... 59
3.5 Subsurface Hydrology..... 59
3.5.1 Regional and Area Characteristics..... 59
3.6 Geology and Seismology..... 60
3.6.1 Geologic and Seismologic Overview..... 60
3.6.1.1 Summary of Regional and Site Geology..... 61
3.6.1.1.1 Regional Physiography..... 61
3.6.1.1.2 Regional Geologic History..... 62
3.6.1.1.3 Regional Stratigraphy..... 62
3.6.1.1.4 Regional Structure..... 62
3.6.2 Vibratory Ground Motion..... 62
3.6.2.1 Underlying Tectonic Structures..... 62
3.6.2.2 Behavior During Prior Earthquakes..... 63
3.6.2.3 Engineering Properties of Materials Underlying the Site..... 63
3.6.2.4 Earthquake History..... 63
3.6.2.5 Correlation of Epicenter with Geologic Structures..... 64
3.6.2.6 Identification of Active Faults..... 64
3.6.2.7 Description of Capable Faults..... 64
3.6.2.8 Maximum Earthquake..... 65
3.6.2.9 Design Basis Earthquake..... 65
3.6.2.9.1 Original Design Earthquake..... 65
3.6.2.9.2 NFS Upgrade Maximum Earthquake..... 65
3.6.2.9.3 WVDP Design Basis Earthquake..... 65
3.6.2.9.4 Design Basis Earthquake Response Spectra..... 66
3.6.2.9.5 Re-evaluation of Design Basis Earthquake..... 66
3.6.3 Surface Faulting..... 66
3.6.4 Stability of Subsurface Materials..... 66
3.7 Summary of Site Characteristics Impacting Safety Considerations..... 67
3.8 Validity of Existing Environmental Analyses..... 68
REFERENCES FOR SECTION 3.0..... 70

4.0 PRINCIPAL DESIGN CRITERIA..... 82
4.1 Integrated Radwaste Treatment System, Main Plant, Fuel Receiving and Storage Facility, and Vitrification Facility 84
4.1.1 Feed..... 84
4.1.1.1 HLW Pretreatment..... 85
4.1.1.2 Feed Preparation..... 85
4.1.2 Products and By-Products..... 85
4.1.3 IRTS, Main Plant, FRS Facility, and VF Functions..... 86
4.1.4 Facility Interfaces..... 86
4.1.4.1 IRTS and Main Plant Interfaces With the Vitrification Facility.... 87
4.1.4.2 FRS Interfaces with the Main Plant..... 87
4.2 Structural and Mechanical Safety Criteria..... 87
4.2.1 Wind Loadings..... 89

TABLE OF CONTENTS
(Continued)

4.2.2 Tornado Loadings..... 89
4.2.3 Flood Design..... 90
4.2.4 Missile Protection..... 90
4.2.5 Seismic Design..... 91
4.2.6 Snow Loading..... 92
4.2.7 Process and Equipment Derived Loads..... 92
4.2.8 Combined Load Criteria..... 93
4.2.9 Subsurface Hydrostatic Loadings..... 93
4.2.10 Temperature Design Loadings..... 93
4.3 Safety Protection Systems..... 93
4.3.1 General..... 93
4.3.2 Protection Through Defense-in-Depth..... 94
4.3.2.1 Passive Confinement Barriers..... 94
4.3.2.2 Waste Form and Inventory..... 96
4.3.2.3 Active Confinement Barriers..... 96
4.3.2.4 Alarms and Monitors..... 97
4.3.2.5 Personnel Training..... 97
4.3.2.6 Administrative Planning and Controls..... 97
4.3.3 Protection by Equipment and Instrumentation Selection..... 98
4.3.4 Nuclear Criticality Safety..... 99
4.3.5 Radiological Protection..... 99
4.3.5.1 Access Control..... 99
4.3.5.2 Shielding..... 99
4.3.6 Fire and Explosion Protection..... 100
4.3.7 Radioactive Waste Handling and Storage..... 102
4.3.8 Industrial and Chemical Safety..... 102
4.4 Classification of Structures, Systems, and Components..... 103
4.5 Decommissioning..... 103
4.5.1 IRTS D&D..... 103
4.5.2 VF D&D..... 103
4.5.2.1 Design Philosophy..... 104
4.5.2.2 Design Criteria for Decommissioning..... 105
4.5.2.2.1 Process Cell Decontamination and Decommissioning..... 105
4.5.2.2.2 Decontamination Support Area..... 106
4.5.2.3 Future Isolation of Radioactive Materials to Protect the Public.. 107
4.6 Human Factors Engineering..... 107
REFERENCES FOR CHAPTER 4.0..... 108

5.0 FACILITY DESIGN..... 121
5.1 Summary Description..... 121
5.1.1 Location and Facility Layout..... 121
5.1.2 Principal Features..... 121
5.1.2.1 Site Boundary..... 121
5.1.2.2 Property Protection Area..... 121
5.1.2.3 Site Utility Supplies and Systems..... 121
5.1.2.4 Surface Impoundments and Storage Tanks..... 121
5.1.2.5 Atmospheric Release Points..... 121
5.2 Structures, Systems, and Components (SSCs)..... 122
5.2.1 VF Overview and Design Criteria, Codes, and Standards..... 122
5.2.1.1 Basis For Design..... 123
5.2.1.2 Design Basis Loads..... 123
5.2.1.3 Modified Existing Structures..... 125
5.2.1.4 New Non-Confinement Structures..... 125
5.2.1.5 Soil Loads and Foundation Design..... 125
5.2.2 VF Passive Barriers and Key Confinement Systems..... 126
5.2.3 IRTS, Main Plant, and FRS Buildings Structural Specifications and Layout 126
5.2.4 STS/SMWS and HLWTS Facility Descriptions..... 126

TABLE OF CONTENTS
(Continued)

5.2.4.1 Tank 8D-1 127
5.2.4.2 Tank 8D-2 128
5.2.4.3 Associated STS/SMWS Facilities 129
5.2.4.4 Leak Detection Systems 130
5.2.4.5 Containment of Metal Corrosion 130
5.2.5 LWTS/Main Plant Facility Descriptions 131
5.2.5.1 High-Level Waste Interim Storage Area Cells and Rooms 132
5.2.5.1.1 Chemical Process Cell 132
5.2.5.1.2 Equipment Decontamination Room 132
5.2.5.1.3 Chemical Crane Room 132
5.2.5.2 Liquid Waste Treatment System Cells and Rooms 133
5.2.5.2.1 Extraction Cell 3 133
5.2.5.2.2 Product Purification Cell 133
5.2.5.2.3 Uranium Product Cell 133
5.2.5.2.4 Uranium Load Out 134
5.2.5.2.5 Miscellaneous LWTS Support Cells and Areas 134
5.2.5.3 Head End Cells 134
5.2.5.3.1 Process Mechanical Cell 135
5.2.5.3.2 PMC Crane Room and PMCR Enclosure 136
5.2.5.3.3 Manipulator Repair Room 136
5.2.5.3.4 General Purpose Cell 136
5.2.5.3.5 GPC Crane Room, GCR Extension, and GCRE 137
5.2.5.3.6 Scrap Removal Room 138
5.2.5.3.7 Miniature Cell 138
5.2.5.4 Main Plant Support Cells 138
5.2.5.4.1 Liquid Waste Cell 138
5.2.5.4.2 Off-Gas Cell 139
5.2.5.5 Other Main Plant Cells and Rooms 140
5.2.5.5.1 Extraction Cells 1 and 2 140
5.2.5.5.2 Acid Recovery Cell/Acid Recovery Pump Room 140
5.2.5.5.3 Hot Acid Cell/Hot Acid Pump Room 140
5.2.6 Fuel Receiving and Storage 140
5.2.7 Cement Solidification System 01-14 Building 141
5.2.8 Drum Cell 141
5.2.9 Warehouse Facilities 141
5.3 Fire Protection Systems 142
5.3.1 Fire Protection Systems 142
5.3.1.1 Wet Pipe Sprinkler Systems 142
5.3.1.2 Dry Pipe Sprinkler Systems 143
5.3.1.3 Deluge Systems 143
5.3.1.4 Pre-Action Systems 143
5.3.1.5 Wet Standpipe Hose Stations 143
5.3.1.6 Halon Systems 143
5.3.1.7 Dry Chemical Systems 144
5.3.1.8 Wet Chemical System 144
5.3.1.9 VF Fire Protection Systems 144
5.3.1.10 Lightning Protection 146
5.4 Description of Service and Utility Systems 147
5.4.1 HVAC Systems 147
5.4.1.1 Key Components and Characteristics of WVDP HVAC Systems 147
5.4.1.1.1 Permanent Ventilation System 147
5.4.1.1.2 Main Plant Ventilation System 148
5.4.1.1.3 Head End Ventilation System 150
5.4.1.1.4 FRS Building Heating and Ventilation System 151
5.4.1.1.5 01-14 Building Heating and Ventilation System 151
5.4.1.1.6 VF HVAC Systems 152
5.4.1.1.6.1 Vitrification Building HVAC 153
5.4.1.1.6.2 VF Control Room HVAC 155

TABLE OF CONTENTS
(Continued)

5.4.1.1.7 Ventilation System Stacks..... 156
5.4.1.2 Safety Considerations and Controls of WVDP HVAC Systems..... 156
5.4.2 Electrical..... 158
5.4.2.1 Vitrification Facility Electrical Distribution System..... 159
5.4.2.2 VF Standby AC Power Supply..... 160
5.4.2.3 VF Uninterruptible Power Supply..... 161
5.4.2.4 VF-Related Support Power and Interfaces..... 162
5.4.3 Compressed Air..... 162
5.4.3.1 VF Compressed Air..... 162
5.4.4 Steam Generation and Distribution..... 163
5.4.4.1 VF Steam Supply and Condensate Return..... 163
5.4.5 Water Supplies and Water Cooling Systems..... 164
5.4.6 Natural Gas Supply and Distribution..... 165
5.4.7 Wastewater Treatment Facility..... 165
5.4.8 Safety Communications and Alarms..... 166
5.4.8.1 Safety Communications..... 166
5.4.8.2 Alarms..... 166
5.4.9 Maintenance Systems..... 168
5.4.10 Cold Chemical Systems..... 168
REFERENCES FOR CHAPTER 5.0..... 169

6.0 PROCESS SYSTEMS AND FACILITY DECONTAMINATION..... 236
6.1 Process Description..... 236
6.1.1 Narrative Description..... 236
6.1.1.1 Vitrification Operations..... 236
6.1.1.2 IRTS Operations..... 237
6.1.1.3 Cleanup of the Head End Cells..... 237
6.1.2 Identification of Items for Safety Analysis Concern..... 237
6.1.2.1 Radiation Protection..... 237
6.1.2.2 Criticality Prevention..... 238
6.1.2.3 Management, Organization, and Institutional Safety Provisions.... 238
6.1.2.4 Hazardous Material Protection..... 238
6.2 Vitrification Process Systems..... 238
6.2.1 Vitrification Cell..... 239
6.2.2 Off-Gas Treatment, Facility Vent, and Liquid Waste Systems..... 240
6.2.2.1 Ex-Cell Off-Gas Treatment and Filtering..... 240
6.2.2.2 Final Off-Gas Reheating and Filtration..... 240
6.2.2.3 Off-Gas Discharge Duct..... 241
6.2.2.4 Facility Ventilation Systems..... 241
6.2.2.5 Waste Header System..... 241
6.2.3 Mechanical Process Systems..... 242
6.2.3.1 Cell Cranes..... 242
6.2.3.2 Crane Maintenance Room..... 243
6.2.3.3 Transfer Cart..... 244
6.2.3.4 Transfer Tunnel Shielding Doors..... 244
6.2.4 Process Support Systems..... 244
6.2.4.1 Cold Chemical Building..... 244
6.2.4.1.1 Slurry Make-up and Transfer..... 245
6.2.4.1.2 Decontamination Solution Make-up and Transfer..... 245
6.2.4.1.3 Drain Tank..... 246
6.2.4.1.4 Pneumatic Subsystem for Solids Transfer..... 246
6.2.4.1.5 Steam Jet Subsystem for Liquids Transfer..... 247
6.2.4.1.6 Vessel Ventilation Subsystem..... 247
6.2.4.2 Equipment Decontamination Room..... 247
6.2.4.3 High-Level Waste Interim Storage..... 248
6.2.4.4 Cell Viewing and Lighting Systems..... 248
6.3 Integrated Radwaste Treatment System..... 249
6.3.1 Supernatant Treatment System/Sludge Mobilization and Wash System... 249

TABLE OF CONTENTS
(Continued)

6.3.2 Liquid Waste Treatment System..... 249
6.3.3 Cement Solidification System..... 250
6.3.4 Drum Cell..... 251
6.4 Control Systems..... 252
6.4.1 Process Instrumentation and Controls..... 252
6.4.2 DCS Architecture..... 253
6.4.3 Detection System and Locations..... 253
6.4.4 Cold Chemical Instrumentation and Controls..... 253
6.4.5 High-Level Waste Transfer System Instrument and Control..... 254
6.4.6 LWTS Instrumentation and Control..... 254
6.4.7 CSS Instrumentation and Control..... 254
6.5 System and Component Spares..... 255
6.6 WVDP Control Areas..... 255
6.6.1 VF Control Room..... 255
6.6.2 IRTS and Main Plant Control Rooms..... 256
6.7 Facility Decontamination and Deactivation..... 257
6.7.1 Size-Reduction..... 258
6.7.2 Decontamination..... 259
6.7.3 Assurance of Decontamination Safety..... 259
6.8 Sampling-Analytical..... 260
6.8.1 Sampling..... 260
6.8.1.1 LWTS Sampling Capabilities..... 260
6.8.1.2 Nonroutine Sampling Activities..... 260
6.8.2 WVDP Analytical Capabilities..... 260
REFERENCES FOR CHAPTER 6.0..... 261

7.0 WASTE CONFINEMENT AND MANAGEMENT..... 274
7.1 Waste Management Criteria..... 274
7.2 Low-Level, Low-Level Mixed, and TRU Wastes..... 275
7.3 Nonradiological Wastes..... 276
7.4 Off-Gas Treatment and Ventilation..... 277
7.4.1 Vessel Off-Gas System..... 277
7.4.2 Safety Criteria and Assurance..... 277
7.5 Liquid Waste Treatment and Retention..... 278
7.5.1 Design Objectives..... 278
7.5.2 Equipment and Systems Description..... 279
7.5.2.1 Neutralization Pit and Interceptors..... 279
7.5.2.2 Lagoon System..... 279
7.5.2.3 Low-Level Waste Treatment Replacement Facility..... 280
7.5.2.3.1 Liquid Waste Handling..... 280
7.5.2.3.1.1 Skid A..... 280
7.5.2.3.1.2 Skid B..... 281
7.5.2.3.2 Resin Removal and Handling..... 281
7.5.2.3.3 Low-Level Waste Treatment Replacement Facility Ventilation..... 281
7.5.2.3.4 Instrumentation and Control..... 282
7.5.3 North Plateau Groundwater Recovery System..... 282
7.6 Solid Wastes..... 282
7.6.1 Design Objectives..... 283
7.6.2 Equipment and Systems Description..... 283
7.6.2.1 Waste Reduction and Packaging Area Compactor..... 283
7.6.2.2 Contact Size-Reduction Facility..... 283
7.6.2.3 Container Sorting and Packaging Facility..... 284
7.6.3 Operating Procedures..... 285
7.6.4 Characteristics, Concentrations, and Volumes of Solid Waste..... 285
7.6.5 Packaging..... 286
7.6.5.1 TRUPACT-II Mobile Loading Unit Operations..... 286
7.6.6 Storage and Disposal Facilities..... 287
7.6.6.1 Lag Storage Building..... 287

TABLE OF CONTENTS
(Continued)

7.6.6.2 Lag Storage Area-1 288
7.6.6.3 Lag Storage Area-3 288
7.6.6.4 Lag Storage Area-4 288
7.6.6.5 LSA-4 Shipping Depot 288
7.6.6.6 Hardstands 289
7.6.6.7 Pump Storage Vaults 290
7.6.6.8 Rail Packaging and Staging Area 290
7.6.6.9 Interim Waste Storage Facility 291
7.6.6.10 NRC-Licensed Disposal Area 291
7.6.6.11 NDA Interceptor Trench Liquid Pretreatment System 292
7.6.6.12 Remote Handled Waste System 293
7.7 Hazardous and Mixed Wastes 293
7.7.1 Characteristics and Volumes of Hazardous and Mixed Wastes 293
7.7.1.1 Hazardous Wastes 293
7.7.1.2 Low-Level Mixed Wastes 294
7.7.2 Storage Facilities 294
7.7.2.1 Hazardous Waste Storage Facility 294
7.7.2.2 Chemical Process Cell-Waste Storage Area 294
7.7.3 Operating Procedures 296
REFERENCES FOR CHAPTER 7.0 297

8.0 HAZARDS PROTECTION 314
8.1 Assuring that Occupational Hazards Exposures Are ALARA 314
8.1.1 Policy Considerations 314
8.1.2 Design Considerations 314
8.1.2.1 General Design Considerations for Maintaining Exposures ALARA 316
8.1.2.2 Equipment Design Considerations for ALARA 316
8.1.2.3 Facility Layout Design Considerations for ALARA 316
8.1.3 Operational Considerations 317
8.1.4 Defense-In-Depth 317
8.1.4.1 Passive Confinement Barriers 318
8.1.4.2 Wasteform and Limited Inventory 318
8.1.4.3 Active Confinement Barriers 318
8.1.4.4 Alarms and Monitors 319
8.2 Sources of Hazards 319
8.2.1 Contained Sources 319
8.2.1.1 Radioactive Material Sources 319
8.2.1.2 Hazardous Material Sources 320
8.2.2 Airborne Hazards Sources 321
8.2.2.2 Airborne Hazardous Material Sources 321
8.3 Hazard Protection Design Features 321
8.3.1 Radiation Protection Design Features 321
8.3.1.1 Vitrification Facility 322
8.3.1.2 IRTS and Legacy Facilities 322
8.3.2 Shielding 322
8.3.3 Ventilation 323
8.3.4 Radiation and Airborne Radioactivity Monitoring Instrumentation 324
8.3.5 Hazardous Material Protection Design Features 326
8.4 Estimated Collective On-site Dose Assessment 326
8.4.1 Vitrification Facility 326
8.4.2 IRTS and Legacy Facilities 327
8.5 WVDP Hazards Protection Programs 327
8.5.1 Integrated Safety Management System 327
8.5.2 WVDP Health Physics Program 328
8.5.2.1 Organization 328
8.5.2.1.1 Radiological Protection Operations 328
8.5.2.1.2 Facility Operations 329
8.5.2.1.3 Radiation and Safety Committee 330

TABLE OF CONTENTS
(Continued)

8.5.2.2 Radiation Detection Equipment, Instrumentation, and Support Facilities..... 330
8.5.2.3 Radiological Control Procedures..... 330
8.5.2.3.1 Radiation and Contamination Surveys..... 330
8.5.2.3.2 Procedures for Ensuring that Occupational Doses are ALARA..... 332
8.5.2.3.3 Access Control..... 332
8.5.2.3.4 Sealed Source and Radioisotope Control..... 333
8.5.2.3.5 Radiation Safety Training..... 333
8.5.2.3.6 Personnel Monitoring Program..... 333
8.5.2.3.7 Airborne Radioactivity Monitoring Program..... 334
8.5.3 WVDP Industrial Hygiene and Safety Program..... 335
8.5.3.1 Hazardous Material Protection Program..... 335
8.5.3.2 ALARA Policy and Program..... 336
8.5.3.3 Hazardous Material Training..... 336
8.5.3.4 Hazardous Material Exposure Control..... 336
8.5.3.5 Hazardous Material Identification Program..... 338
8.5.3.6 Administrative Limits..... 339
8.5.3.7 Occupational Medical Programs..... 339
8.5.3.8 Respiratory Protection..... 339
8.5.3.9 Hazardous Material Monitoring..... 340
8.5.3.10 Hazardous Materials Protection Instrumentation..... 340
8.5.3.11 Hazardous Material Protection Record Keeping..... 341
8.5.3.12 Hazard Communication Program..... 341
8.5.3.13 Occupational Chemical Exposures..... 341
8.6 Off-Site Dose Assessment..... 341
8.6.1 Environmental Monitoring Program..... 341
8.6.1.1 Radiological Monitoring..... 342
8.6.1.1.1 Radioactivity in Air..... 342
8.6.1.1.2 Radioactivity in Surface Water and Groundwater..... 344
8.6.1.1.3 Radioactivity in the Food Chain..... 344
8.6.1.1.4 Direct Environmental Radiation..... 345
8.6.1.2 Nonradiological Monitoring..... 345
8.6.2 Analysis of Multiple Contributions..... 345
8.6.3 Estimated Exposures..... 346
8.6.3.1 Source Term Estimation..... 346
8.6.3.2 Environmental Pathways..... 346
8.6.3.3 Radiological Parameters..... 347
8.6.3.4 Analytical Tools..... 347
8.6.3.5 Estimated Exposures from Airborne Releases..... 348
8.6.3.6 Estimated Exposures from Liquid Releases..... 349
8.7 Prevention of Inadvertent Criticality..... 349
8.7.1 Introduction..... 349
8.7.2 Requirements..... 349
8.7.3 Criticality Concerns..... 350
8.7.3.1 General Criticality Concerns..... 351
8.7.3.2 Criticality Concerns During Facility Decontamination..... 352
8.7.3.2.1 Criticality Concerns Related to Head End Cell Decontamination.. 352
8.7.3.2.2 Criticality Concerns Related to PPC Decontamination..... 353
8.7.3.2.3 Criticality Concerns Related to Vit Facility Decontamination... 354
8.7.3.3 Criticality Concerns During Liquid Transfers of Fissile Materials 354
8.7.3.4 Criticality Concerns Associated with Waste Storage..... 354
8.7.4 Criticality Controls..... 355
8.7.4.1 Engineering Controls..... 356
8.7.4.2 Administrative Controls..... 356
8.7.4.3 Application of Double Contingency..... 358
8.7.5 Criticality Protection Program..... 358
8.7.5.1 Criticality Safety Organization..... 358
8.7.5.2 Criticality Safety Plans and Procedures..... 359

TABLE OF CONTENTS
(Continued)

8.7.5.3 Criticality Safety Training..... 359
8.7.5.4 Determination of Operational Nuclear Criticality Limits..... 359
8.7.5.5 Criticality Safety Inspection/Audits..... 359
8.7.5.6 Criticality Infraction Reporting and Follow-Up..... 360
8.7.6 Criticality Instrumentation..... 360
8.8 Fire Protection..... 360
REFERENCES FOR CHAPTER 8.0..... 362

9.0 HAZARD AND ACCIDENT ANALYSES..... 408
9.1 Hazard Analysis..... 408
9.1.1 Methodology..... 408
9.1.1.1 Hazard Identification..... 408
9.1.1.2 Hazard Evaluation..... 408
9.1.2 Hazard Analysis Results..... 409
9.1.2.1 Hazard Identification..... 409
9.1.2.2 Hazard Categorization..... 409
9.1.2.3 Hazard Evaluation..... 410
9.1.2.3.1 Summary of Significant Worker-Safety Features..... 410
9.1.2.3.2 Accident Selection..... 410
9.1.3 Evaluation Guideline..... 411
9.2 Accident Analyses..... 412
9.2.1 Methodology..... 412
9.2.1.1 Initiating Event Summary..... 414
9.2.1.2 Scenario Development..... 414
9.2.1.3 Source Term Analysis..... 415
9.2.1.4 Consequence Analysis..... 415
9.2.1.5 Comparison to Guidelines..... 416
9.2.2 Accident Evaluations..... 416
9.2.2.1 Ventilation System Filter Failure..... 416
9.2.2.1.1 Scenario Development..... 416
9.2.2.1.2 Source Term Analysis..... 416
9.2.2.1.3 Analysis of Results..... 417
9.2.2.1.4 Comparison with the EG..... 417
9.2.2.2 Hydrogen Peroxide Spill..... 417
9.2.2.2.1 Scenario Development..... 417
9.2.2.2.2 Source Term Analysis..... 417
9.2.2.2.3 Analysis of Results..... 418
9.2.2.2.4 Comparison with the EG..... 418
9.2.2.3 Energetic Event Involving TRU Waste..... 418
9.2.2.3.1 Scenario Development..... 418
9.2.2.3.2 Source Term Analysis..... 421
9.2.2.3.3 Analysis of Results..... 422
9.2.2.3.4 Comparison with the EG..... 422
9.2.2.4 Drop of a Loaded High Integrity Container..... 422
9.2.2.4.1 Scenario Development..... 422
9.2.2.4.2 Source Term Analysis..... 422
9.2.2.4.3 Analysis of Results..... 422
9.2.2.4.4 Comparison with the EG..... 423
9.2.2.5 Failure of UPC Vessels..... 423
9.2.2.5.1 Scenario Development..... 423
9.2.2.5.2 Source Term Analysis..... 423
9.2.2.5.3 Analysis of Results..... 424
9.2.2.5.4 Comparison with the EG..... 424
9.2.2.6 HLW Canister Drop..... 424
9.2.2.6.1 Scenario Development..... 424
9.2.2.6.2 Source Term Analysis..... 424
9.2.2.6.3 Analysis of Results..... 425
9.2.2.6.4 Comparison with EG..... 425

TABLE OF CONTENTS
(Continued)

9.2.2.7 Process Off-Gas or HVAC System HEPA Failure..... 425
9.2.2.7.1 Scenario Development..... 425
9.2.2.7.2 Source Term Analysis..... 426
9.2.2.7.3 Analysis of Results..... 426
9.2.2.7.4 Comparison with EG..... 426
9.2.2.8 Beyond Design Basis Failure of HLWIS Area Roof..... 426
9.2.2.9 Beyond Design Basis Crane Falls in HLWIS Area..... 426
9.2.3 Accident Analysis Summary for VF Accidents..... 427
REFERENCES FOR CHAPTER 9.0..... 428

10.0 CONDUCT OF OPERATIONS..... 475
10.1 Organizational Structure..... 475
10.1.1 Westinghouse Government Services Group Organization..... 476
10.1.2 WVNSCO Organization..... 476
10.1.3 Personnel Qualification Requirements..... 477
10.1.4 Liaison with Outside Organizations..... 478
10.2 Preoperational Testing..... 478
10.2.1 Administrative Procedures for Conducting the Test Program..... 478
10.3 Training Programs..... 479
10.3.1 Program Description..... 479
10.3.1.1 Development of Training Programs..... 479
10.3.1.2 Maintenance of Training Programs..... 480
10.3.1.3 Modification of Training Materials..... 480
10.3.1.4 General Training..... 481
10.3.1.5 Radiation Worker Training..... 481
10.3.1.6 Operations Training..... 481
10.3.1.7 Safety Training..... 482
10.3.2 Continuing Training Programs..... 482
10.3.2.1 Requalification..... 482
10.3.3 Administration and Records..... 482
10.4 Normal Operations..... 483
10.4.1 Procedures..... 483
10.4.1.1 Development of Procedures..... 483
10.4.1.2 Distribution and Maintenance of Procedures..... 484
10.4.1.3 Safety Basis Review..... 484
10.4.1.4 Project Records..... 484
10.4.2 Safety Management Policies and Programs..... 484
10.4.2.1 Safety Performance Assessment..... 484
10.4.2.2 Configuration and Document Control..... 485
10.4.2.3 Event Reporting..... 486
10.4.2.4 Safety Culture..... 486
10.4.3 Maintenance and In-Service Surveillance Program..... 487
10.4.4 Conduct of Operations..... 489
10.5 Emergency Preparedness Program..... 491
10.5.1 Introduction..... 491
10.5.1.1 Purpose..... 491
10.5.1.2 Scope..... 492
10.5.1.3 Emergency Response Organizations..... 492
10.5.1.3.1 U.S. Department of Energy..... 492
10.5.1.3.2 WVDP ERO..... 492
10.5.1.3.3 WVDP Emergency Response Groups..... 493
10.5.1.3.4 Medical Facilities..... 493
10.5.1.3.5 Off-Site County and State Agencies..... 493
10.5.1.4 Emergency Control Facilities..... 494
10.5.1.4.1 Emergency Support Facilities..... 494
10.5.1.4.2 Environmental and Dosimetry Laboratories..... 495
10.5.1.5 Communications..... 495
10.5.1.5.1 WVDP Communications Equipment..... 495

TABLE OF CONTENTS
(Continued)

10.5.1.6 Detection and Warning Systems..... 496
10.5.1.6.1 Fire..... 496
10.5.1.6.2 Radiation/Contamination..... 496
10.5.1.6.3 On-Site Relocation..... 497
10.5.1.6.4 Sheltering Signal..... 497
10.5.1.7 Training, Tests, and Exercises..... 497
10.5.1.7.1 Personnel Training..... 497
10.5.1.7.2 Equipment Testing..... 497
10.5.1.7.3 Exercises and Drills..... 498
10.5.1.8 Emergency Response Levels..... 498
10.5.1.8.1 Alert..... 498
10.5.1.8.2 Site Area Emergency (SAE)..... 498
10.5.1.9 Notification..... 499
10.5.1.9.1 West Valley Demonstration Project..... 499
10.5.1.9.2 Notification of Off-Site Agencies and Authorities..... 499
10.5.1.9.3 Notification of DOE Headquarters..... 499
10.5.1.9.4 Notification of New York State..... 499
10.5.1.9.5 Special Notification..... 499
10.5.1.10 Public Information..... 500
10.5.1.10.1 Policy..... 500
10.5.1.10.2 Emergency Operations and Response Concepts..... 500
10.5.1.11 Emergency Resources..... 500
10.5.1.11.1 Emergency Equipment and Resources..... 500
10.5.1.11.2 Federal Government Resources..... 500
10.5.1.12 Recovery and Reentry..... 500
10.5.1.13 Emergency Plan Review..... 501
10.6 Decommissioning..... 501
10.6.1 Decommissioning Program..... 501
10.6.2 Decontamination..... 501
10.6.3 Agreements with Outside Organizations..... 501
10.6.4 Arrangements for Funding..... 502
10.7 Human Factors..... 502
REFERENCES FOR CHAPTER 10.0..... 503

11.0 TECHNICAL SAFETY REQUIREMENTS..... 509
11.1 Introduction..... 509
11.2 Requirements..... 509
11.3 Technical Safety Requirement Input..... 509
11.3.1 Safety Limits, Limiting Control Settings, Limiting Conditions for Operation, and Surveillance Requirements..... 509
11.3.2 Design Features..... 509
11.3.3 Administrative Controls..... 510
11.4 Interface with TSRs from Other Facilities..... 512
REFERENCES FOR CHAPTER 11.0..... 513

12.0 QUALITY ASSURANCE..... 515
12.1 Organization..... 516
12.1.1 Responsibilities..... 516
12.1.1.1 WVNSCO Responsibilities..... 516
12.1.1.2 WVNSCO President/Project Director Responsibilities..... 517
12.1.1.3 Manager, Environmental, Safety, Health & Quality..... 517
12.1.1.4 WVNSCO Quality Assurance Organization Responsibilities..... 517
12.1.1.5 URS Responsibilities..... 517
12.1.1.6 Other Departments within WVNSCO..... 518
12.1.1.7 Site Personnel..... 518
12.1.1.8 Pacific Northwest National Laboratories Responsibilities..... 518
12.1.1.9 Review of Quality Assurance Manuals..... 518

TABLE OF CONTENTS
(Concluded)

12.2 Quality Assurance Program..... 518
12.2.1 Design Control..... 520
12.2.2 Procurement Document Control..... 520
12.2.3 Instructions, Procedures, and Drawings..... 521
12.2.3.1 Document Control..... 521
12.2.4 Control and Identification of Purchased Material, Equipment, and Services..... 521
12.2.4.1 Identification and Control of Items..... 522
12.2.4.2 Control of Processes..... 522
12.2.5 Inspection, Surveillance, and Testing..... 523
12.2.5.1 Inspection..... 523
12.2.5.2 Test Control..... 523
12.2.5.3 Control of Measuring and Test Equipment..... 524
12.2.5.4 Handling, Storage, and Shipping..... 524
12.2.5.5 Inspection, Test, and Operating Status..... 524
12.2.6 Nonconforming Materials, Components, and Fabrication and Construction Features 525
12.2.7 Corrective Action..... 525
12.2.8 Quality Assurance Records..... 526
12.2.9 Audits..... 526
12.3 Quality Level Classification of Structures, Systems, and Components. 527
REFERENCES FOR SECTION 12.0..... 529

LIST OF TABLES

Table Number	Title
TABLE 1.6-1	LOCATION OF DOE-STD-3009 INFORMATION IN WVNS-SAR-001
TABLE 3.1-1	LOCATIONS AND POPULATIONS OF TOWNS AND VILLAGES PARTIALLY OR TOTALLY WITHIN 16 KILOMETERS OF THE SITE
TABLE 3.6-1	(1 of 3) HISTORICAL SEISMICITY WITHIN 480 km (300 mi) OF SITE
TABLE 3.6-1	(2 of 3) HISTORICAL SEISMICITY WITHIN 480 km (300 mi) OF SITE
TABLE 3.6-1	(3 of 3) HISTORICAL SEISMICITY WITHIN 480 km (300 mi) OF SITE
TABLE 4.1-1	WVDP LOW-LEVEL RADIOACTIVE WASTE SUMMARY
TABLE 4.1-2	REFERENCE RADIONUCLIDE CONTENT OF A CANISTER OF WVDP HLW (IN 1990)
TABLE 4.1-3	COMPARISON OF CALCULATED VALUES FOR THE TYPICAL WVDP CANISTER TO WASTE ACCEPTANCE PRODUCT SPECIFICATIONS (WAPS)
TABLE 4.2-1	SUMMARY OF REPROCESSING BUILDING SEISMIC ANALYSIS RESULTS
TABLE 4.2-2	FUEL RECEIVING AND STORAGE FACILITY DESIGN CODES
TABLE 5.1-1	OUTSIDE STORAGE TANKS AND IMPOUNDMENTS
TABLE 5.2-1	DESIGN CODES AND STANDARDS FOR VITRIFICATION FACILITY
TABLE 5.2-2	ENGINEERING CODES/STANDARDS FOR VITRIFICATION FACILITY
TABLE 5.2-3	IRTS EQUIPMENT DESIGN CODES AND STANDARDS
TABLE 5.2-4	DESIGN CODES AND STANDARDS FOR KEY IRTS EQUIPMENT
TABLE 5.2-5	ORIGINAL DESIGN CODES AND STANDARDS FOR THE MAIN PLANT AND FRS
Table 5.2-6	SUMMARY OF MAJOR EQUIPMENT IN THE WTF AND STS
TABLE 5.2-7	DESIGN CODES AND STANDARDS FOR HLWTS CONFINEMENT SYSTEMS
TABLE 5.2-8	SUMMARY OF MAJOR ACTIVE VESSELS IN THE MAIN PLANT
TABLE 5.2-9	SUMMARY OF MAJOR EQUIPMENT IN THE OFF-GAS CELL
TABLE 5.2-10	SUMMARY OF MAJOR EQUIPMENT IN EXTRACTION CELL NO. 1
TABLE 5.2-11	SUMMARY OF MAJOR EQUIPMENT IN THE ACID RECOVERY CELL
TABLE 5.4-1	AREA PRESSURE DIFFERENTIAL
TABLE 5.4-2	SUMMARY OF FILTER MONITORING INSTRUMENTATION
TABLE 5.4-3	SUMMARY OF UTILITY SUPPLY CAPABILITIES
TABLE 5.4-4	IRTS UTILITY REQUIREMENTS
TABLE 5.4-5	STANDBY POWER LOADS ON VF DIESEL GENERATOR
TABLE 5.4-6	DIESEL GENERATOR FAILURE MODES AND EFFECTS ANALYSIS
TABLE 5.4-7	UPS 67-UPS-1 POWER REQUIREMENT
TABLE 5.4-8	UPS 63-UPS-2 POWER REQUIREMENT
TABLE 5.4-9	UPS 63-UPS-3 POWER REQUIREMENT
TABLE 6.2-1	CRANE MOTION SPEEDS
TABLE 7.1-1	WASTE MANAGEMENT PLANS, CODES, AND REGULATIONS EMPLOYED AT THE WVDP
TABLE 7.2-1	TYPICAL INVENTORY OF WASTE STORED AT THE WVDP
TABLE 7.2-2	RADIOLOGICAL CHARACTERISTICS OF HIC CONTENTS
TABLE 7.4-1	VESSELS VENTILATED BY THE VESSEL OFF-GAS SYSTEM
TABLE 7.5-1	LLWTS EFFLUENT ISOTOPIC CONCENTRATIONS TEN-YEAR AVERAGE
TABLE 7.6-1	ESTIMATED AVERAGE RADIOLOGICAL INVENTORY OF LAG STORAGE WASTE CONTAINERS[1]
TABLE 7.6-2	WASTE TYPE AND AVAILABLE STORAGE LOCATIONS IN WVDP STORAGE FACILITIES
TABLE 7.6-3	NDA WASTE DISPOSAL SUMMARY PROFILE
TABLE 7.7-1	CPC-WSA INVENTORY

LIST OF TABLES
(Concluded)

Table Number	Title
TABLE 8.2-1	DESIGN BASIS Cs-137 CONCENTRATIONS FOR IRTS FACILITIES
TABLE 8.2-2	GAMMA CURIES OF DESIGN FUEL FOR THE MAIN PLANT BUILDING* Basis 1000 kg Uranium 150 Day Cooling
TABLE 8.2-3	MATERIAL AT RISK CONCENTRATIONS IN HEPA FILTERS
TABLE 8.2-4	MATERIAL AT RISK CONCENTRATIONS IN HIGH LEVEL WASTE
TABLE 8.2-5	MATERIAL AT RISK CONCENTRATIONS IN LAGOON LIQUID
TABLE 8.2-6	MATERIAL AT RISK CONCENTRATIONS IN LIQUID LLW
TABLE 8.2-7	MATERIAL AT RISK CONCENTRATIONS IN SOLID LLW
TABLE 8.2-8	VITRIFICATION IN-CELL OFF-GAS SYSTEM SOURCE TERM June 1993
TABLE 8.2-9	VITRIFICATION IN-CELL PRIMARY FILTER SOURCE TERM June 1993
TABLE 8.3-1	SUMMARY OF STS SHIELDING CALCULATIONS
TABLE 8.3-2	RESULTS OF LWTS SHIELDING ANALYSES
TABLE 8.3-3	SHIELDING SUMMARY FOR SOURCE AREA - PROCESS MECHANICAL CELL
TABLE 8.3-4	SHIELDING SUMMARY FOR SOURCE AREA - GENERAL PURPOSE CELL
TABLE 8.3-5	SHIELDING SUMMARY FOR SOURCE AREA - CHEMICAL PROCESS CELL
TABLE 8.3-6	SHIELDING SUMMARY FOR SOURCE AREA - EXTRACTION CELL NO. 3
TABLE 8.3-7	SHIELDING SUMMARY FOR SOURCE AREA - ANALYTICAL CELLS
TABLE 8.3-8	SPECIFICATIONS OF MONITORING INSTRUMENTS
TABLE 8.3-9	PROCESS AND EFFLUENT RADIATION MONITORS
TABLE 8.3-10	CONTINUOUS AIRBORNE RADIOACTIVITY MONITORS
TABLE 8.3-11	RADIATION MONITORING EQUIPMENT TYPICAL LOCATIONS
TABLE 8.4-1	Cumulative Dose CEDE
TABLE 8.4-2	2004 ALARA Budget (CY)
Table 8.6-1	TOTAL RADIOACTIVITY (CURIES) IN AIRBORNE EMISSIONS RELEASED FROM WVDP STACKS IN 2003
Table 8.6-2	TOTAL RADIOACTIVITY (CURIES) IN LIQUID EFFLUENTS RELEASED FROM LAGOON 3 IN 2003
TABLE 8.7-1	SUMMARY OF CRITICALITY ANALYSIS RESULTS FOR NORMAL AND ACCIDENT CONDITIONS
TABLE 9.1-1A	PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
TABLE 9.1-1B	PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
TABLE 9.1-1C	PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
TABLE 9.1-1D	PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
TABLE 9.1-1E	PROCESS HAZARDS ANALYSIS FOR THE VITRIFICATION FACILITY AND SUPPORT SSCs
TABLE 9.2-1	FAILURE OF MAIN PLANT HEPA FILTER BANK
TABLE 9.2-2	ENERGETIC EVENT INVOLVING TRU WASTE DRUM AT LAG STORAGE BUILDING
TABLE 9.2-3	DROP OF A HIGH INTEGRITY CONTAINER
TABLE 9.2-4	FAILURE OF UPC VESSELS
TABLE 9.2-5	DROP OF HLW WASTE CONTAINER
TABLE 9.2-6	VITRIFICATION PROCESS OFF-GAS OR HVAC SYSTEM HEPA FAILURE
TABLE 9.2-7	SUMMARY OF CONSEQUENCES OF FACILITY ACCIDENTS
TABLE 12.2-1	COVERAGE OF DOE-STD-3009-94 QUALITY ASSURANCE REQUIREMENTS IN WVNS-SAR-001

LIST OF FIGURES

Figure Number	Title
1.1-1	LOCATION OF THE WESTERN NEW YORK NUCLEAR SERVICE CENTER
1.1-2	WESTERN NEW YORK NUCLEAR SERVICE CENTER
1.2-1	LIQUID WASTE TREATMENT SYSTEM PROCESS FLOW DIAGRAM
1.2-2	WEST VALLEY DEMONSTRATION PROJECT VITRIFICATION FACILITIES
3.1-1	LOCATION OF WEST VALLEY DEMONSTRATION PROJECT SITE AND LOCAL SURROUNDING AREA
3.4-1	100-YEAR FLOODPLAIN MAP
3.6-1	SEISMICITY IN THE NORTHEASTERN UNITED STATES
3.6-2	COMPARISON OF GENERAL EASTERN UNITED STATES ATTENUATION WITH DATA FOR SITE REGION
3.6-3	FRACTILE SEISMIC HAZARD CURVES
5.1-1	LOCATION OF FACILITIES
5.2-1	SHEET METAL ENCLOSURES AND EXTERIOR SPECIAL DOORS ASSOCIATED WITH THE VITRIFICATION BUILDING AND COLD CHEMICAL BUILDING
5.2-2	VITRIFICATION BUILDING AND EDR AT EL. 100' AND 110'
5.2-3	VITRIFICATION BUILDING PLAN AT EL. 120' AND EL. 127'
5.2-4	VITRIFICATION BUILDING PLAN AT ROOF EL. 146.25'
5.2-5	SECTION A-A - VITRIFICATION BUILDING
5.2-6	SECTION G-G - VITRIFICATION BUILDING
5.2-7	GENERAL ARRANGEMENT - STS TANK 8D-1 SECTION
5.2-8	PUREX HLW TANK INTERNAL FLOOR STRUCTURE (TYP.) (TANK 8D-1 SHOWN)
5.2-9	PLAN VIEW - HLW TANKS 8D-1 AND ID-2
5.2-10	GENERAL ARRANGEMENTS STS BUILDING AND 8D-3 & 4 TANKS - PLAN ELEVATION 92.0'
5.2-11	STS PROCESS FACILITIES SECTION
5.2-12	GENERAL ARRANGEMENT - STS BUILDING SECTIONS
5.2-13	HLW TANK 8D-3 AND TANK 8D-4 SECTION
5.2-14	MAIN PLANT PLAN BELOW GRADE
5.2-15	MAIN PLANT PLAN AT ELEVATION 100.0'
5.2-16	MAIN PLANT PLAN AT ELEVATION 114.5'
5.2-17	MAIN PLANT PLAN AT ELEVATION 131.0'
5.2-18	EQUIPMENT ARRANGEMENT - OFF GAS AND ACID RECOVERY CELLS - PLAN ELEVATION 111'-6" TO 128'-3"
5.2-19	EQUIPMENT ARRANGEMENT - LIQUID WASTE CELL PLAN
5.2-20	LWTS PLAN AT ELEVATION 100.0'
5.2-21	LWTS PLAN AT ELEVATION 114.5'
5.2-22	LWTS ELEVATION VIEW
5.2-23	GENERAL ARRANGEMENT - LWTS SECTIONS
5.2-24	RADWASTE PROCESS BUILDING PLAN AND SECTIONS
5.2-25	HIGH INTEGRITY CONTAINER
5.2-26	GENERAL ARRANGEMENT - 01-14 BUILDING PLAN ELEVATION 98.0'
5.2-27	GENERAL ARRANGEMENT - 01-14 BUILDING PLAN 116.5'
5.2-28	GENERAL ARRANGEMENT - 01-14 BUILDING PLAN ELEVATION 130.0'
5.2-29	GENERAL ARRANGEMENT - 01-14 BUILDING PLAN ELEVATION 144.0'
5.2-30	GENERAL ARRANGEMENT - 01-14 BUILDING SECTIONS
5.4-1	BUILDING AND OFF-GAS TREATMENT VENTILATION SYSTEMS
5.4-2	MAIN PLANT VENTILATION FLOW
5.4-3	HEAD END VENTILATION SYSTEM FLOW
5.4-4	01-14 BUILDING VENTILATION FLOW
5.4-5	VITRIFICATION BUILDING HVAC ZONES EL. 110.00'
5.4-6	VITRIFICATION BUILDING HVAC ZONES EL. 125.00'
5.4-7	VENTILATION SUPPLY/EXHAUST SYSTEMS

LIST OF FIGURES
(Concluded)

Figure Number	Title
5.4-8	COLD CHEMICAL BUILDING H&V AIR FLOW DIAGRAM AND P&ID
5.4-9	PRIMARY POWER SYSTEM EXPANSION ONE-LINE DIAGRAM
5.4-10	CLOSED-LOOP COOLING WATER (CLCW) SYSTEM
5.4-11	NATURAL GAS DISTRIBUTION SYSTEM ON-SITE
6.1-1	FORMER VITRIFICATION FACILITY FLOW DIAGRAM
6.1-2	IRTS PROCESS FLOW DIAGRAM - SUPERNATANT TREATMENT, WASTE MOBILIZATION & TRANSFER, AND PNEUMATIC SAMPLE TRANSPORT SYSTEMS
6.1-3	IRTS PROCESS FLOW DIAGRAM - LIQUID WASTE TREATMENT SYSTEM
6.2-1	FORMER VITRIFICATION CELL
6.2-2	FORMER VITRIFICATION FACILTY VESSEL VENT HEADER INPUTS
6.2-3	VITRIFICATION PROCESS OFF-GAS FLOW DIAGRAM
6.2-4	FORMER VITRIFICATION PRIMARY OFF-GAS VESSELS FLOW DIAGRAM
6.2-5	FORMER VITRIFICATION WASTE HEADER SYSTEM
6.2-6	FORMER VITRIFICATION FACILITY LOAD-IN BUILDING AT EL. 100.00'
6.3-1	CONTROL ROOM LOCATIONS
7.5-1	FLOW DIAGRAM OF LOW-LEVEL WASTE TREATMENT SYSTEM
7.5-2	LOCATION OF WASTE STORAGE AND PROCESSING FACILITIES
7.5-3	ESTIMATED ANNUAL WATER BALANCE FOR LLWTS FOR CY-2001
8.6-1	ON-SITE AIR MONITORING AND SAMPLING POINTS
8.6-2	OFF-SITE AIR AND FALLOUT SAMPLING POINTS
8.6-3	ON-SITE SURFACE WATER AND SOIL/SEDIMENT SAMPLING LOCATIONS
8.6-4	OFF-SITE SURFACE WATER AND SOIL/SEDIMENT SAMPLING LOCATIONS
8.6-5	ACTIVE WVDP GROUNDWATER MONITORING POINTS
8.6-6	NEAR-SITE DRINKING WATER AND BIOLOGICAL SAMPLING POINTS
8.6-7	LOCATION OF ON-SITE THERMOLUMINESCENT DOSIMETERS (TLDS)
8.6-8	LOCATION OF OFF-SITE THERMOLUMINESCENT DOSIMETERS (TLDS)
8.6-9	SCHEMATIC OF PATHWAYS CONSIDERED FOR DOSE ASSESSMENTS
9.1-1	PROCESS HAZARDS ANALYSIS RISK BINS
10.1-1	WVDP ORGANIZATION HIERARCHY
10.1-2	WVNS ORGANIZATION
12.2-1	QUALITY ASSURANCE PROGRAM IMPLEMENTATION HIERARCHY

LIST OF ACRONYMS AND ABBREVIATIONS

A&PC	Analytical and Process Chemistry
AADT	Average Annual Daily Traffic
ACFM	Absolute Cubic Feet Per Minute
ACGIH	American Conference of Governmental Industrial Hygienists
ACI	American Concrete Institute
ADA	Analytical Decontamination Aisle
ADS	Air Displacement Slurry
AEA	Atomic Energy Act
AEC	Atomic Energy Commission
AED	Assistant Emergency Director
AEDE	Annual Effective Dose Equivalent
AEOC	Alternate Emergency Operations Center
AIHA	American Industrial Hygiene Association
AISC	American Institute of Steel Construction
ALARA	As Low As Reasonably Achievable
ALS	Advanced Life Support
AMS	Alarm Monitoring Station
ANC	Analytical Cell
ANS	American Nuclear Society
ANSI	American National Standards Institute
AOC	Ashford Office Complex
AR-OG	Acid Recovery - Off-Gas
ARC	Acid Recovery Cell
ARF	Airborne Release Fraction
ARI	Air-Conditioning and Refrigeration Institute
ARM	Area Radiation Monitor
ARPR	Acid Recovery Pump Room
ARR	Airborne Release Rate
ASCE	American Society of Civil Engineers
ASER	Annual Site Environmental Report
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWG	American Wire Gauge
AWS	American Welding Society
B&P	Buffalo & Pittsburgh
BDBA	Beyond Design Basis Accident
BDBE	Beyond Design Basis Earthquake
BIT	Bass Islands Trend
BNFL	British Nuclear Fuels Limited
BSW	Bulk Storage Warehouse
CAM	Continuous Air Monitor
CAM	Consequence Assessment Manager
CAS	Criticality Alarm System
CAS	Chemical Abstract Services
CC	Chilled Water
CCB	Cold Chemical Building
CCR	Chemical Crane Room
CCS	Cold Chemical System
CCSR	Cold Chemical Scale Room
CCTV	Closed-Circuit Television
CCZ	Criticality Control Zone

LIST OF ACRONYMS AND ABBREVIATIONS
(Concluded)

CD	Communication Director
CDDS	Computer Data Display System
CDS	Criticality Detection System
CEC	Cation Exchange Capacity
CEDE	Committed Effective Dose Equivalent
cfm	Cubic feet per minute
CFMT	Concentrator Feed Make-up Tank
CFR	Code of Federal Regulations
cfs	Cubic feet per second
Ci	Curie
CLCW	Closed-Loop Cooling Water
CMAA	Crane Manufacturers Association of America
CMP	Corrugated Metal Pipe
CMR	Crane Maintenance Room
COA	Chemical Operating Aisle
CPC	Chemical Process Cell
CPC-WSA	Chemical Process Cell Waste Storage Area
CR	Control Room
CRT	Cathode Ray Tube
Cs	Cesium
CSE	Criticality Safety Engineer
CSPF	Container Sorting and Packaging Facility
CSRF	Contact Size Reduction Facility
CSRT	Confined Space Rescue Team
CSS	Cement Solidification System
CTS	Component Test Stand
CUP	Cask Unloading Pool
CVA	Chemical Viewing Aisle
CW	Cooling Tower Water
CWTP	Commercial Waste Treatment System
CY	Calendar Year
D&D	Decontamination and Decommissioning
D&M	Dames & Moore
DAC	Derived Air Concentration
DBA	Design Basis Accident
DBE	Design Basis Earthquake
DBT	Design Basis Tornado
DBW	Design Basis Wind
DC	Direct Current
DCF	Dose Conversion Factor
DCG	Derived Concentration Guide
DCS	Distributed Control System
DEIS	Draft Environmental Impact Statement
DF	Decontamination Factor
DGR	Diesel Generator Room
DOE	Department of Energy
DOE-HQ	Department of Energy - Headquarters
DOE-HQ-EOC	Department of Energy - Headquarters - Emergency Operations Center
DOE-ID	Department of Energy - Idaho
DOE-OH	Department of Energy - Ohio Field Office
DOE-PD	Department of Energy - Project Director
DOE-WV	Department of Energy - West Valley Area Office
DOE-WVDP	Department of Energy - West Valley Demonstration Project
DOELAP	Department of Energy Laboratory Accreditation Program
DOT	Department of Transportation
dpm	Disintegrations per minute
DR	Damage Ratio

LIST OF ACRONYMS AND ABBREVIATIONS
(Concluded)

DWPF	Defense Waste Processing Facility
E-Lab	Environmental Laboratory
EAM	Environmental Assessment Manager
EBA	Evaluation Basis Accident
EBE	Evaluation Basis Earthquake
ECN	Engineering Change Notice
ED	Emergency Director
EDE	Effective Dose Equivalent
EDR	Equipment Decontamination Room
EDRVA	Equipment Decontamination Room Viewing Aisle
EDS	Electrical Power Distribution
EG	Evaluation Guideline
EHS	Employee Health Services
EID	Environmental Information Document
EIS	Environmental Impact Statement
EM	Emergency Management
EMAP	Environmental Management Administrative Procedure
EMC	Emergency Management Coordinator
EMOA	East Mechanical Operating Aisle
EMRT	Emergency Medical Response Team
EMT	Environmental Monitoring Team
EOC	Emergency Operation Center
EP	Engineering Procedure
EPA	Environmental Protection Agency
EPD	Elevation Plant Datum
EPI	Emergency Public Information
EPIcode	Emergency Protection Information Code
EPRI	Electric Power Research Institute
EPZ	Emergency Protection Zone
ERO	Emergency Response Organization
ERPG	Emergency Response Planning Guideline
ES&H	Environment, Safety, and Health
FHA	Fire Hazards Analysis
fpm	Feet per minute
fps	Feet per second
FRS	Fuel Receiving and Storage
FSAR	Final Safety Analysis Report
FSFCA	Federal and State Facility Compliance Act
FSP	Fuel Storage Pool
g	Gravitational Acceleration Constant
G	Giga, prefix for 10^9
GAC	Granular Activated Carbon
GCR	General Purpose Cell Crane Room
GCRE	General Purpose Cell Crane Room Enclosure
GCRX	General Purpose Cell Crane Room Extension
GET	General Employee Training
GM	Geometric Mean
GOA	General Purpose Cell Operating Aisle
GPC	General Purpose Cell
gpd	Gallons per day
gpm	Gallons per minute
GPCCR	General Purpose Cell Crane Room
GPCCRE	General Purpose Cell Crane Room Enclosure
G_s	Specific gravity

LIST OF ACRONYMS AND ABBREVIATIONS
(Concluded)

ha	Hectare
HAC	Hot Acid Cell
HAF	Hot Acid Feed
HAPR	Hot Acid Pump Room
HAZMAT	Hazardous Materials
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEC	Head End Cell
HEME	High Efficiency Mist Eliminator
HEPA	High Efficiency Particulate Air
HEV	Head End Ventilation
HFE	Human Factors Engineering
HIC	High Integrity Container
HLW	High-Level Waste
HLWIS	High-Level Waste Interim Storage
HLWTF	High-Level Waste Tank Farm
HLWTS	High-Level Waste Transfer System
hp	Horsepower
HPS	High Pressure Sodium
HRA	Human Reliability Analysis
HV	Heating and Ventilation
HVAC	Heating, Ventilation, and Air Conditioning
HVOS	Heating, Ventilation Operating Station
HWSF	Hazardous Waste Storage Facility
i.d.	Inner Diameter
I&C	Instrumentation and Control
IA	Instrument Air
IAP	Integrated Assessment Program
IC	Incident Commander
ICRP	International Commission on Radiological Protection
IEEE	Institute of Electrical and Electronics Engineers
IH&S	Industrial Hygiene and Safety
ILDS	Infrared Level Detection System
INEL	Idaho National Engineering Laboratory
INEEL	Idaho National Engineering and Environmental Laboratory
IR	Incident Report
IRTS	Integrated Radwaste Treatment System
ISM	Integrated Safety Management
ISMS	Integrated Safety Management System
IWP	Industrial Work Permit
IWSF	Interim Waste Storage Facility
IWTS	Integrated Waste Tracking System
IX	Ion Exchange
JIC	Joint Information Center
JTG	Joint Test Group
k	Kilo, prefix for 10^3
K_d	Partition Coefficient
k_{eff}	Effective Neutron Multiplication Factor
K_h	Horizontal hydraulic conductivity
KOH	Potassium Hydroxide
kPa	Kilo-Pascal
kPag	Kilo-Pascal gauge
kph	Kilometer per hour
kV	Kilo-Volt
K_v	Vertical hydraulic conductivity
kVA	Kilovolt-ampere

LIST OF ACRONYMS AND ABBREVIATIONS
(Concluded)

kW	kilo-Watt
LADS	Liquid Abrasive Decontamination System
LANL	Los Alamos National Laboratory
LASL	Los Alamos Scientific Laboratory
lfpm	Linear feet per minute
LLL	Lawrence Livermore Laboratory
LLMW	Low-Level Mixed Waste
LLNL	Lawrence Livermore National Laboratory
LLRW	Low-Level Radioactive Waste
LLW	Low-Level Waste
LLW2	Low-Level Waste Treatment Replacement Facility
LLWTF	Low-Level Waste Treatment Facility
LLWTS	Low-Level Waste Treatment System
LOA	Letter of Agreement
LPF	Leak Path Factor
LPG	Liquid Propane Gas
lpm	Liters per minute
LPS	Liquid Pretreatment System
LSA-4	Lag Storage Area-4
LSB	Lag Storage Building
LWA	Lower Warm Aisle
LWC	Liquid Waste Cell
LWTS	Liquid Waste Treatment System
LXA	Lower Extraction Aisle
m	Meter
m/s	Meters per second
m	Milli, prefix for 10^{-3}
M	Mega, prefix for 10^{6}
M&O	Management and Operating
M&TE	Maintenance and Test Equipment
MAR	Material at Risk
m_b	Earthquake Magnitude
MBtu	Mega-British Thermal Units
MC	Miniature Cell
MCC	Motor Control Center
mCi	milli-Curie
MEOSI	Maximally Exposed Off-Site Individual
MeV	Mega-electron Volt
MFHT	Melter Feed Hold Tank
mi	Mile
MMI	Modified Mercalli Intensity
MOA	Mechanical Operating Aisle
mol	Mole
MOU	Memorandum of Understanding
MPO	Main Plant Operator
mR/hr	Milli-Roentgen per hour
mrem	Millirem
MRR	Manipulator Repair Room
MSDS	Material Safety Data Sheet
MSM	Master-Slave Manipulator
mSv	milli-Sievert
MT	Metric Ton
n	Nano, prefix for 10^{-9}
Na	Sodium
NaOH	Sodium Hydroxide

LIST OF ACRONYMS AND ABBREVIATIONS
(Concluded)

NC	News Center
NDA	NRC-Licensed Disposal Area
NDA-LPS	NRC-Licensed Disposal Area - Liquid Pretreatment System
n_e	Effective porosity
NEC	National Electric Code
NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NESHAP	National Emission Standard for Hazardous Air Pollutants
NFPA	National Fire Protection Association
NFS	Nuclear Fuel Services, Inc.
NGVD	National Geodetic Vertical Datum
NH_3	Ammonia
NIOSH	National Institute of Occupational Safety and Health
NMPC	Niagara Mohawk Power Corporation
NO	Notification Officer
NO_x	Nitrogen Oxide
NPH	Natural Phenomena Hazard
NRC	Nuclear Regulatory Commission
NWS	National Weather Service
NY	New York
NYCRR	New York Code of Rules and Regulations
NYS	New York State
NYSDEC	New York State Department of Environmental Conservation
NYSDOH	New York State Department of Health
NYSDOT	New York State Department of Transportation
NYSERDA	New York State Energy Research and Development Authority
NYSGS	New York State Geological Survey
OAM	Operational Assessment Manager
OBE	Operating Basis Earthquake
OEHMP	Operational Emergency Hazardous Material Program
OEP	On-Site Evaluation Point
OGA	Off-Gas Aisle
OGBR	Off-Gas Blower Room
OGC	Off-Gas Cell
OH	DOE, Ohio Field Office
OITS	Open Item Tracking System
OM	Operations Manager
OOS	Out-of-Service
ORNL	Oak Ridge National Laboratory
ORT	Operations Response Team
OSC	Operations Support Center
OSHA	Occupational Safety and Health Act
OSHA	Occupational Safety and Health Administration
OTS	Operations Technical Support
p	Pico, prefix for 10^{-12}
P	Peta, prefix for 10^{15}
P&ID	Piping and Instrument Diagram
Pa	Pascal
PAG	Protective Action Guideline
PBT	Performance-Based Training
pcf	Pounds per cubic foot
PCM	Personal Contamination Monitor
PDAH	Pressure Differential Alarm High
PDAL	Pressure Differential Alarm Low
PDCH	Pressure Differential Control High
PDCL	Pressure Differential Control Low

LIST OF ACRONYMS AND ABBREVIATIONS
(Concluded)

PDR	Pressure Differential Recorder
PEL	Permissible Exposure Limit
PGA	Peak Ground Acceleration
PGSC	Pasquill-Gifford Stability Class
PHA	Process Hazards Analysis
PID	Public Information Director
PLC	Programmable Logic Controller
PM	Preventive Maintenance
PMC	Process Mechanical Cell
PMCR	Process Mechanical Cell Crane Room
PMCRE	Process Mechanical Cell Crane Room Enclosure
PMF	Probable Maximum Flood
PMP	Probable Maximum Precipitation
PNL	Pacific Northwest Laboratory
PNNL	Pacific Northwest National Laboratory
PPC	Product Purification Cell
PPE	Personal Protective Equipment
ppm	Parts Per Million
psf	Pound per square foot
psi	Pound per square inch
psig	Pound per square inch gauge
PSOSS	Plant Systems Operations Shift Supervisor
PSR	Process Safety Requirement
Pu	Plutonium
PVC	Polyvinyl chloride
PVS	Permanent Ventilation System
PVU	Portable Ventilation Unit
PWS	Potable Water System
QA	Quality Assurance
QA/QC	Quality Assurance/Quality Control
QAP	Quality Assurance Program
QAP	Quality Assurance Plan
R	Roentgen
R/hr	Roentgen per hour
R&SC	Radiation and Safety Committee
RAM	Radiological Assessment Manager
RAP	Radiological Assistance Plan
RCOS	Radiological Controls Operations Supervisor
RCRA	Resource Conservation and Recovery Act
rem	Roentgen Equivalent Man
RESL	Radiological and Environmental Sciences Laboratory
RF	Respirable Fraction
RIR	Radioisotope Inventory Report
RM	Recovery Manager
RMW	Radioactive Mixed Waste
RP	Radiation Protection
RPO	Radiation Protection Operations
RPOS	Radiation Protection Operations Supervisor
RPSA	Rail Package and Staging Area
RSAC	Radiological Safety Analysis Code
RWMC	Radioactive Waste Management Complex
RWP	Radiation Work Permit
s	Second
SAA	Satellite Accumulation Area
SAE	Site Area Emergency

LIST OF ACRONYMS AND ABBREVIATIONS
(Concluded)

SAI	Science Applications International
SAR	Safety Analysis Report
SBS	Submerged Bed Scrubber
SCBA	Self-Contained Breathing Apparatus
scfm	Standard cubic feet per minute
SCR	Selective Catalytic Reduction
SCS	U.S. Soil Conservation Service
SDA	New York State-Licensed Disposal Area
SEN	Secretary of Energy Notice
SER	Site Environmental Report
SFCM	Slurry-Fed Ceramic Melter
SFPE	Society of Fire Protection Engineers
SFR	Secondary Filter Room
SI	International System of Units
slpm	Standard liter per minute
SM	Security Manager
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SMS	Sludge Mobilization System
SMT	Slurry Mix Tank
SMWS	Sludge Mobilization and Wash System
SNF	Spent Nuclear Fuel
SNL	Sandia National Lab
SOP	Standard Operating Procedure
SPDES	State Pollutant Discharge Elimination System
Sr	Strontium
SRE	Search and Reentry
SRR	Scrap Removal Room
SS	Stainless Steel
SSCs	Structures, Systems, and Components
SSE	Safe Shutdown Earthquake
SSI	Soil-Structure Interaction
SSS	Security Shift Supervisor
STP	Sewage Treatment Plant
STP	Standard Temperature and Pressure
STS	Supernatant Treatment System
Sv	Sievert
SWMU	Solid Waste Management Unit
TBP	Tri-butyl phosphate
TEDE	Total Effective Dose Equivalent
TEEL	Temporary Emergency Exposure Limit
Ti	Titanium
TLD	Thermoluminescent Dosimeter
TLV	Threshold Limit Value
TRU	Transuranic
TSB	Test and Storage Building
TSC	Technical Support Center
TSD	Technical Support Document
TSR	Technical Safety Requirement
UA	Utility Air
UAP	Upper Annealing Point
UBC	Uniform Building Code
UCRL	University of California Research Laboratory
ULO	Uranium Load Out
UPC	Uranium Product Cell
UPS	Uninterruptible Power Supply
UR	Utility Room

LIST OF ACRONYMS AND ABBREVIATIONS
(Concluded)

URE	Utility Room Expansion
USDOE	U.S. Department of Energy
USDOI	U.S. Department of the Interior
USDOL	U.S. Department of Labor
USDOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USGS	U.S. Geological Survey
USNRC	U.S. Nuclear Regulatory Commission
USQ	Unreviewed Safety Question
USQD	Unreviewed Safety Question Determination
UWA	Upper Warm Aisle
UWS	Utility Water Supply
UXA	Upper Extraction Aisle
V	Volt
VA	Volt-Ampere
VAC	Volt Alternating Current
VAST	Vitrification Analytical Sample Tracking
VDC	Volt Direct Current
VEC	Ventilation Exhaust Cell
VEM	Vitrification Expended Materials
VEMP	Vitrification Expended Materials Processing
Vit	Vitrification
VF	Vitrification Facility
VFFCP	Vitrification Facility Fire Control Panel
VIV	Variable Inlet Vane
VOG	Vessel Off-Gas
VTF	Vitrification Test Facility
VWR	Ventilation Wash Room
W	Watt
WAPS	Waste Acceptance Product Specifications
WC	Water Column
WDC	Waste Dispensing Cell
WGES	Westinghouse Government Environmental Services
WGSG	Westinghouse Government Services Group
WHC	Westinghouse Hanford Company
WIP	Work Instruction Package
WIPP	Waste Isolation Pilot Plant
WMO	Waste Management Operations
WMOA	West Mechanical Operating Aisle
WNYNSC	Western New York Nuclear Service Center
WRAP	Waste Receiving and Processing Facility
WRPA	Waste Reduction and Packaging Area
WSF	Waste Storage Facility
WSRC	Westinghouse Savannah River Company
wt%	Weight percent
WTF	Waste Tank Farm
WVDP	West Valley Demonstration Project
WVNSCO	West Valley Nuclear Services Company
WVPP	West Valley Policies and Procedures
WVVHC	West Valley Volunteer Hose Company
WWTF	Waste Water Treatment Facility

LIST OF ACRONYMS AND ABBREVIATIONS
(Concluded)

XC-1	Extraction Cell 1
XC-2	Extraction Cell 2
XC-3	Extraction Cell 3
XCR	Extraction Chemical Room
XSA	Extraction Sample Aisle
y	Year
Y_d	Dry density
YOY	Young of Year
yr	Year

1.0 INTRODUCTION AND OVERALL DESCRIPTION OF THE FACILITY

1.1 Introduction

The Western New York Nuclear Service Center (WNYNSC), at West Valley, New York, was the site of the first commercial nuclear fuel reprocessing operation in the United States. The West Valley fuel reprocessing plant (Main Plant) was originally constructed by Bechtel Corporation from 1963 to 1966 for Nuclear Fuel Services, Inc. (NFS). As a reprocessing facility, the Main Plant provided for spent fuel storage, mechanical handling, dissolution, chemical extraction, and product and by-product handling with a reprocessing capacity of one ton per day. In total, approximately 640 metric tons of spent nuclear fuel was reprocessed by NFS generating about 600,000 gallons of liquid, high-level radioactive waste that was stored in underground tanks contained within concrete vaults. The design, construction, and operation of the original facility as a fuel reprocessing plant was the subject of a U.S. Atomic Energy Commission (AEC)-approved Final Safety Analysis Report (FSAR).

Operation of the NFS plant continued until early 1972, when the plant was shut down for facility expansion.

On September 22, 1976, NFS announced its intention to withdraw from commercial nuclear fuel reprocessing operations and the plant was placed in standby status.

In 1980, Congress passed the West Valley Demonstration Project (WVDP) Act, directing the U.S. Department of Energy (DOE) to carry out a high-level waste (HLW) management demonstration project at the site to demonstrate solidification techniques for preparing the HLW for disposal. Vitrification, determined to be the best demonstrated available technology for the treatment of HLW, was selected as the preferred technique.

Through a contractual agreement with New York State, DOE is operating the Project in conjunction with the New York State Energy Research and Development Authority (NYSERDA). In 1981, DOE selected West Valley Nuclear Services Company, Inc. (WVNSCO), as prime Project contractor. WVNSCO is part of Washington Group International.

The WVDP (established to implement the WVDP Act) is located on approximately 200 acres within the 3,345-acre WNYNSC in rural Cattaraugus County, about 35 mi south of Buffalo, New York. The WVDP site is within the Town of Ashford, one of thirty-two distinct towns that comprise Cattaraugus County. The Project facilities include the former NFS plant and related facilities, portions of which have been decontaminated sufficiently for use by the WVDP. Several additional buildings and facilities were constructed to complete the WVDP mission. Figure 1.1-1 is a local area map, showing the WVDP site in relation to the WNYNSC and the WNYNSC in relation to nearby communities and geographical features. Facilities located outside the WVDP premises, but within the WNYNSC, which are related to the operations of the WVDP include the two reservoirs to the south, the Bulk Storage Warehouse to the southeast, the school house to the south, and environmental monitoring equipment surrounding the site. The reservoirs are the source of water for the Project facilities. The Bulk Storage Warehouse provides storage for excess nonradioactive materials and equipment.

In addition to the facilities mentioned above, the WNYNSC includes two former disposal areas; the Nuclear Regulatory Commission Licensed Disposal Area (NDA) within the Project premises, and the State of New York Licensed Disposal Area (SDA), which is not part of the Project premises. Figure 1.1-2 shows the relative location of these features within the WNYNSC.

The West Valley Demonstration Project Act directed the Secretary of Energy to undertake five major activities, as follows:

i. Solidify the liquid HLW stored at the WNYNSC into a form suitable for transportation and disposal (completed);
ii. Develop containers for the solidified HLW suitable for permanent disposal of the HLW (completed);
iii. Transport the waste to a federal repository for disposal (pending);
iv. Dispose of low-level radioactive waste (LLRW) and transuranic (TRU) waste produced by the Project (in progress); and
v. Decontaminate and decommission the HLW storage tanks (deactivated, July 2003), the HLW solidification facilities, and any material and hardware used in connection with the Project.

Primary tasks required to accomplish the mission objectives as identified in the Act included the following:

- Development and operation of a supernatant treatment system (STS), which processed the liquid supernatant remaining after fuel reprocessing as well as the liquid from sludge washing (completed);
- Development and operation of a liquid waste treatment system (LWTS) that was required to concentrate dissolved solids carried over in decontaminated process solutions that were transferred from the STS (completed);
- Development and operation of a cement solidification system (CSS) that was used to stabilize the concentrated brine solutions produced by the LWTS (completed);
- Development and operation of a sludge mobilization and washing system, and HLW transfer system that was required to remove excess sulfates from HLW sludges prior to vitrification (completed);
- Development and operation of a HLW vitrification facility to be used for the encapsulation of HLW solids (sludge and zeolite) (completed);
- Development and operation of a vitrified HLW interim storage system for the interim storage of HLW storage canisters produced in the Vitrification Facility (ongoing); and
- Final decontamination and decommissioning (D&D) of the Project facilities and shipment of wastes designated for off-site disposal (ongoing).

Ancillary tasks and supporting activities include the following:

- Maintenance and operation of the existing site and plant (ongoing);
- Development (complete) and operation of a size reduction facility for contact-handleable, contaminated equipment;
- Development and operation of a compactor facility (removed from site);
- Development and operation of storage facilities to be used during the time interval between waste generation and waste disposal; and
- Disposal area operation and maintenance.

As implemented by the DOE, the WVDP comprised two primary radioactive material processing components: the Integrated Radwaste Treatment System (IRTS) and the Vitrification Facility (VF). The IRTS was originally designed for supernatant and sludge wash solution processing, solidification, and storage, while the VF was designed for the stabilization and storage of radioactive HLW sludge and zeolite. The initial objective of the IRTS was successfully attained in 1995,

resulting in the production of 19,877 drums of solidified waste placed in safe storage at the WVDP.

The IRTS comprises four component systems - the STS, which decontaminated solutions from the HLW tanks through an ion removal process; the LWTS, which employs an evaporator to concentrate solutions; the CSS, which solidified LWTS concentrates; and the Drum Cell, which provides storage for solidified wastes received from the CSS. Facilities associated with the IRTS are discussed in Section 1.2.1, and the IRTS process description is provided in Section 1.3.1.

The VF successfully stabilized the following waste streams in a borosilicate glass matrix: the radioactive HLW sludge that had been generated during PUREX reprocessing by NFS, contaminated ion removal resin (zeolite) generated as a byproduct of STS operations, and acidic THOREX waste that resulted from the reprocessing of thorium fuel by NFS. The facilities associated with vitrification are discussed in Section 1.2.2, and the vitrification process description is provided in Section 1.3.2.

In addition to these primary facilities, several support facilities exist at the WVDP. These include facilities that provide interim storage of radioactive and hazardous waste generated during processing and decontamination activities, effluent treatment facilities, warehouses, and maintenance and office areas. Support facilities are discussed in Section 1.2.1.

1.2 Facility Descriptions

1.2.1 IRTS, Main Plant, and Support Facilities Descriptions

Processing equipment for IRTS components is contained in independent facility structures. Processing equipment for the STS was installed in the spare HLW Tank 8D-1 located in the Waste Tank Farm (WTF).

Processing equipment for the LWTS is contained within the Main Plant and 01-14 Building. Feed and product tanks for the LWTS are located in the Uranium Product Cell (UPC), while equipment to support waste concentration (i.e., evaporation) is located in Extraction Cell 3 (Figure 1.2-1).

Equipment associated with the CSS is located in the 01-14 Building; solidified waste is stored in the Drum Cell. The CSS facility is currently inoperative.

Liquid and solid LLW treatment, processing, and storage facilities have also been provided at the WVDP. Liquid LLW at the WVDP comprises contaminated waters resulting from area or equipment decontamination, treated solutions from the LWTS, system flushwater, filter backwash, and laundry operations. These waste waters are treated using equipment located in the Low-Level Waste Treatment Replacement Facility (LLW2). Temporary storage of these liquid wastes is provided by the four lagoon storage basins.

Interim (lag) storage of solid LLW, nonradioactive hazardous waste, low-level mixed waste, and TRU waste is provided in the Lag Storage Facility, Hazardous Waste Storage Facility, Satellite Accumulation Areas, and the Interim Waste Storage Facility which are discussed further in Chapter 7.

Solid waste at the WVDP is processed for volume reduction. Processing facilities include the Contact Size-Reduction Facility (CSRF), the Waste Reduction and Packaging Area (WRPA) compactor, the Container Sorting and Packaging Facility (CSPF), and the Lag Storage Area-4 (LSA-4) Shipping Depot Containment Area. The CSRF is located north of the Main Plant building and is connected to it. This area provides facilities for decontamination and size-

reduction of bulk, contact-handled equipment, including failed process equipment and tanks and vessels removed during Main Plant decontamination activities. The WRPA compactor is located in a dock area on the east side of the Main Plant building and is used for size-reduction of easily compressed solid LLW such as disposable anti-contamination clothing. The CSPF, a stand-alone facility located in LSA-4, is used to sort, segregate, and repackage LLW, low-level mixed waste, TRU, and suspect TRU waste containers. The LSA Shipping Depot is attached to the south side of LSA-4 and is used to sort, repackage, and size-reduce waste and perform other activities necessary to prepare waste for shipment.

1.2.2 General Vitrification Facility Description

The VF consists of several associated structures, including the Transfer Trench, Vitrification Building (which includes the Vitrification Cell, operating aisles, and Control Room), Cold Chemical Building, 01-14 Building, Transfer Tunnel, Load-In/Out Area, Equipment Decontamination Room (EDR), High-Level Waste Interim Storage (HLWIS) area, Off-Gas Trench, and Diesel Fuel Oil Storage Tank Building. These facilities are shown in Figure 1.2-2. Vitrification operations were completed in 2002.

The Transfer Trench contains pipes that were used to transfer waste between the Vitrification Building and Waste Tank Farm. After the HLW was vitrified in the Vitrification Cell and sealed into stainless steel canisters, the canisters were transported to the HLWIS area in the Main Plant. The Load-In/Out Area adjoins the west wall of the existing EDR. In conjunction with the Load-In/Out Area, the EDR was also instrumental in the load-in of empty canisters, replacement equipment, and materials. Currently, or in the future, the EDR and Load-In/Out Area will be involved in the load-out of canisters, vitrification process expended materials/components, and waste from Head End Cell (HEC) decontamination that are to be stored in the HLWIS area.

The Off-Gas Trench contains piping that directed process off-gases from various Vitrification Cell process tanks and the melter to portions of the Off-Gas system located in the 01-14 Building. Process off-gases and the Vitrification Cell atmospheric gases were filtered through High Efficiency Particulate Air (HEPA) filters prior to leaving the Vitrification Cell. Both of these gas streams also received HEPA filtering after leaving the Vitrification Cell. Ex-cell HEPA filtering equipment for the Vitrification Cell atmospheric gases is located in the Vitrification Building.

1.3 Process and Activity Descriptions

1.3.1 IRTS Process Description

Waste treatment processes at the WVDP were developed to decontaminate and stabilize the neutralized high-level wastes formerly contained in Tank 8D-2 and Tank 8D-4. These wastes were generated during NFS fuel reprocessing operations and together served as the feed to WVDP process facilities. Due to the nature of these wastes, the WVDP required two distinct processing systems: the IRTS and the VF.

Originally, wastes contained in Tank 8D-2 partitioned into a supernatant layer and an associated layer of insoluble sludge. Initial STS process operations removed and decontaminated the supernatant layer. Sulfate removal and "sludge" washing were achieved in the Sludge Mobilization and Wash System (SMWS) through the addition of a dilute caustic solution that was mixed with the sludge to dissolve the sulfate salts. Following mobilization and washing, the sludge was allowed to settle and the resulting sludge wash solution was removed for processing in the STS.

Processing of supernatant and sludge wash solutions through the STS was completed in 1995. The STS was deactivated in July 2003.

The LWTS was designed to concentrate decontaminated HLW tank solution transferred from the STS. Waste handling and processing activities associated with the LWTS were conducted in Main Plant cells. (LWTS equipment has not been taken out-of-service and may be relied upon for future plant liquid management.)

Product transferred from Tank 8D-3 was received in Tank 5D-15B (the primary evaporator feed tank) located in the UPC. Alternatively, Tank 5D-15A1 could be used as additional storage for feed to the LWTS. From the feed tank, waste could be transferred to Tank 5D-15A1 and/or processed through the high-efficiency evaporator, which reduces the volume of water in the process solution. Evaporator concentrates are cooled and can be pumped to the LWTS product Tank 5D-15A1 or 5D-15A2. The effluent of 5D-15A1 and 5D-15A2 is processed based on the radiological, and hazardous materials content, with solidification the most likely alternative. Current contents of 5D-15A1 and 5D-15A2 will be solidified by the Sodium Bearing Waste Disposition Project.

The CSS solidified LWTS concentrates until completion in 1995. The CSS product drums are stored in the Drum Cell.

1.3.2 Vitrification Process Description

The process mission of the VF was to convert the HLW from its initial sludge/liquid form into borosilicate glass in stainless steel canisters. The filled canisters are stored temporarily in the HLWIS area until they can be shipped to an approved federal repository. The final high-level waste canister was poured on August 14, 2002. In total, 275 canisters of vitrified HLW were produced by the VF.

The sludge fraction of the HLW in Tank 8D-2 was washed to remove salts. During the vitrification process, the mobilized sludge and cesium-loaded zeolite resin were transferred to the CFMT in the Vitrification Cell, where excess water was removed and glass formers were added. The resulting mixture was then transferred to the Melter Feed Hold Tank (MFHT). From this tank, the feed was delivered to the Slurry-Fed Ceramic Melter (SFCM), where it was joule-heated to form a molten, waste-loaded, borosilicate glass. The molten glass was poured into a stainless steel canister. After cooling, canister closure and decontamination, the canister had the lid welded, was decontaminated, and then was loaded onto a transfer cart and moved to the HLWIS area for storage.

1.3.3 Overview of Waste Management, Storage, and Disposal

Various operations at the site produce LLW streams that must be treated and prepared for disposal or shipment.

Several Lag Storage Buildings and weather structures (pre-engineered steel frame and fabric enclosures) are used to store LLW awaiting shipment or disposal and TRU waste awaiting shipment. The WVDP has approximately 570,000 cubic feet of LLW in storage and sufficient on-site storage space is now available to accommodate waste generation. More than 34,000 cubic feet of LLW was shipped for disposal in CY2003.

1.4 Identification of Agents and Contractors

The Department of Energy Ohio Field Office (DOE-OH) has overall responsibility for the WVDP. The DOE on-site area office, DOE-OH/WVDP, is responsible for on-site administration of the Project.

The State of New York is the owner of the site and is required by the Act to participate in the funding of the Project. Therefore, a cooperative agreement between the DOE and the State has been established (Cooperative Agreement October 1980). The State is represented in this relationship on-site by NYSERDA.

The Act also requires the DOE to consult with the NRC concerning substantive aspects of the Project that could affect the health and safety of the public. In addition, the NRC must issue the final D&D criteria that must be met for site closure and/or long-term maintenance following completion of the Project. The relationship between the DOE and NRC has been outlined in a memorandum of understanding (MOU) between the two agencies (Memorandum of Understanding November 19, 1981) and by the "Decommissioning Criteria@ give in 67 FR 5003.

In addition, the Act requires the DOE to consult with the U.S. Department of Transportation (USDOT), the U.S. Environmental Protection Agency (USEPA), and the U.S. Geological Survey (USGS) in matters relating to their respective areas of expertise and concern. These relationships have also been established, though less formally than those with the State of New York and the NRC.

The DOE has retained WVNSCO as the prime contractor for design and operation of the WVDP. URS joined with WVNSCO in the original procurement to provide geotechnical, environmental, safety analysis report preparation, and safety assessment services for the Project. Additional information on organizational structure is presented in Section 10.1.

Pacific Northwest National Laboratory (PNNL) has been retained to provide research and development services for the WVDP. The contractor providing security services for the WVDP is Pinkerton Government Services.

The Project also consults with and is engaged in technology transfer on a national level by means of the Commercial Waste Treatment Program (CWTP), Defense Waste Processing Facility (DWPF), and other DOE government-owned, contractor-operated facilities, as well as on an international level with United Kingdom, German, French, and Japanese nuclear program organizations.

1.5 Hazard Categorization

DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, provides a uniform methodology for determining a facility<s hazard category. The hazard category is determined by considering the total inventory of radioactive material in a given facility and the consequences of an unmitigated release. Historically, facilities at the WVDP have been segmented, as permitted by DOE-STD-1027-92, to avoid placing excessive requirements on simple operations involving few hazards. Decontamination of several facilities that have historically contained significant radiological inventories (leading to categorization as hazard category 2 nuclear facilities) has reduced the radiological inventories of these facilities to the point that these facilities may be recategorized using the final hazard category methodologies described in DOE-STD-1027-92 (URS, Approval Request 2005-0050 "Technical Basis for Final Hazard Categorization of WVDP Facilities", 2004). Individual

facility hazard categories are documented in WVDP-227, *WVDP Facility Identification and Classification Matrix*.

1.6 Structure of this Safety Analysis Report

The DOE employs safety analyses of its nuclear and non-nuclear facilities as the principal safety basis for decisions to authorize the design, construction, or operation of these facilities. 10 CFR 830 addresses the requirements for the development of safety analyses that evaluate and establish the adequacy of the safety bases of Hazard Category 2 and 3 nuclear facilities. The requirements of 10 CFR 830 apply to all nuclear and non-nuclear hazards associated with DOE non-reactor nuclear facilities. This SAR has therefore been developed to meet the requirements of 10 CFR 830 and in accordance with the methodology provided in DOE Standard DOE-STD-3009-94, which is a methodology acceptable to the DOE per Table 2 of Appendix A of Subpart B of 10 CFR 830. Because 10 CFR 830 does not require a specific format for nuclear safety analysis reports, the format of this SAR corresponds to the format set forth in NRC Regulatory Guide 3.26, *Standard Format and Content of Safety Analysis Reports for Fuel Reprocessing Plants*. A listing of DOE-STD-3009-94 sections and the corresponding or equivalent sections of this SAR is provided in Table 1.6-1.

WV-365, *Preparation of WVDP Safety Documents*, establishes the administrative process for the initiation, preparation, and in-house and independent review of safety analyses. Once a given safety analysis has been approved by the WVNSCO Radiation and Safety Committee, it is forwarded to DOE-OH/WVDP. Any safety analyses for activities that might have a significant impact on public health and safety are reviewed by the NRC.

Pursuant to the requirements of 10 CFR 830, Subpart B and WV-914, *Unreviewed Safety Question Determination (USQD)*, which implements the Rule, no activity or system about which an unreviewed safety question exists will be operated. WV-914 provides the guidance for conducting and documenting the review associated with the USQD process. Throughout the life of the WVDP, the safety analyses are revised as new information is obtained, as preliminary analyses are replaced with final analyses, as DOE Directives evolve, and as the Project matures.

REFERENCES FOR CHAPTER 1.0

Cooperative Agreement between the USDOE and NYSERDA on the WNYNSC at West Valley, New York. October 1980, amended September 19, 1981 and February 1991.

Federal Register. 67 FR 5003, *Decommissioning Criteria for the West Valley Demonstration Project (M-32) at the West Valley Site; Final Policy Statement.* February 1, 2002.

Memorandum of Understanding Between the U.S. Department of Energy and the Nuclear Regulatory Commission: Implementation of the West Valley Demonstration Project Act of 1980. November 19, 1981. Federal Register Vol. 46, No. 223.

Nuclear Fuel Services, Inc. 1970. *Safety Analysis, Spent Fuel Reprocessing Plant*, AEC Docket No. 50-201. Revision 5.

URS. Approval Request 2005-0050 *Technical Basis for Final Hazard Categorization of WVDP Facilities.* 2004.

U.S. Congress. October 1, 1980. *An Act to Authorize the Department of Energy to Carry Out a High-Level Liquid Nuclear Waste Management Demonstration Project at the Western New York Nuclear Service Center in West Valley, New York.* Public Law 96-368 [S.2443]. Congressional Record, Vol. 126.

U.S. Department of Energy. December 1992. Change 1 (September 1997). DOE-STD-1027-92: *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.* Washington, D.C.

_____. July 1994. Change 2 (April 2002). DOE-STD-3009-94: *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Documented Analyses.* Washington, D.C.

_____. January 10, 2001. *Nuclear Safety Management.* 10 CFR 830.

U.S. Nuclear Regulatory Commission. 1975. *Regulatory Guide 3.26: Standard Format and Content of Safety Analysis Reports for Fuel Reprocessing Plants.*

West Valley Nuclear Services Co. WV-365: *Preparation of WVDP Safety Documents.* (Latest Revision).

_____. WV-914: *Unreviewed Safety Question Process (USQP).* (Latest Revision).

_____. Safety Analysis Report WVNS-SAR-023: *Preliminary Safety Analysis for Remote-Handled Waste Facility.*

TABLE 1.6-1

LOCATION OF DOE-STD-3009 INFORMATION IN WVNS-SAR-001

DOE-STD-3009-94 Chapter		WVNS-SAR-001 (Reg. Guide 3.26 Chapters)	
	Executive Summary	1.0 2.0	Introduction and General Description of the IRTS/Main Plant/FRS/VF Summary Safety Analysis
1.0	Site Characteristics	3.0	Site Characteristics
2.0	Facility Description and Operation, including Design of Principal Structures, Components, All Systems, Engineering-Safety Features, and Processes	4.0 5.0 6.0	Principal Design Criteria Facility Design Process Systems
3.0	Hazard Analysis and Classification of the Facility	1.0 9.0	Introduction Hazard and Accident Analysis
4.0	Safety Structures, Systems, and Components	5.0 6.0	Facility Design Process Systems
5.0	Derivation of TSRs	11.0	Technical Safety Requirements
6.0	Prevention of Inadvertent Criticality	8.0	Hazards Protection
7.0	Radiation Protection	8.0	Hazards Protection
8.0	Hazardous Material Protection	8.0	Hazards Protection
9.0	Radioactive and Hazardous Waste Management	7.0	Waste Confinement and Management
10.0	Initial Testing, In-Service Surveillance, and Maintenance	10.0	Conduct of Operations
11.0	Operational Safety	10.0	Conduct of Operations
12.0	Procedures and Training	10.0	Conduct of Operations
13.0	Human Factors	Each Chapter, as appropriate	
14.0	Quality Assurance	12.0	Quality Assurance
15.0	Emergency Preparedness	10.0	Conduct of Operations
16.0	Provisions for Decontamination and Decommissioning	10.0	Conduct of Operations
17.0	Management, Organization, and Institutional Safety Provisions	10.0	Conduct of Operations

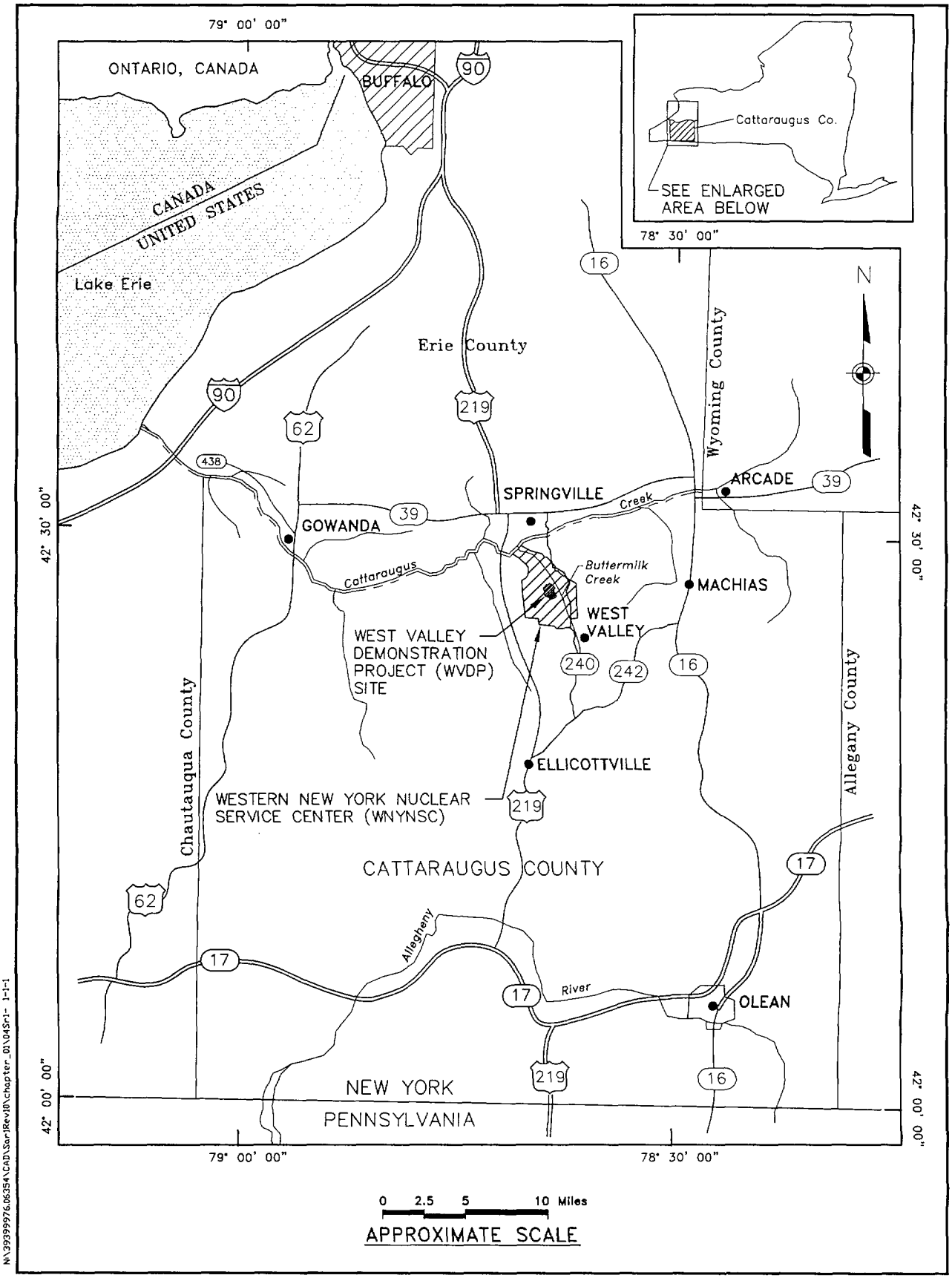


Figure 1.1-1 Location of the Western New York Nuclear Service Center.

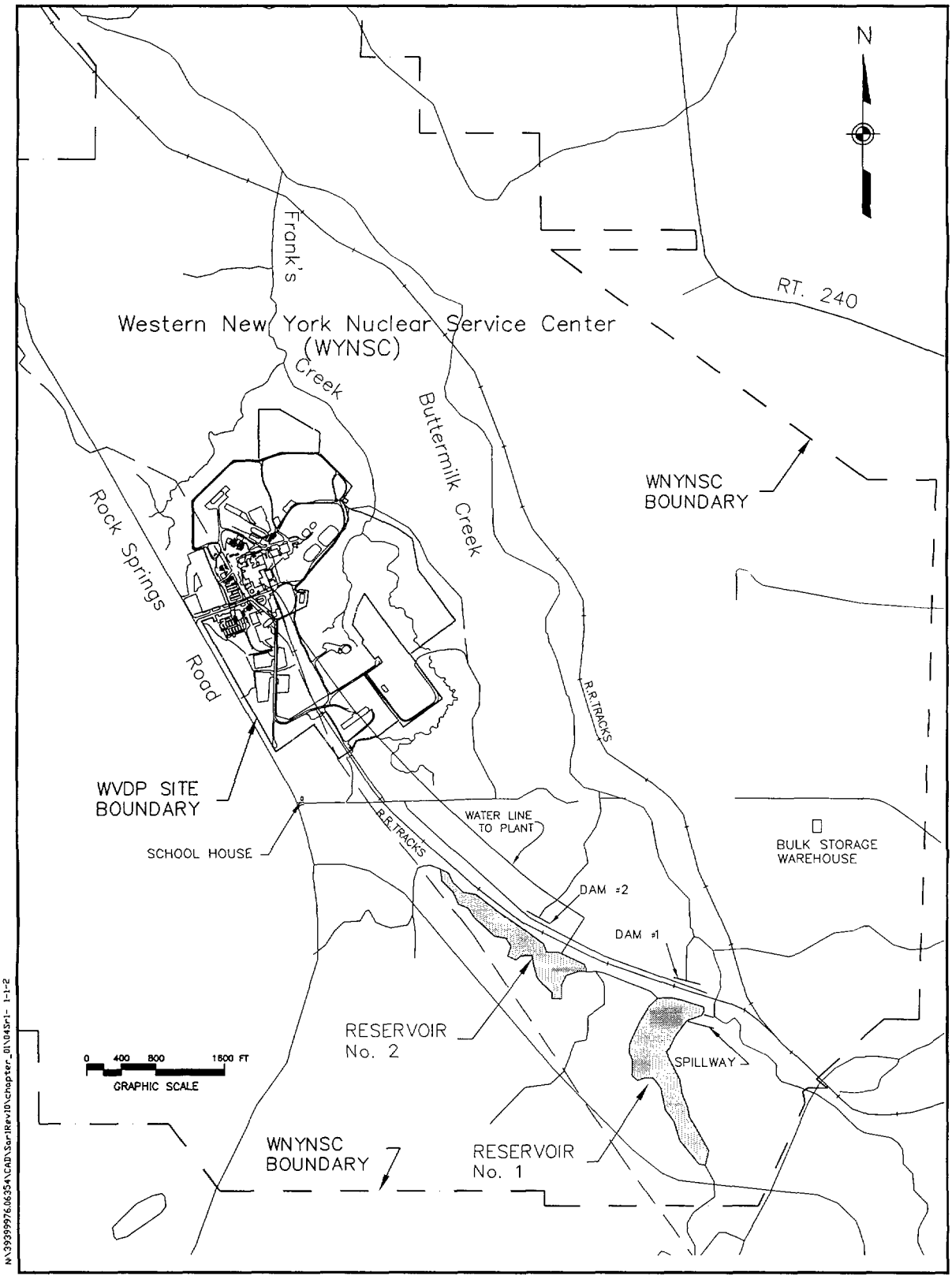


Figure 1.1-2 Western New York Nuclear Service Center.

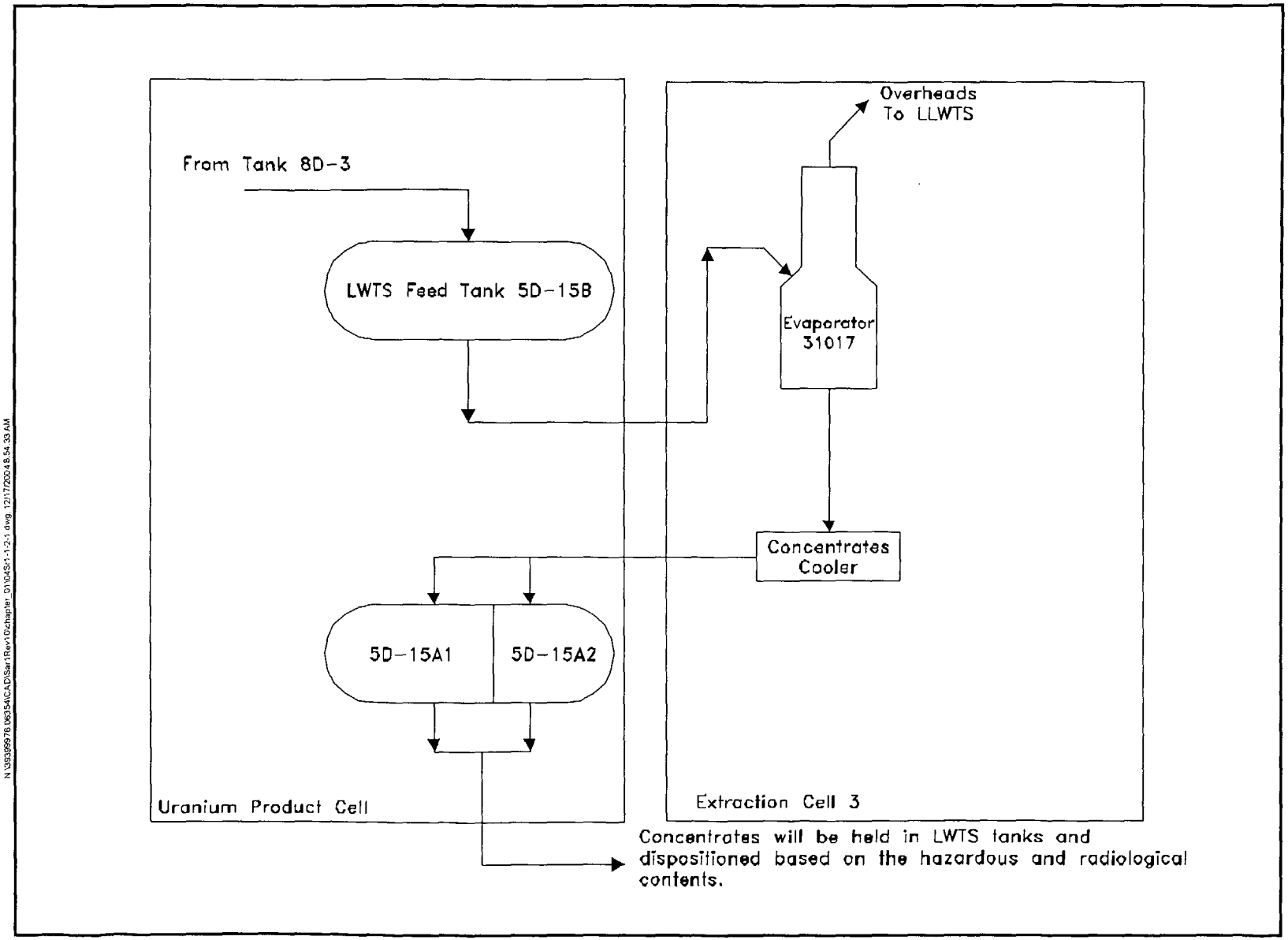


Figure 1.2-1 Liquid Waste Treatment System Process Flow Diagram.

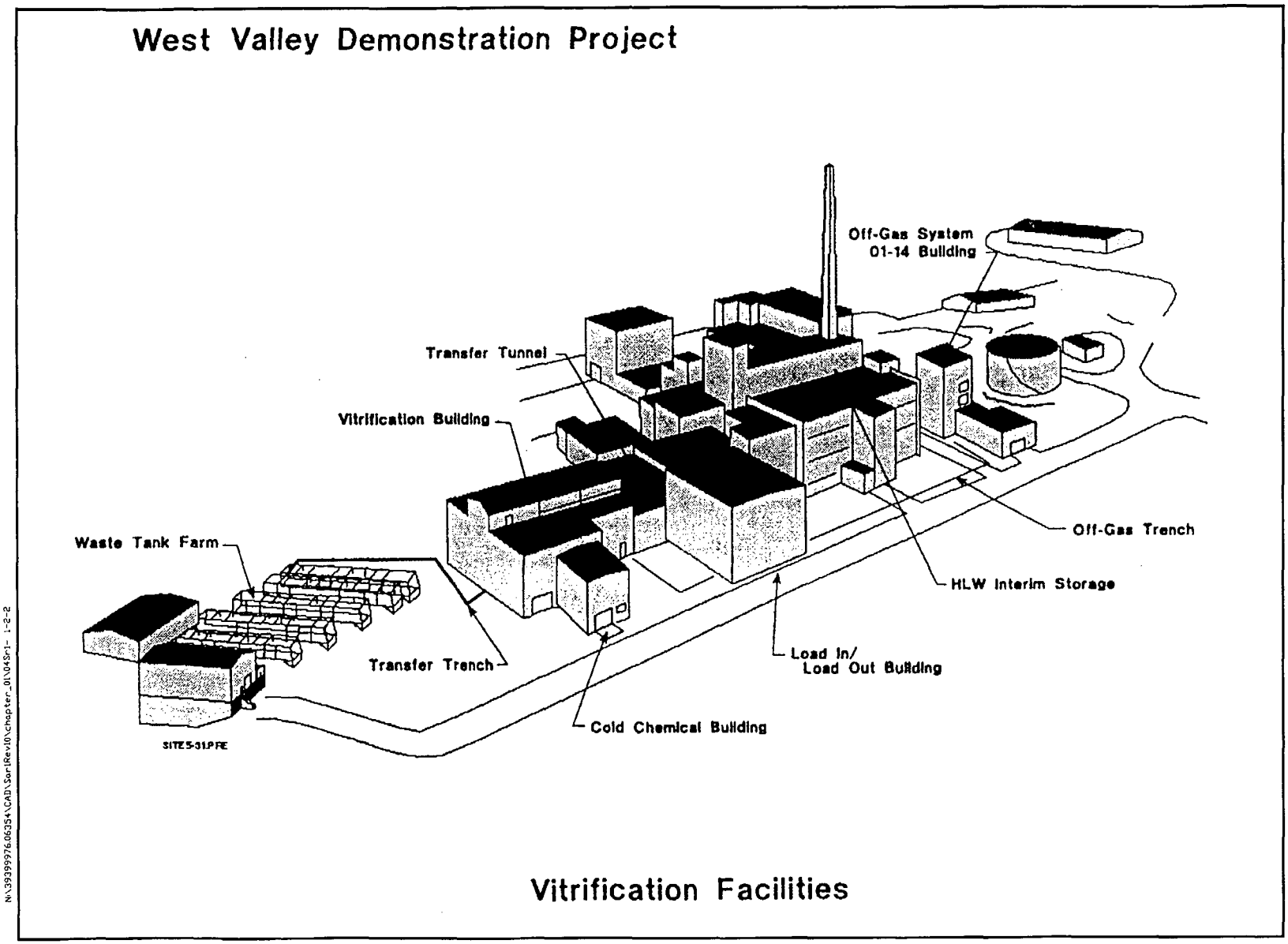


Figure 1.2-2 West Valley Demonstration Project Vitrification Facilities.

2.0 SUMMARY SAFETY ANALYSIS

A summary of the safety analyses performed for the West Valley Demonstration Project (WVDP), with the exception of the Remote Handled Waste Facility (RHWF), is presented in this chapter. The safety analysis for the RHWF is presented in WVNS-SAR-023, *Safety Analysis Report for the Remote Handled Waste Facility*. In all of the accidents analyzed in this Safety Analysis Report (SAR), no credit was taken for any preventive or mitigative design features to reduce the potential consequences of accidents. All consequences from accidents analyzed are well below the Department of Energy (DOE) - provided Evaluation Guideline (EG) and West Valley Nuclear Services Company (WVNSCO) best management practice toxicological EG specified in Section 9.1.3. Worker doses from routine operations are well below the occupational radiation protection limits established in Title 10, Code of Federal Regulations, Part 835, *Occupational Radiation Protection*. No structures, systems, or components are designated as safety class or safety significant, as defined in DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. Select Safety Management Programs (SMPs) were identified that need to be addressed as Technical Safety Requirement (TSR) Administrative Controls (ACs). Other ACs that are related to specific aspects of site management and operations were also identified, as well as a TSR-designated "design feature" as discussed in Chapter 11. Additional information regarding hazards and accidents is provided in Chapters 8 and 9 of this SAR.

2.1 Site Analysis

2.1.1 Natural Phenomena

Natural phenomena that can affect the safety of operations include earthquakes, tornadoes, and floods. The site is situated in a region that has experienced a moderate amount of relatively minor seismic activity. The record of earthquake activity in Western New York and the surrounding area dates back over 200 years. In that time period, the only significant (Modified Mercalli Intensity [MMI] VII) earthquake activity in Western New York occurred in the vicinity of Attica and is associated with the Clarendon-Linden Structure. Several smaller shocks in the Buffalo-Hamilton (Ontario) area were probably due to glacial rebound effects.

Outside the immediate West Valley area there is a zone of major seismic activity near LaMalbaie, Quebec, in the lower St. Lawrence River Valley. Major earthquakes (MMI IX or X) have occurred in the LaMalbaie area, most recently in 1988. The earthquakes were felt over the entire eastern section of Canada and the northeastern United States. The WVDP site probably experienced no more than mild MMI IV shock from any of these events. See Section 3.6.2.9 for discussion on the design basis earthquake.

The frequency and intensity of tornadoes in Western New York is low in comparison to many other parts of the United States. An average of about two tornadoes of short and narrow path length strikes New York State each year. During the period 1950 through 1990, seventeen tornadoes were reported within 80 km (49.7 miles) of the Project site. The design basis tornado (DBT) for the Project was developed based on detailed analyses of historical records of tornado occurrences in Western New York. The characteristics of the DBT are:

Recurrence time:	10^6 years
Maximum wind speed:	260 km/hr (160 mi/hr)
Rotational speed:	180 km/hr (110 mi/hr)
Translational speed:	80 km/hr (50 mi/hr)
Radius of maximum rotational wind:	46 m (150 ft)

Peak pressure differential:	2.4 kPa (0.35 psi)
Rate of pressure drop:	1.0 kPa/sec (0.15 psi/sec)

Although the amount of precipitation in West Valley is relatively high (averaging about 104 cm [41 in] a year), flooding is not expected to be a major hazard due to the local topography, the relatively even distribution of precipitation throughout the year, and the elevation of the site. Thunderstorms are infrequent because of the stabilizing influence of Lake Erie.

2.1.2 Site Characteristics Affecting the Safety Analysis

The pathways by which radiologically and/or toxicologically hazardous materials may be dispersed into the environment may be broadly categorized as airborne or liquid. For airborne releases, the capacity of the atmosphere to dilute and disperse effluents is of prime importance in evaluating the environmental effects of site operations under both normal and abnormal conditions. The dispersive capability of the atmosphere is a function of wind speed and direction, and atmospheric stability. Local climatological data have been and continue to be obtained from an on-site meteorological tower where wind speed, wind direction, and temperature are measured at 10 m and 60 m (32.8 ft and 196.9 ft) from the base.

The temperature difference, calculated by subtracting the temperature measured at the 10 m (32.8 ft) level from the temperature measured at the 60 m (196.9 ft) level, is used to determine atmospheric stability at the on-site meteorological tower. The 10 m (32.8 ft) and 60 m (196.9 ft) winds are channeled such that the wind blows predominantly from the south-southeast to the north-northwest and from the northwest to the southeast reflecting the topography in the vicinity of the site.

The major surface water drainage features of the site area are Cattaraugus Creek and Buttermilk Creek. Buttermilk Creek originates south of the site, but its lower portions, including its confluence with Cattaraugus Creek, are wholly within the boundaries of the WNYNSC.

The site<s topographic setting renders the likelihood of major flooding not credible, and local run-off and flooding is adequately accommodated by natural and man-made drainage systems in and around the WVDP. Additional information on surface hydrology may be found in Chapter 3.

2.1.3 Effect of Nearby Industrial, Transportation, and Military Facilities

There are no nearby industrial, transportation, or military facilities that could adversely affect the safety of the operations at the WVDP. Nearby industrial, transportation, and military facilities do not pose a level of risk to the WVDP that warrants detailed, qualified analysis because of the distance of these facilities from the site and the nature of the operations at these facilities. The most proximate industries are at least 4 km (2.5 miles) from the site and are relatively small and low-threat in nature. The impact to site operations due to military facilities is discussed in Chapter 3.

There are two State highways, classified as rural arterial highways, that are fairly distant from the site: US Route 219 and NY Route 240. US Route 219 is a two(or four)-lane, major north-south road between Buffalo and the Pennsylvania border. Located about 4 km (2.5 miles) west of the site, US Route 219 has an annual average daily traffic volume of 6100 vehicles (1994 data) (New York State Department of Transportation 1995). NY Route 240, also a two-lane road, is about 3 km (1.9 miles) to the east. The annual average

daily traffic on NY Route 240 in the hamlet of West Valley is 1850 vehicles (1993 data) (New York State Department of Transportation 1995).

The Buffalo and Pittsburgh (B&P) railroad line is located within 0.80 km (0.50 miles) of the Project premises. Running from Salamanca, NY, north to Buffalo, the B&P carries a variety of freight and coal north and freight and newly manufactured vehicles south from Canada. As a result of the general decline of heavy industry in the Niagara Frontier and of rail traffic in the northeast, use of this route has also declined. In recent years, the tracks have also experienced several washouts and kindred problems, forcing traffic rerouting for extended periods. While railroad accidents are not uncommon in the United States, the relatively low utilization of the line in the vicinity of the WVDP, coupled with the demographic factors outlined above, tends to minimize the likelihood of an accident with consequences for site operations. This conclusion is reinforced by the presence of a deep ravine with perennial streams between the tracks and the Project premises. These features reduce the threat of a rail accident which might result in a fire or a spill affecting the Project. An airborne threat from a rail accident still exists, but is also significantly mitigated by both topography and distance of the site from the rail line.

In 1999, the B&P Railroad completed connection of track between Ashford Junction and Machias, New York. Service by B&P on the rail line from the WVDP to Ashford Junction and then to Machias now provides the WVDP rail access.

There are no commercial airports in the site vicinity. The only major aviation facility in Cattaragus County is the Olean Municipal Airport, located in the Town of Ischua, 34 km (21.1 miles) southeast of the site. Regularly scheduled commercial air service was terminated at this airport in early 1972. The nearest major airport is Greater Buffalo International Airport, 55 km (34.2 miles) north of the site. Review of DOE-STD-3014-96, *Accident Analysis for Aircraft Crash into Hazardous Facilities*, shows that due to the size of aircraft, number of flights, location of the airports and the size of WVDP hazardous facilities, a release due to an aircraft crash is not credible.

2.2 Impacts from Normal Operations

Chapter 8 of this SAR presents both on-site and off-site dose assessments that have been performed to determine the radiological impact of normal operations at the WVDP. Occupational exposures are minimized at the WVDP through strict adherence to as-low-as-reasonably-achievable (ALARA) principles.

The WVDP programmatically monitors the surrounding environment and effluent from on-site facilities to fulfill federal and state requirements. The results of this program show that during the course of activities at the WVDP, public health and safety and the environment are being protected. The *Site Environmental Report* summarizes the environmental monitoring data collected during calendar year 2003. On-site and off-site radiological monitoring in 2003 confirmed that site activities were conducted well within state and federal regulatory limits. Results of data analyzed show that the Project did not exceed any of the limits on radioactivity or radiation doses in 2003, including the emission standards promulgated by the U.S. Environmental Protection Agency (EPA) and incorporated in DOE Orders.

2.3 Impacts from Abnormal Operations

Abnormal operations are events that could occur from malfunctions of systems or operator error. Abnormal events are only of consequence when they affect systems in facilities that process, control, or confine radioactivity or hazardous materials. Abnormal events considered in this SAR (Section 9.1) are

of little consequence and are not predicted to result in a significant release of radioactive or hazardous material. Qualitative radiological and nonradiological consequences from abnormal operations at the WVDP, with the exception of the RHWF, are provided in the Process Hazards Analysis (PHA) found in Table 9.1-1.

2.4 Accidents

Some WVDP facilities contain sources of radioactivity that have the potential for causing doses to both on-site and off-site individuals under accident conditions. Bounding radiological accidents associated with the operation of WVDP facilities (with the exception of the RHWF) have been analyzed in Section 9.2.

The first radiological accident considers the effect of a pressure excursion in the Main Plant ventilation system that results in the release of radioactivity from each of the filters in the bank of 30 high-efficiency particulate air (HEPA) filters. This accident would result in an off-site total effective dose equivalent (TEDE) of 2.68E-01 rem. The second radiological accident assumes that an energetic event (i.e., overpressurization, explosion, and/or fire) involving a TRU waste drum results in an airborne release of radioactive material. The off-site TEDE for this event is 3.49E-01 rem. The third radiological accident postulates the dropping of a High Integrity Container (HIC) that results in its rupture and release of its contents to the ground, causing a ground level release of radioactive material. This accident would result in an off-site TEDE of 2.40E-03 rem. The fourth radiological accident assumes the failure of vessels located in the Uranium Product Cell (UPC). The off-site TEDE calculated for this accident is 1.40E-01 rem.

One nonradiological accident was analyzed. The accident assumed catastrophic failure of one 1,250 L (330 gal) tote of technical grade 35% hydrogen peroxide outside the oxidizer room in the warehouse. This postulated accident resulted in a maximum concentration of 1.6 ppm of hydrogen peroxide at a distance of 1,050 m (3,445 ft). The ERPG-2 value for hydrogen peroxide is 50 ppm.

Other radiological accidents that were evaluated are associated with the VF. (There are no nonradiological accidents associated with the VF.) The credible VF-related radiological accidents are dropping of a high-level waste canister and failure of the process off-gas or heating, ventilation, and air conditioning (HVAC) system HEPA filters. The off-site TEDE for these accidents is 3.90E-02 rem and 7.86E-02 rem, respectively. A beyond design basis earthquake (BDBE) is postulated to result in the failure of the High-Level Waste Interim Storage (HLWIS) area roof and/or falling of the HLWIS area crane. No releases from the high-level waste canisters are expected should the roof fail, and the off-site TEDE from the crane falling is estimated to be 5.20E-03 rem.

2.5 Conclusions

A summary of the consequences of accidents analyzed in this SAR is provided in Table 9.2-5. Potential consequences were determined at distances of 100 m (328 ft) and 1,050 m (3,445 ft). These distances correspond to the location of the on-site evaluation point and the nearest site boundary, respectively. All credible accidents analyzed are within the DOE-provided EG and WVNSCO best management practice toxicological EG specified in Section 9.1.3.

An energetic event involving a TRU drum results in a TEDE to the maximally exposed off-site individual (MEOSI) of 3.49E-01 rem. This represents the bounding accident for radiological releases. The spill of technical grade 35% hydrogen peroxide results in a concentration of 1.6 ppm of hydrogen peroxide at 1,050 m (3,445 ft), which is much less than the ERPG-2 value for hydrogen peroxide. This represents the bounding accident for nonradiological releases.

Routine doses to off-site individuals are well within the requirements of DOE Order 5400.5, *Radiation Protection of the Public and the Environment.*

REFERENCES FOR CHAPTER 2.0

New York State Department of Transportation. *1995 Traffic Volume Report.* Albany, New York.

U.S. Department of Energy. February 8, 1990. Change 2 (January 7, 1993). DOE Order 5400.5: *Radiation Protection of the Public and the Environment.* Washington, D.C.

_____. July 1994, Change 2 (April 2002). DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.* Washington, D.C.

_____. October 1996. DOE-STD-3014-96, *Accident Analysis for Aircraft Crash into Hazardous Facilities.* Washington, D.C.

_____. January 1, 2001. *Occupational Radiation Protection.* Code of Federal Regulations Title 10, Pt. 835. Washington, D.C.

West Valley Nuclear Service Co. WVNS-SAR-023: *Safety Analysis Report for the Remote Handled Waste Facility.* (Latest Revision).

West Valley Nuclear Services Co. and URS Corporation. 2004. *West Valley Demonstration Project Site Environmental Report Calendar Year 2003.* West Valley, NY: West Valley Nuclear Services Co.

3.0 SITE CHARACTERISTICS

This chapter provides a description of site characteristics necessary for understanding the facility environs important to the safety basis. Information is provided to support and clarify assumptions used in the hazard and accident analyses to identify and analyze potential external and natural event accident initiators and accident consequences external to the facility.

DOE-STD-3009-94 states that this chapter should list "the design codes, standards, regulations, and DOE Orders which have been used for establishing the safety basis of the facility. The intent is to provide only the requirements that are specific for this chapter and pertinent to the safety analysis, and not a comprehensive listing of all industrial standards or codes or criteria." This information is provided in Chapter 4 of this document.

3.1 Geography and Demography

The following subsections provide basic geographic and demographic information. Geographic information includes the state and county in which the site is located; the site=s location relative to prominent natural and man-made features; figures of the site and surrounding area; identification of public exclusion and access controlled areas; and identification of the distance to the site boundary for accident consequence analysis purposes. DOE-STD-3009-94 states the following: "Demographic information emphasizes worker populations and nearby residences, major population centers, and major institutions such as schools, hospitals, etc., to the degree warranted by potential offsite consequences. The minimum area addressed is defined by the area significantly affected by the accidents analyzed." As previously stated, the hazards at the WVDP do not have the potential to cause offsite consequences of concern. Consequently, limited demographic information is provided in the following subsections.

3.1.1 Site Location

The WVDP site is located in Ashford Township, Cattaraugus County, N.Y., at approximately 42.45°N latitude and 78.646°W longitude. The New York state plane coordinates are approximately 892800 W and 480840 N. The site location with respect to major natural and man-made features in Western New York State is shown in Figures 1.1-1 and 3.1-1.

The facility is 3.8 km (2.4 miles) southeast of Cattaraugus Creek at its nearest approach. Cattaraugus Creek forms the boundary between Cattaraugus and Erie counties, N.Y. Buttermilk Creek, a tributary to Cattaraugus Creek, is 0.8 km (0.5 mile) east of the plant site. The nearest incorporated village is Springville, N.Y., 0.8 km (0.5 mile) north of Cattaraugus Creek and 5.6 km (3.5 miles) north of the plant.

3.1.2 Site Description

The WVDP site consists of approximately 220 acres within the 3,345-acre Western New York Nuclear Service Center (WNYNSC). The WNYNSC is located within the Cattaraugus highlands, which is a transitional zone between the Appalachian Plateau to the south and east and the Great Lakes Plain to the north and west. The Cattaraugus highlands range in elevation from 304.8 to 548.6 m (1,000 to 1,800 ft) above National Geodetic Vertical Datum (NGVD). Deep valleys dissect rather flat-topped plateaus and support a plant community of northern hardwoods substantially reduced by agricultural activities.

Slopes range from <5% to >25%, with 5 to 15% slopes predominant. The WNYNSC is drained by Buttermilk Creek, which flows into Cattaraugus Creek. Much of the WNYNSC was previously cleared (prior to 1961) for agriculture. As a result, the WNYNSC now consists of a mixture of abandoned agricultural areas in various stages of ecological succession, forested tracts, and wetlands and transitional ecotones between these areas. The generally acidic and poorly drained soils influence the occurrence, distribution, and relative abundance of plant communities and their associated faunal species. The WNYNSC area experiences an average of 107 cm (42 in) of precipitation per year, including 254 to 381 cm (100 to 150 in) of snow. The region's temperate climate is not prone to natural forest or grassland fires.

The WVDP is on a plateau in the central portion of the WNYNSC. The WVDP plateau elevation is approximately 429.8 m (1,410 ft) NGVD. The plateau margins are subject to erosion especially along the banks of gully and stream drainageways that cut into the plateau and feed to several named streams that feed in turn to Buttermilk Creek.

The WNYNSC is owned and controlled by New York State Energy Research and Development Authority (NYSERDA). However, by cooperative agreement between NYSERDA and DOE, NYSERDA has agreed not to use or authorize use of the WNYNSC in a manner that would interfere with DOE's objectives associated with the WVDP. During the term of the Project, DOE will provide general surveillance and security services for the entire WNYNSC, including the WVDP site.

Rock Springs Road, a county road, traverses the WNYNSC immediately to the west of the WVDP site. If required by an emergency situation at the Project, access to this road can be controlled by Cattaraugus County authorities.

3.1.2.1 Site Boundary

Figure 3.1-1 delineates the boundaries of the WNYNSC and the WVDP. The WNYNSC, which is also referred to as the exclusion zone, is fenced with barbed wire and posted, and the boundary is patrolled by security officers in vehicles at random times several times a day. The WVDP site, also referred to as the Security Area, is surrounded by a high chain-link fence and can be entered only through one of three gates. Access is controlled through the use of magnetically coded picture badges, which must also be displayed at all times within the Security Area. The current layout within the Security Area is presented in Figure 5.1-1.

All Project-specific activities are performed within the WVDP site boundary. The New York State licensed low-level waste burial area (SDA), which is currently inactive, is located within the WVDP site boundary but is not part of the Project. For all facilities and activities evaluated in this Safety Analysis Report (SAR), the maximally exposed off-site individual (during accident conditions) is assumed to be located at 1,050 m (3,445 ft) from the point of the release. This applies to elevated and ground-level releases, as documented in WVDP-065, *Manual for Radiological Assessment of Environmental Releases at the WVDP*.

3.1.2.2 Boundaries for Establishing Effluent Release Limits

The WNYNSC boundary (shown on Figure 3.1-1) is used to establish effluent release limits.

3.1.3 Population Distribution and Trends

The information regarding population and population distribution was obtained from the U.S. Department of Commerce - U.S. Census Bureau.

3.1.3.1 Current Population

The area within 16 km (10 miles) of the site lies within Cattaraugus and Erie counties. The 1990 to 2000 resident populations of towns and villages within this area are presented in Table 3.1-1.

Cattaraugus County is predominantly rural and contains 32 townships and 16 villages. It is 3,460 sq km (1336 sq miles) in size, has a 2000 population of 83,955 people, and a density of 24.5 persons per sq km (64.1 persons per sq mile). The county population occurs primarily in rural residential areas and in villages with populations less than 2,000. There are two incorporated cities in the county: Olean (population 15,347) and Salamanca (population 6,097). Olean is located 43.5 km (27 miles) southeast of the site. Salamanca is located 32 km (19.8 miles) south of the site.

The southern third of Erie County, near the WVDP site, consists of rural townships in which the population is concentrated primarily in small villages and along roadways, much like in Cattaraugus County. Traditionally, the majority of people residing in this area worked in agriculture or nearby small industries. The portion of Erie County south of Buffalo generally has not lost population. Several of the towns south of the city have increased in population such that the population decline for the county as a whole was held to 8.9% for the period from 1960 to 2000.

The nearest village to the WVDP site is Springville, in Erie County. Springville is 5.6 km (3.47 miles) north of the site. Springville had a 2000 resident population of 4,252, a decrease of 1.3% from 1990. The only other incorporated village within 16 km (10 miles) of the site is Delevan, 14.5 km (9.0 miles) east-northeast, which had a 2000 resident population of 1,089, down 10.3% from 1990. The nearest hamlets are more than 5 km (3.1 miles) away. Since hamlets, because they are unincorporated, do not have defined boundaries, population statistics are generally unavailable. The West Valley area, approximately 5.5 km (3.4 miles) southeast of the site, is estimated to have a resident population of 600, making it one of the most populous unincorporated areas in the Town of Ashford (2000 population = 2,223).

3.1.4 Uses of Nearby Land and Waters

3.1.4.1 Site Vicinity Land Use

Land use within 8 km (5 miles) of the site is predominantly agricultural (active and inactive) and forestry uses. The major exception is the Village of Springville, which is comprised of residential, commercial, and industrial land uses. Other major nonagricultural land uses in the site vicinity are as follows:

Hamlet of West Valley - residential/commercial/land use, 5.5 km (3.4 miles) to the southeast

Cattaraugus County Forest - forestry/recreation - 6 km (3.7 miles) to the south, campground - 8 km (5.0 miles) to the southwest

machine shop - industrial land use - 6.4 km (4 miles) to the northwest

2 retail shopping complexes - commercial land use - 6.4 km (4 miles) to the north northwest

WVDP Bulk Storage Warehouse - commercial land use - 6 km (3.7 miles) to the north northwest (Village of Springville on Waverly Street)

3.1.4.2 Community Facilities and Institutions

The WNYNSC vicinity is rural and there are few places where population is grouped in large numbers except for the schools and hospital in Springville and the Town of Ashford.

3.1.4.3 Water Use

Upper Cattaraugus Creek extends from Springville to Gowanda (32 km [20 miles] downstream of the site), and lower Cattaraugus Creek extends from Gowanda to Lake Erie (62 km [38.5 miles] downstream from the site).

A field review of the land use patterns downstream of the site indicated the predominant land uses are rural in nature -- agricultural (both active and inactive), forest, scattered residential, and open space proximate to the Creek. Closer to Lake Erie, the land uses along NY Routes 5 and 20 are commercial. At the mouth of Cattaraugus Creek, the Sunset Bay area is dense residential with mixed recreation - swimming beaches, marinas, boating and fishing. The Cattaraugus Creek is not used as a source of public drinking water, and the creek is not developed for organized water contact recreation activities.

Fishing occurs primarily near the mouth of the creek at Lake Erie, and at the Springville Dam which is located on Cattaraugus Creek downstream from where Route 219 crosses the creek (see Figure 3.1-1). Unsupervised swimming takes place throughout the creek. Boating is generally limited to the stretch of water within 3 km (1.9 miles) of the mouth of the creek. There is whitewater rafting and canoeing occurring on the creek especially in the Zoar Valley, west of the site, when the water depth permits. There are no data available on recreational uses of the creek.

3.2 Nearby Industrial, Transportation, and Military Facilities

Based on the analyses provided in Chapter 9, no significant impact would result at nearby industrial, transportation, or military facilities due to accidents at the WVDP. Furthermore, no credible accidents or abnormal operations at off-site facilities were identified that would contribute to the potential for an accident at the WVDP. All WVDP facilities are covered under a single, site-wide emergency plan in WVDP-022, *WVDP Emergency Plan*, and no facilities require operators to perform a nuclear safety function.

3.2.1 Nuclear Facilities

The State University of New York at Buffalo, Main Street, has a research reactor, located roughly 60 km (37 miles) north of the site. It is presently shut down.

3.2.2 Industries

The industry within 8 km (5 miles) of the site is light-industrial and commercial - either retail or service oriented. A field review of the 8 km (5 mile) radius did not indicate the presence of any industrial facilities that would present a hazard in terms of safe operation of the site.

A similar land use field review of the Village of Springville and the Town of Concord does not indicate the presence of any significant industrial facilities. Industrial facilities near the WNYNSC include Winsmith-Peerless Winsmith, Inc., a gear reducer manufacturing facility; Ashford Concrete Co., Inc., a readi-mix concrete supplier and concrete equipment manufacturing facility; and Springville Manufacturing, a fabricating facility for air cylinders.

The industries within the Village of Springville and the Town of Concord, Erie County, are located in a valley approximately 6 km (4 miles) to the north and east of the WVDP. There are two propane storage and supply locations on NY RT 219: NORCO Propane, located on the east side of NY RT 219, approximately 1.6 km (1 mile) south of the intersection of NY RT 219 and Schwartz Rd; and M&M Holland Propane, which is located on the west side of NY RT 219, approximately 2 km (1.25 miles) south of the intersection of NY RT 219 and Schwartz Road.

Due to the distance and topography between the WVDP and the Village of Springville, and between the WVDP and the propane supply and storage facilities, it is unlikely that even a catastrophic incident at any of the identified industries and facilities would impact operations at the WVDP.

3.2.3 Military Installations

A small military research installation is located in Cattaraugus County approximately 5 km (3.1 miles) northeast of the WVDP. The facility, operated by Calspan Corporation is used to conduct research operations for the United States Government's Department of Defense. The facility does not produce any products of a hazardous nature, but provides services through performing research projects. The combined aggregate storage total of the particularly hazardous compounds never exceeded one liter. Operations using these compounds are conducted with milliliter quantities. Mishap scenarios were developed and analyzed by Calspan. If the maximum credible event (worst case realistic mishap) occurred there would be no hazard experienced at the WVDP (Baker, April 9, 1993).

3.2.4 Transportation Facilities

The transportation facilities near the WVDP include: highways in the vicinity of the WVDP, transport repair and refueling services, rail lines, and aviation facilities.

The primary method of transportation in the site vicinity is motor vehicle traffic on the highway system shown in Figure 3.1-1.

In Cattaraugus County, all roads with the exception of those within the cities of Olean and Salamanca are considered rural roads. Rural principal arterial highways are connectors of population and industrial centers. This category, includes U.S. Route 219, located 4.2 km (2.6 miles) west of the site, NY RT 17, the Southern Tier Expressway located approximately 35 km (21.7 miles) south of the site, and the New York State Thruway (I-90), approximately 35 km (21.7 miles) north of the site. Traffic volume along U.S. 219 between the intersection with NY RT 39 at Springville and the intersection with Cattaraugus County RT 12 (East Otto Rd) ranges from a low average annual daily traffic (AADT) volume of 6,100 to a high volume of 7,500 (New York State Department of Transportation [NYSDOT] 1995). Seasonal holiday traffic is as much as 128% of the AADT. Approximately 18% of the traffic consists of trucks.

Collectors are roads connecting smaller communities and industrial centers to the arterials. They frequently are intra-county in nature and serve short hauls and cross-county traffic. There are three county collector roads within 2 km (1.2 miles) of the site. Rock Springs Road, adjacent to the site on the west, serves as the principal site access road. A portion of this collector road is known as Schwartz Road between Edies Rd. and NY 219. Along this road, between the site and the intersection of NY 219, there are fewer than 24 residences. State Route 240, also identified as County RT 32, is 2 km (1.2 miles) northeast of the site. AADT on the portion of NY RT 240 proximate to the site (between County Route 16 - Rosick Hill Rd. and NY RT 39) ranges from a low of 440 AADT to a high of 2,250 AADT (NYSDOT 1993).

Dutch Hill Road is approximately 2 km (1 mile) west of the WVDP. South of the intersection with Schwartz Road, Dutch Hill Road is maintained by the Town of Ashford. Designed to accommodate local, lightweight vehicles, it is an oil and stone chip hard surface on a gravel base.

North of the intersection with Schwartz Road to the Cattaraugus/Erie county line, Edies Road is designed for local lightweight vehicle traffic. It is an oil and stone chip surface on a gravel base. In Erie County, Edies Road continues, but is known as Mill Street. It is maintained as a county road. While part of Mill Street was recently paved with an asphalt course over a gravel base, the road is located on unstable soils. The road surface deteriorates and the driving conditions discourage use by heavy trucks and through traffic.

All other roads within the site vicinity are within the jurisdiction of towns and are classified as local.

Railroad service in a north-south direction is provided to the central part of Cattaraugus County. The Buffalo and Pittsburgh railroad transects the WNYNSC approximately 800 m (0.5 miles) east of the WVDP site at its nearest point. The site is served by a railroad siding from this line.

There are no commercial airports in the site vicinity. The only major aviation facility in Cattaraugus County is the Olean Municipal Airport, located in the Town of Ischua, 34 km (21.1 miles) southeast of the site. Regularly scheduled commercial air service was terminated at this airport in early 1972. The nearest major airport is Greater Buffalo International Airport, 55 km (34.2 miles) north of the site. Review of DOE-STD-3014-96, *Accident Analysis for Aircraft Crash into Hazardous Facilities*, shows that due to the size of aircraft, number of flights, location of the airports, and the size of WVDP hazardous facilities, a release due to an aircraft crash is not credible.

3.3 Meteorology

The effects of severe natural phenomena on operations in facilities within the scope of this SAR have been assessed in the Process Hazards Analysis presented in Chapter 9.

3.3.1 Regional Climatology for Western New York

The West Valley Demonstration Project is situated approximately 50 km (31 miles) inland from the eastern end of Lake Erie in Western New York State, at approximately 42°27′ north latitude and 78°39′ west longitude. The climate of Western New York State is of the moist continental type prevalent in the northeastern United States. The climate is diverse due to the influence of several atmospheric and geographic factors or controls.

Western New York is exposed to a variety of air masses. Cold dry air masses that form over Canada reach the area from the northwesterly quadrant. Prevailing winds from the southwest and south bring warm, humid air masses from the Gulf of Mexico and neighboring waters of the subtropical Atlantic Ocean. On occasion, cool, cloudy, and damp weather affects Western New York through air flow from the east and northeast.

Western New York is affected by a variety of cyclonic and anticyclonic pressure systems as they move across the continent. The path of continental storms and frontal systems is frequently across or in close proximity to this region. In addition, Western New York usually feels the effects of well-developed storms moving up the Atlantic Coast. Consequently, a variety of weather is often experienced within a period of a few days. Temperature, sunshine, wind and other atmospheric conditions during one week can be quite different from those of the preceding or following week. At times, however, a particular type of weather may persist from several days to a week or more. Seasonal weather, too, often varies considerably from one year to the next.

Western New York is bordered by two of the Great Lakes; Lake Erie on the west and Lake Ontario on the north. These exert a major controlling influence on the climate of the region.

Topography also affects the climate. Elevations in Western New York range from about 350 feet NGVD along the Lake Ontario shore in Oswego County to more than 2,000 feet NGVD in the southwestern highlands of Cattaraugus and Allegheny counties. The lake plain extends inland about 40.2 km (25 miles) from Lake Ontario, but along Lake Erie it gradually narrows from about 16.1 km (10 miles) in the Buffalo area to 8 km (5 miles) or less in Chautauqua County. The southern two-thirds of the region is composed of hilly, occasionally rugged terrain with elevations generally above 1,000 feet NGVD. This area is interspersed with numerous river valleys and gently sloping plateau areas. Such topographic features may produce locally significant variation of climatic elements within relatively short distances.

The winters are long and cold. Persistent cloudiness is a characteristic of the colder months and causes the temperatures at night to be more moderate than those occurring at similar elevations and latitudes in the less cloudy regions of central and eastern New York. In November and December, the western half of the state receives only 25 to 30 percent of the possible sunshine, though the amount gradually increases during the latter half of the winter.

The coldest temperature in most winters varies between 5°F below zero and 10°F below zero near the Great Lakes, 5°F below zero to 15°F below zero in the Finger Lakes and Chemung River Valley, and from 10°F below to 20°F below zero in the southwestern highlands. Extreme winter temperatures as cold as 40°F below zero have been recorded in the higher elevations of Cattaraugus and Allegheny Counties. Severe winter cold with below-zero minimums and/or lengthy periods of continuous subfreezing temperatures occur between early December and mid March. Winter thaws result in temperatures in the 40s to low 50s for a few days at a time, with rare maximums in the 60s.

The winter climate of Western New York is marked by abundant snowfall. The areas with the lightest snowfall, with average seasonal accumulations of 101.6 to 127 cm (40 to 50 in), are the lower Chemung Valley, the western Finger Lakes, and northern Niagara County. The heaviest snowfall occurs in the eastern lee of Lake Erie, where the average total is in excess of 304.8 cm (120 in). The snow season normally begins in mid November and extends into mid or late March. Snow cover is continuous from early December until the

middle of March, although occasional midwinter thaws greatly reduce or eliminate the cover for brief periods.

The summer season is cool in the southwestern highland, but warm elsewhere. On average, the weather is sunny for 65 percent of the total daylight hours during this season. High temperatures and high humidity are infrequent during the summer and seldom persist for more than a few days at a time. Temperatures of 90°F or higher are recorded on five days or less per year at the higher elevations and along the shore of the Great Lakes, but the remainder of Western New York has an average frequency of from 8 to 15 days. Such temperatures occur between early June and early September. Readings of 100°F or higher are rare. The range of temperature on summer days is commonly from near 60° at night to the low 80s in the afternoon.

Summer season precipitation increases to the south, ranging from about 20.3 cm (8 in) along the Lake Ontario shore to 25.4 to 30.5 cm (10 to 12 in) in the counties along the Pennsylvania border. Showers and thundershowers account for much of the warm season rainfall and the distribution pattern reflects the contrasting influences of the cool Lake Ontario waters to the north and the hilly terrain in the Southern Tier.

3.3.2 Local Meteorology for Buffalo, New York

Off-site data for representation of the general regional climate and the local meteorological conditions are collected from the National Weather Service (NWS) observing station at Buffalo, New York.

3.3.3 On-Site Meteorological Program for the WVDP

The measurement program for meteorological parameters at the WVDP consists of:

- A primary location with measurement levels of 10 and 60 m (32.8 and 196.9 ft) above ground, located on site;
- A hilltop location off the site, measuring wind parameters at 10 m (32.8 ft) above the ground for the purpose of monitoring regional wind.

At the primary monitoring location, wind speed, wind direction, and air temperature are measured at both 10 m and 60 m (32.8 ft and 196.9 ft). The standard deviation of the horizontal wind (sigma theta) at both heights is calculated from 5-second interval samplings of the direction monitor. Data are recorded directly on a digital data acquisition system with backup on a chart recorder. Select data from the 10 m and 60 m (32.8 ft and 196.9 ft) locations are reported in WVDP-065. This data is used to develop site-specific dispersion values (i.e., χ/Q values) used in accident consequence analyses, as presented in WVDP-065.

The regional meteorological tower is a 10 m (32.8 ft) tall galvanized steel tower equipped with a crossarm and wind monitoring instruments. This site is located on Dutch Hill, approximately 5.2 km (3.2 miles) south-southwest of the project facilities. This site is on some of the highest terrain in the area, at an elevation of approximately 2,000 ft NGVD (approximately 180 m (590.6 ft) above the elevation of the site). Parameters measured at the regional site include wind speed, wind direction, and sigma theta.

The regional site will remain in operation for the life of the project to provide real-time data on regional airflow for emergency preparedness purposes. Because these data are required in real time by emergency response personnel at the project, the data are transmitted back to the site via a

dedicated telephone line. At the WVDP site, the data are recorded by the data acquisition system and an analog strip chart recorder in the same manner as data from the on-site tower. Meteorological data collected from both the regional and primary monitoring locations are summarized and reported in the Annual Meteorological Data Reports.

3.4 Surface Hydrology

Specific surface hydrological conditions were not found to affect the conclusions of the analyses contained in Chapter 9.

3.4.1 Hydrologic Description

The WVDP facilities obtain potable and process water from two water supply reservoirs that are located near the head water area of the Buttermilk Creek basin. Buttermilk Creek roughly bisects the WNYNSC property and flows in a northwestward direction to its confluence with Cattaraugus Creek at the northwest end of the WNYNSC. Several tributary (perennial) streams flow into Buttermilk Creek in the WNYNSC. The flow length of Buttermilk Creek through the WNYNSC is about 7,620 m (25,000 ft). About 2,743 m (9,000 ft) of this is adjacent to the project facilities and the water supply reservoirs.

Within the Buttermilk Creek watershed, a small 18-acre sub-basin on the east side of Buttermilk Creek drains the area around the bulk storage warehouse, which is used for general equipment and furniture storage. Hydrological events and conditions in this area would not have safety-related effects on the Main Plant facilities and therefore, this sub-basin will not be further discussed in this section.

Buttermilk Creek lies in a deep, narrow valley cut into glacial soils, with a downstream portion downcut to shale bedrock. The reach of stream to the east of the WVDP facilities has downcut through the Lavery till and the underlying Kent recessional units, and is presently incising the Kent till. The stream invert drops from an elevation of 1,310 feet NGVD at the southern site boundary, to 1,215 feet NGVD at the northern edge of the project facilities, to 1,110 feet NGVD at the confluence with Cattaraugus Creek. The drainage area of the Buttermilk Creek basin was estimated to be 19,600 acres (Boothroyd et al. 1982). The U.S. Geological Survey (USGS) operated a gauging station at the Bond Road bridge about 1,524 m (5,000 ft) upstream of the mouth of Buttermilk Creek from October 1961 to September 1968. The drainage area to this point is estimated to be about 18,820 acres (29.4 sq mi).

Cattaraugus Creek flows westward from the Buttermilk Creek confluence to Lake Erie, 62.8 km (39 miles) downstream. The total drainage area is estimated to be 335,060 acres (524 sq mi). A gauging station has been maintained at Gowanda, N.Y., since 1939. The drainage basin to this point is estimated to be about 276,480 acres (432 sq mi). The drainage area of Cattaraugus Creek upstream of the Buttermilk Creek confluence is 139,450 acres (220 sq mi).

A small hydroelectric dam and water impoundment is located on Cattaraugus Creek about 304.8 m (1,000 ft) upstream of the Scoby Road bridge, southwest of Springville, N.Y. Neither Buttermilk Creek nor Cattaraugus Creek downstream of the WVDP are used as a regular source of potable or agricultural water. The steep-walled nature of the downstream valley and the region's ample precipitation combine to make irrigation and livestock watering from the creeks impracticable and unnecessary. Because Buttermilk Creek downstream of the site is entirely within the WNYNSC, there are no other uses made of these waters. Cattaraugus Creek downstream of Buttermilk is a popular fishing and canoeing/rafting waterway. As such, Cattaraugus Creek water, fish, and

sediments are monitored as part of the WVDP environmental monitoring program (WVDP Annual Site Environmental Reports).

The two water supply reservoirs, which are interconnected by a short canal, are located to the south of the main project facilities. They were formed by blocking off two tributaries to Buttermilk Creek with earthen dams. The south reservoir drains to the north reservoir, which then discharges to Buttermilk Creek through a sluice gate water level control structure. The emergency spillway is located on the south reservoir. The reservoirs collect drainage from numerous small streams over a 3,100-acre drainage basin. The watershed ground cover is a mix of forest, cultivated fields, and pastures. Several small farm ponds are located throughout the basin.

The project facilities drainage basin is relatively small, consisting of approximately 1,200 acres. The outfall of the watershed, that is, the point where all surface runoff from the site reaches a single stream channel, is at the confluence of Frank's Creek and Quarry Creek, north of the main project facilities. The watershed extends in a southwest direction from this point. Ground cover consists of the main project facilities, forest, abandoned farmlands, and a small amount of active farmland.

The project facilities watershed is drained by three named streams: Quarry Creek, Frank's Creek, and Erdman Brook. Erdman Brook and Quarry Creek are tributaries to Frank's Creek, which in turn flows into Buttermilk Creek. Erdman Brook, the smallest of the three streams, drains the central and largest fraction of the developed Project premises, including a large portion of the disposal areas and the areas surrounding the lagoon system; the plant, office, and warehouse areas; and a major part of the parking lots. Following treatment, the Project's waste waters are also discharged to this brook. Erdman Brook flows from a height of over 1,400 feet NGVD west of Rock Springs Road to 1,305 feet NGVD at the confluence with Frank's Creek northeast of the lagoons. It flows for about 914.4 m (3,000 ft) through the project facilities.

Quarry Creek, which drains the largest area of the three named streams, receives runoff from the HLW tank farm, the north half of the northern parking lot, and the temporary radioactive waste storage tents. It flows from an elevation of 1,930 feet NGVD west of Dutch Hill Road to 1,245 feet NGVD at its confluence with Frank's Creek. The segment that flows along the north side of the project is about 914.4 m (3,000 ft) in length.

Frank's Creek receives runoff from the east side of the project, including the Drum Cell, part of the state radioactive waste burial area, and the former construction demolition and debris landfill. It flows into Buttermilk Creek about 609.6 m (2,000 ft) downstream of its confluence with Quarry Creek. It flows from an elevation of 1,790 feet NGVD west of Rock Springs Road, to 1,245 feet NGVD at the Quarry Creek confluence, to 1,180 feet NGVD at the Buttermilk Creek confluence. About 1,828.8 m (6,000 ft) of its length is adjacent to WVDP project facilities.

Flow impediments (log jams, bridges, etc.) in the main stream channels are located at elevations below the plateau on which the project facilities are located. Thus, the stream flow could overtop the impediments and not flood the site. Numerous culverts for drainage ditches and the channels of the stream headwaters are located on or above the site. The most significant of these are culverts under the site railroad spur and under Rock Springs Road because of their large storage capacity. The locations, number, and flow directions of storm drain systems associated with the former processing plant are not precisely known. There is a man-made constriction on Erdman Brook

downstream of the radioactive burial areas, consisting of a former road embankment. Potential impediments from beaver activity are also a concern. However, the beaver dams can be cleared away if necessary.

3.4.1.1 Site and Facilities

The main project facilities and burial areas are located on a plateau, divided into a North Plateau and South Plateau by Erdman Brook. The entire plateau is being actively incised by the three main streams and their tributary gullies. These gullies are growing at various rates, influenced by the amount of runoff through them. Since the start of the project, increased runoff has resulted from the construction of parking lots, buildings, and office trailers. A runoff control program was implemented in the North plateau in the 1990's. Project facilities which are likely to be first affected by the stream and gully growth are the radioactive waste treatment lagoons, the access road along the north perimeter of the WVDP, the NDA, and some perimeter fence sections. Erosion protection measures are limited to small-scale, irregular efforts around on-site facilities and do not involve the main stream channels and their tributary gullies. Critical slopes (particularly along Frank's Creek and Erdman Brook) are being monitored.

Erosion monitoring primarily consists of general visual observations of site areas and intermittent monitoring of previously installed instrumentation, such as erosion frames. The frequency of such monitoring is based on measured rates of change and visual observations. Additionally, in 1991, an investigation was conducted to evaluate the stability of the lagoon no. 3 slope embankment and provide recommendations for slope stabilization. The investigation included drilling and installation of slope indicators (i.e., inclinometers) for monitoring deep movements within the slope.

3.4.1.2 Hydrosphere

The WVDP is underlain by the following water-bearing units in ascending order: 1) weathered shale bedrock; 2) inter- and intra-till sand units; and 3) alluvial/fluvial sand and gravel deposits overlying the uppermost till on the North Plateau but absent on the South Plateau. The uppermost water-bearing unit on the South Plateau is the upper, fractured Lavery till. Refer to Section 3.5 for an expanded discussion of subsurface hydrology.

Kappel and Harding (1987) estimated that 70% of the total stream flow from the North Plateau is base flow, while only 20% of stream flow on the South Plateau is base flow. This is due to the clayey, silty till at the South Plateau surface, which limits infiltration and causes more precipitation to run off directly to channels. Although the North Plateau surface sands and gravels permit more infiltration, construction activities have left much of the surface area impermeable.

The project low-level radioactive waste treatment facility includes four in-series lagoons (lagoons 2, 3, 4, and 5). The largest is Lagoon 3, which has a capacity of 467,900 cubic feet (10.7 acre-ft). Lagoon 3 is also the final lagoon in the system before the wastewater is discharged into Erdman Brook. A fifth basin, Lagoon 1, was decommissioned in 1984 and filled with material dug from a radioactively contaminated hardstand. The site's sewage treatment plant (STP) discharges to a gully that flows into Erdman Brook. A former equalization basin for the STP now acts as a sludge pond for utility room discharges.

3.4.2 Floods

3.4.2.1 Flood History

Cattaraugus and Buttermilk creeks lie in deep, narrow valleys. Therefore, the effects on the WVDP of flooding by these creeks is negligible, as supported by historical data.

Frank's Creek, Quarry Creek, and Erdman Brook are also located in deep valleys. Historical evidence and computer modeling indicate that flood conditions (including the probable maximum flood) will not result in stream flows overtopping their banks and flooding the plateau. However, indirect damage from the erosional effects of high stream flows and excessive slope saturation during flood conditions is a possibility. The facilities likely to be most affected by bank failure and gully head advancement due to extreme precipitation are lagoons 2 and 3, the NDA, and site access roads in several places.

Constriction of the stream channels is not likely to result in flooding. Major constriction points on the WVDP site are the culverts through the railroad spur, the wreckage of the old Rock Springs Road bridge, and the remnants of a road embankment that crossed Erdman Brook downstream of the SDA. There are also numerous culverts for drainage ditches throughout the site.

3.4.2.2 Flood Design Considerations

Floodplain analyses have been performed using the U.S. Army Corps of Engineers HEC-2 computer modeling program (U.S. Army Corps of Engineers, 1982). Creeks that border or cut into the plateau were modeled. Storm return frequencies of 2, 10, and 100 years were analyzed. Results of the 100-year calculation are represented in Figure 3.4-1.

The steep-walled nature of these creeks produces a well-confined floodplain, and sufficient reservations have been allowed for headwater pools. As a result, the 100-year floodwater elevations would not impact any safety-related facilities, nor is it necessary to design or provide flood-protection measures anywhere on-site.

In the case of the hypothetical probable maximum flood (PMF), which has a peak discharge nearly eight times that of the 100-year flood, it was demonstrated using the TR-20 program (Soil Conservation Service, 1983) that culvert headwaters would overtop Rock Springs Road and some part of the floodwaters would flow across the plant area. Based on the topography in the plant area, it is likely that some portions of the site would experience shallow flows of moderate velocity. Flows would recede quickly, however, since the ditches that drain the site have gradients of up to 5%. It is difficult to quantify the effects of such an extreme event. Part of the difficulty stems from the likelihood that drainage areas would become interconnected and flow paths would be altered. The effects of ground saturation on site facilities is also hard to predict.

The separate issue of erosion resulting from catastrophic rainfall events is of particular significance at this site. Slopes adjacent to facilities such as the lagoons and burial areas would be especially susceptible to failure as a result of severe channel downcutting coupled with excessive soil moisture.

3.4.2.3 Effects of Local Intense Precipitation

The 24-hour PMP for this watershed as supplied by the U.S. Weather Bureau is 63.2 cm (24.9 in). As noted in the section above, the effects of the PMP on site drainage systems would be overwhelming. Capacities of storm drain inlets at grade and in sumps would be exceeded. Ditches along open section roadways would overflow, flooding roadways and adjacent areas. None of the culverts

within the watershed would be expected to prevent overtopping of its embankments, which raises the possibility of embankment failures. In the case of the 61-cm (24-in) corrugated metal pipe (CMP) culvert beneath the railroad embankment along Frank's Creek, flow would be directed to the water supply reservoirs before the embankment elevation was exceeded. Failures of culvert embankments would not threaten any safety-related facilities in the plant area. However, the erosion produced by a failure-induced flood wave at the railroad embankment would likely compromise the integrity of the northern slope of the SDA. This, in turn, could adversely affect downstream surface water channels within the Project premises.

The principal design consequences of precipitation are flooding and erosion. Design considerations for ditches along roadways, culverts, and culvert embankments are provided in Chapter 4.0. The principal design consequence of snow is increased loading on rooftops. Design considerations for snow loading on rooftops are provided in Chapter 4.0.

3.4.3 Probable Maximum Flood on Streams

Peak discharges of the PMF have been generated for the subareas constituting the watershed using the SCS TR-20 computer modeling program. These discharges were then used in a Manning's equation-based analysis of depth of flow at four cross sections on streams adjacent to safety-related facilities (these locations coincide with HEC-2 cross sections, 10790, 20160, 21090, and 6695). The results of these analyses demonstrate that the depths of flow associated with the PMF on area streams is well below the elevations of site facilities. The lowest portion of the Main Plant is approximately 1,410 feet NGVD, whereas under PMF conditions, the nearest stream would rise to only 1347.2 feet NGVD.

3.4.3.1 Probable Maximum Precipitation

According to U.S. Weather Bureau meteorological analysis, the theoretically greatest precipitation that could be expected over the applicable drainage area in a 24-hour period is 63.2 cm (24.9 in). Factors figuring into this estimate include the size of the 1,200-acre drainage area, its topography, and seasonal effects.

3.4.4 Potential Dam Failures

While dam failure would not present a direct flooding hazard to the Project facilities, it would require a significant reduction of site operations until a large-volume supply could be restored. Given the WVDP mission objectives and the cost of the upgrades necessary to insure a long-term water supply, this has been judged an acceptable risk. The dams are not on Project premises, but since they are the source of Project water, the WVDP has performed limited maintenance on them.

Moreover, it is estimated that the flood wave peak discharge would be entirely attenuated within the WNYNSC property limits (i.e., within approximately 5.6 km (3.5 miles) downstream of the dam). There are no private residences in the attenuation area.

3.5 Subsurface Hydrology

Specific subsurface hydrological conditions were not found to affect the conclusions of the analyses contained in Chapter 9.

3.5.1 Regional and Area Characteristics

The hydrostratigraphic system beneath the WNYNSC consists of a sequence of unlithified Holocene and Pleistocene deposits occupying a steep-sided valley carved in Devonian bedrock. The Holocene deposits are mainly alluvial fans and aprons derived from the glacial sediments covering the uplands surrounding the WNYNSC, and floodplain deposits derived from the Pleistocene valley-fill sequence; the latter consist mainly of lag from the Lavery till. The valley fill is an interstratified succession of glacial tills of low permeability and periglacial water-laid deposits of somewhat higher permeability. Hydraulic gradients within the till sheets are predominantly vertical and characteristically lateral towards the channel of Buttermilk Creek in the non-till units.

The complete geologic sequence for the WVDP comprises shale bedrock, characterized by enhanced permeability due to disintegration and decomposition near the bedrock-overburden interface; a sequence of three glacial tills separated by intervals of interstadial stratified drift; and an association of alluvial-fluvial deposits that directly overlies the uppermost till (Lavery) in the plant area and is absent in the southern sector of the WVDP.

Flow patterns within the shallow course grained fan, the uppermost weathered and fractured zone of the Lavery till, the main mass of the Lavery till, and the upper lacustrine sequence are well understood and are supported by abundant potentiometric data and computer simulations. Flow patterns within the lower till unit are supported by few data, but are consistent with anticipated hydraulic relationships. Water levels measured during construction of well 83-4E in July 1983 indicate that: 1) the entire interval below the upper lacustrine sequence is saturated, 2) the bedrock aquifer and the lower lacustrine aquifer are artesian beneath the WVDP, and 3) groundwater flow within the two lower confining tills is characterized by very weak upward gradients. These head relationships and the low permeability of the tills indicate that groundwater flow through the lower part of the sequence occurs mainly within the lower lacustrine sequence towards the axis of the bedrock valley.

The lacustrine sequence of stratified drift between the Kent and Lavery tills was deposited during recession of the Kent ice sheet and is represented by a variety of facies including lake sediments, kames and deltas. These deposits have been referred to in other site reports as the Kent recessional sequence, thus encompassing the various depositional environments and simplifying its usage.

The surficial course-grained deposits, Lavery till, and the underlying Kent recessional sequence generally are regarded as containing all of the potential routes for the migration of contaminants to the surface water system and to off-site areas. Each unit in that unconsolidated sequence and the underlying bedrock is described below as to its distribution, fundamental hydrologic properties, capacity to retard the passage of solutes, and potential for being perceived as a source of usable groundwater.

3.6 Geology and Seismology

The physiography, geologic history, stratigraphy, structure, and hydrology of the site are summarized in this section.

3.6.1 Geologic and Seismologic Overview

The WNYNSC is located within the glaciated northern portion of the Appalachian Plateau Physiographic Province, a maturely dissected upland region underlain in western New York by shales and siltstones of Devonian age. The plateau region has been subjected to multiple glaciations that resulted in the

deepening and oversteepening of many pre-glacial valleys and in the accumulation in those valleys of as much as 150 m (492 ft) of glacial drift. The WNYNSC is situated within one of these north-trending valleys.

The region around the WNYNSC has undergone a moderate amount of relatively minor seismic activity. The only historical earthquake of Modified Mercalli Intensity (MMI) >VII in western New York assigned to a discrete tectonic feature occurred near Attica on the Clarendon-Linden Structure; the epicenter of that event was 50 km (31.1 miles) northeast of the site. Several smaller shocks in the Buffalo-Hamilton (Ontario), area have been interpreted as related to stress concentrations and crustal readjustments associated with glacial rebound. Ground motion at the site in historical time, probably has not exceeded MMI IV.

The WVDP has undergone intense geologic investigation and characterization since the early 1960s. To date, in excess of 100 publications dealing with almost every aspect of the site geology, seismology, and hydrogeology have been generated. These studies can be categorized as follows:

Borehole Records - Site boring data were collected in the course of subsurface characterization studies, foundation investigations, and monitoring-well installation programs. As of May 1991, in excess of 500 boreholes had been drilled inside the fenced area. Hollow-stem augers were used in most instances, but several deeper on-site monitoring wells were installed using either hydraulic rotary or cable-tool drilling methods. Since 1994, the use of hydraulically-powered, percussion probing equipment have been used extensively in the collection of soil and groundwater samples.

Geophysical Surveys - Four geophysical surveys have been conducted at the WNYNSC. The first survey was reported in 1973 in the NFS SAR. This was a shallow reflection type investigation and included surveys along 12 lines across various areas of the site. The second survey, conducted in December 1983, employed electromagnetic, resistivity, and magnetometric techniques in and around the NDA. The third survey, conducted during 1989 at the SDA, employed electromagnetics, resistivity, magnetometry, and seismic refraction profiling. The fourth survey was conducted in June 2001. This study collected seismic reflection data along a east-west line of nearly 46.7 km (29 miles) and a north-south line 8 km (5 miles) long.

Trenching - Several trench studies have been carried out by the NYSGS. These consisted of the trenching of tills at various locations east of the SDA and resulted in detailed descriptions and interpretation of till structural and sedimentary features.

3.6.1.1 Summary of Regional and Site Geology

The following subsections provide summary descriptions of regional and site geology.

3.6.1.1.1 Regional Physiography

The site is located on the Glaciated Allegheny Plateau section of the Appalachian Plateau Physiographic Province. This region is bounded on the north by the Erie Ontario Lowlands, on the east by the Tughill Upland, on the south by the unglaciated Appalachian Plateau, and on the west by the Interior Lowlands.

During the Wisconsinan glacial period 38,000 to 14,500 years ago, the Allegheny Plateau was subjected to the erosional and depositional actions of repeated glaciations, resulting in accumulation of upwards of 150 meters (492

ft) of Pleistocene age glacial tills, lacustrine, and glaciofluvial sediments over the area. Fluvial erosion and mass wasting have been the main focus that have altered the landscape since the glacial deposits.

Surface water leaves the WVDP via Frank's Creek which joins Buttermilk Creek on the WNYNSC. Buttermilk Creek flows northward to join Cattaraugus Creek at the boundary of the WNYNSC. Cattaraugus Creek flows generally to the west and enters Lake Erie near Silver Creek, New York.

3.6.1.1.2 Regional Geologic History

The bedrock underlying the glacial cover was deposited from Precambrian time to early to middle Paleozoic time. The later periods of the Paleozoic Era (Mississippian, Pennsylvanian, and Permian) are not extensively distributed throughout the region. However, small outliers of Mississippian and Pennsylvanian age rocks are present near Olean, New York. Five or more Pleistocene glacial ice sheets advanced over the region, depositing the thick sequence of tills and glacial outwash that directly underlie the modern landforms of the site and its environs.

3.6.1.1.3 Regional Stratigraphy

Precambrian crystalline rocks comprise the basement rocks of the region. The crystalline terrains are overlain by approximately 2,300 m (7,544 ft) of Paleozoic strata consisting predominantly of shales, siltstones, sandstones, carbonate rocks, and some evaporites. Bedrock stratification in the area is nearly flat and essentially undeformed, with an average dip of 6-8 m/km to the south. The overburden consists of glacial deposits that mantle the higher elevations and fill the preglacial valleys that had been eroded into bedrock. The thickness of glacial deposits at the site ranges from 1.5 m (4.9 ft) or less on the uplands to 150 m (492 ft) along the axis of the valley.

3.6.1.1.4 Regional Structure

The structural feature in closest proximity to the site area would be those associated with the Bass Islands Trend (BIT), a regional non-active NE-trending Alleghenian foreland fold and thrust structure that extends from northeastern Ohio through Chautauqua Lake and into Southern Erie County where it parallels Cattaraugus Creek. Bedrock mapping in the south branch of Cattaraugus Creek, 20 km (12.4 miles) west of WVDP indicates the presence of NE striking bedding, folds and faults which are attributed to faults associated with the BIT.

The closest major structural zone is the St. Lawrence Rift Valley System, located about 480 km (300 miles) to the northeast. The north-trending Clarendon-Linden Structure, located 30 km (18.6 miles) northeast of the site, is the only significant structural feature in the western New York region. The Paleozoic strata in the site region are essentially horizontal, as indicated in 3.6.1.1.3.

3.6.2 Vibratory Ground Motion

Characterization of the seismicity of the site and site region is presented in this section.

3.6.2.1 Underlying Tectonic Structures

No tectonic features are recognized that would result in conditions conducive to a significant geological event at the site.

3.6.2.2 Behavior During Prior Earthquakes

Evidence of seismically induced ground failure, such as liquefaction, slumping, and fissuring has not been observed on or near the site during intensive geologic exploration programs. This lack of evidence is consistent with the reported and estimated epicentral intensities of historic earthquakes in the site region and their projected intensities (i.e., MMI ≤IV) at the WVDP, as discussed in Section 3.6.2.4.

Intensities of MMI (Modified Mercalli intensity) IV or less typically are associated with accelerations of less than 0.05 g (Coulter et al. 1973; Krinitzsky and Chang, 1977), and likely would not have produced detectable physical effects in the soil and rock materials encountered at the site.

3.6.2.3 Engineering Properties of Materials Underlying the Site

The engineering properties of on-site subsurface materials are discussed in Section 3.6.4.

3.6.2.4 Earthquake History

Numerous analyses of seismicity within the WVDP site region have been performed both for project purposes and for requirements of nearby critical facilities by federal and state agencies, private consultants, and university researchers. This subsection summarizes the results of these studies.

From 1737 to 1999, there have been 119 recorded earthquakes within 480 km (300 miles) of the WVDP with epicentral intensities of MMI V to MMI VII; their geographic distribution is shown on Figure 3.6-1. Of the 119 events shown, 25 occurred within 320 km (200 miles) of the WVDP. Dates, locations, intensities, and magnitudes (where available) of these events are listed on Table 3.6-1 (Chiburis, 1981).

Assuming that MMI II is the limit of perceptible ground motion, all earthquakes listed in Table 3.6-1 with epicenters within 210 km (130 miles) of the WVDP could have been felt at the WVDP. Based on the published eastern United States attenuation curve (Fig. 3.6-2), six MMI V earthquakes could have been felt at the site since 1840, and all nine MMI VI events within 320 km (200 miles) of the site could have been felt at the site.

Figure 3.6-2 also suggests that all MMI VII events that occurred within 480 km (300 miles) of the site could have been felt at the WVDP and that the 1871 and 1954 earthquakes could have been felt as MMI III at the site.

The only historic earthquakes within or near the site region known to have produced intensities higher than MMI III at the site were the 1929 Attica earthquakes and the 1944 Cornwall-Massena earthquakes. Both of these earthquakes produced an estimated MMI IV at the site.

Large distant shocks of record such as the Charleston, S.C., event of 1886, the New Madrid, Mo., events of 1811-12, and the more significant (MMI IX-X) events in the upper St. Lawrence Valley probably produced small effects at the WVDP. Using empirical relationships (Coulter et al. 1973) to correlate MMI with ground acceleration, and considering attenuation, it is concluded that ground acceleration at the WVDP has not exceeded 0.05 g during the last two centuries.

3.6.2.5 Correlation of Epicenter with Geologic Structures

The Clarendon-Linden Structure is the only seismogenic crustal feature known to exist in the site region, and earthquakes in the Attica area generally have been associated with this structure. Other earthquakes within the site region, including those on the Niagara Frontier, have not been definitely assigned to known geologic structures but have been associated with tectonic provinces.

3.6.2.6 Identification of Active Faults

In several investigations, the Clarendon-Linden Structure has been associated with seismicity near Attica, N.Y. The 1929 Attica earthquake (MMI-VII) was centered near a complex portion of the Clarendon-Linden Structure. An array of seismic stations operated by the Lamont-Doherty Geological Observatory of Columbia University and designed to accurately locate events in the Buffalo-Attica region has been monitoring earthquake activity in the Attica area since 1971. A number of small naturally occurring events with magnitudes generally less than $m_b = 3.0$ have been reported (Fletcher and Sykes 1977; Sbar and Sykes 1973). A swarm of microseismic events also occurred during the summer and fall of 1971. That activity correlated well in time and space to the injection of water under high pressure into a brine well and was localized along the strike of the Clarendon-Linden Structure, indicating that the fluid injection triggered the release of tectonic stress that had accumulated on the fault. Much of the natural and induced activity has occurred within the triangular area bounded by the main Clarendon-Linden Structure and the southwestward-directed splay in the Attica-Dale area.

Focal mechanism solutions of two earthquakes that occurred near Attica in 1966 ($m_b = 4.6$) and 1967 ($m_b = 4.4$) (Hermann 1978), and a composite focal mechanism solution of earthquake swarms near Attica (Fletcher and Sykes 1977) indicate a combination of right-lateral strike-slip and reverse faulting on planes parallel to the northerly trend of the Clarendon-Linden Structure. The events analyzed by Fletcher and Sykes occurred at depths of less than 1 km (0.62 miles) and were thought to be related to hydraulic mining of salt at a depth of 0.5 km (0.31 miles).

There has been no known surface movement along the trace of the structure as a result of earthquakes, but basement-involved faulting and the distribution of seismic activity indicate that the Clarendon-Linden Structure is active in the geologic sense.

3.6.2.7 Description of Capable Faults

In the absence of surface offset, the Clarendon-Linden Structure cannot be considered "capable" in the strict sense of the 10 CFR 100 Appendix A definition. However, evidence at hand indicates that the structure is certainly capable of generating earthquakes. Consequently, this analysis makes the conservative assumption that the Clarendon-Linden Structure is "capable" and as such, should be considered in defining the maximum earthquake for the WVDP.

The Clarendon-Linden Structure extends about 90 km (55.9 miles) southward from Lake Ontario to Bliss, NY, 37 km (23 miles) east-northeast of the WVDP. The Clarendon-Linden Structure was initially described (Chadwick 1920) as a north-trending normal fault extending from Lake Ontario into Allegheny County and may continue across the New York-Pennsylvania border. Chadwick found surficial displacement of the Onondaga and Niagara escarpments, with the western side displaced to the north relative to the eastern side, and in the vicinity of Linden he observed stratigraphic offset to indicate down-on-the-

west displacement. Chadwick, therefore, concluded that the feature was a fault, downthrown on the west. Subsequently, Chadwick (1932) redefined the feature as a monocline at the Linden end and a fault at the Clarendon end, and termed the entire structure the Clarendon-Linden Displacement.

3.6.2.8 Maximum Earthquake

The assessment of seismic hazard to DOE non-reactor nuclear facilities has commonly drawn on the techniques and terminology borrowed from the commercial nuclear power industry. The maximum earthquake is a deterministic assessment based on the greatest intensity or magnitude historic earthquakes that have been correlated with tectonic structures close to the site or tectonic provinces in which the site is located.

Historically, three maximum earthquakes have been considered:

- the maximum event associated with a tectonic structure (the Clarendon-Linden Structure);
- the maximum event within the site tectonic province not assigned to a specific structure; and
- the maximum event exterior to the site tectonic province.

The Clarendon-Linden Structure, the seismic source zone closest to the site, is the dominant contributor to the seismic hazard at the site.

3.6.2.9 Design Basis Earthquake

This section provides a summary of the seismic hazard analyses of the WVDP site going back to the original design of the reprocessing facility in the early 1960s.

3.6.2.9.1 Original Design Earthquake

At the time of the NFS plant construction (1964), no specific seismic standards had been established for nuclear fuel reprocessing facilities. In lieu of these standards, the seismic zone maps of the 1961 Uniform Building Code (UBC) were used and the facility designed to the requirements of the 1961 UBC for Seismic Zone 3.

3.6.2.9.2 NFS Upgrade Maximum Earthquake

In the early 1970s NFS planned to expand the reprocessing operation and sought an operating license from the NRC under 10 CFR 50. Following the criteria outlined in 10 CFR 50, analyses were made to define the Maximum Earthquake, the Safe Shutdown Earthquake (SSE) (determined to be 0.12 g) and the Operating Basis Earthquake (OBE). However before the license was approved, NFS withdrew from the reprocessing business and no designs were completed using this criteria.

3.6.2.9.3 WVDP Design Basis Earthquake

The WVDP DBE was established in 1983 using a probabilistic assessment. The WVDP adopted a DBE having a horizontal peak ground acceleration (PGA) of 0.10g. The probabilistic assessment (Dames & Moore 1983) of the seismic hazard to the site was consistent with then-current analyses for a typical nuclear power plant in the eastern United States. Using the site median seismic hazard curve (Figure 3.6-3), the annual probability of exceeding the DBE peak ground acceleration of 0.10 g is 5.0×10^{-4} /year. Seismic criteria for facilities constructed or modified in recent years are given in various DOE documents as discussed in Chapter 4.

3.6.2.9.4 Design Basis Earthquake Response Spectra

The WVDP DBE established a PGA of 0.10 g horizontally and 0.067 g vertically and is quantified in engineering terms using the US Nuclear Regulatory Commission (NRC) Regulatory Guide 1.60 response spectra. The use of this spectra is conservative as the NRC spectra is a mean plus one sigma spectra, yet UCRL 15910 (Kennedy, 1990) allows the use of a median spectra. The NRC spectra is also likely to be more conservative than a site specific response spectra that could be developed.

3.6.2.9.5 Re-evaluation of Design Basis Earthquake

The ground motion hazard at the WVDP was evaluated (Dames & Moore January, 1995) based on information in publications by the Electric Power Research Institute (EPRI 1986, 1989) and by Lawrence Livermore National Laboratory (LLNL) pertaining to seismic hazard analyses of nuclear power plant sites in the central and eastern United States. In particular, the data in these publications relevant to the seismic hazard at the closest nuclear power plant (Ginna) to the WVDP site were reviewed. Using these publications, the results of a 1992 study by Dames & Moore that applied the EPRI hazard analysis methodology, and the guidance of (archived) DOE-STD-1024-92, the PGA at the 1 x 10^{-3} and 5 x 10^{-4} annual probabilities were estimated to be 0.053 g and 0.078 g, respectively.

3.6.3 Surface Faulting

Neither geologic nor geophysical studies have revealed evidence of faulting at the site.

3.6.4 Stability of Subsurface Materials

This section discusses geologic features and processes that could have an impact on the integrity and longevity of on-site structures and facilities and summarizes the results of field and laboratory tests conducted to determine the engineering properties of the geologic media at the site.

The discussion of features and processes is based on the results of regional and on-site drilling programs, regional aeromagnetic and Bouguer gravity surveys, surface geophysical surveys conducted on-site, geologic field mapping, and photogrammetric analyses of the region and the site area. Most of the engineering data were generated from samples recovered during numerous drilling programs conducted at the WVDP since 1963.

Subsidence is the settlement of the earth's surface with little or no horizontal motion. Subsidence typically occurs when solids or fluids such as salt or groundwater are removed by natural or artificial processes. Lack of support may then lead to collapse of the overlying sediments and the formation of depressions (i.e., sinkholes) at the land surface. This process is not likely to occur at the WVDP because the shallowest rock unit susceptible to solution by groundwater, the Onondaga Limestone, occurs at depths greater than 600 m (1,968 ft) at the site and because the overlying few hundred meters of shale and siltstone are typically chemically stable and do not contain economically significant mineral resources.

Neither bedrock nor surficial deposits are considered to be regional aquifers and neither possesses characteristics to suggest the presence of economic mineral deposits. The shale bedrock has poor primary permeability and produces very limited quantities of water from shallow-seated joints and fractures. The glacial deposits are discontinuous and therefore not suitable for large-scale withdrawal of groundwater. The possibility of subsidence as a result of fluid withdrawal is considered remote.

Two photogrammetric analyses have been conducted to determine the presence in the Buttermilk Creek drainage basin and beyond of lineaments that might indicate persistent discontinuities in bedrock. Geologic mapping within the Buttermilk Creek drainage basin and geophysical surveys conducted on the WVDP have provided no evidence to indicate the presence of either warping or faulting in either bedrock or overburden.

In situ stress measurements made in recent years in the Eastern United States, include two measurements taken near Niagara Falls and Rochester. Both of these indicate that the maximum in situ compressive stress in the region is on the order of 6,900 kilo-Pascals (kPa). Although similar determinations were not made at the site, in situ stress in bedrock at the WVDP probably is quite similar to the listed values. Based on the available stress data and site geologic information, the unrelieved residual stress at the WVDP is too small to compromise plant structures.

Prior to Main Plant construction, soil investigations were conducted by Dames & Moore (Dames & Moore 1963a) to determine the general soil conditions at the site and to obtain soil data directly relevant to foundation design and construction. Based on its analysis of soil borings taken at the site, Dames & Moore recommended that the main process area be supported by piles. Preliminary analysis of boring data indicated that shorter piles could be used if the plant were moved from the originally proposed site to an alternative location due to a significant rise in the elevation of the rock surface in that area.

As part of the characterization program, laboratory tests were conducted on soil borings to determine the shear strength of the compact soil layers and the consolidation characteristics of the silty till layers. Moisture content and dry density of all samples was also determined. A record of moisture content, density, and shear strength were included on boring logs provided in the characterization report (Dames & Moore 1963b).

Piles selected for foundation support by Bechtel were 12-BP-53 steel H-piles driven into the compact glacial till soil stratum, which underlies the site and consists of a mixture of sand, gravel, silt and clay. In all, 476 piles were driven to elevations between 32 and 42 ft, plant datum. (Elevation 100 ft, plant datum, corresponds to the northwest corner of the Chemical Process Cell foundation and is approximately ground level). Pile load tests and pile driving criteria developed by Dames & Moore are summarized in a report to Bechtel Corporation (Dames & Moore 1963b).

Soil conditions and site seismic criteria identified in Section 3.6 were used in both the original design and structural review evaluations for the Supernatant Treatment System (STS) facility.

3.7 Summary of Site Characteristics Impacting Safety Considerations

The following factors involve safety considerations and are accounted for by design criteria, including operating procedures, presented in Chapter 4.

Site Characteristics (Factors) Impacting Design	Consequence on Structures	Section Where Design Criteria Are Addressed
Snowfall	The principal design consequence of snowfall is additional loading on structures (particularly roofs)	(4.2.6)
Wind	The principal design consequence of winds is additional loading on structures.	(4.2.1)
Temperature	The principal design consequence with regard to temperatures is the requirement for freeze protection.	(4.2.10)
Precipitation	The principal design consequence with regard to precipitation relates to sizing of drainage structures.	(4.2.3)
Tornado	The principal design consequence with regard to tornados relates to perforation of confinement or collapse of structures	(4.2.2)
Earthquake	The principal design consequence with regard to earthquakes relates to the collapse of structures	(4.2.5)
Near Surface Groundwater	The principal design consequence with regard to near surface groundwater is hydrostatic loading on foundations and the potential for buoyant uplift of structures.	(4.2.9)

3.8 Validity of Existing Environmental Analyses

Environmental analyses for facilities within the scope of this SAR are contained in the following documents:

Main Plant/Fuel Receiving and Storage - Supplemental Analysis to the West Valley Final Environmental Impact Statement (U.S. Department of Energy January 1993)

Supernatant Treatment System/Sludge Mobilization and Wash System - *Revised Environmental Checklist for Tank 8D-2 PUREX Sludge Washing*

Liquid Waste Treatment System - WVDP-049, Environmental Evaluation for the Liquid Waste Treatment System

Cement Solidification System - WVDP-037, Environmental Evaluation for Operation of the Cement Solidification System

Drum Cell - DOE/EA-0295, Environmental Assessment for Disposal of Project Low-Level Waste West Valley Demonstration Project

Lag Storage - Environmental Checklist for Low-Level Waste Drum Supercompaction in an Addition to the Lag Storage Building and Environmental Checklist for Interim Size Reduction Facility in MSM Shop (Roberts, February, 1986); Revised Memo to File for Operation of Site-Wide Mixed and Low Level Radioactive Waste Storage System, Including Construction of Additional, Temporary Waste Storage Facilities (Roberts October 12, 1989)

Contact Size Reduction Facility - Environmental Checklist for Low-Level Waste Drum Supercompaction in an Addition to the Lag Storage Building and Environmental Checklist for Interim Size Reduction Facility in MSM Shop (Roberts February 24, 1986).

No significant discrepancies exist between the information provided in these documents and the information provided in this SAR.

REFERENCES FOR SECTION 3.0

Baker, A. Radford, April 9, 1993. Letter 0262:93:01, A. Radford Baker to B.A. Mazurowski, *Information Regarding Calspan's Ashford Experimental Operations.*

Boothroyd, J.C., B.S. Timson, L.A. Dunne. 1982. *Geomorphic Processes and Evolution of Buttermilk Valley and Selected Tributaries, West Valley, New York.* U.S. Nuclear Regulatory Commission Technical Report. NUREG/CR-2862.

Chadwick, G.H. 1920. *Large Fault in Western New York.* Geological Society of American Bulletin, 31: 117-120.

_____. 1932. *Linden Monocline, a Correction.* Geological Society of America Abstract, 43: 143.

Chiburis, E.F. 1981. *Seismicity, Recurrence Rates, and Regionalization of the Northeastern United States and Adjacent Southeastern Canada.* Weston, Massachusetts. Weston Observatory of Boston College, NUREG/CR-2309.

Coulter, H.W., Waldren, H.H., and Devine, J.F. 1973. *Seismic and Geologic Siting Considerations for Nuclear Power Facilities.* Fifth World Conference on Earthquake Engineering Paper No. 302, Rome, Italy.

Dames & Moore. 1963a. *Site Investigation, Proposed Plutonium Fuel Plant, West Valley, New York*: Prepared for Nuclear Fuel Services, Inc.

_____. 1963b. *Report of Consultation: Pile Load Tests and Pile Driving Criteria Spent Nuclear Fuel Reprocessing Plant, Springville, New York.* Nuclear Fuel Services, Inc.

_____. 1983. *Seismic Hazard Analysis — West Valley Demonstration Project.*

_____. 1992. *Seismic Hazard Analysis — West Valley Demonstration Project.*

_____. January 1995. *Evaluation of Ground Motion Hazard at the West Valley Demonstration Project (WVDP) Site, for West Valley Nuclear Services Company, Inc.*

Electric Power Research Institute. July 1986. *Seismic Hazard Methodology for the Central and Eastern United States*: Electric Power Research Institute Report NP-4726, Vols. 5 - 10.

_____. April 1989. *Probabilistic Seismic Hazard Evaluation at Nuclear Plant Sites in the Central and Eastern United States: Resolution of the Charleston Earthquake Issue*: Electric Power Research Institute Report NP 6395-D.

Fletcher, J.B., and L.R. Sykes. 1977. *Earthquakes Related to Hydraulic Mining and Natural Seismic Activity in Western New York State.* Journal of Geophysical Research, Vol. 82.

Herrmann, R.B. 1978. *A Seismological Study of Two, Attica, New York Earthquakes.* Bull. Seism. Soc. of Amer., Vol. 68, No. 3, p. 641-651.

REFERENCES FOR SECTION 3.0
(Continued)

Kappel, W.M., and W.E. Harding. 1987. *Surface Water Hydrology of the Western New York Nuclear Service Center Cattaraugus County, New York.* U.S. Geological Survey Water Resources Investigation Report 85-4309.

Kennedy, R.P. et al. 1990. *Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards*: LLNL Report UCRL-15910, June.

Krinitzsky, E.L. and F.K. Chang. December 7, 1977. *State-of-the-Art for Assessing Earthquake Hazards in the United States, Specifying Peak Motions for Design Earthquakes.* Misc. Paper S-73-1, Report 7, U.S. Army Engineers Waterways Exp. Station, CE, Vicksburg.

New York State Department of Transportation. 1993-1995. *Traffic Volume Reports.* Albany, New York.

Roberts, C.J. February 24, 1986. Environmental Checklist for Low-Level Waste Drum Supercompaction in an Addition to the Lag Storage Building and Environmental Checklist for Interim Size Reduction Facility in MSM Shop. Memo to Master Records Center (Memo HE:86:0021). West Valley, NY: West Valley Nuclear Services Co.

_____. October 12, 1989. Revised Memo to File for Operation of Site-Wide Mixed and Low Level Radioactive Waste Storage System, Including Construction of Additional, Temporary Waste Storage Facilities. Memo to Dr. W. W. Bixby (Memo FB:89:0241). West Valley, NY: West Valley Nuclear Services Co.

Sbar, M.L. and L.R. Sykes. 1973. *Contemporary Compressive Stress and Seismicity in Eastern North America*: An Example of Intra-Plate Tectonics. Geol. Soc. Amer. Bull., Vol. 84, No. 6, p 1861-1882.

Soil Conservation Service. 1983. *Technical Release 20 - Computer Program for Project Formulation Hydrology.* Version 3.40. Washington, D.C.

U.S. Army Corps of Engineers. 1982. *HEC-2 Water Surface Profiles Users Manual. Computer Program.* Updated February 1989. Davis, California.

U.S. Department of Energy. 1982. DOE/EIS-0081. *Final Environmental Impact Statement, Long-term Management of Liquid High-level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley.*

_____. 1986. DOE/EA-0295. *Environmental Assessment for Disposal of Project Low-level Waste.*

_____. 1992. DOE-STD-1024-92. *Guidelines for Use of Probabilistic Seismic Hazard Curves at Department of Energy Sites.* (Archived October 2001)

_____. January 1993. DOE/EIS-0081: *Supplemental Analysis to the West Valley Final Environmental Impact Statement.* Washington, D.C.

_____. July 1994. Change 2 April 2002. DOE-STD-3009-94. *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.*

REFERENCES FOR SECTION 3.0
(Concluded)

_____. October 1996. DOE-STD-3014-96, *Accident Analysis for Aircraft Crash into Hazardous Facilities*.

U.S. Nuclear Regulatory Commission. *Domestic Licensing of Production and Utilization Facilities*, 10 CFR 50.

West Valley Nuclear Services Co. WVDP-022: *WVDP Emergency Plan* (latest revision).

_____. WVDP-037: *Environmental Evaluation for Operation of the Cement Solidification System*. (latest revision).

_____. WVDP-049: *Environmental Evaluation for the Liquid Waste Treatment System*. (latest revision).

_____. WVDP-065: *Manual for Radiological Assessment of Environmental Releases at the WVDP*. (latest revision).

TABLE 3.1-1

LOCATIONS AND POPULATIONS OF TOWNS AND VILLAGES
PARTIALLY OR TOTALLY WITHIN 16 KILOMETERS OF THE SITE

TOWN/ VILLAGE[1]	DISTANCE/ DIRECTION (KM)	POPULATION				1970-1980 % CHANGE	1980-1990 % CHANGE	1990-2000 % CHANGE
		1970	1980	1990	2000			
Ashford (T)		1,577	1,922	2,162	2,223	21.9	12.5	2.82
Concord (T)	4.8N	7,573	8,171	8,387	8,526	7.9	2.6	1.66
Springville (V)[2]	5.6N	4,350	4,285	4,310	4,252	-1.5	0.6	-1.35
Sardinia (T)	6.4 NNE	2,505	2,792	2,667	2,692	11.5	-4.5	0.94
Yorkshire (T)	5.6 NNE	2,627	3,620	3,905	4,210	37.8	7.9	7.81
Delevan (V)[3]	14.4 ENE	994	1,113	1,214	1,089	12.0	9.1	-10.30
Machias (T)	6.4 ESE	1,749	2,058	2,338	2,482	17.7	13.6	6.16
Franklinville (T)	12.5 SSE	2,847	3,102	2,968	3,128	9.0	-4.3	5.39
Ellicottville (T)	7.7 S	1,779	1,677	1,607	1,738	-5.7	-4.2	8.15
Mansfield (T)	12.0 SSW	605	784	724	800	29.6	-7.7	10.50
East Otto (T)	4.8 SW	910	942	1,003	1,105	3.5	6.5	10.17
Otto (T)	12.0 WSW	731	828	777	831	13.3	-6.2	6.95
Collins (T)	12.0 WNW	6,400	5,037	6,020	8,307	-21.3	19.5	37.99
North Collins (T)	14.4 NW	4,090	3,791	3,502	3,376	-7.3	-7.6	-3.60
TOTAL ALL TOWNS		33,393	34,724	36,060	39,418	4.0	3.8	

[1] (T) indicates town and (V) indicates village.
[2] Springville village population is included in the town of Concord.
[3] Delevan village population is included on the town of Yorkshire.
Source: U.S. Department of Commerce, 1990 Census of Population and Housing, August 1991.

TABLE 3.6-1 (1 of 3)
HISTORICAL SEISMICITY WITHIN
480 km (300 mi) OF SITE

(Only events with MM intensity ≥ V are listed. Only events shown with a magnitude have an independently-determined magnitude.)

Date (yr/mth/day)		Longitude (°W)	Latitude (°N)	Intensity (MMI)	Magnitude (m_b)	Distance (km)
1737	1219	74.00	40.80	VII←		449.1
1776	0 0	81.90	39.60	VI	4.7	422.3
1783	1130	74.50	41.00	VI		401.7
1840	116	75.00	43.00	VI←		321.5
1840	910	79.90	43.20	V←		113.7
1840	1111	75.20	39.80	-VII←		433.1
1847	929	74.00	40.50	V←		464.9
1848	9 9	74.00	40.40	V		470.6
1853	312	75.50	43.70	VI←		302.3
1853	313	79.40	43.10	V←		74.9
1853	5 2	79.50	38.50	V		458.9
1855	1 3	77.50	39.20	V		392.8
1855	2 7	74.00	42.00	VI		407.7
1857	1023	78.60	43.20	VI←		68.7
1861	713	75.40	45.40	VII←		421.6
1867	1218	75.20	44.70	VI		381.2
1871	10 9	75.50	39.70	+VII←		424.4
1873	425	74.20	44.80	V		456.3
1873	7 6	79.50	43.00	VI←		73.6
1874	1211	73.80	40.90	V		459.5
1877	910	74.90	40.30	V		414.7
1877	1218	76.80	45.70	V		382.7
1878	10 4	74.00	41.50	V		420.4
1879	326	75.50	39.20	V		467.9
1884	531	75.50	40.60	V		354.6
1884	810	74.00	40.60	VII←		459.4
1885	1 3	77.50	39.20	V		392.8
1886	5 3	82.10	39.50	V	3.6	441.5
1889	3 8	76.00	40.00	V		371.9
1893	3 9	74.00	40.60	V		459.4
1895	9 1	74.80	40.70	VI		396.0
1900	4 9	81.90	41.40	VI←	4.7	291.9
1901	517	82.50	39.30	V	4.2	479.9
1903	1225	75.50	44.70	V		361.7
1906	627	81.60	41.40	V	4.2	269.8
1908	531	75.50	40.60	VI		354.6
1908	616	74.80	45.10	V		435.2

TABLE 3.6-1 (2 of 3)
HISTORICAL SEISMICITY WITHIN
480 km (300 mi) OF SITE

Date (yr/mth/day)		Longitude (°W)	Latitude (°N)	Intensity (MMI)	Magnitude (m_b)	Distance (km)
1909	4 2	78.00	39.40	V		361.5
1912	527	79.70	43.20	V←		100.6
1913	429	75.30	44.90	VI	4.4	388.8
1916	1 5	73.70	43.70	V		444.5
1916	2 2	74.00	42.90	V		403.6
1916	2 3	74.00	43.00	V		404.7
1916	11 2	73.70	43.30	V		434.4
1917	522	75.60	45.10	V		385.9
1918	410	78.40	38.70	V		434.2
1918	410	78.40	38.70	VI		434.2
1919	9 6	78.20	38.80	VI		424.8
1919	9 6	78.20	38.80	V		424.8
1921	126	75.00	40.00	V		429.8
1922	12 8	75.10	44.40	V		368.9
1923	1231	78.00	39.20	V		383.3
1924	715	76.50	45.70	V		394.4
1926	126	75.00	40.00	V		429.8
1926	512	73.90	40.90	V		451.9
1926	11 5	82.10	39.10	-VII←	4.0	476.9
1927	129	81.20	40.90	V		275.8
1927	6 1	74.00	40.30	-VII←		476.4
1928	318	74.30	44.50	VI	4.1	432.1
1928	9 9	82.00	41.50	V	4.2	294.6
1929	812	78.40	42.91	VII←	5.2	48.0 o
1929	12 2	78.30	42.80	V←		47.4 o
1931	420	73.79	43.47	-VII←	4.7	430.8
1931	610	84.00	41.30	V	4.2	459.0
1932	121	81.50	41.10	V	4.2	280.9
1933	125	74.70	40.20	V		434.8
1934	415	73.80	44.70	VI	4.5	479.5
1934	1029	80.20	42.00	V←		134.9
1935	11 1	79.05	46.87	VII←	6.2	474.4
1938	715	78.43	40.68	VI←	3.3	215.4 o
1938	823	74.34	40.10	V	3.9	465.5
1938	1118	75.30	44.80	V		381.7
1939	1115	75.05	39.58	V	4.0	459.5
1939	1126	76.60	39.50	V		390.4
1944	1 8	75.50	39.80	V		416.0
1944	9 5	74.72	44.96	VIII	5.8	430.7
1949	1016	74.90	45.49	V	4.0	457.9
1951	9 3	73.86	41.36	V	3.8	436.3
1952	620	82.02	39.64	VI	4.1	425.2
1952	825	74.50	43.00	V		363.1
1952	10 8	74.00	41.70	V		414.5
1953	327	73.50	41.10	V		474.3

TABLE 3.6-1 (3 of 3)
HISTORICAL SEISMICITY WITHIN
480 km (300 mi) OF SITE

Date (yr/mth/day)		Longitude (°W)	Latitude (°N)	Intensity (MMI)	Magnitude (m_b)	Distance (km)
1954	1 7	76.00	40.30	VI		346.7
1954	221	75.90	41.20	+VII←		288.5
1955	121	73.70	43.00	V		429.7
1955	526	81.70	41.50	V	3.8	272.0
1955	629	81.70	41.50	V	3.8	272.0
1955	816	78.30	42.90	V		53.5 o
1957	323	74.80	40.60	VI	4.8	402.0
1958	5 1	81.70	41.50	V	4.0	272.0
1961	222	83.40	41.20	V	4.2	415.6
1961	420	74.80	45.00	V	2.0	428.2
1961	915	75.50	40.80	V		341.2
1961	1227	74.80	40.50	V		408.3
1962	327	79.30	43.00	V←	3.0	61.0
1964	1 8	77.53	46.41	V	4.3	436.1
1964	329	74.90	44.90	V		414.7
1964	512	76.41	40.30	VI←	3.2	324.5
1964	1117	73.70	41.20	V		454.8
1966	1 1	78.25	42.84	VI←	4.6	53.2 o
1967	4 8	82.53	39.65	V	3.5	452.7
1967	613	78.23	42.84	VI←	4.4	54.7 o
1967	1122	73.80	41.20	V		446.9
1968	1210	74.82	39.92	V	3.0	446.9
1971	523	74.47	43.87	V	4.1	389.3
1972	211	75.60	39.70	V		419.0
1972	12 8	76.24	40.14	V	3.5	347.3
1973	228	75.44	39.77	V	3.8	421.9
1974	6 7	73.94	41.63	VI	2.9	421.3
1974	1020	81.61	39.06	V	3.8	458.1
1976	311	74.40	41.00	V	2.4	409.3
1976	413	74.00	40.80	VI	3.1	449.1
1977	210	75.50	39.80	VI	2.0	416.0
1977	3 9	83.50	41.00	V		432.1
1978	716	76.34	39.93	V	3.0	361.0
1978	10 6	76.10	40.10	VI	3.0	358.1
1980	820	83.10	42.10	V	3.3	364.6

Notes: ← Could have been felt at site

o Associated with Clarendon-Linden Structure

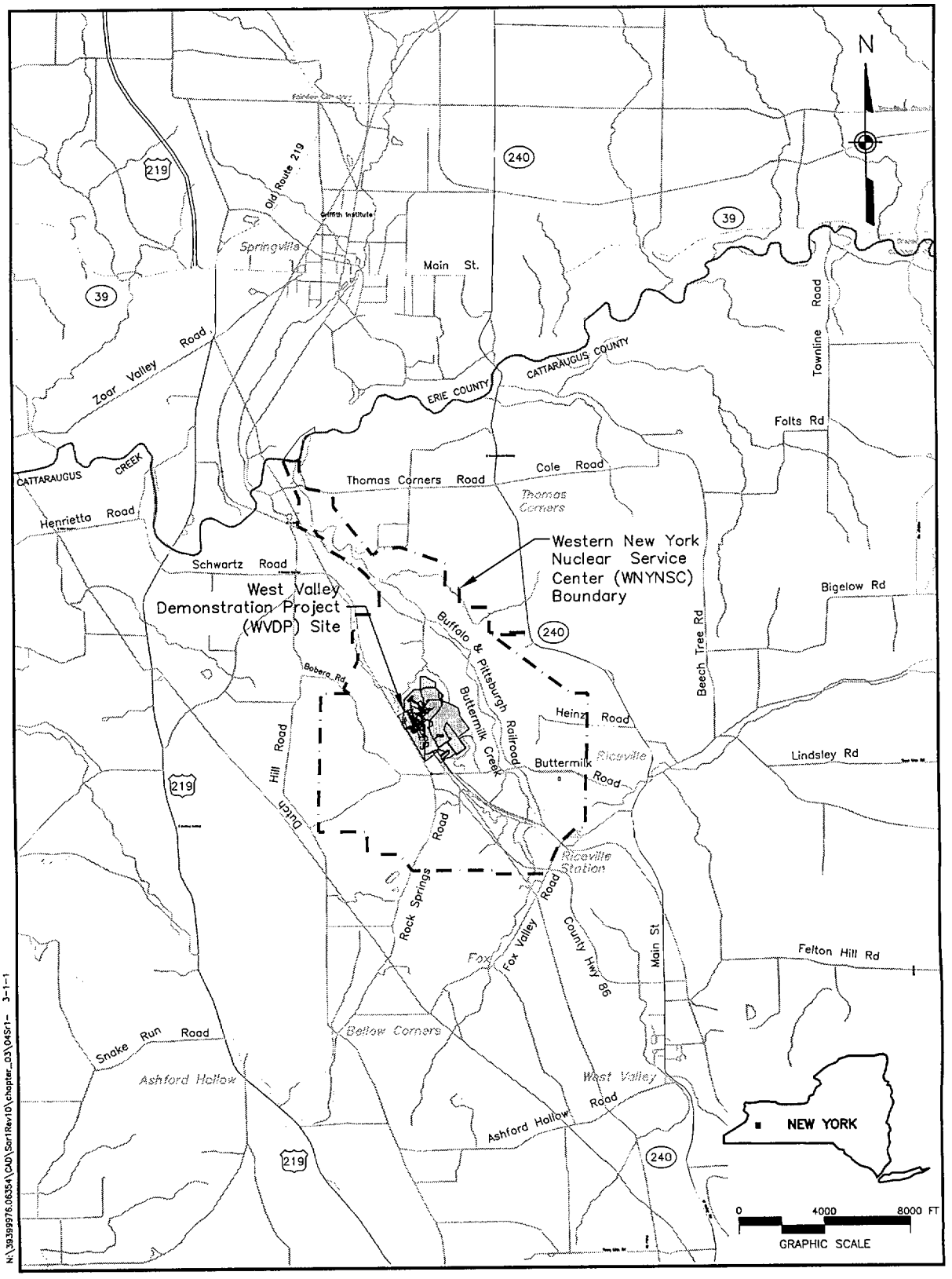
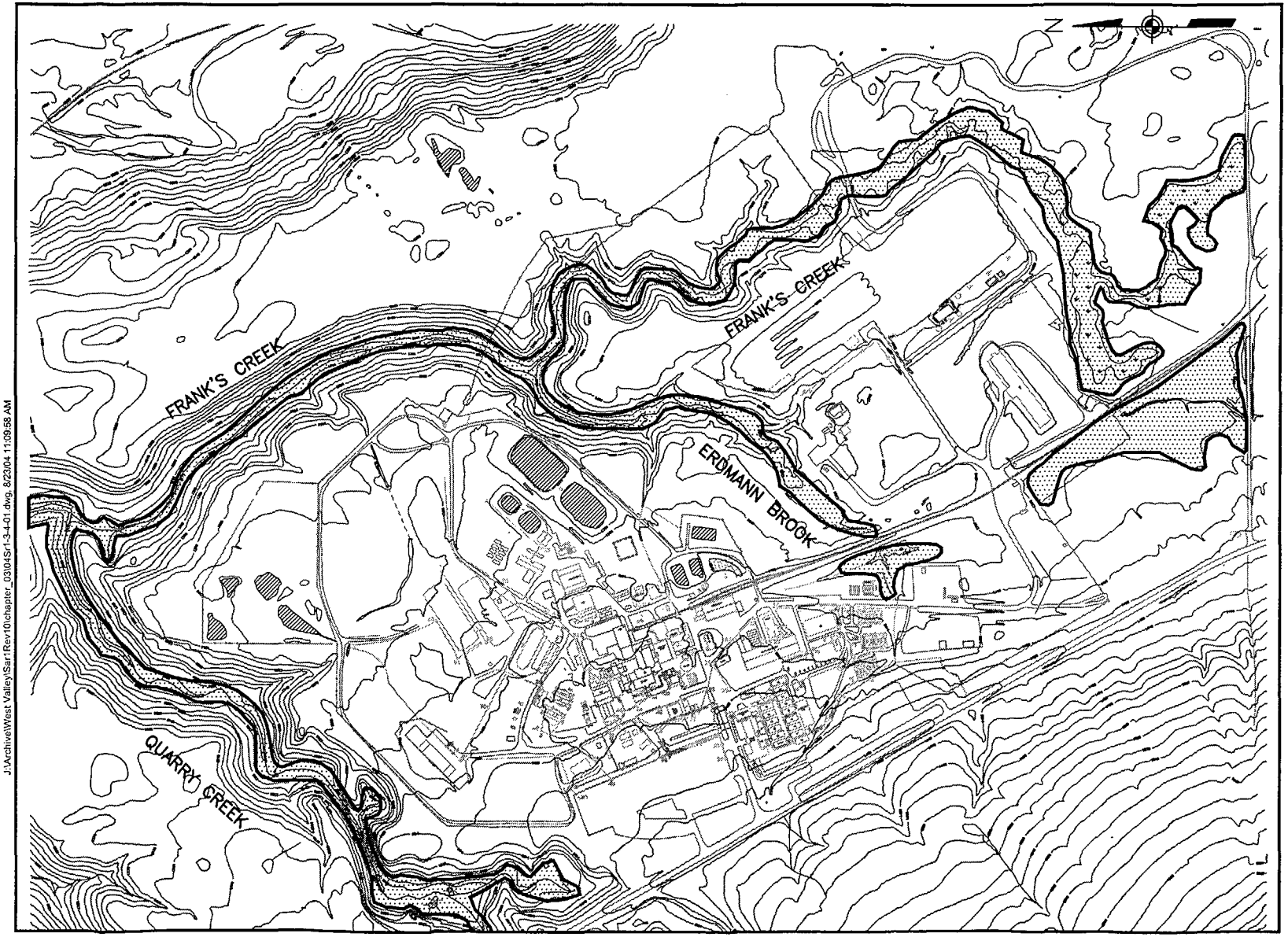


Figure 3.1-1 Location of West Valley Demonstration Project Site and Local Surrounding Area.



J:\Archive\West Valley\Sar\Rev10\chapter_03\04Sr1-3-4-01.dwg, 8/23/04 11:09:58 AM

Figure 3.4-1 100–Year Floodplain Map.

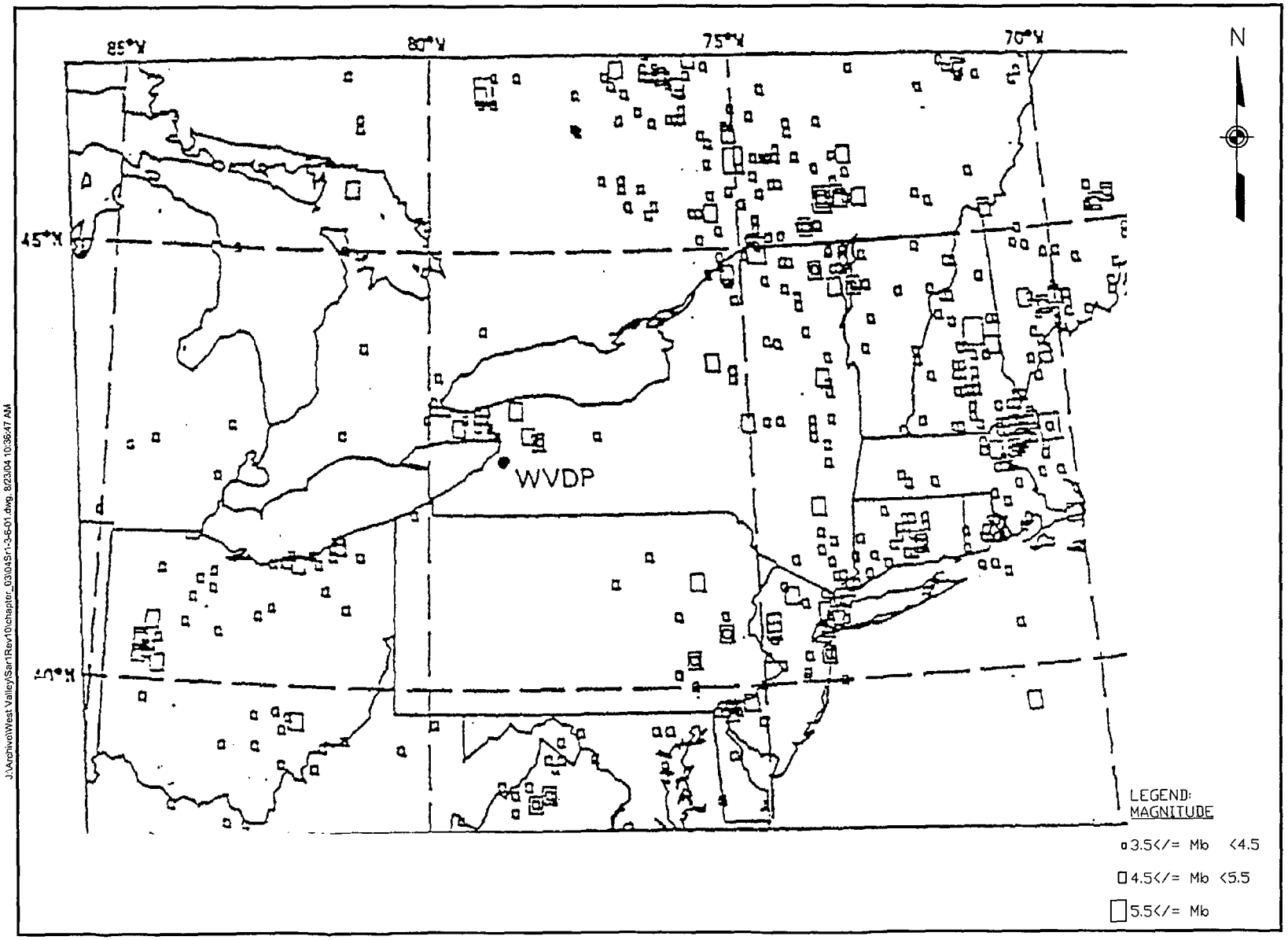


Figure 3.6-1 Seismicity In Northeastern United States.

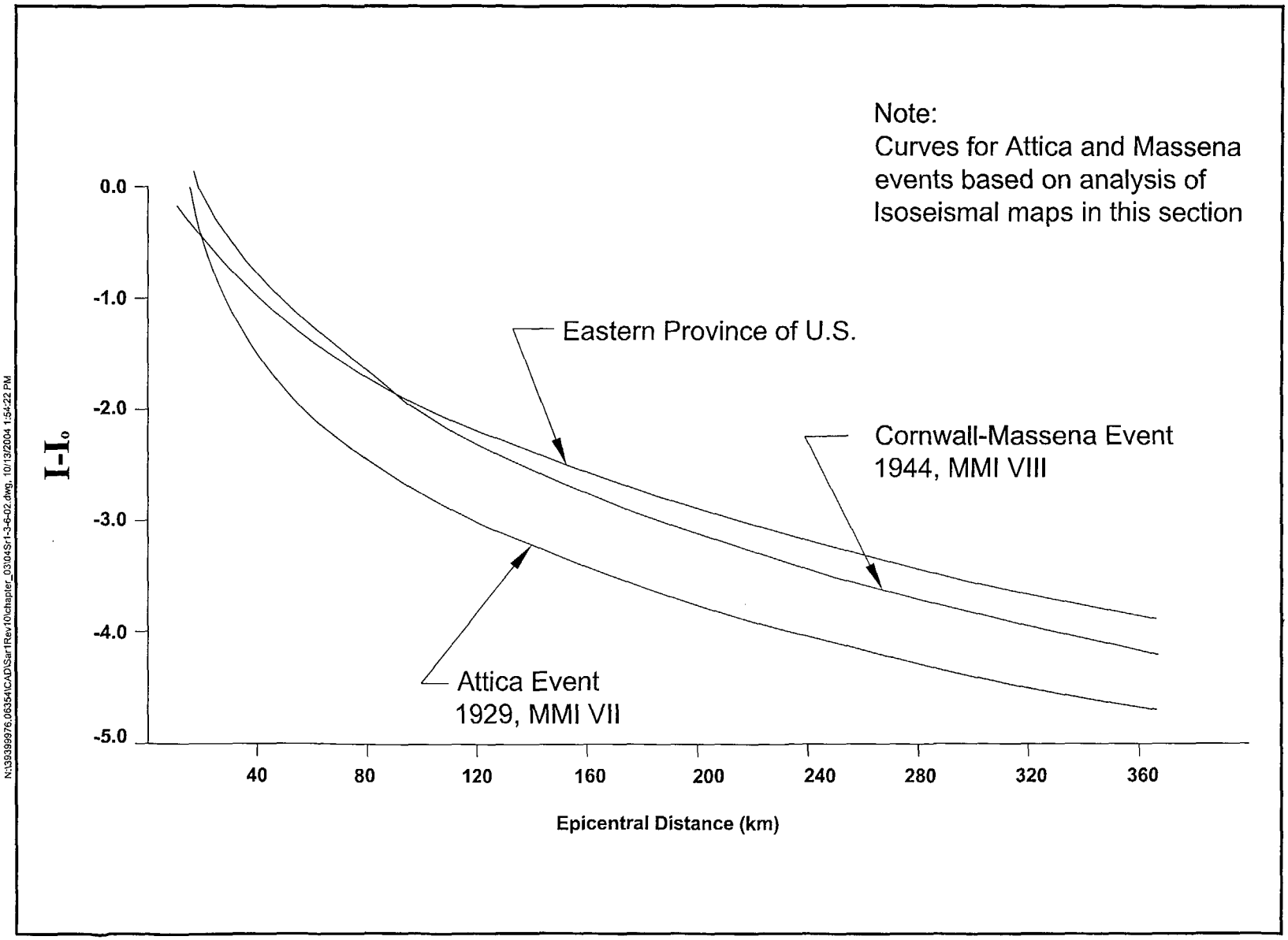
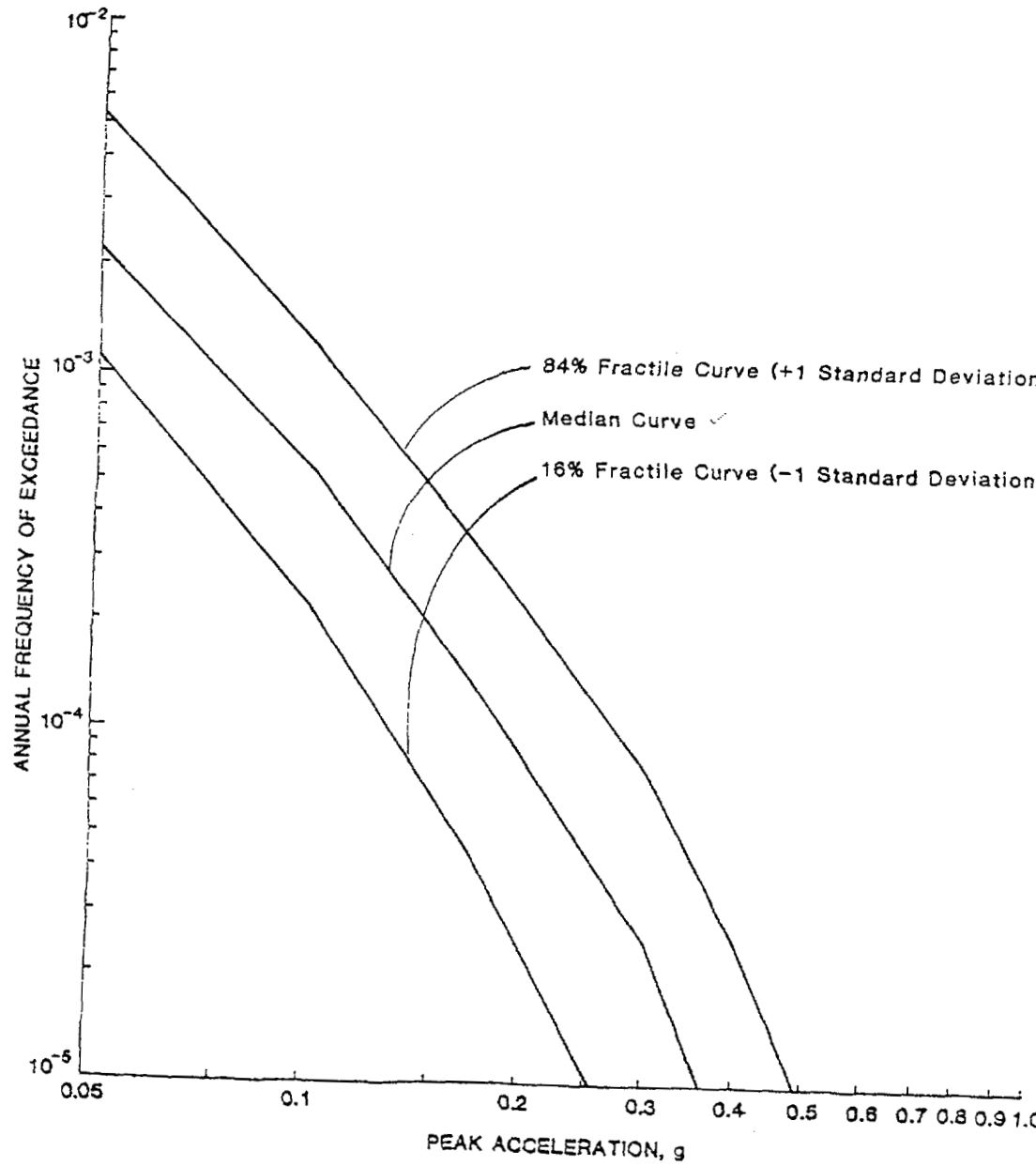


Figure 3.6-2 Comparison of General Eastern United States Attenuation With Data For Site Region.



J:\Archive\West Valley\Sar1\Rev10\chapter_03\04Sr1-3-6-03.dwg, 8/23/04 11:11:48 AM

Figure 3.6-3 Fractile Seismic Hazard Curves.

4.0 PRINCIPAL DESIGN CRITERIA

This chapter identifies and discusses the principal engineering design criteria and design bases for the WVDP structures, systems, and components (SSCs). Current design criteria for non-reactor nuclear facilities are specified in DOE Order 420.1A, *Facility Safety*. The DOE has produced several documents related to the design and safety analysis of non-reactor nuclear facilities and activities. The requirements and guidance contained in these documents, some of which are listed below, should be considered and applied as appropriate when designing new SSCs or making major modifications to existing SSCs at the WVDP.

- DOE Guide 420.1-1, dated 3-28-00, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide for Use with DOE Order 420.1, Facility Safety*.
- DOE Guide 420.1-2, dated 3-28-00, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities*.
- DOE-STD-1020-2002, dated January 2002, *Natural Phenomena Hazards* Design and Evaluation Criteria For Department of Energy Facilities.
- DOE-STD-1021-93, Change 1, dated January 1996, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*.
- DOE-STD-1022-94, Change 1, dated January 1996, *Natural Phenomena Hazards Characterization Criteria*.
- DOE-STD-1023-95, Change 1, dated January 1996, *Natural Phenomena Hazards Assessment Criteria*.
- DOE-STD-1024-92, Change 1, dated January 1996, *Guidelines for Use of Probabilistic Seismic Hazard Curves at Department of Energy Sites for Department of Energy Facilities* (Archived October 2001).
- DOE-STD-101-92, dated March 1992, *Compilation of Nuclear Safety Criteria with Potential Application to DOE Nonreactor Facilities* (Archived October 2001).
- DOE-HDBK-1132-99, dated April 1999, *Design Considerations*.
- DOE Order 460.1A, dated 10-2-96, *Packaging and Transportation Safety*.
- DOE Guide 460.1-1, dated 6-5-97, *Implementation Guide for Use with DOE Order 460.1A, Packaging and Transportation Safety*.
- DOE-STD-1027-92, Change 1, dated September 1997, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*.
- DOE-STD-3009-94, Change 2, dated April 2002, *Preparation Guide for U.S. Department of Energy Non-Reactor Nuclear Facility Documented Safety Analyses*.

DOE-STD-1020-2002 states the following regarding natural phenomena hazards (NPH) design-related requirements:

> There is an established hierarchy in the set of documents that specify NPH requirements. In this hierarchy, 10 CFR Part 830 (for nuclear facilities only) has the highest authority followed by DOE Order 420.1A and the associated Guides DOE G 420.1-1 and DOE G 420.1-2. The four NPH standards (DOE-STDS-1020, 1021, 1022, 1023) are the last set of documents in this hierarchy. In the event of conflicts in the information provided, the document of higher authority should be utilized (e.g., the definitions in the Guides should be utilized even though corresponding definitions are provided in the NPH standards).

The Western New York Nuclear Service Center (WNYNSC) was originally located at West Valley because the area is suitable in several ways for nuclear materials handling and disposal. Section 4.3 discusses the approach used in the design safety evaluation of the original WNYNSC facilities.

Due to the nature of the Project, a number of the Project facilities, such as the Main Plant and the HLW Tank Farm, predate the Project and the DOE's presence at the site. These facilities were constructed from 1963 through 1966 by Bechtel for the previous operator of the site, Nuclear Fuel Services, Inc. (NFS), according to Atomic Energy Commission (AEC) license CSF-1 and the various criteria in effect at that time, as documented in a U.S. AEC-approved Final Safety Analysis Report (FSAR) (Nuclear Fuel Services 1970). In as much as records handed down by NFS do not always provide complete criteria information, these facilities were initially inspected and are continually monitored to determine their adequacy to meet Project needs. In cases where pre-existing facilities may not meet current design criteria, but the facilities are judged adequate to meet the current Project objectives (based on its temporary nature), it has often been determined that it would not be cost-effective to replace or refurbish the facilities.

The West Valley Nuclear Services Company (WVNSCO) used the U.S. Department of Energy (DOE) Draft Order 6430.1, *General Design Criteria*, DOE-Idaho (ID), *Architectural Engineering Standards*, DOE Order 5481.1B, *Safety Analysis and Review System*, and ID-12044, *Operational Safety Design Criteria Manual*, as general guidelines to develop the WVDP principal design criteria.

The DOE Idaho Field Office (DOE-ID), DOE-West Valley Area Office (DOE-WV), and WVNSCO agreed (Bixby July 17, 1989) that DOE Order 6430.1A would not apply to existing facilities but would apply to new facilities and major modifications to existing facilities then in design or to be designed. The DOE Ohio Field Office (DOE-OH) subsequently concurred with the design basis (Hamric June 15, 1995).

WVNSCO was designing to the guidance of ID-12044 when DOE Order 6430.1A, dated April 6, 1989, was received for evaluation and implementation. The WVDP site status at that time was as follows: 1) the existing plant and the Integrated Radwaste Treatment System (IRTS) were operating; and 2) the basic designs and interfaces for the Vitrification System, Sludge Mobilization System (SMS) and Cold Chemical System (CCS) were complete.

The High-Level Waste Interim Storage (HLWIS) area uses an existing building and heating, ventilation, and air conditioning (HVAC) system that predate DOE Order 6430.1A, and hence the HLWIS area is considered an "existing facility." The Vitrification Load-In Facility has been designed to comply with the applicable requirements of DOE Order 6430.1A.

WVNSCO evaluated the principal design criteria documents listed above against DOE Order 6430.1A using a three-phased approach: 1) a review of DOE Order 6430.1A to determine what paragraphs were applicable to the WVDP site; 2) a complete review of DOE Order 6430.1A codes and standards to determine which were applicable to the WVDP; and 3) a review of every paragraph that contained the words environment, environmental, fire, health, safe, and/or safety.

The completion of these reviews established that the Vitrification System, SMS, CCS, and HLWIS area designs meet DOE Order 6430.1A, Section 7, *Policy and Objectives*, paragraph (4), "All Department facilities are to be designed and constructed to be reasonable and adequate for their intended purpose and

consistent with health, safety, security, and environmental protection requirements."

4.1 Integrated Radwaste Treatment System, Main Plant, Fuel Receiving and Storage Facility, and Vitrification Facility

The WVDP is located at the site of a former nuclear fuel reprocessing plant which was modified to house a HLW vitrification system (now inoperative) and ancillary waste treatment and storage systems. The Vitrification Cell is undergoing dismantlement.

The IRTS was designed to process supernatant and sludge wash solutions from Tank 8D-2. This was completed in 1995, resulting in 19,877 drums of solidified cement-based waste placed in the Drum Cell. In 2002 vitrification operations were completed and lay-up of HLW facilities, including the STS, Waste Tank Farm (WTF), and Vitrification Facility (VF) commenced. The LWTS remains in-service to support various site activities.

The Main Plant was designed for the reprocessing of commercial spent nuclear fuel (SNF). The original facility provided for the receipt and storage of SNF in the Fuel Receiving and Storage (FRS) facility; mechanical processing of fuel in the Head End Cells (HECs); chemical dissolution in the Chemical Process Cell (CPC) (which currently serves as the High-Level Waste Interim Storage Area); fission product separation and storage; and uranium and plutonium recovery and shipping.

The last of the SNF assemblies were shipped off-site in July 2003.

The purpose of the VF was to solidify the HLW that was stored in underground tanks at the WVDP site into a borosilicate glass waste form that is encased in stainless steel canisters.

4.1.1 Feed

The HLW vitrified at the WVDP site resulted from the reprocessing of about 640 metric tons (1.4E+06 lb) of nuclear reactor fuel from 1966 to 1972. The initial waste that was contained in Tanks 8D-2 and 8D-4. The dominant radionuclides present were cesium-137 (Cs-137) and its short-lived decay product barium-137m (Ba-137m) and strontium-90 (Sr-90) and its short-lived decay product yttrium-90 (Y-90). Analyses contained in RIR-364-001, *High-Level Waste Tanks 8D-1 and 8D-2 Radionuclide Inventory Report as of September 1, 2002,* provide recent information about activity in Tank 8D-2.

The largest volume of HLW (approximately 2,271 m^3 [600,000 gal]), produced from the reprocessing of the uranium fuel using the PUREX process, was highly acidic and was neutralized by the addition of sodium hydroxide before transferring it to Tank 8D-2 for storage. The neutralization process caused most of the radionuclides (with the exception of the Cs isotopes) to precipitate and form a layer of sludge on the bottom of Tank 8D-2 beneath the supernatant. The sludge layer was about 483 mm (19 in) in depth and was composed of oxides and hydroxides of iron, aluminum, manganese, chromium, uranium, and nickel.

Acidic THOREX waste resulted from reprocessing batches of thorium-uranium fuel using the THOREX process and produced an initial volume of approximately 31 m^3 (8,189 gal), which was stored in Tank 8D-4. The Tank 8D-4 waste consisted of about 71% (w/w) salts and 29% (w/w) water. The Tank 8D-4 waste was largely a single-phase liquid and was not neutralized because the thorium would have precipitated out of the solution.

4.1.1.1 HLW Pretreatment

The initial pretreatment of Tank 8D-2 supernatant was accomplished using the IRTS, which consisted of the STS, in which the cesium-laden supernatant flows through columns of zeolite to remove the cesium; the LWTS, an evaporative concentration process; the CSS, in which Low-Level Waste (LLW) was placed in steel drums and solidified in cement; and the Drum Storage Facility. The sludge in Tank 8D-2 was then washed to remove as much of the soluble material as possible. Water was added to Tank 8D-2, the sludge was mixed and allowed to settle and then the supernatant was processed through the IRTS. This step was repeated several times.

The supernatant sent to the IRTS was processed through ion removal columns designed to remove the cesium, plutonium, and strontium dissolved in the sludge wash solution.

After the Tank 8D-2 sludge washing was completed, the THOREX waste from Tank 8D-4 was transferred to Tank 8D-2 and neutralized. The neutralization was done in Tank 8D-2 because the tank has design features for removal of solids. The neutralized mixture of PUREX and THOREX wastes was then washed to remove as much soluble material as possible.

The final mixture of the contents of the three tanks was mobilized in Tank 8D-2 and transferred to the Concentrator Feed Make-up Tank (CFMT) in the VF for further processing. The description of the above process is addressed in Chapter 6 of this SAR.

4.1.1.2 Feed Preparation

The feed preparation cycle, took place in the CFMT, and consisted of those processes necessary to prepare the HLW, glass formers and chemicals, and other additives into an acceptable feed for introduction into the Slurry-Fed Ceramic Melter (SFCM) for vitrification. The cold chemicals and glass formers were prepared in the CCS and added to the CFMT to form an SFCM feed slurry. The vitrification mass balance (Nixon 1995) contains the chemical and radionuclide mass balance information for the vitrification campaign.

4.1.2 Products and By-Products

The initial product of IRTS low-level waste processing was solidified cement-based waste contained in 269-L (71-gal) steel drums. The solidified product meets the waste form criteria of 10 CFR Part 61, Sections 61.55 and 61.56, for low-level wastes. Table 4.1-1 summarizes the radioactive waste resulting from CSS operations, currently stored in the Radwaste Treatment System (RTS) Drum Cell.

Low-level liquid waste in the form of LWTS evaporator overheads is sent to the LLWTS for processing and release to the environment.

The VF produced a radioactive borosilicate glass waste form contained in stainless steel canisters. The canister dimensions are 610 mm (24 in) outside diameter by 3,000 mm (118 in) high and are filled to a minimum of 80% of their volume as required in *Waste Acceptance Product Specifications* (WAPS) established by the DOE Office of Environmental Restoration and Waste Management (U.S. Department of Energy 1993). Each canister contains approximately 1,900 kg (4,189 lb) of waste glass with a density of approximately 2.7 g/cm^3 (169 lb/ft^3) and a waste loading of about 15% (w/w) solids.

Table 4.1-2 provides information regarding the radionuclide content of a canister of the glass waste form. See WVDP-186, *Waste Qualification Report*, for detailed information about the canistered glass waste. Estimates have been completed for canister surface dose rates, thermal power generated by decay heat, neutron and photon source terms per canister, and the neutron multiplication factor (K-effective) for a typical product canister using these nominal canister content values (Yuan January 1994). The results of this analysis are presented in Table 4.1-3, along with corresponding maximum allowable limits from the WAPS. The table shows that the typical WVDP waste canister characteristics for the above-listed parameters are at least an order of magnitude below the maximum acceptable repository criteria established in the WAPS.

By-products resulting from maintenance and support activities in the Main Plant, VF, FRS, and IRTS include low-level radioactive liquid and solid wastes. By-products include radioactive or contaminated decontamination solutions, flush solutions, spent roughing and High-Efficiency Particulate Air (HEPA) filters, contaminated swipes, hardware, sample bottles and sample solutions, vessel off-gases, and miscellaneous trash. Handling and storage of these by-products are discussed in Chapter 7.

4.1.3 IRTS, Main Plant, FRS Facility, and VF Functions

Tanks 8D-1 and 8D-2, the STS, and the CSS have been placed in lay-up condition. Tanks 8D-3 and 8D-4 remain in-service to potentially support site activities. Liquids collected in Tanks 8D-3 and 8D-4 may be sent to the LWTS. Solutions generated by various site activities are concentrated in the LWTS by evaporation. Liquid low-level wastes in the form of LWTS evaporator overheads are sent to the LLWTS.

The Main Plant is currently used to house LWTS equipment and to provide interim storage for vitrified HLW produced by the VF. Many areas of the Main Plant have been placed in standby pending final decontamination and decommissioning. Use of Main Plant areas in support of the WVDP is discussed in Chapter 5.

Main Plant facilities and original NFS utility and ventilation systems provide contamination confinement and support for site activities. These facilities and support activities include:

- housing for the LWTS and High-Level Waste Interim Storage Area
- operations associated with the Analytical and Process Chemistry laboratory
- supply of utilities, including back-up electricity, utility and instrument air, steam, water (including utility water, demineralized water, potable water, and water supplies for fire protection), natural gas distribution, and wastewater treatment
- heating, ventilation, and cooling for habitable Main Plant spaces
- collection and handling of liquid wastes within the Main Plant
- confinement of contamination within cells in the Main Plant
- remote monitoring of 01-14 HVAC and Main Plant equipment in the Main Plant control room

The function of the VF was to solidify into a borosilicate glass form the HLW slurry that was contained in the HLW tanks. HLW vitrification operations no longer occur at the WVDP.

4.1.4 Facility Interfaces

4.1.4.1 IRTS and Main Plant Interfaces With the Vitrification Facility

Consistent with the mission of the WVDP, IRTS and Main Plant facilities have been used to the maximum extent possible. Consequently, interfaces exist between IRTS/Main Plant facilities and systems and vitrification-related structures and systems. These interfaces, which are discussed in Chapters 5, 6, and 7, include the following:

- Interim storage of vitrified HLW in the CPC (HLWIS)
- Ventilation support, including:
  - Main Plant Ventilation System
  - Main Plant Stack
- Utility support, including:
  - Fire Protection
  - Electrical Supply
  - Utility/Instrument Air
  - Steam
  - Cooling Water
- Routing of Vitrification Cell Sump and other non-routine waste waters back to Tank 8D-4 via the VF Waste Header
- Waste Management support, including:
  - Processing of low-level liquid wastes in the LLWTS
  - Processing of low-level liquid wastes in the IRTS
  - Solid radioactive waste interim storage
  - Hazardous waste storage
- Analytical chemistry support

4.1.4.2 FRS Interfaces with the Main Plant

The FRS was part of the original NFS facility and therefore maintains several interfaces with the Main Plant. Main Plant utilities, including demineralized water, electric, and steam are provided to the FRS for routine facility operating requirements such as lighting and equipment operation, and facility heating.

The FRS also maintains several interfaces with Main Plant ventilation systems. The FRS is serviced by three separate ventilation systems: the Main Plant Ventilation System, the Recirculation Ventilation system, and the FRS building ventilation exhaust system. Two of these systems interface with the Main Plant. Air from the original FRS water treatment system equipment is combined with air from the decontamination stall and is exhausted to the Main Plant ventilation washer via an 8-in diameter duct. The FRS building ventilation exhaust system exhausts 5,000-cfm from the FRS south aisle directly to the Main Plant stack via a blower located in the Main Plant Ventilation Exhaust Cell (VEC).

4.2 Structural and Mechanical Safety Criteria

The loads used for structural design and analysis include the following:

- Dead load (D)
- Live load (L)
- Thermal load (T_o)
- Internal pressure (P_o)
- Differential settlement (Δ)
- Soil pressure load (H_{static}, $H_{hydrostatic}$, $H_{dynamic}$)

- Snow load (S)
- Wind load (W)
- Tornado load (W_t)
- Seismic load (E_{DBE})

The basis for selecting specific values of these loads for design and analysis are discussed in subsequent sections.

At the time of the NFS plant construction (1963 through 1966), no specific standards had been established for nuclear fuel reprocessing facilities. The mechanical and structural aspects of the facility were designed by Bechtel using typical commercial hazardous chemical plant design criteria. The design criteria and design codes used in the original 1964 construction are discussed in the 1973 NFS SAR (NFS, 1973) and in various NRC evaluations under Docket No. 50-201.

For new construction, the design criteria and design basis loads have been selected based on the WVDP graded approach to the classification of SSCs. QM-2 discusses the process used in the selection of design criteria and design standards. QM-2 specifies the design codes and standards to be used in the design of SSCs.

Specific design criteria for the IRTS can be found in the design criteria documents listed below.

- WVNS-DC-013 *Supernatant Treatment System*
- WVNS-DC-046 *Sludge Mobilization Waste Removal System*
- WVNS-DC-025 *Liquid Waste Treatment System*
- WVNS-DC-020 *Cement Solidification System*
- WVNS-DC-037 *Radwaste Treatment System (RTS) Drum Cell*

A summary of the seismic analyses that have been performed for the former reprocessing building (i.e., Main Plant) is provided in Table 4.2-1. These analyses are discussed in Section 4.2.5.

The FRS Building was constructed as part of the original NFS facility, which was designed for NFS by Bechtel in 1963 as a conventional chemical process plant to conventional seismic standards. A summary of the seismic analyses that have been performed for the FRS is provided in Table 4.2-2. These analyses are discussed in Section 4.2.5. Structural design codes referenced by the Bechtel design specifications are given in Table 4.2-3.

For the VF, design criteria can be found in the design criteria documents listed below.

- WVNS-DC-022 - Vitrification of High-Level Wastes
- WVNS-DC-045 - Cold Chemical System
- WVNS-DC-048 - High-Level Waste Interim Storage System
- WVNS-DC-066 - Vitrification Load-In Facility

The structures and components in the VF originally fell into two different design categories based on their confinement requirements. They were confinement structures or nonconfinement structures. A structure required to confine radioactive or hazardous material during the vitrification campaign that could affect the health and safety of the public or site personnel was designed to withstand the effects of natural hazards and still perform its safety function(s) and confine the radioactive or hazardous material to acceptable levels. No VF structures are required to be seismically qualified.

VF structures that were not required to confine radioactive or hazardous material have been designed to the *New York State Code Manual for the State Building Construction Code*, and incorporated seismic considerations from the *Uniform Building Code (UBC)*. These structures are not required to survive extreme environmental loads (natural hazard phenomena) without loss of function. However, these structures should survive without collapse to satisfy minimum life safety requirements under less severe environmental loadings. These criteria apply to both new construction and to modifications to existing structures.

VF natural hazard phenomena include the following: Design Basis Earthquake (DBE), Design Basis Tornado (DBT), Design Wind Forces, Design Snow Loading, and Reference Design Flooding. The bases for these loads are provided in Section 5.2.1.2.

4.2.1 Wind Loadings

Historically, the design basis wind (DBW) has a fastest mile wind speed (or basic wind speed) of 145 kph (90 mph) and with gust factor included is 185 kph (115 mph). The design basis wind load on structures was calculated using the methods of ANSI A58.1 with exposure condition C and importance factor I=1.

The extreme winds are non-rotating such as those found in thunderstorm gust fronts and are often termed "straight" winds to distinguish them from tornado and hurricane winds. The straight wind speed of 145 kph (90 mph) corresponds to a return period of 1,000 years based on a Fisher-Tippett Type I extreme wind analysis (Simiu 1979; Fujita 1981; McDonald 1981) using historical data from the National Oceanic and Atmospheric Administration weather station at Buffalo, New York which is 35 miles NW of the site.

Facilities judged to present lesser hazards are designed using lower wind speeds. For example, the design fastest mile wind speed used for the office trailers is 119 kph (73 mph) which corresponds to the value specified by the NY State Building Code and by UBC.

Facility specific design wind loads can be found in the appropriate design criteria documents.

4.2.2 Tornado Loadings

The DBT has the following characteristics:

maximum windspeed	260 kph (160 mph)
rotational speed	180 kph (110 mph)
translational speed	80 kph (50 mph)
radius of maximum rotational wind	46 m (150 ft)
peak pressure differential	2.4 kPa (0.35 psi)
rate of pressure drop	1.0 kPa/sec (0.15 psi/sec)

The design basis tornado for the WVDP is established in Nicholas and Eagan (1983) and was selected based on an assessment of the frequency of occurrence using the work of Dames & Moore (July 27, 1972), Fujita (1981), McDonald (1981), and Murray (1981).

The maximum wind speed is taken as the sum of the translational and rotational components. The 260 kph (160 mph) maximum wind speed tornado corresponds to a one million year return period event. The 1,000,000 year return period value is more conservative than that stated (i.e., 2×10^{-5} /year) in currently archived DOE guidance. The 2×10^{-5}/year tornado would correspond to a maximum wind speed of only 80 kph (50 mph) which would be insufficient to generate any missiles.

Facility specific design basis tornado wind loadings can be found in the appropriate design criteria documents. The tornado load is a combination of wind pressure and atmospheric pressure drop. The tornado wind load on structures was calculated using the methods of ANSI A58.1 with exposure condition C and importance factor I=1.

4.2.3 Flood Design

The site is situated at an elevation which will not be affected by flooding of either Buttermilk Creek or Cattaraugus Creek as discussed in Chapter 3. Thus, no special considerations are required to design against flood. Site grading practices are employed to protect Project facilities from local flooding during heavy rains or snow melt and spring run-off.

4.2.4 Missile Protection

The DBT generated missiles considered during design efforts have had the following characteristics associated with them.

Missile	Weight	Cross Sectional Area	Horizontal Velocity*	Maximum Height Above Ground
Timber Plank 10 cm x 30 cm x 3.7 m long	63 kg (139 lb)	269 cm^2 (.29 ft^2)	136 kph (85 mph)	61 m (200 ft)
Steel Pipe 8 cm diameter x 3.1 m long	34.4 kg (76 lb)	14.4 cm^2** (.0155 ft^2)	80 kph (50 mph)	30 m (100 ft)

* Vertical velocities are taken as two-thirds the horizontal missile velocity. Horizontal and vertical velocities should not be combined vectorially.
** Value represents metal area.

McDonald (1981) forms the historical technical basis for the selection of the WVDP site DBT missiles. After reviewing lists of potential missiles, McDonald provided tornado generated missile parameters for wind speeds of 320, 400, 480 and 560 kph (200, 250, 300 and 350 mph). The four most likely missiles considered by McDonald were a 63 kg (139 lb) timber plank, a 34.4 kg (76 lb) steel pipe, a 676 kg (1,490 lb) utility pole and a 1814 kg (4,000 lb) automobile. The utility pole and the automobile would not be picked up or sustained by tornado wind speeds less than 320 kph (200 mph).

Murray (1981) reviewed the McDonald report and recommended a DBT wind speed of 260 kph (160 mph) based on an assessment of the probability of occurrence. Murray then recommended design basis missiles consistent with this maximum wind speed (which is lower than the range of values provided by McDonald). McDonald reviewed and concurred with these recommended design missile values.

Tornado missile barrier protection is incorporated into structures determined to require such protection. The barriers are considered to be in the direct path of a tornado borne missile and are designed against penetration and crushing effects. Facility-specific DBT generated missiles can be found in the appropriate design criteria documents.

4.2.5 Seismic Design

Historically, the DBE at the WVDP corresponds to a peak horizontal ground acceleration of 0.1g, with a vertical component of two-thirds the horizontal (i.e., 0.067g) and an annual recurrence frequency of 5E-04/year, consistent with the guidance of UCRL-15910 (Kennedy et al. June 1990) (which has been replaced by the guidance in various DOE standards). The DBE peak ground acceleration response spectra, anchored at 0.1g, was developed using the standard Design Response Spectra and associated damping values given in NRC Regulatory Guides 1.60, *Design Response Spectra for Seismic Design of Nuclear Power Plants,* and 1.61, *Damping Values for Seismic Design of Nuclear Power Plants*. This results in a DBE response spectra that conservatively envelopes the response spectra evaluated using the DOE Standard methodology over the entire range of frequencies.

The 0.1g DBE was established and accepted by DOE (Letter Hannum to Mairson, October 20, 1983) in accordance with DOE guidance in effect at the time and was based on well documented and reviewed seismic hazard studies completed for WVDP (Dames & Moore, 1983). More recent seismic hazard re-evaluations (WVNSCO, December 23, 1992; Dames & Moore, 1995) have confirmed the 0.1g peak horizontal ground acceleration DBE. Further discussion of the background and history of the many seismic hazard evaluations conducted since the original NFS plant design in the early 1960s are provided in Chapter 3.

Dames & Moore (1995) shows that for the important oscillator periods between 0.1 and 1.0 second, the annual probabilities of exceedance for the WVDP DBE are lower than 5×10^{-4}. Structures designed for the DBE are analyzed using dynamic analysis procedures and have been independently reviewed.

At the time of Main Plant and FRS construction (1963 through 1966), no specific seismic standards had been established for nuclear fuel reprocessing facilities. In lieu of these standards, the facility was designed to meet the requirements of the 1961 UBC Seismic Zone III specifications. The UBC is a static method of analysis appropriate for non-critical facilities.

The NY State Building Code with seismic loads determined using the UBC was used for the structural design of non-confinement structures. Facility specific design seismic loads can be found in the appropriate design criteria documents.

To assess the seismic safety of the then-dormant Nuclear Fuel Service reprocessing plant, structural investigations were undertaken by the Los Alamos Scientific Laboratory (LASL) and Lawrence Livermore Laboratory (LLL) in the mid to late 1970s at the request of the NRC (Murray, et al. 1977; Endebrock et all. March 1978). These studies were performed as independent analyses of an earlier assessment performed by the Chemical Plants Division of Dravo Corporation (1976) for NFS. The results of the LASL and LLL reports, which are summarized in Table 4.2-1, served as the basis for the NRC

conclusion that "earthquake occurrence at the site is infrequent, and even if one did occur, the building structure would remain standing after the earthquake and any likely winds would not remove any significant radioactivity from the cells of the structure" (U.S. Nuclear Regulatory Commission January 1982).

4.2.6 Snow Loading

Snow loads specified by modern standards for structural design are calculated as the product of a ground snow load and a snow load coefficient that transforms the ground load to a roof load. The ground snow load is dependent on the building site, and is determined from basic meteorological data.

The design ground snow load (ASCE,1990) is based on an analysis (Ellingwood, 1983) of data for 184 National Weather Service (NWS) "first-order" stations at which ground snow loads are measured. This data was supplemented by data at over 9000 other locations at which only snow depths were measured and snowpack densities estimated. Statistical analysis of the data shows that the maximum snow load can be represented by a log normal distribution. Using this distribution, the maximum snow loads for various probabilities of exceedance (or their inverse, return period) can be estimated.

Wilks & McKay (1994) report snowpack density relationships for 30 northeastern United States NWS first-order stations and provide maximum snow water equivalent contour maps for various return periods. An appropriate probability distribution was used to extrapolate the data beyond the current observational record to various return periods.

Forty-one years of direct snow load measurements are available for the NWS Buffalo station. The maximum snow water equivalent depths, interpolated from the maps and converted to loads, are in close agreement to the Ellingwood (1983) analysis.

The 2% probability of exceedance per year value is used as a basis for design by most building codes (e.g. ASCE,1990; NY State Building Code; Uniform Building Code). This corresponds to a site ground snow load of 1.91 kPa (40 lb/ft^2). Facility specific design snow loadings can be found in the appropriate design criteria documents. Design criteria WVNS-DC-022 (VF) and WVNS-DC-046 (HLWTS) specify 1.91 kPa (40 lb/ft^2) for the site snow load.

4.2.7 Process and Equipment Derived Loads

Process- and equipment-derived loads are divided into dead loads and live loads. Dead loads include the weight of SSCs. Live loads include floor and roof area loads, crane loads, lay down loads due to temporary placement of moveable equipment or SSCs, impact loads and other processing loads.

The parameters used to establish process and equipment loads for the Main Plant are not fully specified in the historical record of the site. Design considerations for new facilities and modifications to existing facilities will include all feasible load combinations, including process and equipment derived loads, in accordance with applicable building and design codes. Facility-specific design requirements for process and equipment derived loads can be found in the appropriate design criteria documents.

4.2.8 Combined Load Criteria

Parameters used to establish the combined load design for the original facility are not fully specified in the historical record.

Three groups of load combinations were used in the design:

a. Normal Operating Load Conditions - these are loads which are encountered during normal plant operations and shutdown and include dead, live, thermal, internal pressure and soil pressure loads.
b. Severe Environmental Load Conditions - these are loads that could infrequently be encountered during the plant life and include wind and snow.
c. Extreme Environmental Load Conditions - these are loads which are credible but are highly improbable and include tornado and earthquake.

Facility specific design load combinations can be found in the appropriate design criteria documents.

4.2.9 Subsurface Hydrostatic Loadings

Parameters used for the design of subsurface hydrostatic loading for the original facility are not fully specified in the historical record.

For new facilities, subsurface loadings due to soil and groundwater are developed using accepted engineering practices including rational analysis in accordance with established principles of soil mechanics. As indicated in Chapter 3, for design conservatism, the hydrostatic surface is assumed to be at ground level. This results in a maximum lateral and vertical (buoyant) loading.

Facility-specific design requirements for subsurface hydrostatic loadings can be found in the appropriate design criteria documents.

4.2.10 Temperature Design Loadings

Parameters used for the design of temperature loading for the original facility are not fully specified in the historical record. New SSCs are designed to withstand thermal loads due to expansion and/or contraction and thermal gradients due to severe environment temperatures.

The WVDP has a freeze protection program in place to prevent damage to existing equipment and facilities due to cold weather (WVDP-183, *WVDP Freeze Protection Plan*). Requirements for freeze protection are incorporated into new designs. Facilities are equipped with heating systems and are insulated to maintain inside temperatures above freezing. Main Plant and FRS facility foundations and buried utilities are placed below the frost line of 1 m (3 ft). Facility-specific design requirements for design temperature loadings can be found in the appropriate design criteria documents.

4.3 Safety Protection Systems

4.3.1 General

The WNYNSC was sited at West Valley because the area is suitable in several ways for nuclear materials handling and disposal. The population density around the site is low, yet access to the site via road and rail is good. The rolling terrain and high elevation provide good atmospheric dispersion, and the geology and hydrology were considered, at the time the site was selected,

to be compatible with near surface disposal of LLW. In particular, the relatively impermeable silty till underlying the site affords excellent protection of the groundwater from downward vertical migration of contaminated leachate. Special care must be exercised in design and operation of waste disposal systems to ensure that the integrity of this barrier is maintained.

All the newer facilities, designed since the Project began, have been built in accordance with specifications approved by the DOE. However, the DOE criteria continue to evolve. New facilities and major modifications and additions to existing facilities will comply, as appropriate, with DOE orders and other applicable regulations at the time of design approval.

The IRTS, Main Plant, VF, and FRS were designed for safe operation. Criticality control, confinement of radioactive contamination, and control of worker radiation exposure are the primary safety concerns. Specific safety protection systems are described in the following subsections.

4.3.2 Protection Through Defense-in-Depth

The design and operation of IRTS, Main Plant, VF, FRS, and waste management facilities provided defense-in-depth for public and worker safety during normal, off-normal, and accident conditions. Implementation of the defense-in-depth philosophy ensures that layers of defense are provided against the release of radiological and hazardous materials such that no one layer by itself is completely relied upon. The primary layers of defense are given below:

- passive confinement barriers
- waste form and inventory
- active confinement barriers
- alarms and monitors
- personnel training
- administrative planning and controls

Details of IRTS, Main Plant, VF, and FRS facility design and process operations are discussed in this Chapter and Chapters 5 and 6 of this SAR. Personnel training and administrative controls are discussed in Chapters 8, 10, 11, and 12. Elements of these design features and administrative controls, as they relate to defense-in-depth, are discussed below.

4.3.2.1 Passive Confinement Barriers

The primary safety concern in the IRTS, Main Plant, VF, and FRS is the confinement of radioactivity. Several features provide protection from the uncontrolled spread of contamination. Primary confinement for the LLW process stream in the Main Plant and IRTS is provided by tankage, process vessels, and piping. Secondary confinement is provided by cell linings and sumps, liner pans, and the concrete structures of the trenches, pump pits, tank vaults, and Main Plant cells. Typically, liners are constructed of stainless steel, cover the floor, and extend up the walls of the cells and pump pits. Liquids in cells accumulate in sumps and are transferred to tanks via jets or pumps.

The primary IRTS confinement barriers of highest reliability under earthquake and tornado loading are the reinforced concrete vaults and chambers that enclose the STS process vessels and piping. These buildings and tank vaults have been designed to higher structural safety standards than required for life safety by local building codes used in the design of industrial process plants in New York State. The radiological shielding requirements for these structures generally resulted in greater reserve strength than found in

conventional industrial plant building design. With a safety factor of approximately three, the connecting piping between the valve aisle, pipeway, and shield structure would be the most vulnerable in an earthquake. The inventory of liquid radioactive waste in the IRTS is limited by the size of the process vessels in the system. The LWTS evaporator feed tank 5D-15B is the largest vessel in the IRTS process with a volume of 57,000 L (15,000 gal). All tanks associated with the IRTS and Main Plant are located in the heavily shielded, monolithic cells of the Main Plant. This substantial passive barrier ensures that the limited quantities of liquid radioactive waste stored in the Main Plant are adequately isolated from the environment.

Secondary confinement for spills from underground equipment in the WTF is provided by the silty till. Water is maintained around the outside of the vaults to maintain a piezometric potential greater than the level that would exist if the entire contents of either Tank 8D-1 or 8D-2 were released to their respective vaults. The head on the outside of the vault would cause the leakage to be from the outside to the inside. The water on the outside of the vaults also keeps the silty till wet and highly impermeable (very low migration rates ~ 1E-8 cm/s) to water flow.

The margin of safety against failure of the steel tank and concrete vault, which serve as the first and second line of confinement barrier, is conservatively estimated at six times the design basis earthquake and more than ten times the design basis tornado. Thus, there is little potential for leakage of the remaining high-level radioactive liquid waste into the environment even under extreme environmental loading.

The margin of safety against potential vapor release to the environment from the HLW tanks is on the order of 0.5 to 1.5 times the design basis tornado and 1.5 to 4 times the design basis earthquake, assuming tank ventilation is nonoperational. The most vulnerable link in the systems is the flexible bellows connection that serves to accommodate lateral and vertical movements of the mobilization pump support structure above Tank 8D-2 and the tank access riser.

Confinement barriers for the radioactively contaminated wastes that were generated in the Submerged Water Filtration System have also been provided. Resin wastes from the treatment system were transferred to a polyethylene High-Integrity Container (HIC) located in the adjacent Radwaste Treatment Building. This container provides the primary barrier to release of this material. Concentric concrete and steel radiation shields around the HIC provide a second barrier to an unplanned release. The Radwaste Treatment Building has been provided with an 18-cm (7-in) high curb that completely surrounds the perimeter of the pad on which the storage container is located. This berm, and an associated sump, constitute a third confinement barrier. The metal structure of the Radwaste Treatment Building would afford some degree of confinement in the event of an airborne release of radioactive contamination.

Confinement for loaded resin contained in full HICs is provided by the High-Integrity Container itself and by the outer concrete storage containers (Surepaks) located in the north FRS yard.

WVNS-DC-022, *Design Criteria, Vitrification of High-Level Waste*, stipulates three primary design principles for the confinement of radioactive materials: 1) use sufficiently air-tight physical boundaries to keep contamination as close to the source as practical; 2) use multiple barriers, such as cells, walls, and double-wall piping; and 3) maintain pressure differentials between each confinement zone so that air flow travels from zones of lesser contamination potential to zones of greater contamination potential. The

method of confinement for a given substance depends on several factors such as the physical form, mobility, and degree of hazard associated with the substance.

The multiple barrier approach is also used externally to the Vitrification Cell. In the Sludge Mobilization and Transfer system, the pumps, vessels, and piping are the first barrier. The pumps and vessels are located in vaults and pits that are ventilated and can be drained. The piping between the wall of Pit 8Q-2 and the Vitrification Building is double-walled, except for where it passes through diversion Pit 8Q-5. Return piping from the Vitrification Building to HLW tank vaults is also double-walled. All of the subject double-walled piping is housed in a concrete trench.

Confinement and containment barriers are designed to limit potential releases of radioactive material in accordance with as-low-as-reasonably-achievable (ALARA) practices outlined in WVDP-010, *Radiological Controls Manual*. Although the barriers are identified as confinement barriers, no credit was taken for their mitigative features in the accident analyses presented in Chapter 9.

4.3.2.2 Waste Form and Inventory

The IRTS Drum Cell contains the solidified waste produced by the CSS. Although a significant quantity of radioactivity exists in the waste stored in the Drum Cell, this activity is tightly bound within the cement matrix of the qualified waste form received by the Drum Cell.

The vitrified waste/glass product is in canisters that are decontaminated and transferred to the HLWIS area. The primary confinement barrier is the glass matrix itself. The second barrier is the sealed stainless steel canister. Additional confinement barriers are provided by: 1) the HLWIS area, and 2) the Vitrification Building and Main Plant HVAC systems.

4.3.2.3 Active Confinement Barriers

Active confinement barriers in the IRTS and Main Plant have been designed to prevent the release of contamination during normal and off-normal conditions. The primary active confinement systems are building ventilation systems and vessel off-gas systems, which include the Main Plant Ventilation System, Head End Ventilation System, Vessel Off-Gas System, Permanent Ventilation System, 01-14 Ventilation System, and Contact Size-Reduction Facility Ventilation System. These systems ensure positive confinement of airborne radioactive material as discussed in Chapter 5.

VF process off-gas and potentially hazardous atmospheres of cells/rooms/areas are processed through equipment so that releases to the environment are below all applicable DOE, U.S. Environmental Protection Agency (EPA), and New York State Department of Environmental Conservation (NYSDEC) limits.

The VF Process Off-Gas system provides environmental atmospheric protection by removing radioactive particulates.

VF HVAC systems have three primary functions: to provide pressure differential and direction of air flow to aid in confinement, to environmentally protect the equipment and components, and to provide human comfort. The Vitrification Building has three differential pressure zones designed to direct the flow of air from the zone with the least potential for contamination to the zone with the greatest potential for contamination. The use of controlled zones is a common practice when handling or treating radioactive or hazardous material. Generically, Zone I consists of those areas that are expected to contain a

significant amount of airborne activity during normal operations. Zone II generally consists of those areas immediately surrounding Zone I that provide a buffer to Zone I and could contain airborne activity on a very infrequent basis. Zone III designates areas that are expected to remain free of any contamination, such as a main control room. The Vitrification Building HVAC system has chilled water and refrigerant systems, as well as steam and electrical heating systems to control the temperature and humidity to protect the equipment and components, and to provide human comfort.

4.3.2.4 Alarms and Monitors

Alarms and monitors have been employed throughout the IRTS, VF, and Main Plant to notify operations personnel of abnormal operating conditions. Ventilation systems have been provided with filter differential pressure and plenum pressure instrumentation as well as effluent monitoring equipment. These systems, which are discussed in Chapters 5, 6, and 8, have also been provided with alarms that annunciate in the appropriate control area.

Liquid releases in areas of the IRTS, Vitrification Cell, Cold Chemical Building, and Main Plant can be detected through the use of sump level instrumentation and alarms. The onset of conditions potentially resulting in liquid releases is detected through vessel level monitoring equipment. The pans associated with HLW Tanks 8D-1 and 8D-2 have also been provided with leak detection capabilities.

Monitoring and alarm systems for the Main Plant and VF can be supplied with standby power during periods when normal electrical power is interrupted. The capability for supplying standby power to the monitoring and alarm systems is tested quarterly per an approved procedure.

Continuous Air Monitors (CAMS) are placed at strategic locations throughout IRTS facilities, the Main Plant, the VF, and FRS to warn operators of elevated airborne contamination levels.

Additional discussion of alarms and monitors is presented in Chapter 8 of this SAR.

4.3.2.5 Personnel Training

Qualification standards and training requirements are established for all Main Plant, waste management, decontamination and decommissioning, and High-Level Waste Tank Farm (HLWTF) operations positions. Operators are qualified in accordance with documented performance-based training programs. Training includes responsibilities and actions during emergency situations. Periodic emergency drills are performed, with follow-up debriefing sessions, to gain experience and confidence and to ensure that personnel are ready to respond to accident situations.

4.3.2.6 Administrative Planning and Controls

Operations at the WVDP are conducted in accordance with a protocol that has been established both procedurally and through training. Operational and maintenance activities are controlled through the use of WVNSCO procedures that implement applicable DOE Orders.

WVNSCO systematically integrates safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment. This integration is accomplished by implementing an Integrated Safety Management System (ISMS), which is described in WVDP-310, *WVDP Safety Management System (SMS) Description*. The DOE has developed seven

guiding principles to provide the focus for implementing an ISMS. While these principles guide the implementation of an ISMS, five core functions define its make-up. These functions comprise a cycle of activities which, although different in detail, are the same for activities on a program or site level and a facility and work task level.

4.3.3 Protection by Equipment and Instrumentation Selection

In general, a fundamental concern is that the structural and/or operational features of equipment provide confinement of radioactive and hazardous materials if required. Beyond this first-order objective, ALARA principles apply. Where appropriate, in circumstances important to safety, the effects of design-basis accidents such as fires, explosions, and impacts involving natural phenomena are factored into design or selection. Equipment is selected for reliability, and where protection in depth is required, redundant systems are provided (using different motive forces when practical) to increase the likelihood of functional availability.

New equipment and instrumentation are procured in compliance with WVNSCO's Quality Assurance Program, which is described in Chapter 12. Existing equipment and instrumentation is inspected and tested commensurate with its intended use.

Because the IRTS is a remotely operated system, it has been designed for minimum personnel access and is heavily instrumented. Most controlled parameters have at least two sensors of dissimilar operating principles or an alternative instrument detection system that can be used in the event of failure of one sensor. Those variables that could affect the safety of operations have both an audible alarm and an illuminated face plate on an alarm panel. See Section 5.4.8 of this SAR for a discussion of site-wide communications and alarms.

The VF is provided with redundant operator stations in the control room, redundant process trains and fans for the process off-gas system, and redundant filter trains and fans in the HVAC systems. Normal electrical power is backed up with (1) uninterruptible power supplies for the instrumentation and controls, and (2) diesel generators to support confinement systems. Instrument air is backed up with high pressure bottled air to support operation of confinement-related equipment.

Sections 4.1.2 and 4.2.8 of WVNS-DC-022 specify the design criteria for remote maintenance and cell cranes. Section 4.1.2 of WVNS-DC-022 lists specific design criteria for features associated with maintenance in the Vitrification Cell. Section 4.1.2.1 of WVNS-DC-022 states "The basic plan for maintenance of the Vitrification System shall be remote removal and replacement. Systems and components in contaminated areas shall be designed to be either remotely maintainable in place, or remotely removable and replaceable." Systems and components associated with the VF and not located in the Vitrification Cell, Transfer Tunnel, EDR, and HLWIS area are generally accessible for hands-on maintenance. Though not formally invoked in the VF design documents, much of the guidance contained in UCRL-15673, *Human Factors Design Guidelines for Maintainability of Department of Energy Nuclear Facilities*, has been incorporated into the design and construction of the VF (Lawrence Livermore National Laboratory June 18, 1985).

Little to no maintenance is anticipated in the Transfer Trench. The need to perform hands-on maintenance or remote maintenance in the Transfer Trench is made on a case-by-case basis. WVNS-DC-046, *Design Criteria Sludge*

Mobilization Waste Removal System, provides remote maintenance and replacement design criteria for the Transfer Trench and associated hardware.

4.3.4 Nuclear Criticality Safety

Nuclear criticality safety has been established at the WVDP through implementation of WVDP-162, *WVDP Nuclear Criticality Safety Program Manual*, and WV-923, *Nuclear Criticality Safety*. These documents have been written to implement the requirements of DOE Order 420.1A, *Facility Safety*, and referenced ANSI/ANS nuclear criticality safety standards.

Nuclear criticality safety is addressed in Chapter 8 of this SAR.

4.3.5 Radiological Protection

Activities at the WVDP are performed in accordance with WVDP-010, which is based on occupational radiation protection requirements given in Title 10, Code of Federal Regulations, Part 835, *Occupational Radiation Protection*. Shielding (walls, windows, water, etc.), confinement SSCs, as well as administrative controls (procedures, training, etc.) are used as necessary to maintain radiation doses to occupationally exposed personnel ALARA. Personnel protective equipment (e.g., anti-Cs and respiratory protection) is worn when required by radiological conditions, as prescribed in WVDP-010. In addition, system decontamination and flushing may be performed when contact maintenance is required.

CAMs and area radiation monitors (ARMs) are provided and audibly alarm if set points are exceeded. The alarm set points for CAMs and ARMs are in accordance with guidance provided in WVDP-010.

4.3.5.1 Access Control

Area access in the IRTS, Main Plant, VF, FRS, and support facilities is dictated by the requirements of WVDP-010 and 10 CFR 835.

4.3.5.2 Shielding

Shielding from the major sources of radioactivity in the Main Plant and VF is provided primarily by massive concrete structures. It is expected that the integrity of shield structures will be maintained in the event of severe natural phenomena, as discussed in Section 4.2. In light of the structural ability of the shield walls to withstand tornado-induced missiles, it is reasonable to expect that integrity will also be maintained when subjected to explosion-induced missiles. Facility-specific shielding requirements for the IRTS are based on maximum concentrations of Cs-137 in the process stream as specified in the appropriate design criteria documents.

Routine operations in the Main Plant are primarily associated with analytical laboratory activities. Shielding required to attenuate radiation from high-activity sources during routine maintenance activities or non-routine operations activities such as filter changeouts is determined before work starts.

4.3.6 Fire and Explosion Protection

A comprehensive fire protection program based on the requirements of DOE Order 420.1A, *Facility Safety*, and NFPA-101, *Life Safety Code*, has been developed for the WVDP. The philosophy and requirements of this program are presented in WVDP-177, *WVDP Fire Protection Manual*. This manual establishes a formalized fire protection program governing the conduct of all activities at the WVDP to ensure that employees, the public, and the environment are protected from the effects of a fire. The WVDP Fire Protection Program establishes minimum requirements for ensuring compliance with the improved risk criteria as outlined in DOE Order 420.1A.

Fire Hazard Analyses (FHAs) have been conducted to comprehensively and qualitatively assess the fire risk within individual fire areas comprising the facilities on-site. A complete discussion of the FHA process and its requirements is given in WVDP-177. In addition, WVDP-178, *Pre-Fire Plan*, which describes the fire hazards and protection system(s) specific to each facility on the WVDP site, has been prepared. As with WVDP-177, the Pre-Fire Plan seeks to ensure that a safe environment is maintained to protect the health and safety of workers, the general public, and the environment, and to limit the extent of property damage caused by fire at the WVDP.

The WVDP Fire Protection Program has the following objectives:

- Minimize the potential for the occurrence of a fire.
- Ensure that fire does not cause an unacceptable on-site or off-site release of hazardous or radioactive material that will threaten the worker or public health and safety, or the environment.
- Establish requirements that will provide an acceptable degree of life safety from fire for WVDP personnel and the public.
- Ensure that process control and safety systems are not damaged by fire or related perils.
- Ensure that vital DOE Programs will not suffer unacceptable delays as a result of fire and its effects.
- Ensure that property damage from fire and related perils does not exceed an acceptable level.

The WVDP Fire Protection Program, which goes beyond the minimum requirements established by the National Fire Protection Association (NFPA), encompasses the defense-in-depth concept to ensure that a high level of fire protection is provided. The defense-in-depth concept incorporates the following attributes:

- Fire Resistive/Non-Combustible Construction
- Physical Compartmentalization and Separation
- Automatic Fire Suppression
- Automatic/Manual Fire Detection
- Manual Fire Fighting
- Fire Protection System Surveillance
- Fire Prevention Activities
- Administrative Controls
- Fire Protection Inspections
- Fire Protection Appraisals
- Training for Fire Awareness and Response

Various inspections, appraisals, and assessments are incorporated into the WVDP Fire Protection Program. These activities, which identify potential fire and explosive hazards and ensure that new and existing facilities and

activities maintain the level of fire protection required by DOE Orders, include the following:

- Fire protection appraisals of facilities, structures, and equipment are conducted in accordance with the scope and frequency established by DOE Order 420.1A. The guidelines for conducting these appraisals are listed in WVDP-177 and documented in WVDP-319, *Facility Fire Assessments*.
- As part of the WVDP Conduct of Operations program as implemented through WVDP-106, *West Valley Demonstration Project (WVDP) Conduct of Operations Manual,* routine facility inspections are carried out by line managers, supervisors, or cognizant engineers. These "walk your spaces" inspections include control and handling of flammables and combustibles, control and handling of ignition sources, identification of potential fire and explosive hazards, and general housekeeping practices.
- To ensure that activities (e.g., modifications or work practices) do not reduce the level of provided fire protection required per the DOE Orders, activities are reviewed for potential fire protection impact in accordance with EP-5-002, *Administration of Work Instruction Packages*. Fire protection reviews are also conducted on all new facilities and modifications to facilities as appropriate, per WVDP-114, *Engineering Procedures*. A documented design review program has been developed to ensure that designs, specifications, modifications, fire system acceptance test procedures, fire equipment procurement, and fire system testing/inspection/ maintenance procedures, are reviewed and/or approved per WVDP-114. This program includes a formal tracking system for comment resolution.

Ultimate responsibility for the WVDP Fire Protection Program rests with the Management and Operating (M&O) contractor, West Valley Nuclear Services Company. Management is responsible for executing the procedures in the program and for adhering to the requirements of the fire protection program for the facilities and/or operations under their jurisdiction. Responsibilities of the WVNSCO management and line organizations regarding the WVDP Fire Protection Program are listed in WVDP-177.

Combustible loading at the WVDP is controlled through procedures and requirements contained in WVDP-177. In compliance with applicable DOE Orders and NFPA codes, combustible materials are stored such that their accumulation does not present an increased risk to facilities or personnel or create a fire hazard. WVDP-177 contains guidance for minimizing and controlling the use of combustible materials and provides the design and operation requirements and responsibilities for hazardous material storage. The potential for a fire is kept low by minimizing the amount of combustible material. Electrical insulation is made of a fire-resistant material. The Vitrification Cell, Crane Maintenance Room, Transfer Tunnel, EDR, and HLWIS area contain essentially no combustible materials. Cellulosic (e.g., paper, wood, natural fibers) type materials are not stored within the process cells. Hence, the potential for a fire is considered to be minimal.

Facility inspections, which include control and handling of flammables and combustibles, are conducted on a schedule consistent with facility use. These inspections, whose findings are documented and reviewed, give facility managers a consistent method of documenting in-house fire safety inspections and corrective actions taken to resolve findings.

Section 5.3 of this SAR addresses fire protection systems.

4.3.7 Radioactive Waste Handling and Storage

Radioactive wastes in the IRTS, Main Plant, VF, FRS, and support facilities are handled per approved procedures. Liquid LLW meeting on-site specifications is handled in the LLWTS. Waste minimization is achieved at the WVDP by following principles outlined in the WVDP-087, *Waste Minimization Plan*. Solid radioactive wastes generated at the WVDP are stored in the Lag Storage Facilities discussed in Chapter 7.

The vitrification campaign produced 275 canisters of solidified HLW. These canisters are located in the HLWIS area for interim storage until shipped to a federal repository. Pertinent design criteria are provided in WVNS-DC-048, *Design Criteria, High-Level Waste Interim Storage System*.

4.3.8 Industrial and Chemical Safety

Bulk chemicals at the WVDP are received, stored, and handled per approved procedures. Administrative controls concerning industrial and chemical safety are found in WVDP-011, which is based on DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*. Consequences of accidents involving hazardous materials are discussed in Section 9.2. Cold chemical systems are discussed in Section 5.4.10. Hazardous material protection is addressed in Chapter 8.

Recognizing that major or even minor spills could result in hazards to WVDP personnel, the public, and the environment, the WVDP has implemented a spill prevention, control and countermeasures plan contained in WVDP-043, *WVDP Oil, Hazardous Substances, and Hazardous Wastes Spill Prevention, Control and Countermeasures Plan*. This operating plan reviews in detail release flow paths, sources, system design, and the containment of possible spills or releases as well as prevention, preparedness, response, and notification procedures.

WVDP-011 establishes the policies used to control chemical and industrial hazards for all West Valley operations. Safety is controlled by use of:

- Proper facility and equipment design,
- Proper protective clothing and equipment,
- Personnel training,
- Safe disposal practices,
- Operating procedures, and
- Industrial Work Permits.

Assisting in the control of industrial and chemical hazards are techniques prescribed in DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*. Good work practices are required for operations such as orderly shift turnover, required reading lists, facility surveillances and walk-downs, and use of logbooks. Routine operations are governed by formal procedures. An Industrial Work Permit (IWP) is required whenever non-routine handling operations, such as maintenance, are conducted on equipment with safety hazards. Lockout/tagout procedures are inherently used in conjunction with the IWP and craftsmen and operators are trained in the use of locks and tags.

4.4 Classification of Structures, Systems, and Components

DOE-STD-3009-94 defines the terms "safety-class SSCs" and "safety-significant SSCs." The accident analyses presented in Chapter 9 of this SAR demonstrate that there is no need for "safety-class SSCs" or "safety-significant" SSCs for facilities and activities within the scope of this SAR.

4.5 Decommissioning

The primary objectives of the WVDP, to solidify liquid HLW and provide interim storage while awaiting disposal, have been achieved. The facilities that were used by DOE to conduct the Project are to be decontaminated and decommissioned prior to being returned to the custody of New York State. Therefore, the topic of Decontamination and Decommissioning (D&D) is ingrained in the Project culture. Because of this, and the lessons learned from the Project's earlier D&D efforts (many of the Project's functional components are housed in the former reprocessing plant, in cells that required decontamination prior to use for Project activities), the design of new facilities and components is undertaken with the need for future D&D as a major consideration. Since this approach is consistent with ALARA and the need for day-to-day contamination control, with frequent application of remote handling methods, and with requirements for in-service maintenance, design objectives for future D&D are generally consistent with the requirements for current waste processing.

4.5.1 IRTS D&D

The IRTS has been designed in a manner that will facilitate eventual D&D. Specific design details include the following:

- System components (such as ion removal columns, pumps, and filters) installed in original HLW tanks have been designed to permit semi-remote removal and replacement.
- With the future reconnecting of the demineralization line, a series of spray nozzles installed in the Tank 8D-2 access sleeve can be used to flush a mobilization pump as it is removed from the tank.
- Components in accessible areas (valves and instruments) are subject to either contact maintenance or modular replacement following remote decontamination via flushing of vessels, equipment, and pipes.
- Pumps, valves, and associated piping connections are designed to minimize "collection pockets" for ease of decontamination, maintenance, and replacement.
- All components and lines are capable of handling a wide range of strong decontamination fluids.
- The material of construction is 300-series stainless steel to minimize incorporation of contamination into surfaces.
- Pump volutes are fitted with a volute flush line that allows flushing out the volute, impeller, and pump suction screen.
- Cell floors slope to sumps to allow for use of liquid decontamination solutions on the cell walls and exterior of vessels.
- Sumps are lined.

4.5.2 VF D&D

The VF was designed in accordance with the decommissioning policies of both 10 CFR Part 50, Appendix F, *Policy Relating to the Siting of Fuel Reprocessing Plants and Related Waste Management Facilities* and the guidance provided in DOE Order 6430.1 (Draft), *General Design Criteria*. These regulations require

the design to facilitate decontamination and removal of all significant radioactive wastes at the time the facility is permanently decommissioned.

Decontamination is also a requirement of the WVDP Act (U.S. Congress October 1, 1980), the Memorandum of Understanding (MOU), and the Cooperative Agreement. The MOU requires the DOE to D&D the nuclear facilities, at Project end, to criteria developed by the U.S. Nuclear Regulatory Commission (NRC). Decommissioning of the VF will be performed in accordance with both the NRC criteria and guidelines established in DOE Order 435.1, *Radioactive Waste Management*.

4.5.2.1 Design Philosophy

The decommissioning of any nuclear facility is controlled by the operational considerations of removing radioactive contamination and hazardous materials from the facility and treating and packaging them for disposal, as required by governing radioactive and hazardous material regulations. The VF systems and structures are designed for ease of facility D&D. This includes decontamination of the structures and equipment, and removal of sources of toxic, hazardous, and radioactive materials to acceptable levels or concentrations.

The VF design includes a decontamination process capability with a dedicated chemical makeup area, process piping, and remote handling equipment to perform the internal and external decontamination of process vessels and equipment. The design of the VF includes those D&D design features suggested in DOE Order 6430.1 (Draft), which are appropriate for a "Special" (as designated in the order) nonreactor nuclear facility. Examples of these provisions include:

- Location of exhaust filtration components of the ventilation systems at or near individual enclosures so as to minimize long runs of internally contaminated ductwork.
- Equipment, including effluent decontamination equipment, that precludes, to the extent practicable, the accumulation of radioactive or other hazardous materials in relatively inaccessible areas including curves and turns in piping and ductwork. Accessible, removable inspection covers are provided where feasible to allow visual inspection.
- Designs that ease cut-up, dismantling, removal, and packaging of contaminated equipment from the facility (e.g., removal and dismantling of gloveboxes, air filtration equipment, large tanks, vessels, equipment, and ductwork).
- Fully drainable piping systems that carry contaminated or potentially contaminated liquids.

The VF has remotely operated equipment that will aid in D&D activities. Systems and components in contaminated areas are designed to be either remotely maintainable in place, or remotely removable and replaceable. Components which may require relatively frequent routine preventive or corrective maintenance (e.g., valve packing replacement or valve stem lubrication) are located outside of Zone I areas to the maximum extent practicable.

All vessels are designed to be remotely washed down internally or filled with suitable decontaminating solution to accomplish decontamination of the internal surfaces. Piping from each vessel is provided to route the decontamination solutions to an appropriate liquid waste treatment and/or storage system.

The design provides capabilities for the receipt, storage, and makeup of decontamination chemicals and for the treatment, solidification, and packaging for disposal of radioactive chemical solutions.

4.5.2.2 Design Criteria for Decommissioning

WVNS-DC-022 establishes the criteria used to design the facility D&D features and equipment. This document requires the VF design to incorporate features that facilitate future decommissioning of the facility. The VF facilities and structures are designed in accordance with ANSI N300, *Design Criteria for Decommissioning of Nuclear Fuel Reprocessing Facilities.*

The VF systems and structures are designed to facilitate post solidification decontamination. This includes decontamination of the structure and equipment, and removal of sources of toxic, hazardous, and radioactive materials to acceptable levels or concentrations.

4.5.2.2.1 Process Cell Decontamination and Decommissioning

The Vitrification Cell is currently undergoing dismantlement. The equipment located in the vitrification process cells are highly contaminated and have radiation fields which are prohibitively high for direct personnel handling, until significant decontamination of the equipment exterior and interior surfaces is accomplished. Equipment installed in the VF includes features to minimize time required for decontamination efforts. Examples of these remaining relevant features are provided below:

- Cell floors are stainless steel lined. Cell walls are also stainless steel lined to the 37.5-m (123-ft) level. Surfaces not stainless steel lined are protected with Ameron 400 epoxy coatings to facilitate decontamination.
- Cell floors are sloped for drainage and include a means of emptying and decontaminating sump areas.
- A high pressure (i.e., approximately 6,895 kPag [1,000 psig]) water hose is provided in-cell to facilitate decontamination activities.

Remote operations are accomplished by use of the facility crane, impact wrench, or local overhead remote manipulators, and a Brokk (a mobile remote-operated, manipulator deployed from cell floor). Bails, lifting rigs, and grapples are provided to augment the basic crane capabilities.

Thus, the design inherently provides features and equipment that aid in accomplishing the final facility dismantling and decommissioning. Contaminated in-cell process equipment can be disassembled and removed from the cell using design features of the facility. Examples of these features are provided below:

- Equipment such as tanks, vessels, columns, and airlifts located in the shielded cell are designed to permit remote replacement. Space is provided for equipment removal with reasonable disassembly and removal of adjacent equipment.
- Shielded windows are provided for viewing of routine remote operations. Where viewing through a window is not feasible, closed-circuit TV with movable in-cell support assemblies is provided.
- All in-cell filter banks can be remotely changed.
- In-cell lights are remotely replaceable.
- Cell access is provided through ceiling hatches as far as practicable.

- Bridge cranes provide complete cell coverage.
- In-cell remote handling equipment is provided with redundant features and/or retrieval systems to facilitate recovery from failure.
- A shielded maintenance cell is provided for parking and decontaminating the crane, and hands-on maintenance. Hatches are provided in the roof of the room so that crane trolleys and components can be removed from the facility.

Rails are provided between the Vitrification Cell and EDR/HLWIS area for removal of equipment from the cell. The rail dimensions, location, and spacing match the existing rails in the HLWIS area and EDR cells. A transfer cart is provided for removal of components, vessels, and jumpers.

Equipment such as the melter, the turntable and canisters are capable of being removed through the EDR. An area is specifically designed for wall removal to provide egress in the EDR for removal of these large components. Access to the special opening is provided to the Melter and Turntable by the in-cell rail cart transfer system. Current dismantlement plans involve removing the melter, CFMT, and MFHT through the EDR to the Load-In Facility.

The Vessel Vent Header is "permanently" installed on a ledge where there is no access by either crane hooks or remote manipulators. Therefore, after the Vitrification Cell has been decontaminated and all equipment that can be remotely removed has been removed, the Vessel Vent Header will be removed. The Waste Header System can be remotely cut into manageable pieces at the expansion loops and remotely removed from the Vitrification Cell.

Radioactive ventilation systems, off-gas treatment systems, and HEPA filter housings are constructed of stainless steel and are designed to be decontaminated to levels acceptable for removal from the facility.

First stage roughing and primary filters on these systems are located as close to the inlet as possible to minimize the amount of contamination deposited on downstream ducting and filtering components. First stage filters are remotely changeable since this is where the majority of contamination in the ventilation system air will be captured.

Once the sources of high radiation are removed from the cell by remote means, the cell radiation fields will eventually be lowered to a point which will allow personnel entry to the cell. Final cell decontamination may be performed using manual cleanup methods in accordance with ALARA principles and under the provisions of industrial work permits and radiation work permits.

4.5.2.2.2 Decontamination Support Area

The CCS provided capability for the addition of decontamination chemicals to the vitrification process vessels. Operation of the system for this purpose would be performed by both hands-on chemical handling into the makeup vessels and remote (control room) control and monitoring of feed to the process vessels. An exhaust system is provided to remove chemical makeup vessel fumes and dust.

Process reagents and decontamination solutions such as acids, caustics, metal salt solutions, and oxidizing solutions would be prepared and used in the facility. Chemical handling would be in accordance with existing site and plant chemical standards. Adequate chemical receipt, storage, and makeup areas are provided as a part of the facility design.

4.5.2.3 Future Isolation of Radioactive Materials to Protect the Public

After completion of the WVDP decommissioning activities, operational control of the Project premises will revert back to the state of New York for continued monitoring and maintenance.

Solid radiological wastes will be generated during D&D activities. These wastes will consist of spent roughing and HEPA filters, equipment, piping, conduit, instrumentation, tools, contaminated clothing, and other miscellaneous wastes. These wastes will be decontaminated as appropriate, packaged, and disposed of in accordance with existing WVDP policies and procedures (e.g., WVDP-010).

The Project does not dispose of radiological waste on-site. Pending completion of the WVDP Waste Management Environmental Impact Statement (EIS), a decision will be made regarding off-site disposal of LLW and TRU currently stored on-site. Transuranic (TRU) waste will be stored on-site until it can be treated and/or shipped to a TRU waste storage or disposal facility. The Project will not dispose of TRU waste on-site. Project-generated, nonradioactive, nonhazardous solid wastes are disposed of off-site in a licensed sanitary landfill. HLW will be stored on-site until it can be shipped to an approved disposal (i.e., final repository) facility. Nonradioactive hazardous waste will be shipped to a licensed Resource Conservation and Recovery Act (RCRA) facility for treatment and final disposal.

4.6 Human Factors Engineering

All of the facilities addressed in this SAR, but particularly the VF, are designed to be comfortable and natural for humans to operate and maintain. Human factors have been considered in the positioning of equipment, switches, valves, and instruments, both from an operating and a maintenance viewpoint. The following are examples of how human factors engineering was incorporated into the design of the VF.

- Instrument readouts are located at an average eye elevation for ease of reading, and controls for such instruments are located to permit visual monitoring without large shifts of body position.
- Equipment is accessible for ease of operation and maintenance.
- Manipulators and viewing equipment are properly located for ease of remote operation.
- Equipment is designed for male and female operators.
- Operations that require special skills or attention have been minimized or automated.
- Audible and visual alarms are provided that warn operators in advance of exceeding process limits.
- Instrument failure warning lights are provided to avoid use of or reliance on incorrect indications.
- Communications systems are provided that allow for rapid reporting of abnormal conditions.
- Human factors considerations associated with system control, display devices, component arrangement, vibration, noise, lighting, emergency lighting, ventilation, temperature, humidity, human dimensions, protective equipment, warning and annunciator systems, and maintainability are incorporated into the VF control room design and layout.

REFERENCES FOR CHAPTER 4.0

American Concrete Institute. 1990. *Code Requirements for Nuclear Safety Related Concrete Structures.* ACI 349-90.

_____. 1980. *Building Code Requirements for Reinforced Concrete.* ACI 318-80. (Revised 1992.)

American National Standards Institute. 1975. *Design Criteria for Decommissioning of Nuclear Fuel Reprocessing Facilities.* ANSI N300. New York: American Institute of Chemical Engineers.

_____. 1992. *American National Standard for Respiratory Protection.* ANSI Z88.2-1992.

American Society of Civil Engineers. 1990. *Minimum Design Loads for Buildings and Other Structures*, ASCE 7-88 (Formerly ANSI A58.1).

American Society for Nondestructive Testing. December 1992. *Recommended Practice for Nondestructive Testing.* SNT-TC-1A.

Atomic Energy Act of 1954, as amended.

Bixby, W.W. July 17, 1989. Letter to R.A. Thomas. *DOE Order 6430.1A* DW:89:0365.

Blaw-Knox Chemical Plants, Inc. December 12, 1972. *Evaluation of the Fuel Receiving and Storage Structure for Tornado and Earthquake Forces.*

Dames & Moore. May 8, 1963. *Site Investigation: Proposed Spent Nuclear Fuel Reprocessing Plant Near Springville, New York, for Nuclear Fuel Services, Inc.*

_____. July 27, 1972. *Tornado Wind Damage Probability and Recurrence for West Valley, New York, for Nuclear Fuel Services Company, Inc.*

_____. 1983. *Seismic Hazard Analysis - West Valley Demonstration Project.*

_____. January 1995. *Evaluation of Ground Motion Hazard at the West Valley Demonstration Project (WVDP) Site, for West Valley Nuclear Services Company, Inc.*

_____. July 25, 1995. *Report - Seismic Integrity Review, Fuel Receiving and Storage Facility, West Valley, New York, for West Valley Nuclear Services Co., Inc.* W.E. Gates. Dames & Moore Job Number 19895-967-004.

Dravo Corporation. 1976. *Seismic Competence of the Existing Process Building at the West Valley Reprocessing Plant.* Chemical Plants Division Report No. 0476.0-15.

Duckworth, J.P. 1976. *Decommissioning Study Report, Nuclear Fuel Services, Inc.* West Valley New York.

REFERENCES FOR CHAPTER 4.0
(Continued)

Ellingwood, B., and R. Redfield. April 1983. *Ground Snow Loads For Structural Design*, Journal of the Structural Division, ASCE, Vol. 109, No. 4, pp 950 - 964.

Endebrock, E.G, R.J. Bartholomew, J.G. Bennett, R.I. Braiser, and W.F. Corcoran. March 1978. *Seismic Investigation of the Nuclear Fuel Services, Inc., Reprocessing Plant at West Valley, New York.* Los Alamos Report LA-7087-MS.

Fujita, T. Theodore. 1981. *Tornado and High Winds Hazards at Western New York State Nuclear Service Center.* West Valley, New York.

Gates, W. E. September 10, 1992. *Report - Wind, Tornado and Seismic Vulnerability Analysis of Reprocessing Plant Guyed Stack - West Valley Demonstration Project For West Valley Nuclear Services.* Dames & Moore Report to V. A. DesCamp, WVNSCO, Contract No. 19-53574-C-VS.

Hamric, J.P. June 15, 1995. Letter to T.J. Rowland. *WVNS-SAR-003, Revision 2, Draft D, Safety Analysis Report (SAR) for Vitrification Operations and High-Level Waste Interim Storage.* DW:95:0570.

Hannum, W.H. October 20, 1983. *Seismic Hazard Analysis* (DW:83:0555). Letter to R.C. Mairson. West Valley Nuclear Services Co., Inc.

Humphrey, R. A. June 20, 1991. Letter to T.J. Rowland. *Revised Responses to John C. Tuck memorandum on Approval and Terms requested during ESAARS meeting.* WD:91:0671.

International Commission on Radiological Protection (ICRP). 1977. *Recommendations of the ICRP.* ICRP Report 26.

International Conference of Building Officials. 1961 Edition. *Uniform Building Code.*

_____. 1988 Edition. *Uniform Building Code.*

Kennedy, R.P., S.A. Short, J.R. McDonald, M.W. McCann, Jr., R.C. Murray, and J.R. Hill. June 1990. *Design and Evaluation Guidelines for Department of Energy Facilities Subjected to Natural Phenomena Hazards.* LLNL Report UCRL-15910.

Lawrence Livermore National Laboratory. May 1978. *Structural Analysis of the Fuel Receiving Station at the Nuclear Fuel Reprocessing Plant, West Valley, New York.* UCRL-52575.

_____. June 18, 1985. *Human Factors Design Guidelines for Maintainability of Department of Energy Nuclear Facilities.* UCRL-15673. Prepared for U.S. Department of Energy.

McDonald, James R. July 1981. *Assessment of Tornado and Straight Wind Hazard Probabilities at the Western New York State Nuclear Service Center, West Valley, New York.*

Murray, R.C. October 1, 1981. *Natural Phenomena Hazard Studies and Recommended Design Criteria for the West Valley Site, Lawrence Livermore National Laboratory.*

REFERENCES FOR CHAPTER 4.0
(Continued)

Murray, R.C., T.A. Nelson, and A.M. Davito. May 1977. *Seismic Analysis of the Nuclear Fuel Services Reprocessing Plant at West Valley, N.Y.* LLNL Report UCRL-52266.

National Fire Protection Association. 1993. NFPA 70: *National Electrical Code.*

_____. 1994. *National Fire Protection Association Manual.*

_____. February 11, 1994. NFPA 101: *Code for Safety to Life from Fire in Buildings and Structures.* (See also *Life Safety Code Handbook.*)

New York State Code Manual for the State Building Construction Code. New York State.

Nicholas, G.W., and R.C. Eagan. January 1983. *Meteorological Program for West Valley Demonstration Project.* Dames & Moore. (See also Knabenschuh, J.L. February 10, 1993. WD:83:0074.)

Nixon, Justina. May 1, 1995. *Vitrification Mass Balance,* Rev. 8. Memo No. CC:95:0031. Letter to V.S. Arakali, et al. West Valley Nuclear Services Co. Inc.

Nuclear Fuel Services, Inc. 1964. *Final Safety Analysis Report: Spent Fuel Reprocessing Plant.* Nuclear Regulatory Commission Docket 50-201. West Valley, NY: Nuclear Fuel Services, Inc.

_____. 1970. *Safety Analysis, Spent Fuel Reprocessing Plant, AEC Docket No.50-201.* Revision 5. West Valley, NY: Nuclear Fuel Services, Inc.

_____. 1973. *Safety Analysis Report: NFS Reprocessing Plant, West Valley, New York.*

Riethmiller, G. Ellis. 1981. *History of Decontamination - Nuclear Fuel Service, Inc., West Valley, New York.*

SAI. December 1981. *Seismic Resistance Capacity Evaluation of Spent Fuel Storage Racks and Fuel.* SAI Report SAI-148-026. NUREG/CR-2236.

Simiu E., M.J. Cangery, J.L. Filliben. 1979. *Extreme Wind Speeds at 129 Stations in the Continental United States.* Science 118, National Bureau of Standards, pp. 314.

U.S. Congress. October 1, 1980. *West Valley Demonstration Project Act.* Public Law 96-368.

U.S. Department of Energy. 10 CFR 835: *Occupational Radiation Protection.*

_____. December 12, 1983. Draft DOE Order 6430.1: *General Design Criteria.* Washington, D.C.: U.S. Department of Energy.

_____. April 1985. ID-12044. *Operational Safety Design Criteria Manual.* Washington, D.C.: U.S. Department of Energy, Operational Safety Division. (See also Hannum, W.H. May 28, 1985. DW:85:0266.)

REFERENCES FOR CHAPTER 4.0
(Continued)

_____. September 23, 1986. DOE Order 5480.5: *Safety of Nuclear Facilities.* Washington, D.C.: U.S. Department of Energy.

_____. October 1986. DOE-ID: *Architectural Engineering Standards* (Rev. 7). Idaho Falls, Idaho: U.S. Department of Energy.

_____. May 19, 1987. DOE Order 5481.1B: *Safety Analysis & Review System.* Washington, D.C.: U.S. Department of Energy.

_____. April 6, 1989. DOE Order 6430.1A: *General Design Criteria Manual.* Washington, D.C.: U.S. Department of Energy.

_____. July 9, 1990. Change 1 (May 18, 1992). DOE Order 5480.19: *Conduct of Operations Requirements for DOE Facilities.* Washington, D.C.: U.S. Department of Energy.

_____. March 1992. DOE-STD-101-92, *Compilation of Nuclear Safety Criteria with Potential Application to DOE Nonreactor Facilities* (Archived October 2001).

_____. 1993. EM-WAPS, *Office of Environmental Restoration and Waste Management: Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms.* Rev. 0.

_____. July 1994. Change 1 (January 2000). DOE STD-3009-94. *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports.* Washington, D.C.: U.S. Department of Energy.

_____. Orders 5480 series: *Environmental Protection, Safety, and Health Protection Program for DOE.* Washington, D.C.: U.S. Department of Energy.

_____. November 15, 1994. DOE Order 5480.20A: *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities.* Washington, D.C.

_____. DOE Order 5481.1A: *Safety Analysis and Review System.* Washington, D.C.: U.S. Department of Energy.

_____. *Technical and Administrative Approach for the WVDP Safety Program.* DOE/NE/44139-20. Washington, D.C.: U.S. Department of Energy.

_____. May 20, 2002. DOE Order 420.1A: *Facility Safety.* Washington, D.C.

_____. January 1996. DOE-STD-1021-93, Change 1, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components.*

_____. January 1996. DOE-STD-1022-94, Change 1, *Natural Phenomena Hazards Characterization Criteria.*

_____. January 1996. DOE-STD-1023-95, Change 1, *Natural Phenomena Hazards Assessment Criteria.*

REFERENCES FOR CHAPTER 4.0
(Continued)

_____. January 1996. DOE-STD-1024-92, Change 1, *Guidelines for Use of Probabilistic Seismic Hazard Curves at Department of Energy Sites for Department of Energy Facilities* (Archived October 2001).

_____. October 2, 1996. DOE Order 460.1A, *Packaging and Transportation Safety.*

_____. June 5, 1997. DOE Guide 460.1-1, *Implementation Guide for Use with DOE Order 460.1A, Packaging and Transportation Safety.*

_____. September 1997. DOE-STD-1027-92, Change 1, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.*

_____. March 17, 1998. DOE Order 440.1A: *Worker Protection Management for DOE Federal and Contractor Employees.* Washington D.C.

_____. October 14, 1998. DOE Order 430.1A: *Life Cycle Asset Management.* Washington, D.C.

_____. April 1999. DOE-HDBK-1132-99, *Design Considerations.*

_____. July 9, 1999. DOE Order 435.1: *Radioactive Waste Management.* Washington, D.C.: U.S. Department of Energy.

_____. March 28, 2000. DOE Guide 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide for Use with DOE Order 420.1, Facility Safety.*

_____. March 28, 2000. DOE Guide 420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Nonnuclear Facilities.*

_____. January 1, 2001a. *Licensing Requirements for Land Disposal of Radioactive Waste.* Code of Federal Regulations Title 10, Part 61. Washington, D.C.

_____. January 1, 2001b. *Occupational Radiation Protection.* Code of Federal Regulations Title 10, Part 835. Washington, D.C.

_____. January 1, 2001c. *Nuclear Safety Management.* Code of Federal Regulations Title 10, Pt. 830. Washington, D.C.

_____. January 2002. DOE-STD-1020-2002. *Natural Phenomena Hazards Design and Evaluation Criteria For Department of Energy Facilities.* Washington D.C.

U.S. Department of Energy, Idaho Field Office. October 1986. *INEL Architectural Engineering Standards.* Idaho National Engineering Library. Rev. 6.

U.S. Department of Labor. *Occupational Safety and Health Standards,* 29 CFR 1910, as amended.

REFERENCES FOR CHAPTER 4.0
(Continued)

U.S. Nuclear Regulatory Commission. *Policy Relating to the Siting of Fuel Reprocessing Plants and Related Waste Management Facilities.* 10 CFR 50, Appendix F, as amended.

_____. Code of Federal Regulation. Title 10. Part 61, Section 55: *Licensing Requirements for Land Disposal of Radioactive Waste: Waste Classification.*

_____. Code of Federal Regulation. Title 10. Part 61, Section 56: *Licensing Requirements for Land Disposal of Radioactive Waste: Waste Characteristics.*

_____. 1973a. *Regulatory Guide 1.60, Design Response Spectra for Seismic Design of Nuclear Power Plants.*

_____. 1973b. *Regulatory Guide 1.61, Damping Values for Seismic Design of Nuclear Power Plants.*

_____. May 14, 1979. L.C. Rouse, Letter to NFS. Docket 50-201.

_____. January 1982. *Nuclear Regulatory Staff Safety Evaluation Report on the Dormant West Valley Reprocessing Facility.* Docket No. 50-201 May 14, 1979. L.C. Rouse, Letter to NFS. Docket 50-201.

West Valley Nuclear Services Co. EP-5-002, *Work Instruction Preparation.* (Latest Revision).

_____. RIR-364-001, *High-Level Waste Tanks 8D-1 and 8D-2 Radionuclide Inventory Report as of September 1, 2002.* Rev. 0.

_____. WV-365: *Preparation of WVDP Safety Documents.* (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WV-620: *Purchase Requisitions & Changes.* (Latest Revision).

_____. WV-905: *Radiological Protection and Nuclear Criticality Safety.* (Latest Revision).

_____. WV-906: *Safety Review Program.* (Latest Revision).

_____. WV-923: *Nuclear Criticality Safety.* (Latest Revision). West Valley Nuclear Services Co., Inc.

_____. WV-988: *Employee "Right-to-Know" Program-Hazard Communication.* (Latest Revision.) West Valley Nuclear Services Co., Inc.

_____. WVDP-002: *Quality Management Manual. QM-2: Quality Assurance Program.* (Latest Revision).

_____. WVDP-002: *Quality Management Manual. QM-3: Design Control.* (Latest Revision).

_____. WVDP-007: *Nuclear Material Control and Accountability Plan.* (Latest Revision).

_____. WVDP-010: *Radiological Controls Manual.* (Latest Revision).

REFERENCES FOR CHAPTER 4.0
(Continued)

_____. WVDP-011: *Industrial Hygiene and Safety Manual.* (Latest Revision).

_____. WVDP-022: *WVDP Emergency Plan Manual.* (Latest Revision).

_____. WVDP-043: *West Valley Demonstration Project: Oil, Hazardous Substances, and Hazardous Wastes Spill Prevention, Control, and Countermeasures Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-087: *WVDP Waste Minimization Plan.* (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-106: *West Valley Demonstration Project (WVDP) Conduct of Operations Manual.* (Latest Revision).

_____. WVDP-114: *WVNSCO Engineering Procedures.* (Latest Revision).

_____. WVDP-162: *Nuclear Criticality Safety Program Plan.* (Latest Revision).

_____. WVDP-177: *Fire Protection Manual.* (Latest Revision).

_____. WVDP-178: *Pre-Fire Plan.* (Latest Revision).

_____. WVDP-183: *WVDP Freeze Protection Plan.* (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-186: *Waste Qualification Report.* (Latest Revision).

_____. WVDP-218: *Process Safety Requirements.* (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-310: *WVDP Safety Management System (SMS) Description.* (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-319: *Facility Fire Assessments.* (Latest Revision).

_____. WVNS-DC-013: *Design Criteria Supernatant Treatment System.* (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-DC-020: *Design Criteria Cement Solidification System.* (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-DC-022: *Design Criteria, Vitrification of High-Level Wastes.* (Latest Revision).

_____. WVNS-DC-025: *Design Criteria Liquid Waste Treatment System.* (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

REFERENCES FOR CHAPTER 4.0
(Concluded)

_____. WVNS-DC-037: *Design Criteria Radwaste Treatment System (RTS) Drum Cell.* (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-DC-045: *Design Criteria, Cold Chemical System.* (Latest Revision.) West Valley Nuclear Services Co., Inc.

_____. WVNS-DC-046: Design Criteria, Sludge Mobilization Waste Removal System. (Latest Revision).

_____. WVNS-DC-048: *Design Criteria, High-Level Waste Interim Storage System.* (Latest Revision).

_____. WVNS-DC-066: *Design Criteria, Vitrification Load-In Facility.* (Latest Revision).

_____. WVNS-FHA-011, Addendum 2: *Fire Hazard Analysis Addendum - Main Process Plant* (Fuel Receiving and Storage). (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

_____. December 23, 1992. *Environmental Information Document, Volume II, Seismology.* WVDP-EIS-005.

Wilks, D.S., and M. McKay. November 1994. *Atlas of Extreme Snow Water Equivalent for the Northeastern United States*, Northeast Regional Climate Center, Publication No. RR 94-3, Cornell University, Ithaca, NY.

Yuan, Y.C. January 1994. *WVDP High-Level Waste Nuclear Characteristics: An Independent Study.* (See also Yuan, Y.C. January 31, 1994 D&M:OP:YCY:99:0001).

TABLE 4.1-1

WVDP LOW-LEVEL RADIOACTIVE WASTE SUMMARY

Processing Operation	Volume Processed (Thousand Liters)	Cesium-137 Activity Removed (Ci)	Zeolite Used (kg)	Cement Drums Produced	Cesium-137 Activity in Cement Waste (Ci)
PUREX Supernatant	2,340	5,300,000	45,100*	10,393	302
Sludge Wash #1	1,550	910,000	11,400	7,279	201
Sludge Wash #2	1,350	130,000	1,600	754	21
PUREX/THOREX Wash	1,190	300,000	4,900	1,451	46
Totals	6,430	6,640,000	65,600	19,877	570

* 2,600 kg from nonradioactive start-up testing

TABLE 4.1-2

REFERENCE RADIONUCLIDE CONTENT OF A CANISTER OF WVDP HLW (IN 1990)

Radionuclide	Nominal	Radioactivity (Ci) Range	
55-Fe	1.9E+0	1.7E+0	2.1E+0
59-Ni	3.2E-1	2.9E-1	3.6E-1
63-Ni	2.5E+1	2.3E+1	2.7E+1
60-Co	3.2E+0	2.8E+0	3.6E+0
79-Se	1.5E-2	1.3E-2	1.6E-2
90-Sr	2.7E+4	2.4E+4	3.0E+4
90-Y	2.7E+4	2.4E+4	3.0E+4
93-Zr	9.5E-1	8.5E-1	1.1E+0
93m-Nb	7.8E-1	7.0E-1	8.6E-1
99-Tc	6.7E+0	6.0E+0	7.4E+0
106-Ru	3.2E-2	2.9E-2	3.6E-2
106-Rh	3.2E-2	2.9E-2	3.6E-2
107-Pd	4.7E-3	4.2E-3	5.3E-3
125-Sb	8.4E+0	7.5E+0	9.3E+0
125m-Te	1.9E+0	1.7E+0	2.1E+0
126-Sn	1.6E-1	1.4E-1	1.8E-1
126m-Sb	1.6E-1	1.4E-1	1.8E-1
126-Sb	2.2E-1	2.0E-1	2.5E-1
134-Cs	1.5E+1	1.3E+1	1.6E+1
135-Cs	6.3E-1	5.6E-1	7.0E-1
137-Cs	2.9E+4	2.5E+4	3.2E+4
137m-Ba	2.7E+4	2.4E+4	3.0E+4
144-Ce	3.8E-3	3.4E-3	4.3E-3
144-Pr	3.8E-3	3.4E-3	4.3E-3
147-Pm	5.4E+2	5.0E+2	6.3E+2
151-Sm	8.1E+2	7.2E+2	9.0E+2
152-Eu	1.5E+0	1.3E+0	1.6E+0
154-Eu	4.0E+2	3.6E+2	4.5E+2
155-Eu	5.9E+1	5.3E+1	6.5E+1
232-Th	6.3E-3	4.7E-3	8.0E-3
233-U	3.8E-2	3.4E-2	4.2E-2
234-U	1.7E-2	1.6E-2	1.9E-2
235-U	3.9E-4	3.5E-4	4.4E-4
236-U	1.1E-3	9.9E-4	1.2E-3
238-U	3.1E-3	2.8E-3	3.5E-3
237-Np	4.3E-2	2.0E-2	6.9E-2
239-Np	9.4E+0	4.4E+0	1.5E+1
238-Pu	2.7E+1	2.4E+1	3.0E+1
239-Pu	6.8E+0	6.1E+0	7.6E+0
240-Pu	1.5E+1	8.7E+0	1.9E+1
241-Pu	3.0E+2	2.6E+2	3.3E+2
242-Pu	6.8E-3	6.0E-3	7.5E-3
241-Am	3.4E+2	1.7E+2	5.0E+2
242-Am	8.3E-2	3.8E-2	1.3E-1
242m-Am	8.3E-2	3.8E-2	1.3E-1
243-Am	9.4E+0	4.4E+0	1.5E+1
242-Cm	8.3E-2	3.8E-2	1.3E-1
243-Cm	6.2E-1	3.0E-1	1.0E+0
244-Cm	7.8E+1	3.7E+1	1.2E+2
245-Cm	3.9E-2	1.9E-2	6.3E-2
246-Cm	1.7E-2	8.0E-3	2.7E-2

Data from Eisenstatt 1986.

TABLE 4.1-3

COMPARISON OF CALCULATED VALUES FOR THE TYPICAL WVDP CANISTER TO WASTE ACCEPTANCE PRODUCT SPECIFICATIONS (WAPS)

	WAPS Maximum Allowable	WVDP HLW Canister in 1996	WVDP HLW Canister in 2015
Heat Generation Rate (watts)	1,500	290	186
Maximum Dose Rates (rem/hr)			
Gamma	100,000	4,000	2,600
Neutron	10	0.0074	0.0039
Neutron Multiplication Factor, K-eff.	0.9	<0.1	<0.1

TABLE 4.2-1

SUMMARY OF REPROCESSING BUILDING SEISMIC ANALYSIS RESULTS

Cell, Area or Structure	Acceleration Resulting in Onset of Failure	
	Los Alamos[1]	LLNL[2]
GPC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g. Onset of failure of below-grade sections at 0.09 g.
PMC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g.
CPC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g. Onset of failure of one wall at 0.15 g.
LWC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g. Onset of failure of below-grade sections at 0.17 g.
XC-1,-2,-3, and PPC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g.
ARC and OGC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g. Failure of concrete block sections at 0.07 g.
UPC	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g.
EDR	Lateral pile failure at 0.14 g. No other failure below 0.2 g	Lateral pile failure at 0.11g.
SRR	No failure below 0.2 g.	Lateral pile failure at 0.11g.
Anal. Cells	No failure below 0.2 g.	Not analyzed.
VWR	No failure below 0.2 g.	Not analyzed.
PMCR	Separation from PMC at 0.14 g	Not analyzed.

Notes:
- Onset of shear wall failure occurs between 0.03 g and 0.07 g[1].
- Main stack integrity maintained beyond 0.1 g[3].

[1] LASL, 1978
[2] LLNL, 1977
[3] Gates, 1992

TABLE 4.2-2

FUEL RECEIVING AND STORAGE FACILITY DESIGN CODES

Design Loads[1]	
Snow Load	40 psf on roof areas
Wind Load	100 mph wind
Earthquake	UBC Zone 3 (1961)
Construction Materials[1]	
Masonry Walls	Concrete block
Concrete Walls[2]	3,000 psi concrete
Reinforcing Steel[2]	60,000 psi (yield strength)
Structural Steel	ASTM A 36
Standard Bolts	ASTM A 307, Grade B

(1) - As cited by Bechtel in the design specifications for the original reprocessing plant.
(2) - Specific to the FRS.

5.0 FACILITY DESIGN

5.1 Summary Description

5.1.1 Location and Facility Layout

The Integrated Radwaste Treatment System (IRTS)/Main Plant, Fuel Receiving and Storage (FRS) facility, Vitrification Facility (VF), and associated support facilities are located within the Western New York Nuclear Service Center (WNYNSC). These facilities and their relationship to the WVDP are shown in Figure 5.1-1.

5.1.2 Principal Features

5.1.2.1 Site Boundary

The boundary of the WNYNSC is shown in Figure 3.1-1. This boundary encompasses approximately 3,345 acres (1,354 ha).

5.1.2.2 Property Protection Area

The Property Protection Area comprises approximately 220 acres (89 ha) located near the center of the WNYNSC. This area is enclosed by an eight-foot high chain-link fence topped with three strands of barbed wire. Nearly all the Project facilities are located within this area. This area is accessed through gates that are continuously manned by the Project Security Force.

5.1.2.3 Site Utility Supplies and Systems

Site utilities are located in and controlled from a Utility Room (UR) and a Utility Room Expansion (URE) adjacent to the Main Plant. The UR contains a variety of equipment including steam boilers, air compressors, a demineralizer unit, sand filters, a zeolite ion-exchanger, potable water tanks, and chemical feed tanks. The URE houses two steam boilers that supply steam to the Main Plant and other facilities on-site. Electrical feed to the UR is routed overhead from an on-site substation. Water to the site is provided from two manmade on-site reservoirs located approximately 1.3 km (0.8 mi) southwest of the plant. Water from the northernmost reservoir is pumped via a buried 20-cm (8-in) diameter pipe to the UR. The southern reservoir is maintained as a backup to the primary supply. Natural gas is provided by National Fuel Gas Co. and is routed to the site via a 15-cm (6-in) high pressure gas line. This feed is regulated and metered at the UR. The Main Plant cooling tower is approximately 50 m (160 ft) south of the UR and is shown on Figure 5.1-1. The Waste Water Treatment Facility (WWTF) is located approximately 50 m (160 ft) south of the cooling tower.

5.1.2.4 Surface Impoundments and Storage Tanks

The locations of select surface impoundments are shown in Figure 5.1-1. Primary surface impoundments at the WVDP include the Low-Level Waste Treatment System (LLWTS) lagoons and a nonradiological storage basin. A summary of surface impoundments and outside storage tanks at the WVDP is given in Table 5.1-1.

5.1.2.5 Atmospheric Release Points

The Main Plant off-gas and ventilation stack is located on top of the Main Plant Building and is the primary discharge point for airborne releases from the WVDP. Ventilation discharge for the Permanent Ventilation System (PVS) and 01-14 Ventilation System are two stacks atop the PVS Building and 01-14

building, respectively. Other smaller stacks are associated with existing facility operations: the Laundry Building, Container Sorting and Packaging Facility (CSPF), Environmental Laboratory fumehoods, and the Low-Level Waste Treatment Replacement Facility (LLW2). Ventilation exhaust for the Contact Size-reduction Facility (CSRF) ventilation system is to a stack mounted on the Main Plant Building. Exhaust from the Heating, Ventilating, and Air Conditioning (HVAC) System that services the Vitrification Building is via a relatively small stack on top the Vitrification Building.

5.2 Structures, Systems, and Components (SSCs)

5.2.1 VF Overview and Design Criteria, Codes, and Standards

The Vitrification Project is complete but was composed of different types of structures primarily because of different radiological confinement functional requirements. However, since the cell is being dismantled and the source term has been greatly reduced these confinement functions are no longer required to meet accident release limits. (The inventory in the VF is less than 0.5% of the original inventory.)

The Vitrification Cell and Transfer Tunnel were built to mate with the High-Level Waste Interim Storage (HLWIS). Structures such as the HLWIS area are not required to withstand the Design Basis Earthquake (DBE), since their failure would not result in significant environmental releases. For this reason, the Transfer Tunnel is designed and built to be seismically "decoupled" from the EDR and HLWIS area (Gates, January 25, 1994).

The VF was designed to utilize both newly constructed structures and existing structures of the original fuel reprocessing plant. Existing plant structures were modified to serve as the interim storage and loadout areas for the finished borosilicate glass product within the stainless steel canisters. These structures were designed originally to building codes that have now been superseded. All modifications to these structures are designed to meet current building codes. These original structures include the following:

- Equipment Decontamination Room (EDR)
- Chemical Process Cell (CPC)
- CMR
- 01-14 Building.

There exists a 76-mm (3-in) seismic separation joint between the EDR (old plant) and the new structures. The seismic joint is designed and provided with shielding to prevent radiation shine paths during normal operations and to accommodate out-of-phase motion between these structures. The 76-mm (3-in) separation joint has been filled with sheets of closed-cell, cross linked, polyethylene (Rodofoam II) that is highly resistant to radiation and chemical attack; will not absorb water and hence cannot freeze or thaw; and has no observable deterioration in physical properties with age, such as stiffening. It has been successfully used as a seismic joint fill material on nuclear power plants for 25 years.

Building structures, which were not required as engineered confinement barriers for the processing of high-level waste (HLW), have been designed as conventional structures. These structures are, thus, not required to survive extreme environmental loads (natural phenomena hazards) without loss of function. However, these structures should survive without collapse to satisfy minimum life safety requirements under less severe environmental loadings. These structures include:

- Sheet metal building surrounding the Vitrification Cell
- Cold Chemical Building
- Diesel Fuel Storage Tank Building
- New Portion of 01-14 Building
- Load-In Building

Figure 5.2-1 illustrates the sheet metal enclosures and exterior special doors associated with the Vitrification Building and the Cold Chemical Building.

Liquid spills are contained by the stainless steel-lined pit and sumps within the reinforced concrete walls and floor of the Vitrification Cell.

5.2.1.1 Basis For Design

The basis for design of key confinement structures is found in design criteria WVNS-DC-022, *Design Criteria, Vitrification of High-Level Waste*. This document derived site-specific design basis events from the VF Preliminary Safety Analysis Report. Table 5.2-1 shows specific design codes and standards used for VF confinement barriers. Table 5.2-2 shows the governing engineering codes and standards used in the confinement barriers' general design.

5.2.1.2 Design Basis Loads

The loads used for structural design and analysis included the following:

- Dead load (D)
- Live load (L)
- Thermal load (T_o)
- Internal pressure (P_o)
- Differential settlement (Δ)
- Snow load (S)
- Soil pressure load (H_{static}, $H_{hydrostatic}$, $H_{dynamic}$)
- Wind load (W)
- Tornado load (W_t)
- Seismic load (E_{DBE})

Specific values used for design and analysis of these loads may be found in references discussed in subsequent sections discussing important structural confinement components.

The key natural phenomena hazards design basis loads used for the confinement barrier design included the following:

- Design Basis Earthquake (DBE) - Confinement structures were designed for a peak horizontal ground acceleration of 0.1g with design spectra and structural damping in accordance with U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 1.60 and 1.61 (1973), respectively. The vertical component of peak ground acceleration was taken as 0.067g, using scaled horizontal design spectra, specified in NRC Regulatory Guide 1.60. The DBE, so defined, has an annual frequency of occurrence of 5E-04 based on a median hazard curve from a site-specific probabilistic analysis (Dames & Moore, August 17, 1983).

  The former reprocessing building (including the EDR and CPC) is supported on pile foundations, the Vitrification Building is supported on a reinforced concrete mat footing, and the HLWTS piping is supported in partially buried reinforced concrete trenches. A

seismic separation joint exists between the former reprocessing building and the Vitrification Building to allow for differential movement and seismic ground wave effects. Differential movement and relative movement due to the passage of seismic ground waves were included in the design of various SSCs associated with the VF.

The 0.1g DBE was established and accepted by the U.S. Department of Energy (Hannum, October 20,1983) in accordance with DOE guidance in effect at the time the work was performed.

- Design Basis Tornado (DBT) - Radiological confinement barriers are designed to assure confinement under DBT conditions. In general, confinement barriers may be damaged, but not breached due to DBT conditions. The DBT for the WVDP is established in Nicholas and Eagan (January 1983). The event has an annual frequency of occurrence at the West Valley site of 1E-06. The parameters used for the tornado wind and missile load analysis are:
  - Maximum wind speed 260 kilometers/hour (160 mph)
  - Tornado radius of 45.7 meters (150 ft)
  - Tornado rotational wind velocity of 180 kilometers/hour (110 mph)
  - A translational wind velocity of 80 kilometers/hour (50 mph)
  - Peak pressure differential of 2,413 Pa (0.35 psi) from ambient atmospheric pressure.
  - A rate of pressure change of 1,034 Pa/sec (0.15 psi/sec).
  - Penetration and crushing effects of small, high-velocity missiles. The missiles used in the analysis are typical items that can be found on or near the site and are:
    (1) Wooden plank 0.10 meters x 0.30 meters x 3.65 meters (4 in x 12 in x 12 ft), 63 kilograms (139 lbs) weight at a velocity of 38 meters/second (85 mph).
    (2) Steel pipe 0.076 meters (3 in) diameter by 3.05 meters (10 ft) long, 33.4 kilograms (76 lbs) weight at a velocity of 22.35 meters/second (50 mph).

- Concrete building structures are designed for negative pressures with respect to the outside atmosphere of 746 Pa (negative 3 inch water column).
- Design Wind Loads - Building structures and equipment on the exterior of the buildings are designed for the severe environmental conditions associated with a 100-year wind of 35.8 meters/second (80 mph) having peak gusts of 43.4 meters/second (97 mph). Wind pressure is analyzed using methods specified in ANSI A58.1, Exposure Condition C.
- Design Snow Loading - Buildings and structures are designed for severe environmental conditions to a snow load of 1,915 Pa (40 lbs/ft^2). Snow loads are relatively small compared to the other design requirement loads such as tornado, earthquake and gravity.
- Reference Design Flooding - A flood is not considered to be a hazard to the VF due to the elevation of the site above the local flood plain, and will not result in releases of radioactivity to the environment.

Earthquakes and tornadoes are the extreme environmental conditions that form the two critical design basis events that control the safety margins for natural phenomena hazards. These two design basis events meet or exceed DOE Order 6430.1A and UCRL-15910 guidance for natural phenomena hazards as shown in Pomerening (April 1993).

5.2.1.3 Modified Existing Structures

Now that HLW is in a borosilicate glass waste form and confined within stainless steel canisters, it is considerably more stable and, therefore, less mobile during accident conditions. Chapter 9 of this SAR establishes the fact that once the HLW is processed into this containerized glass waste form, substantial release to the public will not occur, even if the concrete structure confining the stored waste is damaged. For this reason, some areas such as the HLWIS area need not have as much structural integrity as the Vitrification Cell. The HLWIS area has been decontaminated and fitted with canister storage racks to accommodate the filled borosilicate canisters.

Structures that are not required to confine radioactive material, under accident conditions, are designed in conformance with the *New York State Code Manual for the State Building Construction Code* and to the *Uniform Building Code* (UBC) requirements. The original reprocessing plant structures, including the CPC, EDR, and 01-14 Building were built to seismic requirements of the 1961 UBC for Seismic Zone III.

The 1961 UBC Zone III seismic requirements for the reprocessing building produced base shears that were equivalent to design for a peak ground acceleration of 0.3g with possible structural damage but no collapse. To assess the building's earthquake capacity, two independent seismic analyses of the former nuclear fuel reprocessing building were performed in the 1970's for the NRC. One review was performed by Los Alamos National Laboratory (LANL) (1978) and the other by Lawrence Livermore National Laboratory (LLNL) (1977). These analytical reviews were further reviewed by expert consultants for the NRC, who concurred with the conclusions of the LANL and LLNL studies.

The studies by LANL and LLNL have shown that the former reprocessing building, including the CPC, has a margin of safety of > 1 x DBE against structural damage. The margin of safety against structural collapse is significantly > 1 x DBE.

5.2.1.4 New Non-Confinement Structures

Structures that are not required to confine radioactive material, under accident conditions, were designed in conformance with the *New York Code Manual for the State Building Construction Code* and to the UBC requirements as well as American Concrete Institute (ACI) and AISC requirements as applicable.

5.2.1.5 Soil Loads and Foundation Design

The former reprocessing building (including the EDR and CPC) is supported on pile foundations. The Vitrification Cell is supported on a reinforced concrete mat. A seismic separation joint of 76 mm (3 in) exists between the former reprocessing building and the Vitrification Building to allow for differential movement and seismic ground wave effects. The separation is filled with Rodofoam. Differential movement and relative movement due to the passage of seismic ground waves were included in the design. The building surrounding the Vitrification Cell is supported on spread footings and grade beams. The Cold Chemical Building and the Load-In Building are each on separate mats and the HLWTS piping is supported in partially buried reinforced concrete trenches.

Prior to the original reprocessing plant construction, soil investigations were conducted (Dames & Moore, May 8, 1963) to determine the general soil conditions at the site and to obtain soil data directly relevant to the foundation design and construction. Piles were selected by Bechtel for the foundation support and 476 steel H piles were driven into the compact glacial

till soil stratum which underlies the site and consists of a mixture of sand, gravel, silt and clay. The piles were driven to plant elevations between 9.8 m and 12.8 m (32 ft and 42 ft). Pile load tests and pile driving criteria are summarized in the Dames & Moore (July 19, 1963) report to Bechtel.

A comprehensive subsurface investigation was performed for the design and construction of the Component Test Stand (CTS) (Dames & Moore, March 18, 1983). A subsurface investigation was performed (Dames & Moore, June 1988) to verify that the conditions beneath select portions of the proposed VF were consistent with those encountered during the previous investigation for the CTS. In particular, there was some concern regarding the possibility of encountering fill near the EDR. The investigation indicated that conditions were consistent to those encountered beneath the CTS and the report recommended that the foundation design be based on the information included in the CTS report. The VF Preliminary Safety Analysis Report and the HLWTS design criteria (WVNS-DC-046) provide soil and foundation design criteria. A confirmatory geotechnical investigation was performed in 1992 (Dames & Moore, August 24,1992).

A description of the geotechnical background, boring locations, soil static and dynamic material properties, and the recommended parameters for foundation design are provided in Chapter 3 of this document.

5.2.2 VF Passive Barriers and Key Confinement Systems

Safety features were engineered into the design of the VF to minimize the potential environmental risks of the release of radioactivity due to loss of confinement. The safety features included a system of confinement barriers that functioned both during normal vitrification operations and during accident conditions or extreme environmental accident conditions. Now that the Vitrification campaign has been completed and dismantlement is well underway the accident source is less than 0.5% of the original inventory and confinement barriers are not required to meet the evaluation guidelines. It should be noted that these confinement barriers still exist but are no longer required.

5.2.3 IRTS, Main Plant, and FRS Buildings Structural Specifications and Layout

The WVDP was implemented through the use of existing technology and standard engineering practices. Engineering codes, construction codes, and standards applicable to the general design and operation of IRTS component systems are listed in Table 5.2-3. Applicable design codes for key IRTS components are provided in Table 5.2-4.

The Main Plant and FRS were designed and constructed to codes and standards in effect at the time they were built in 1963 (e.g., 1961 New York State Building Code, 1956 American Concrete Institute [ACI] Code 318, and the 1961 Uniform Building Code). Original engineering codes, construction codes, and standards applicable to the general design of the Main Plant are listed in Table 5.2-5.

New facility construction and major modifications to existing facilities at the WVDP conform to the criteria dictated in DOE Order 420.1, *Facility Safety*.

5.2.4 STS/SMWS and HLWTS Facility Descriptions

Modifications were made to the PUREX High-Level Waste (HLW) tanks and their vaults in order to install Supernatant Treatment System (STS) and Sludge Mobilization and Wash System (SMWS) equipment. Major processing components were installed within Tank 8D-1. This equipment is summarized in Table 5.2-6.

Pumps required for PUREX sludge mobilization are installed in Tank 8D-2. Pumps required for zeolite mobilization are installed in Tank 8D-1. Table 5.2-7 shows specific design codes and standards used in HLWTS confinement systems.

5.2.4.1 Tank 8D-1

A detailed discussion of the safety margin associated with the modifications made to Tank 8D-1 are presented in Brown (December 19, 1985). Major STS process components are located within Tank 8D-1. The tank was used to store the loaded zeolite (ion-exchange material) produced by the STS process. Tank modifications were made for the installation of the zeolite mobilization/removal pumps that slurried the loaded zeolite and supernatant post-filter sand from the tank bottom and transferred it to the Vitrification Facility.

Modifications to Tank 8D-1 included the following major steps and activities:

- excavation to expose a portion of the tank vault concrete roof
- penetration of the vault roof
- removal of rafter sections from the tank roof and installation of cross channel beams
- installation of riser assemblies between the vault and tank roof (these risers are carbon steel and are welded to the tank roof)
- penetration of the tank roof within the riser assemblies
- installation of STS components and zeolite mobilization pumps.

Tank 8D-1 is a reinforced carbon steel vessel, approximately 8 m (27 ft) high by 21 m (70 ft) in diameter, fully contained within a thick reinforced concrete vault with a 61-cm (2-ft) thick roof and 46-cm (1.5-ft) thick walls. The tank rests on a 30-crn (12-in) layer of perlite blocks, which in turn rest on an 8-cm (3-in) layer of pea gravel contained in a carbon steel pan. The pan rests on a second 8-cm (3-in) layer of pea gravel on the vault floor.

Components of the STS located in Tank 8D-1 include the ion-exchange columns, filters, and coolers. A summary of equipment located in Tank 8D-1 is given in Table 5.2-6. Figure 5.2-7 shows the general arrangements of components in Tank 8D-1.

ACI Standard 318-77, appropriate loads and load combinations from ACI 349, the Uniform Building Code (UBC) Zone 111, and an importance factor of 1.0 for seismic loads were used in the analysis and design of the reinforced concrete portions of the 8D-1 tank top modification and vault. The American Institute of Steel Construction (AISC) Code was used in designing the structural steel elements of the structure. The loads considered in the design and/or analysis were dead loads, live loads, thermal loads, seismic loads (applied as horizontal static load to both aboveground structures and as part of the dynamic soil pressure loads for below-ground structures), static soil pressure, equipment and piping loads, hydrostatic loads, and construction loads.

An analysis performed by Lawrence Livermore National Laboratory (May 1978a) was used to pro-rate and verify the calculated dynamic soil pressure. The soil pressure established for 0.19 seismic ground acceleration was translated into an equivalent static force using a Mononobe-Okabe formula.

These loads and load combinations were used in the design of the steel and concrete structure. The steel framing system was designed to carry the in-tank components and piping loads and transmit them to the shield structure's concrete walls through embedded plates. Figure 5.2-8 illustrates the tank floor structure.

Tank 8D-1 Concrete Vault Integrity Analysis

The Tank 8D-1 concrete vault was analyzed for the following purposes:

- to assess maintenance of the vault integrity with the loads from the shield structure and 8Q-1 pump pit
- to verify vault structure integrity subsequent to the removal of concrete cut-outs for the STS components
- to assess maintenance of vault integrity under a concrete bucket drop during construction.

The loads delineated above were used in the analysis, including the buoyant uplift due to hydrostatic pressure. These loads were applied to the vault in several different combinations and entered into the Stardyne Static Finite Element Analysis computer program. The computer output was reviewed and the most critical stress elements were then used to verify the vault reinforcement and stresses within the concrete

The assessment indicated that Tank 8D-1 vault integrity would be maintained and complies with ACI-318.

Tank 8D-1 Analysis

Since the steel roof girders were not cut and loads on the channel rafters after cutting were locally transferred to the roof girders, the steel tank as a whole was not reanalyzed dynamically or statically. The equipment suspended inside Tank 8D-1 is structurally isolated from the carbon steel tank roof. The steel liners (risers) connecting the carbon steel tank with the concrete vault contain a flexible "boot" to maintain tank and vault isolation at all times.

In summary, structural modifications to the tank that were made to support HLW processing did not introduce additional stress on the original steel tank.

5.2.4.2 Tank 8D-2

Tank 8D-2 was originally designed for the storage of HLW produced during Nuclear Fuel Service, Inc (NFS) reprocessing operations. Modifications to the Tank 8D-2 vault and tank include:

- coring of the vault roof
- removal of rafter sections from the tank roof and grinding of the roof top
- installation of riser assemblies between the vault and tank roof (these risers are carbon steel and are welded to the tank top)
- penetration of the tank roof
- installation of a shield plug or SMWS mobilization pumps.

Tank 8D-2 is a reinforced carbon steel vessel, approximately 8 m (27 ft) high by 21 m (70 ft) in diameter, fully contained within a thick reinforced concrete vault with a 61-cm (2-ft) thick roof and 46-cm (1.5-ft) thick walls. The tank rests on a 30-cm (12-in) layer of perlite blocks, which in turn rest

on an 8-cm (3-in) layer of pea gravel contained in a carbon steel pan. The pan rests on a second 8-cm (3-in) layer of pea gravel on the vault floor. Figure 5.2-9 provides a plan view of Tanks 8D-1 and 8D-2.

Tank 8D-2 Concrete Vault Integrity Analysis

The Tank 8D-2 concrete vault was analyzed to verify that vault integrity would be maintained with the loads from the new access risers and subsequent to the removal of concrete cutouts for the SMWS pump components (Rockwell August 1985).

Detailed documentation of the concrete tank vault flotation during construction along with mitigative action has been documented by Barnstein (1965 and 1966) and Gates (April 1991). An extensive soil investigation was carried out using a series of shafts under the tank vaults to identify the state of cracking in the vault slabs as well as the voids that had developed under it.

The loads used in the analysis included the buoyant uplift due to hydrostatic pressure. These loads were applied to the vault in several different combinations and entered into the Stardyne Static Finite Element Analysis computer program. The computer output was then reviewed and the most critical stress elements used in verifying vault reinforcement and stresses within the concrete (Ebasco Services, Inc. 1986). Soil properties used in the analysis were verified by additional borings and sample testing (Gates 1986).

In summary, based on the assessment under the load conditions and combinations discussed above, the Tank 8D-2 vault integrity has been maintained (Ebasco 1990; 1986).

Tank 8D-2 Analysis

The analysis of the top of Tank 8D-2 assured the steel roof girders had not been cut and a maximum of two channel rafters had been cut. The steel tank as a whole was reanalyzed statically. The steel risers connecting the carbon steel tank were pulled in tension and supported on the vault, which resulted in the same roof loads as existed before modifications. In summary, this structural modification approach did not cause additional stress on the original steel tank roof (Rockwell 1984).

5.2.4.3 Associated STS/SMWS Facilities

Figure 5.2-10 shows the general arrangement of the STS Building and the 8D-3 and 8D-4 Tanks.

STS/SMWS Pipeway

A concrete and steel shield structure (pipeway) was erected on top of the Tank 8D-1 vault. The outer walls of the pipeway are formed by a curb with support columns to allow for piping runs. These retaining walls and columns support the structural members that span them and support the STS equipment. The walls and columns also support the concrete roof and structural beams. Figure 5.2-11 shows the pipeway above the 8D-1 vault with the STS components suspended from the vault roof/pipeway floor into the tank.

STS Valve Aisle

A shielded valve aisle was constructed at the northwest perimeter of Tank 8D-1 to contain remotely operated valves and associated instrumentation. Shield windows and manipulators permitted remote operation and replacement of

components. The shielded walls and roof of the valve aisle are constructed with 30-cm (12-in) steel. The valve aisle provided secondary containment of HLW piping and valves between the operating aisle in the STS support building and Tank 8D-1. Leakage into the valve aisle or the pipeway behind the valve aisle back wall could be collected in a common sump located near the back wall of the valve aisle as shown in Figure 5.2-12. Sump contents are transferred to the interceptor if the alpha and beta levels are acceptable.

STS Support Building

Adjacent to the valve aisle is the STS support building, which contains auxiliary support systems and equipment for operation of the STS. This structure houses the demineralized water and zeolite storage tanks, associated delivery systems, control room, heating, ventilation, and air conditioning (HVAC) equipment, and utility services. The building is maintained as a radiologically "cold" area. The orientation/layout of the pipeway, valve aisle, and STS support building relative to Tank 8D-1 is shown in Figure 5.2-11.

5.2.4.4 Leak Detection Systems

A liquid level detection system in the pans of Tanks 8D-1 and 8D-2 indicates a leak of HLW from the HLW tanks or the introduction of groundwater into the vault. (An examination of the vault/pan/tank design has revealed that the primary function of the pans is leak detection rather than secondary containment. Secondary containment of HLW is provided by the combination of the pan, concrete vaults, and the surrounding silty till.) Pumps are provided to return leaked liquids to the interceptor if the alpha and beta levels are acceptable. Groundwater may be pumped to Lagoon 2 for treatment at the LLWTS.

The carbon steel pan in the 8D-2 vault has been tested and it is apparent that a leak exists that allows water to pass between the pan and vault. The pan therefore cannot be considered as either sole containment or as a fully functional component of the leak-detection system. The pan-level detection system may, however, provide indication of a leak having a rate of outflow that exceeds the rate of outflow from the pan.

Leakage in the valve aisle/pipeway areas is collected in a sump. returns fluids to Tank 8D-2. A level alarm in this sump identifies the leakage condition. Additionally, a leak-detection system is installed within the annular space between the double walls of the STS transfer piping. Leaked fluids can be returned by gravity to Tank 8D-2. The transfer conduit between Tank 8D-2 and STS is Actuation of a pump connected by a drain to Tank 8D-2 in the event that the double-walled pipe leaks into the conduit.

Leak-detection equipment is installed within the annular space between each of the High-Level Waste Transfer System (HLWTS) primary and secondary pipe segments residing in the transfer trench. The leak-detection equipment is installed at the low point of each continuous pipe segment. Each pump pit also has a level-detection probe installed at its drain.

5.2.4.5 Containment of Metal Corrosion

The design corrosion allowance for the carbon steel HLW tanks (8D-1 and 8D-2) is 6.4 mm (0.25 in), except for the top plate, which has a design corrosion allowance of 4.8 mm (0.188 in).

Tank 8D-1 internal corrosion coupon data show that between 1988 and 1994, the uniform corrosion rate observed in the vapor region was 0.53 mils per year, 0.05 mils per year in the liquid region, and 0.62 mils per year in the zeolite

region. Between 1994 and 1997 only the vapor region indicated an increase in corrosion rates. In this region the observed corrosion rate is in the range of 1.0 - 3.0 mils per year. The internal general corrosion rate for Tank 8D-2 between 1966 and 1976 was reported by NFS to be 0.53 mils per year in the vapor region and 0.03 mils per year in the liquid region. Internal corrosion of the carbon steel HLW tanks is controlled through the addition of corrosion inhibitors (e.g., caustic and sodium nitrate).

Since August 1996, external corrosion of the tanks has been monitored using corrosion coupons placed in the vaults of the tanks. Visual inspection indicated loose surface scale and pitting on the internal tank surfaces and a heavy deposit of corrosion products on the external surfaces. External corrosion of the tanks, which is significantly higher than internal corrosion, is controlled through the use of a nitrogen inerting system that has been in operation since 1996.

Tank 8D-3, which is shown in Figure 5.2-13, is a stainless steel tank used as a temporary hold tank for decontaminated STS process solutions and has never been used to contain HLW. Therefore, it has never been inspected.

Tank 8D-4 is also a stainless steel tank. Inspection of corrosion coupons, which were removed in 1987, indicated minimal thinning (i.e., at least an order of magnitude less than that in Tank 8D-2: a 0.003-mm [0.12-mils] total of corrosion over a 7.5-year time span). The design corrosion allowance for the stainless steel HLW tanks is 1.8 mm (0.07 in).

The corrosion-resistant stainless steel tank is relied upon as a passive means of controlling corrosion in Tank 8D-4. The low corrosion rates observed support this approach.

5.2.5 LWTS/Main Plant Facility Descriptions

The Main Plant building was designed and constructed to house the equipment used by NFS for reprocessing of spent nuclear fuel (SNF). Several areas of the Main Plant were decontaminated and the original equipment was removed. These areas were then fitted with new equipment and returned to service in support of WVDP activities.

Portions of the Main Plant that have been used to support the WVDP mission include the HLWIS area and areas that house the Liquid Waste Treatment System (LWTS). The HLWIS area provides space for vitrified high-level waste processed in the Vitrification Facility. The HLWIS area uses the following areas of the Main Plant: (1) CPC, (2) EDR, (3) CCR, (4) Chemical Viewing Aisle (CVA), and (5) Chemical Operating Aisle (COA). The HLWIS area is also used to store expended or damaged equipment and high activity wastes removed during plant decontamination activities.

The LWTS uses the following areas of the Main Plant: (1) Extraction Cell 3 (XC-3), (2) Product Purification Cell (PPC), (3) Uranium Product Cell (UPC), (4) Uranium Loadout (ULO), (5) Lower Warm Aisle (LWA), (6) Upper Warm Aisle (UWA), (7) Lower Extraction Aisle (LXA) and (8) Upper Extraction Aisle (UXA). Plan views of Main Plant areas, including area utilized for HLWIS and the LWTS, are shown in Figures 5.2-14 through 5.2-23.

Cells within the Main Plant that directly supported WVDP activities are described in the following sections.

5.2.5.1 High-Level Waste Interim Storage Area Cells and Rooms

The CPC, EDR, and CCR were built to seismic requirements of the 1961 UBC edition, which imposed requirements for a Seismic Zone III design of structures. The current edition of the UBC has reduced the seismic requirements for the WVDP site, which is now a Seismic Zone I. Any modifications in the use of the facility that change the facility design loads, such as the addition of heavy canister storage, requires reanalysis and design in conformance with current UBC and New York building codes. Section 5.2.1.3 addresses seismic analyses that have been performed for the CPC.

5.2.5.1.1 Chemical Process Cell

The CPC is located on the northwest side of the Main Plant building at 100-ft EPD (elevation plant datum). The cell is now part of the HLWIS, which is used to provide storage for vitrified HLW, vitrification expended material (VEM), process equipment removed from the Vitrification Cell, and material removed from the HEC.

There are four shielded viewing windows in the CPC. Three windows are located along the west wall in the CVA. The fourth window, located in the north wall, permits viewing along the length of the cell. Shielding is provided by separated slabs of lead glass filled with mineral oil.

Any liquid in the CPC is collected in either the south or north sump. Liquids that accumulate in these sumps are transferred to Tank 7D-2 in the Liquid Waste Cell (LWC) and ultimately to Tank 5D-15B for processing in the LWTS.

Equipment installed in support of the HLWIS area includes storage racks for the product waste canisters and the canister transfer cart. Equipment removed from service in the Vitrification Cell or HECs may also be stored in this cell until it can be removed for disposal.

The glass waste form (confined within stainless steel canisters) that is stored in the HLWIS area is not dispersible during accident conditions. For this reason, it is not necessary that the cell have the structural integrity required for cells containing highly dispersible radioactive materials.

5.2.5.1.2 Equipment Decontamination Room

The EDR is located at the northwest corner of the Main Plant at an elevation of 100 ft EPD. The EDR was used to transfer vitrified waste from the Vitrification Facility to storage racks in the CPC, to receive equipment and empty canisters from the Load-in Facility, and to perform maintenance on the Vitrification Facility transfer cart.

The EDR is serviced by two 9-metric-ton cranes on a single bridge. A motor-driven transfer cart runs on rails into the CPC. The transfer cart is controlled from either the EDR Viewing Aisle (EDRVA) or the north CVA.

5.2.5.1.3 Chemical Crane Room

The CCR is located at the north end of the CPC at a plant elevation of 127 ft. The CCR is a shielded maintenance area for the cranes used in the High-Level Waste Interim Storage Area in the CPC.

5.2.5.2 Liquid Waste Treatment System Cells and Rooms

5.2.5.2.1 Extraction Cell 3

XC-3 measures 4.6 m x 6.5 m x 17.4 m (15 ft × 21 ft 3 in × 57 ft). Entry to the cell is via a personnel door from the Cell Access Aisle at ground level or through the 1.8-m (6-ft) square hatch plug in the floor of the XCR. The floor is stainless steel lined to a height of 46 cm (18 in), providing a volume of 13,500 L (3,600 gal) for spill protection. Walls and ceilings are Carboline-coated concrete.

The principal components of the LWTS are housed in XC-3. The LWTS is used to remove dissolved salts from liquid plant wastes through concentration and subsequent overhead condensation.

Equipment in XC-3 includes the LWTS evaporator, reboiler, and other tanks and vessels associated with low-level waste concentration. A summary of equipment in XC-3 is given in Table 5.2-8.

The monolithic construction of XC-3 assures the confinement of low-level radioactivity under normal and expected abnormal conditions.

5.2.5.2.2 Product Purification Cell

The PPC is located at the south end of the Main Plant immediately next to and east of XC-3 at a plant elevation of 100 ft. Entry to the PPC is via a north wall personnel door from the UPC and through an access hatch from the XCR. A stainless steel liner covers the floor of the cell and extends up the walls, providing a volume of 14,500 L (3,800 gal) for spill protection. The remainder of the cell is Carboline-coated concrete. A 3.8-L (1-gal) sump located midway along the east wall of the cell collects liquids to be transferred to waste holding Tank 13D-8. There are no cranes, manipulators, or windows in the cell.

A concrete partition parallel to the north and south wall divides the PPC. The area south of the partition (PPC-S) is accessible from a man door that was installed to allow access from the Product Packaging and Handling Area to support cell decontamination. Decontamination and Decommissioning (D&D) of PPC-S has been completed, with the former process piping, tanks, and columns removed. This activity removed hazards and lessened the probability and consequences of the associated accidents. The north section currently contains valves and piping that are used to support operation of the LWTS.

The PPC provides housing for the LWTS valve gallery located in the area of the PPC north of the shield partition. No LWTS components other than valves and equipment associated with the valve gallery are located in the PPC.

The monolithic construction of the PPC assures the confinement of the limited radioactivity under normal and expected abnormal conditions.

5.2.5.2.3 Uranium Product Cell

Entry to the UPC is via a door in the south end of the west wall, from the Cell Access Aisle. The lower entry to the PPC is through a door in the south wall of the UPC.

The cell floor is covered with a stainless steel liner that extends up the walls to a height of 46 cm (18 in). The remainder of the cell is Carboline-coated concrete. Liquids from the floor of the cell are accumulated in a sump

located approximately in the center of the cell floor. This sump drains to the interceptor. The drain is closed with a remotely operated valve.

The UPC provides storage and spill containment for the LWTS feed and product vessels. There are two vessels in the UPC, each having a volume of 57,000 L (15,000 gal). The LWTS concentrates storage tank 5D-15A has two compartments: 5D-15A1 with a capacity of 38,000 L (10,000 gal), and 5D-15A2, with a capacity of 19,000 L (5,000 gal). Tank 5D-15B serves as the LWTS feed tank. Tank 5D-15A1 also can serve as a product feed tank.

Tank 5D-15A1/A2 is now called the LWTS concentrates hold tank and it is used to receive the concentrates from the LWTS evaporator.

5.2.5.2.4 Uranium Load Out

The ULO is situated at the northeast corner of the UPC. Access to the cell is through a doorway at the west end of the south wall. A pump niche in the ULO provides maintenance access to pumps associated with LWTS tanks in the UPC.

5.2.5.2.5 Miscellaneous LWTS Support Cells and Areas

Lower Warm Aisle

The LWA is located on the first floor of the Main Plant next to the south walls of the extraction cells at a plant elevation of 100 ft. Two floor drains in the LWA convey any spilled liquid to the Low-Level Waste Treatment Facility (LLWTF). One of the pump niches adjacent to XC-3 is currently being used to support operation of the LWTS.

The niche is 1.2 m (4 ft) high and are 2.2 m (7 ft) wide, extending 1.8 to 3.1 m (6 to 10 ft) into the LWA from the wall separating the LWA from the extraction cells. The floor and walls are lined with a welded stainless steel liner. The niche is equipped with 0.30-m (1-ft) thick concrete covers and drains that convey any accumulated liquid to the adjacent extraction cell.

Lower Extraction Aisle

The LXA is located on the second floor of the Main Plant next to the north walls of the extraction cells. The LXA is currently used to support operation of the LWTS. Two tanks that support the LWTS and that are used to transfer acids and bases into LWTS equipment are located in a bermed area in the LXA. These tanks have been designed and are used for handling acids and caustics.

Process Sample Cell 2

Process Sample Cell 2 (PSC-2) is located in the east end of the LXA to the northwest of the east stairwell on the second floor of the Main Plant at a plant elevation of 114.5 ft. PSC-2 is used to sample liquids from tanks 5D-15A1 and 5D-15A2 in the UPC and is equipped with an airlock and a glove box (15V-52) for sampling liquid from the UPC. It is currently used to sample the LWTS evaporator bottoms that are stored in tanks 5D-15A1 and 5D-15A2.

5.2.5.3 Head End Cells

The Head End Cells (HECs) of the Main Plant include the Process Mechanical Cell (PMC), Process Mechanical Cell Crane Room (PMCR), Process Mechanical Crane Room Enclosure (PMCE), General Purpose Cell (GPC), General Purpose Cell Crane Room (GCR), General Purpose Cell Crane Room Extension (GCRX), General Purpose Cell Crane Room Enclosure (GCRE), Miniature Cell (MC), the Manipulator Repair Room (MRR), and Scrap Removal Room (SRR). (Although formerly a

component of the head end of the original NFS process, the CPC, CCR, EDR, and the Master Slave Manipulator [MSM] Repair Shops are not considered "head end cells" in this SAR). Enclosures on the PMC and GPC crane rooms have been added to support cell decontamination activities.

The PMC and the GPC currently contain a significant amount of contamination remaining from spent fuel reprocessing activities. Other areas of the head end contain much lower levels of contamination. The PMC was used for the mechanical preparation of the fuel, which included removal of assembly hardware and the shearing of the fuel into short sections in preparation for chemical dissolution operations in the CPC. The GPC was used to collect and store the sheared fuel before dissolution operations and to package and transfer the leached hulls for disposal. The location of the GPC is noted in Figure 5.2-14. The location of the PMC is shown in Figures 5.2-15 and 5.2-16. Detailed discussions of head end cell areas are contained in the following sections.

5.2.5.3.1 Process Mechanical Cell

The PMC is located on the ground level of the Main Plant building. It is 16 m (52 ft) long north to south, 4 m (12 ft) wide, and 8 m (25 ft) high. A large rectangular concrete pedestal in the center of the floor served as the base for the saw table. The cell is lined with stainless steel 6.3 m (20 ft 8 in) up from the floor. Above the stainless steel, the interior surface is Carboline-coated concrete. The upper half of the north wall is a 0.9-m (3-ft) thick concrete shield door that leads to the PMCR.

The 2.4 m by 2.4 m (8-ft by 8-ft) PMC shielded transfer port and airlock is located at the 100-ft elevation next to the east wall of the PMC. It was installed in the East Mechanical Operating Aisle (EMOA) to permit small cart transfer of mechanical parts into the cell without exposure to personnel.

The shield walls of the PMC are constructed of ordinary concrete with an average density of 2.36 g/cm^3 and a thickness of 1.7-m (5.5-ft). There are six lead glass oil-filled shielded viewing windows. The PMC 2M-1A, 2M-1B, 2M-1C, and 2M-1D shield windows are along the west wall, with PMC 2M-1A at the south end of the wall. Windows PMC 2M-3A and 2M-3B are in the northwest and southeast corners respectively. Windows A-D, which are 152 cm by 165 cm (60 in by 65 in) are intended to permit observation into the cell from the West Mechanical Operating Aisle (WMOA). These windows were fully refurbished to support decontamination activities in the cell. The clarity in windows 2M-3A and 2M-3B has degraded substantially and the windows are currently opaque.

The PMC is accessible from the following seven locations:

1) a 0.91-m (3-ft) thick vertical lift shield door that connects with the PMCR
2) a 53-cm (21-in) diameter floor hatch in the southeast corner that connects with a transfer tunnel that leads to the FRS
3) a 56-cm (22-in) square hatch in the east wall that connects to the transfer port within the EMOA
4) a 46-cm (18-in) diameter ceiling hatch in the southwest corner that connects with the Sample Storage Cell
5) a 51-cm (20-in) diameter chute in the floor at the northeastern end that connects with the MC;
6) a 0.91-m by 1.2-m (3-ft by 4-ft) floor hatch at the north end that connects with the GPC
7) a 20-cm (8-in) diameter shear discharge chute that connects with the GPC.

A screened floor drain is located in the middle of the cell at its north end and another at the south end. These drain by gravity via a 7.6-cm (3-in) diameter drain line embedded within the concrete floor of the cell to the GPC sump.

The PMC contains a single bridge equipped with an auxiliary 2-ton capacity chain hoist and a bridge-mounted, remote-controlled power manipulator. An auxiliary chain hoist, which is mounted on a separate I-beam attached to the bridge assembly, has a 15-m (50-ft) travel range and lift capacity, allowing it vertical access from the bridge rails in the PMC, through the PMC/GPC hatch, and down to the floor of the GPC.

Above each of the shield windows in the PMC are two manipulator ports.

5.2.5.3.2 PMC Crane Room and PMCR Enclosure

The PMCR is a decontamination and contact maintenance area for the crane and bridges in the PMC. There is a 1.22 m (4 ft) square hatch in the floor of the PMCR leading to the Manipulator Repair Room which can be accessed via an airlock from the MOA.

The PMCR Enclosure was built over the pre-existing roofs of the PMCR and the adjoining Master Slave Manipulator Repair Shop. The enclosure accommodated the removal of the two bridge cranes and bridge-mounted power manipulator in the PMC and allowed installation of the replacement bridge-mounted power manipulator in the PMC. The enclosure also serves as a maintenance area for the bridge-mounted manipulator in the PMC. The section of the enclosure constructed on the PMCR roof is located over a rolling hatch contained in the roof slab of the PMCR. This hatch can be rolled to allow access into the PMCR.

The enclosure is equipped with a bridge crane with a maximum lifting capacity of 5 tons. The PMCR also supplies airflow to the underlying PMC via a pneumatically controlled damper that will close when there is a loss of negative pressure in the PMCR.

5.2.5.3.3 Manipulator Repair Room

The MRR is located north of the North Mechanical Operating Aisle and beneath the PMCR at a plant elevation of 100 feet. The MRR is accessed from the WMOA via an airlock. The MRR is used to repair and adjust the bridge-mounted power manipulator located in the PMC. When repairs are required the power manipulator is transferred into the PMCR and positioned over the floor hatch into the MRR where the arm, wrist, and hand components of the power manipulator can be worked on without exposing workers to the radiation field in the PMCR or the manipulator bridge. The MRR also provides for personnel access to the PMCR, if required.

The MRR does not contain any major equipment.

5.2.5.3.4 General Purpose Cell

The GPC is located below grade beneath the north ends of the CPC and PMC, the south end of the SRR, and under the MOA. The GPC measures 13.9 m long by 3.2 m wide and is 5.9 m high (45 ft 7 in x 10 ft 5 in x 19 ft 6 in). The north wall is constructed of high-density concrete. All other walls, the ceiling and the floor are constructed of ordinary concrete. The GPC north and south walls are 1.2 m (4 ft) thick, the east wall is 1.3 m (4 ft) thick, and the west wall is 1.1 m (4 ft) thick. The floor is 0.91 m (3 ft) thick at the east

end, tapering to 0.45 m (2 ft) at the west end. The ceiling is 1.7 m (6 ft) thick.

The floor is sloped to capture liquid run-off into a stainless steel-lined sump. The floor from the west wall to the sump, 2.4 m (8 ft) from the west wall, is sloped from an elevation of 75 ft to an elevation of 74 ft 3 in near the east wall. Around the sump is the pan area of the cell where the floor drops 18 cm (7 in) to an elevation of 73 ft 6 in and levels out to the east wall. The floor and 4.9 m (16 ft) up the walls are lined with stainless steel. The sump receives liquids from the GPC as well as liquids from the floor drains and hatch in the PMC.

There are three oil-filled lead glass radiation shielding windows, 2M-6A to C, on the north wall, each with two manipulator ports over them. The shield windows are 1.2 m by 1.2 m (4 ft by 4 ft) and contain lead glass panes. Carbon steel shutters (2M-7A to C) which each measure 1.2 m by 1.2 m (4 ft by 4 ft), can be used to cover each shielding window within the GPC. The shutters are not currently covering the shielding windows. In addition to the manipulator ports/plugs, there is a periscope and maintenance port in the north wall. The center window has been refurbished to restore clarity.

The GPC has three ceiling hatches: a hatch measuring 1.2 m by 0.91 m (4 ft by 3 ft) located at the east end of the GPC and shared with the PMC; a hatch measuring 0.76 m by 1.6 m (2.5 ft by 5.25 ft) located in the GPC southwest corner and shared with the CPC; and a hatch with dimensions of 0.99 m by 1.2 m (3.25 ft by 4 ft) located at the GPC northwest corner and shared with the SRR. There is also a 20-cm (8-in) penetration from the PMC which lead from the former location of the bundle shear in the PMC.

The GPC is serviced by a single bridge equipped with a bridge-mounted, remote-controlled power manipulator and an auxiliary 2-ton capacity chain hoist that is mounted on a separate I-beam that is attached to the bridge assembly.

Ventilation flow into the GPC is through the floor hatches in the SRR, PMC, and CPC. Air flow from the PMC is approximately 0.94 m^3/s (2,000 cfm). A smaller volume of air enters the GPC through the shear discharge chute. Air is exhausted from the GPC to the Head End Ventilation (HEV) exhaust filter inlet plenum via a 0.91-m (36-in) duct. A more detailed discussion of the HEV system is provided in Section 5.4.1.

The General Purpose Cell Operating Aisle (GOA) is located below grade at a plant elevation of 73.5 ft immediately north of and adjacent to the GPC. The GOA was designed to be a manned operating area to observe operations and control the cranes, power manipulator, and Master Slave Manipulators (MSM) in the GPC. The GOA also provides access to the MC and the GCR.

5.2.5.3.5 GPC Crane Room, GCR Extension, and GCRE

The General Purpose Cell Crane Room is located below grade at a plant elevation of 73.5 ft immediately west of and next to the GPC. The GCR is a shielded contact maintenance area that contains a work platform located 4 m (13 ft) above the floor to allow worker access to the GPC crane and the power manipulator. An airlock connects the GCR to the GOA.

The GCR contains a shield door and its drive mechanism, work platforms, ladders, spray headers, and utility piping and valves. It does not contain any process equipment.

The General Purpose Cell Crane Room Extension is located below grade at a plant elevation of 86.5 ft immediately west of and next to the GCR. The GCRX

contains a concrete vault that houses Tank 35104, a 22,300-L (5,900-gal) stainless steel tank. The crane rails for the GPC crane also continue into the GCRX from the GCR.

The GCRE is a steel-framed structure built over the roof hatches of the GCRX. These hatch covers are removed as necessary to allow access into the GCRX. The enclosure was installed to facilitate the removal of the bridge crane and the bridge-mounted power manipulator in the GPC and to allow installation of the replacement bridge-mounted power manipulator in the GPC.

5.2.5.3.6 Scrap Removal Room

The Scrap Removal Room (SRR) is located north of the CPC at a plant elevation of 100 ft. The SRR does not contain any major equipment. Operating restrictions have been in place since 1998 for the concrete shield door as the concrete beams supporting the crane rails are weakened and the door is only allowed to be opened 45 inches. The northern drain connects with the interceptor and the southern drain connects to tank 35104 in the General Purpose Cell Crane Room Extension. The floor at the south end of the SRR contains a 1-m (3.25-ft) by 1.2-m(4.0-ft) hatch that connects to the underlying GPC. This hatch is equipped with a hydraulically operated hatch cover. A lead glass shield window equipped with two MSM ports is located in the southeast corner of the SRR.

The SRR receives 30 gallon drums containing waste removed from the GPC and PMC via a hatch between the GPC and the SRR. These containers of waste, along with boxes containing waste, are removed from the facility via the SRR airlock and transferred to Waste Management Operations for interim storage.

5.2.5.3.7 Miniature Cell

The MC is located below grade at a plant elevation of 76.5 ft next to the GPC. The MC does not contain any vessels or tanks and is currently not in use. The MC is accessed from a shielded airlock at the east end of the GOA and from a 51-cm (20-in) diameter chute from the PMC.

5.2.5.4 Main Plant Support Cells

5.2.5.4.1 Liquid Waste Cell

The LWC is an L-shaped cell located in the south central portion of the Main Plant next to the CPC, XC-1, and XC-2 at a plant elevation of 92 ft. The north-south leg of the LWC is 14.1 m (46.25 ft) long by 5.2 m (17 ft) wide, and the east-west leg is 5.8 m (19 ft) long by 4.8 m (15.75 ft) wide. The LWC is 5.9 m (19.5 ft) high across its extent. The floor of the LWC is below grade at a plant elevation of 28 m (92 ft). Access to the cell is from a shield door in the Cell Access Aisle. The floor of the cell is lined with stainless steel extending 46 cm (18 in) up the walls, providing a volume of 42,000 L (11,300 gal) for spill protection. The remainder of the cell is Carboline-coated concrete.

The cell contains nine waste collection tanks which were used to receive radioactive solutions from the extraction cells, the CPC, and the hot analytical cells. A significant amount of piping that conveys plant utilities to the LWC is present within the cell. With the exception of Tank 7D-14, which is constructed of Hastelloy C, equipment, piping, and tanks in the LWC are constructed of 304L stainless steel.

The nine liquid waste storage tanks including the following:

Condensate Catch Tank/Sample Collection Tank (3D-2)

The condensate catch tank (3D-2) is a vertical stainless steel tank with a storage capacity of 3,800 L (1,000 gal). Tank 3D-2 is equipped with a level recorder and temperature indicator.

Tank 3D-2 is still being used and is now called the sample collection tank. It is used as a sampling point for liquids stored in LWC Tank 7D-2, the low-level waste collection tank. A volume of liquid from 7D-2 is transferred to 3D-2 via a steam eductor, sampled, and analyzed for radioactivity. After sampling, the liquid in 3D-2 is transferred back to 7D-2. Sodium hydroxide is added to 3D-2 and then transferred to 7D-2 to neutralize the contents of 7D-2, if necessary.

Low-level Waste Evaporator Feed Tank/Low-level Waste Collection Tank (7D-2)

The low-level waste evaporator feed tank (7D-2) is a horizontal stainless steel tank with a storage capacity of 32,200 L (8,500 gal). Tank 7D-2 is equipped with a level recorder, density indicator, air sparge, a low-level alarm, and a low-density alarm. Tank 7D-2 is currently in use and receives liquid waste from liquid waste cell Tanks 3D-2, 13D-8, 7D-14, and 4D-10H as described in this section. The contents of 7D-2 are discharged to Tank 5D-15B.

Hot Analytical Cell Drain Catch Tank (7D-14)

The hot analytical cell drain catch tank (7D-14) is a vertical 1,890-L (500-gal) storage tank composed of Hastelloy C, a nickel alloy composed of 50% nickel, 20% chromium, 13% molybdenum, and 6% iron (American Society of Materials International 1990). Tank 7D-14 is equipped with a level indicator, air sparge, and a high-level alarm.

Tank 7D-14 is currently used to receive waste solutions from the hot analytical cell drains.

The rework evaporator feed tank (7D-8) and the plutonium cycle waste tank (4D-8) are isolated from the other tanks in a walled-off area in the southwest corner of the cell. Entry to this area is through a 0.69-m x 1.30-m (2.25-ft x 4.25-ft) opening in the southeast corner of the walled area.

A complete summary of active vessels in the LWTS cells in the Main Plant is provided in Table 5.2-8.

5.2.5.4.2 Off-Gas Cell

The Off-Gas Cell (OGC) is a reinforced concrete block cell measuring 3.7 m by 9.2 m by 8.8 m high (12 ft by 30 ft 6 in by 29 ft) located at 100 ft EPD south of the CPC. The cell is painted inside with Carboline paint and has two floor sumps.

The OGC is serviced by the main ventilation distribution system and receives its airflow from the south stairway via the Acid Recovery Cell (ARC). Air discharges from the OGC to the main ventilation plenum, where it passes through roughing and HEPA filters before being discharged through the main stack.

The OGC houses the equipment for the Main Plant's vessel off-gas (VOG) system. The VOG system is still being used to ventilate gases from vessels and tanks in the Main Plant. All of the equipment is fabricated of 304L stainless steel.

Equipment in the Off-Gas Cell is summarized in Table 5.2-9.

5.2.5.5 Other Main Plant Cells and Rooms

5.2.5.5.1 Extraction Cells 1 and 2

XC-1 and XC-2, along with XC-3, which is discussed in Section 5.2.7.2.1, are aligned perpendicular to the CPC and are located east of the south end of the cell. Roof plugs provide access to all three of these cells. XC-2 and XC-3 can also be entered through man doors in the Cell Access Aisle. XC-1 measures 4.9 m by 5.1 m by 16.8 m high (16 ft by 16 ft 6 in by 55 ft high), and XC-2 measures 6.4 m by 6.3 m by 17.5 m high (21 ft by 20 ft 9 in by 57 ft 6 in high). The floors and walls in XC-1 and XC-2 are stainless steel-lined and Carboline-coated in a manner similar to that described for XC-3.

The extraction cells contained the reprocessing equipment necessary to partition uranium and plutonium from fission products in the nitrate solution received from the dissolvers in the CPC and to separate the uranium from the plutonium and to concentrate these process streams for shipment as a nitrate solution. The original equipment was flushed multiple times after cessation of operations by NFS. *History of Decontamination* (Riethmiller, June 12, 1981) states that the vessels are empty, referring to the vessels that supported the partition cycle, uranium cycles, plutonium cycle, solvent systems, acid recovery system, uranium purification system, and the plutonium purification system. A summary of the major equipment in XC-1 is presented in Table 5.2-10.

The extraction cell, XC-2, is undergoing D&D. The piping, tanks, and columns are "telltaled," sampled, and characterized prior to packaging for off-site disposal.

5.2.5.5.2 Acid Recovery Cell/Acid Recovery Pump Room

The Acid Recovery Cell, shown on Figure 5.2-15, measures 8.8 m by 9.3 m (28 ft 9 in by 30 ft 6 in) to the ceiling beneath the Off-Gas Aisle at elevation 128 ft. There is a manway on the north side of the ARC that is open to the Off-Gas Cell. *The History of Decontamination* (Riethmiller 1981) states that ARC decontamination efforts did not involve the use of chemicals and that all vessels are empty except for the general purpose evaporator (7C-5), which indicated a level of 24.5% in 1981 and has a total capacity of approximately 17,000 L (4,500 gal). The makeup of the solution in the general purpose evaporator is unknown but "is probably water that entered the ARC sump from the Off-Gas Aisle." A summary of the major equipment in the ARC is noted in Table 5.2-11.

The Acid Recovery Pump Room (ARPR), at elevation 100 ft, measures 4.9 m by 6.9 m by 3.3 m high (16 ft by 22 ft 10 in by 11 ft high). The ARPR has been decontaminated and is currently empty.

5.2.5.5.3 Hot Acid Cell/Hot Acid Pump Room

The HAC contains several tanks used in acid recovery. *The History of Decontamination* indicates that these tanks are empty and that they were extensively flushed during decontamination activities.

5.2.6 Fuel Receiving and Storage

The Fuel Receiving and Storage facility contained structures and equipment that were used for the storage and shipment of spent nuclear fuel. The FRS

Fuel Storage and Cask Unloading Pools are empty, drained, and out of operation. The Radwaste Process Building (see Figure 5.2-24) houses the shielded containers that provide temporary storage for the spent ion-exchange resin that was discharged from the fuel pool demineralizer unit (see Figure 5.2-25). The Recirculation Ventilation Building houses components of the Recirculation Ventilation System, which provides the HVAC for the FRS Building.

5.2.7 Cement Solidification System 01-14 Building

The CSS facilities located in the 01-14 Building included the Waste Dispensing Cell (WDC), the Process Cell, and the Drum Loadout Area. The WDC contains the Waste Dispensing Vessel. The Process Cell contains the equipment used for mixing waste received from the WDC and equipment for handling filled cement drums. The Drum Loadout Area was used to store full cement drums before shipout for transport to the Drum Cell.

A separate cell in the 01-14 Building contains equipment previously used for the treatment of Vitrification Facility process off-gas.

The 01-14 Building houses for equipment in radioactive service in the CSS. The CSS is shutdown and there are no plans to reactivate the system. Plan and section drawings of equipment in the 01-14 Building are shown in Figures 5.2-26 through 5.2-30.

5.2.8 Drum Cell

The Drum Cell is located approximately 500 m to the southeast of the Main Plant. The Drum Cell provides a shielded secure area for the storage of wastes solidified in the CSS. The temporary weather structure is a Butler-type building that encloses the Drum Cell and waste handling equipment.

Approximately 19,877 drums of cemented waste are stored in the Drum Cell. The square, steel drums have a volume of 269 L (71 gal). There are approximately 450 Ci of cesium-137 contained in the 19,877 drums. On average, the drums contain approximately 9.7 nCi of alpha activity per gram of cement.

The Drum Cell provides storage for cement drums produced by CSS operations. A two-ton bridge crane, used for drum handling, runs the length of the building.

5.2.9 Warehouse Facilities

The WVDP operates three warehouse storage facilities. The Receiving Warehouse (Main 1) is a large metal building located approximately 100 m (330 ft) south of the Main Plant. This facility is the central shipping and receiving area for the WVDP.

A New Warehouse (Main 2) is located approximately 100 m (330 ft) west of the Receiving Warehouse. The facility is a metal structure on a concrete pad and is used for storage of large equipment and bulk chemicals. The main portion of the new warehouse contains nonreactive chemicals and other equipment and supplies for the site. The south end of the warehouse is divided into five individual, concrete block rooms for separate storage of acids, caustics, flammables, oxidizers, and "health hazard" materials. All of these storage rooms have grated floors set on top of berms to control spills and individual ventilation and fire suppression systems. The vent systems discharge directly to the atmosphere. One-gallon containers are stored on reinforced shelves and 55-gal drums are stored on pallets.

The third facility is the Bulk Storage Warehouse. This building is located approximately 2.2 km (1.4 mi) southeast of the Main Plant. It is presently used by the Project for long-term storage of large items such as old office equipment. Although located within the WNYNSC, there is no direct on-site route to this building. Access is by way of public roads.

5.3 Fire Protection Systems

Several fire hazards analysis (FHA) documents have been developed for the various WVDP facilities within the scope of this SAR. These documents contain extensive fire-protection system design and installation-related information. These FHA documents are identified in Chapter 8 of this SAR. Fire suppression systems at the WVDP consist of water, halon, dry chemical, high-expansion foam, and clean agent systems.

Water supplies for the fire protection system are provided by two on-site reservoirs containing approximately 2,100,000 m^3 (560,000,000 gal). Water is pumped from the reservoir by one of two pumps to the clarifier system and to the water storage Tank 32D-1. The capacity of the tank is 1,800,000 L (475,000 gal) with 1,100,000 L (300,000 gal) reserved for fire fighting. An electrically-driven pump provided with a diesel backup is used to pump water from the storage tank through the system. Both pumps are rated at 63 L/s (1,000 gpm) at 690 kPa (100 psi). The electric motor-driven fire pump is arranged to start automatically. The diesel pump starts automatically if the system water pressure continues to drop. Both fire pumps are located in the fire pump house located at the base of the water storage Tank 32D-1. A jockey pump is connected between Tank 32D-1 and the fire service main to maintain system pressure at greater than the fire pump starting pressure.

Water is distributed throughout the site through a system of underground water mains. Dry barrel fire hydrants are provided to allow access to water for use in fire fighting. Fire-fighting water service mains also provide water to building sprinkler systems.

Dry chemical, pressurized water, and CO_2-type portable fire extinguishers are located throughout the site to provide for incipient-stage fire fighting.

Fire detection alarms (smoke or heat detectors) are located in various areas throughout the site and water flow alarms are provided on each sprinkler system. Manual pull stations have also been provided in some areas of the site. These alarms annunciate at the Alarm Monitoring Station located in the main security gate house. In addition to fire alarms, the Alarm Monitoring Station also is capable of monitoring low building temperature, air supervision on dry pipe systems, and valve supervision.

5.3.1 Fire Protection Systems

5.3.1.1 Wet Pipe Sprinkler Systems

The piping of pipe sprinklers is filled with water under pressure. When heat from a fire activates an individual sprinkler head, water is released from the system. Each sprinkler head activates individually when it is heated to its design temperature.

Wet-pipe sprinklers are used only in heated facilities where freeze protection is not a concern. These areas include the Receiving Warehouse (Main 1) and New Warehouse (Main 2); Annex north, Annex south, and Annex conference rooms; Test and Storage Building; PVS Building; 01-14 Building; CSS/LWTS Control Room; Fire Pump House; OB-1; Expanded Laboratory; UR and URE; Laundry; and the

Main Plant Office Building. In cases where there is a need to provide sprinkler protection in an unheated area, a non-freezing system is used.

5.3.1.2 Dry Pipe Sprinkler Systems

Dry-pipe sprinkler system piping is maintained under air pressure, which keeps the dry pipe valve closed. Air pressure is controlled automatically by an air maintenance device such as a dedicated air compressor or the plant air system. Dry-pipe sprinkler systems are installed where freezing temperatures may make wet pipe sprinkler systems inappropriate. Valves for dry pipe sprinkler systems are installed in a heated enclosure.

Areas provided with dry pipe sprinkler systems include the Receiving Warehouse, STS Building, 01-14 Building, Emergency Vehicle Shelter, and Trailer T.

5.3.1.3 Deluge Systems

The arrangement of deluge-system piping is similar to that of a wet-pipe system with one primary difference: open sprinkler heads (or nozzles) are used so that when the deluge valve controlling the system operates, water flows from all the sprinkler heads.

The deluge valve is activated by a loss of supervisory air in a pilot line or the activation of an initiating device. When the heat from a fire reaches the pilot line, it will operate a valve or will melt the link in the closed heads on the pilot line and allow the supervisory air to escape. This creates a difference in pressure in the release device, causing the deluge valve to trip.

Areas protected by deluge systems include the Cooling Tower; Expanded Lab; and UR Transformer.

5.3.1.4 Pre-Action Systems

Pre-action systems are used in areas where it is particularly important to prevent the accidental discharge of water. The detection system chosen to activate the pre-action valve has high reliability and a separate alarm/supervisory signal to indicate status. The detection system is also designed to be more sensitive than the closed sprinklers in the pre-action system but should not cause false alarms and unnecessary activation of the pre-action valve. Pre-action systems are used in the Instrument and Motor Control Center (MCC) rooms of the 01-14 Building.

5.3.1.5 Wet Standpipe Hose Stations

Standpipe systems provide fire hose connections within a building. The hose connections are supplied with water from the underground water main. The hose connections on-site are equipped for use with 3.8-cm (1.5-in) fire hoses. A Class II fire hose station located in the north operating aisle of the FRS Building includes a 3.8-cm (1.5-in) hose connected to the site fire-fighting water supply loop.

5.3.1.6 Halon Systems

Halon extinguishing systems consist of pressurized gas cylinders, a means for automatic and manual actuation, discharge piping and nozzles, a system control panel, and local and remote alarms. Operation of an actuating device initiates an alarm condition at the system control panel. The control panel activates local and remote alarms and also operates the control head on the

halon cylinders. Once the control head on the cylinder has fired, the halon is discharged through the discharge piping and nozzle to extinguish a fire. In addition to halon, systems utilizing FM-200, a CFC-free extinguishing agent, are also in use. These systems are provided in the Dosimetry Computer Room (Trailer 61), Main Computer Room, UR Switchgear Room, URE Switchgear Room, and the Container Sorting and Packaging Facility.

5.3.1.7 Dry Chemical Systems

Dry chemical extinguishing systems at the WVDP have a fixed supply of dry chemical agent connected to fixed piping. Nozzles are arranged to discharge the extinguishing agent onto the burning surface. The extinguishing agent is discharged under pressure by a discharge gas. Actuation of the system can be either manual or automatic. Fixed dry chemical systems operate automatically using a bi-metallic fusible link or a heat detector located above the hazard.

5.3.1.8 Wet Chemical System

A wet chemical extinguishing system, which has a fixed supply of wet chemical agent connected to fixed piping, is located in the site cafeteria at Trailer City. Nozzles are arranged above cooking equipment to discharge the extinguishing agent onto the burning surface. The extinguishing agent is discharged under pressure by a discharge gas. Actuation of the system can be either manual or automatic. Automatic actuation of the fixed wet chemical system is by fusible links located above the hazard.

5.3.1.9 VF Fire Protection Systems

The VF fire protection and life safety features satisfy requirements of the WVDP Fire Protection Program, which has been developed in accordance with DOE Order 420.1A, *Facility Safety* and DOE Order 440.1A, *Worker Protection*. WVDP-177, *WVDP Fire Protection Manual*, provides site-specific guidance in this regard.

An analysis of the fire hazards in the Vitrification Facility was conducted for WVNS-FHA-001, *VF Fire Hazards Analysis* (VF FHA). The VF FHA provides a great deal of specific information related to the VF fire protection system. Flow rates, discharge pressures, volume of water available, types of pumps, power supplies, design density of the coverage, actuation mechanisms, and other information of this nature are provided in the VF FHA.

Fire protection is accomplished through design features (i.e., detection and suppression equipment) and personnel and administrative controls. VF design features meet NFPA codes, as documented in the VF FHA, as appropriate for safety- and non-safety-related SSCs. Noncombustible construction materials are used and fire detection and suppression systems of appropriate capacity and capability are provided to minimize the adverse effects of fires. Fire suppression systems are designed to ensure that inadvertent operation, rupture, or failure would not impair the capability of operating systems and components.

Specific criteria utilized as the design basis for the Fire Protection Program are described in WVNS-FHA-001.

The VF is constructed as much as practicable using building components of fire-resistant and noncombustible material, with attention to locations vital to providing confinement. Confinement barriers have been designed to exclude combustible materials. Confinement barriers, particularly the Vitrification Cell, were designed to retain the confinement function during and after credible fire scenarios.

The 01-14 Building, located south of the Vitrification Building, is used to house the ex-cell Off-Gas system. The 01-14 Building outer walls are constructed of concrete block and interior cell walls are reinforced concrete. The Off-Gas system instrument room, 01 cell airlock, stairwell, and MCC room enclosures are steel-framed, and have gypsum board interior walls, are insulated, and have metal siding outer walls. The off-gas blower room enclosure is steel-framed with concrete block walls.

Fire detection and suppression capabilities in the Vitrification Facility include the following:

- Detection (of heat or smoke),
- Notification of personnel (by audible/visual alarm and control panel light),
- Actuation of flow (of water, halon, or combination thereof), and
- Suppression (of heat, smoke, and/or flame by manual or mechanical methods).

Fire detection and alarm consists of fire detection actuation and alarm and signaling components that detect fires and provide alarm notification of the situation and actuation of fire suppression hardware.

Alarms that respond to flow of water are provided wherever a sprinkler system is installed and comply with requirements of the NFPA standard for the type of signaling system used. Additionally, a manual fire notification method, such as manual fire alarm pull stations, is provided.

Dedicated fire water storage and distribution capabilities are provided. Underground fire water mains, including valves, hydrants, and fittings, have been installed, flushed, and tested in accordance with NFPA 24. Water storage tanks comply with NFPA 22. Fire pumps comply with NFPA 20. Water storage is sufficient to exceed the density, pressure, and duration requirements of NFPA 13. The water distribution system is of the looped grid type, providing two-way flow with sectional valving arranged to provide local isolation at various points in the system. Fire mains (except those supplying a single hydrant or extensions of existing smaller mains) are at least 203 mm (8 in) in diameter. Water mains at the Vitrification Building and the Cold Chemical Building are 203 mm (8 in) in diameter; however, there is some 152-mm (6-in) underground pipe in the distribution piping.

Sprinkler systems have been installed throughout the Vitrification Building, with the exception of the Vitrification Cell. No fire suppression capabilities have been installed in-cell for reasons stated in the VF FHA. Sprinkler systems comply with the requirements and intent of NFPA 13. Sprinkler supply lead-ins are 203 mm (8 in) in diameter. Post indicator valves that can be locked open have been provided on each supply lead-in. A dry pipe sprinkler system is installed in the Vitrification Test Facility.

A pre-action system is installed where it is particularly important to prevent the accidental discharge of water, namely in the VF Control Room. The detection method chosen to activate the pre-action valve has high reliability and a separate alarm and supervisory signal to indicate status. The detection mechanism is designed to be more sensitive than the closed sprinklers in the Pre-Action system, but not so sensitive as to cause false alarms and unnecessary actuation of the Pre-Action system water admission valve.

A Deluge system has been installed in the DGR to remove the heat and lower the temperature of the surrounding area to preclude the spread of fire. The system complies with NFPA 13.

Special Protection systems are used to extinguish or control fire in easily ignited, fast-burning substances such as flammable liquids, some gases, and chemicals. They are also used to protect ordinary combustibles in certain high-value occupancy areas that would be especially susceptible to damage. Special Protection systems supplement automatic sprinklers as described by NFPA codes and have not been used to substitute for them except where water is not available for sprinkler protection. Halon systems are provided in the HVOS. The installation of Halon 1301 systems comply with NFPA 12A.

5.3.1.10 Lightning Protection

The electrical specifications for the construction of the Main Plant (Bechtel Associates, June 18, 1964) invoke the applicable rules and regulations of the American Standards Association (known as the American National Standards Institute [ANSI] since 1969), the National Electrical Manufacturer's Association, and the National Electrical Code, currently published by the National Fire Protection Association (NFPA). These electrical specifications stipulate that (1) non-current-carrying metal parts of electrical apparatus, metallic conduit, transformer secondaries, structural steel, and storage tanks shall be grounded; (2) the conduit system shall form a tight complete metallic continuous ground system for all non-current-carrying metal parts connected to it, and these parts shall be considered grounded; and (3) all ground conductors shall be soft-drawn, stranded, bare copper wire or flat copper bushbar, with a minimum size of #4 American Wire Gauge (AWG) (0.20-in diameter wire).

NFPA 780, "Standard for the Installation of Lightning Protection Systems," (National Fire Protection Association 1997), states that strike termination devices shall not be required for those parts of a structure located within a zone of protection. A strike termination device is a component of a lightning protection system that is intended to intercept lightning flashes and connect them to a path to ground. Strike termination devices include air terminals (i.e., lightning rods), metal masts, permanent metal parts of structures in some instances, and overhead ground wires installed in catenary lightning protection systems. A zone of protection is the space adjacent to a lightning protection system that is substantially immune to direct lightning flashes. The Main Plant stack is considered to serve as a strike termination device and to provide a zone of protection for several of the facilities addressed in this SAR. NFPA 780 states that the zone of protection shall form a cone having an apex at the highest point of the strike termination device, with walls forming approximately a 45-degree or 63-degree angle from the vertical. Hence, the Main Plant, 01-14 Building, UR and URE Fire Pump House, FRS facility, Vitrification Facility, and most of the Waste Tank Farm are within the Main Plant stack's zone of protection and therefore do not require strike termination devices. NFPA 780 also states that metal guy wires and cables used to support stacks shall be grounded at their lower ends. The guy wires used on the Main Plant stack satisfy this requirement.

WVNS-FHA-013, "Fire Hazard Analysis Cross-Reference STS/PVS Facilities," notes that the Main Plant stack substantially reduces the likelihood of a direct lightning strike at the STS and PVS facilities (as these facilities are only slightly beyond the NFPA 780 defined cone of protection provided by the Main Plant stack), and that the facilities, systems, and equipment are grounded to ground grid. WVNS-FHA-013 cites several drawings for more detailed information in this regard.

5.4 Description of Service and Utility Systems

5.4.1 HVAC Systems

Airborne contamination control in WVDP facilities is maintained through the use of building ventilation systems. See Figures 5.4-1 through 5.4-8. These systems have also been designed to satisfy building temperature and humidity control requirements.

Ventilation for the STS building is provided by the STS PVS. This system provides a minimum differential pressure of 15-mm (0.6-in) water column (w.c.) between routinely occupied areas and potentially contaminated areas. Ventilation in the Main Plant building is provided by two independent ventilation systems, namely the HEV system and the Main Plant ventilation system. The HEV system ventilates areas in the head end of the Main Plant, including those areas identified as providing support for storage of vitrified HLW produced in the Vitrification Facility. The Main Plant ventilation system ventilates all other areas of the Main Plant, including those areas housing equipment associated with the LWTS. Ventilation for the CSS is provided by the 01-14 Building heating and ventilation system. Ventilation for the FRS Building is provided by the Main Plant ventilation system and the recirculation ventilation system. The Vitrification Building and Cold Chemical Building have their own HVAC systems.

Building ventilation systems have been designed to ensure contamination confinement during normal operations and to minimize the spread of contamination during abnormal operations. Ventilation filters and blowers are provided with redundant spares to ensure that confinement is maintained in the event of a failure in the on-line system. Airflow during normal and abnormal operations is from uncontaminated areas such as stairwells and operating aisles to areas of increasing contamination such as cell service areas and airlocks to process cells.

Although filter configurations vary between facilities, the final filter in site ventilation systems is a HEPA filter or bank of HEPA filters capable of removing at least 99.95% of aerosol particles having a mean aerodynamic diameter greater than 0.3 microns. Adequate ventilation system performance is assured through effluent stack monitoring. Operation of stack monitoring systems is described in Chapter 8.

5.4.1.1 Key Components and Characteristics of WVDP HVAC Systems

5.4.1.1.1 Permanent Ventilation System

The PVS provides contamination and temperature control to the STS support building, valve aisle, pipeway, and the HLW Tank 8D-1 and 8D-2. During normal operations, air flows from the supply fan through a filter to the demineralized water/zeolite area from which air is directed to the operating area in front of the Valve Aisle. The control room has a separate HVAC system that draws from the outside air. Operating areas are protected by fire dampers between floors.

Approximately 1.9 m^3/s (4,000 cfm) of ventilation air is directed from the Operating Aisle to the Valve Aisle and into the pipeway. Air leaving the Operating Aisle passes through a roughing filter, HEPA filter, and tornado damper. Air is then routed directly to a train consisting of roughing and HEPA filters (two) in series. One of two trains (parallel, redundant) are always operational. The ventilation air then flows to exhaust blowers; both are powered by electricity. One is maintained as a back-up designed to start

automatically if the primary blower fails. An auxiliary power supply (electric) is provided to these blowers.

Permanent Ventilation System Supply and Distribution System

Outside air is supplied to the operating areas of the STS support building from separate supply fans. Approximately 0.7 m^3/s (1,500 cfm) of recirculation air is provided to the control room while 2.3 m^3/s (4,900 cfm) of air is supplied to the fresh zeolite and water tank area on the second floor. In-leakage is expected from the control room and from the fresh zeolite and water area. The operating area in front of the valve aisle receives approximately 1.8 m^3/s (3,800 cfm) from the zeolite area. This air is then directed to the valve aisle or into the pipeway/shield structure on top of the Tank 8D-1 vault. An infiltration of 0.09 m^3/s (190 cfm) enters the pipeway from the tank farm piping trenches. The resulting 1.9 m^3/s (4,000 cfm) is then exhausted to the STS PVS air treatment system.

Exhaust air from Tank 8D-1 and Tank 8D-2 is handled through the PVS. Approximately 0.3 m^3/s (640 cfm) of air is ventilated through Tank 8D-1 or 8D-2 to the PVS during operations requiring access to Tank 8D-1 or 8D-2 through the riser openings. It is required that air flow be through a riser access opening in order to comply with the minimum capture velocity across any opening in the Waste Tank Farm HLW tanks. The minimum capture velocity is 0.64 m/s (2.1 ft/s).

Permanent Ventilation System Exhaust System

The exhaust fans (PVS blowers) provide the system draft and are rated for 100% flow capacity of the heating and ventilation system with all the filters at the changeout pressure drop. Both exhaust blowers are electrically operated. The back-up will automatically activate if the primary blower fails. A diesel generator provides back-up in the event of power failure.

Ventilation air flows from the pipeway and HLW pipe conduit and is exhausted through a bank of roughing filter and two banks of HEPA filters in series. (See Fig. 5.4-1.) The filters are housed within the air treatment system and are connected with a heater and mist eliminator. HEPA filters are contained by a housing constructed of stainless steel. Differential pressure is measured across each filter holder in the heating and ventilation system. The primary filter holder has local low/high pressure alarms that sound a trouble annunciator in the control room. A remote trouble alarm in the STS control room would alert operators of a problem with the PVS.

Following off-gas treatment, ventilation air passes through the blower and discharges to the STS PVS stack. Air is continuously sampled to assess radioactive material releases.

5.4.1.1.2 Main Plant Ventilation System

Air in the Main Plant ventilation system is filtered, conditioned (in the warmer months only) and distributed on a once-through basis from uncontaminated areas to areas containing a progressively greater degree of radioactivity. These more contaminated areas are maintained at a minimum lower relative pressure of approximately -0.075 kPa (-0.30 inches w.c.). Air from these areas exhausts to the Main Plant ventilation exhaust system where it passes through roughing and HEPA filters before being exhausted to the atmosphere through the Main Plant stack. The exhaust rate of gas to the stack by this system is approximately 14.2 m^3/s (30,000 cfm). Primary components of the Main Plant ventilation system are described below. Main Plant ventilation system flow is shown in Figure 5.4-2.

Main Plant Ventilation Supply and Distribution System

Fresh air entering the Main Plant ventilation system is filtered, conditioned for temperature control, and distributed to normally occupied spaces. Distribution of air from the Main Plant ventilation supply system is to the Control Room, North Analytical Aisle, East Stairs, and North Stairs. Air flows from these areas to adjacent operating aisles and stairways and into process cells.

From the Control Room air flows to the East Stairs, South Stairs; and Upper Extraction Aisle. Air from the East Stairs and Upper Extraction Aisle is drawn into operating areas and process cells to the Main Plant ventilation plenum. Air from the South Stairs flows to the Off-Gas Aisle, Acid Recovery Cell, and Off-Gas Cell and exhausts to the Main Plant ventilation plenum. Air from the Off-Gas Aisle flows into the Analytical Decontamination Aisle (ADA) where it is filtered and cooled and subsequently drawn into the analytical cells. It is then exhausted to the ventilation washer plenum.

Makeup air for the Analytical Aisle is filtered and conditioned for temperature control through an air-handling unit mounted on the laboratory roof. Air handlers are installed in the Analytical Aisle and provide filtered and cooled air to the individual laboratories.

Air from the North Stairs flows into operating aisles to the Extraction Cells, Liquid Waste Cell, and PMC. Air from the Extraction Cells and Liquid Waste Cell is combined with air from the FRS water treatment area and decon stall and then is exhausted to the ventilation wash cell plenum.

Main Plant Ventilation Exhaust System

Equipment for the Main Plant ventilation exhaust system is contained in the Ventilation Exhaust Cell (VEC).

The VEC is located on the roof of the CPC at a plant elevation of 148 ft. The VEC contains the ductwork, filters, blowers, and controls for the Main Plant's main ventilation system. The VEC contains two parallel filtration systems, one used for normal operations and the other as a back-up system. Each system has a blower connected to a filter bank containing thirty roughing filters and thirty HEPA filters. The VEC also has a 2.36-m^3/s (5,000-cfm) blower that exhausts air directly from the FRS Building to the Main Plant stack.

Air flow in the Main Plant ventilation exhaust plenum is directed to either of two filter trains and an associated blower. Each train is comprised of a bank of roughing filters and HEPA filters in series. Filter banks are each composed of an array of filters six filters wide and five filters high. The electrically-driven primary blower is provided with a redundant electrically-driven spare, which can be powered by the 1,250-kW diesel generator located in the Utility Room Extension. The operating capacity of the blower is regulated by inlet vortex dampers on each blower that are controlled by a pressure recorder-controller in the Main Plant Control Room. Other instrumentation includes recorders and alarms to monitor filter train differential pressure and controls for automatic switchover. The configuration of Main Plant ventilation system equipment is shown in Figure 5.4-1.

Controls are arranged such that the primary train is isolated and the secondary train is placed on line upon: (a) high filter differential pressure, (b) low filter differential pressure, (c) loss of electric power, or (d) loss of control air pressure.

5.4.1.1.3 Head End Ventilation System

Supply air in the HEV system is filtered, conditioned, and distributed on a once-through basis from uncontaminated areas to areas containing a progressively greater degree of radioactivity. Figure 5.4-3 presents the ventilation flow in the head end of the Main Plant. The system was designed and constructed after initiation of fuel reprocessing activities to supplement the Main Plant ventilation system. Consequently, areas currently ventilated by the HEV may be ventilated by either the HEV system or the Main Plant ventilation system through positioning of a damper in the CPC and/or PMC. Dampers in the CPC and PMC currently isolate the HEV from the Main Plant ventilation system.

The HEV system provides contamination confinement for areas in the Main Plant formerly associated with mechanical processing activities as well as areas used to provide storage for vitrified HLW (i.e., the HLWIS area), namely the Equipment Decontamination Room, Chemical Process Cell, and Chemical Process Cell Crane Room. Air from these areas exhausts to the HEV exhaust system where it passes through prefilters, roughing filters, and two banks of HEPA filters in series before being exhausted to the atmosphere through the Main Plant stack. The exhaust rate of gas to the stack by this system is approximately 6.6 m^3/s (14,000 cfm).

The Vitrification Building interfaces with previously existing Main Plant HVAC zones through limited areas. The interface area is the Transfer Tunnel from the Vitrification Cell to the EDR. The Transfer Tunnel itself normally receives air from the SFR for subsequent transfer into the Vitrification Cell during operation. The EDR interfaces with the "truck lock" from which it normally receives air, which is in turn transferred to the CPC. The CPC is normally maintained at negative pressure by the HEV system to minimize uncontrolled outleakages. The differential between the Transfer Tunnel pressure and the EDR pressure is minimized during normal operation to avoid air transfer.

Head End Ventilation Supply and Distribution System

Supply air in the HEV system is filtered, conditioned, and distributed on a once-through basis to areas in the head end of the Main Plant. Distribution of air in the HEV is from the North Stairway and the COA. From the North Stairway air is distributed to the GOA, the PMCR air lock, and the CCR via the North Analytical Aisle. From the COA air flows to the Equipment Decontamination Room Viewing Aisle and SRR.

From these areas air flows via cell dampers and in-leakage into contaminated process cells. Air flow in the process cells is from the SRR, PMC, and CPC, through floor hatches, to the GPC. Air is exhausted from the GPC to the HEV exhaust filter inlet plenum via a 90-cm (36-in) duct.

Head End Ventilation Exhaust System

The HEV system exhaust treatment equipment comprises of two parallel primary blowers, a back-up blower, and redundant filter trains, each consisting of prefilters, roughing filters, and two stages of HEPA filters. This equipment is depicted schematically in Figure 5.4-1. The HEV exhausts 6.6 m^3/s (14,000 cfm) of air directly to the Main Plant stack where it is discharged to the atmosphere.

The redundant HEV filter trains each contain four filter banks. The first two banks are composed of a prefilter and roughing filter in series. The roughing filters exhibit a removal efficiency of approximately 90% and therefore the majority of particulate contamination is removed at this point. Following the bank of roughing filters are two banks of HEPA filters in series. The second bank of HEPA filters provides assurance of particulate removal and protection from a release of radioactive material in the event of a malfunction in the upstream HEPA filters.

There are three blowers in the HEV system. The two primary blowers are each rated at 3.4 m^3/s (7,200 cfm). They are parallel-mounted and powered by electric motors. There is also a 6.6-m^3/s (14,000-cfm) back-up blower. The backup blower system ensures continuous operation of the HEV system in the event of loss of electrical line power. The back-up blower is a single 6.6-m^3/s (14,000-cfm) blower and is powered by the WVDP back-up electrical power system. Dampers control the flow of air to the blower(s) in use.

Controls are arranged such that the primary train is isolated and the back-up train is placed on-line upon either (a) high filter differential pressure, (b) low filter differential pressure, or (c) loss of electric power.

Air exiting the HEV system exhaust blowers enters the stack at a 30° angle through a stainless steel duct that is welded to a reinforcing plate in the stack. This effluent is then sufficiently mixed with other effluent discharge streams in the stack before reaching the stack gas sampling and monitoring probes.

5.4.1.1.4 FRS Building Heating and Ventilation System

The Recirculation Ventilation System provides the HVAC requirements by recirculating approximately 7.1 m^3/s (15,000 cfm) of air through heating or cooling coils while adding approximately 0.9 m^3/s (2,000 cfm) of makeup air and by filtering the air to remove entrained particulates.

This system includes high efficiency filters, redundant recirculation fans, a reheating coil, a makeup air roughing filter, ductwork, and controls. Two identical recirculation fans provide airflow through the system. Each fan is powered by a 15-kW (20-hp) motor and has a rated flow capacity of 4 m^3/s (8,500 cfm). Only one fan is usually on-line with the other maintained on standby, although both may be run simultaneously.

FRS Building Ventilation and Distribution System

The Recirculation Ventilation System draws 6.6 m^3/s (14,000 cfm) of air from above the fuel pool north aisle, along with a small amount of air that is drawn into the system from the east end of the FRS Building. Air from the FRS Building is filtered through four banks of three high-efficiency filters that are located in the Recirculation Ventilation Building. Filter housings are dampered so that individual filters may be removed and replaced without taking the entire system off-line. Plenums have been installed upstream and downstream of the filter housing to ensure uniform filter loading. A steam-supplied reheat coil is provided to warm air returning to the FRS Building. A total of 8 m^3/s (17,000 cfm) of air is exhausted along the south aisle of the FRS Building.

5.4.1.1.5 01-14 Building Heating and Ventilation System

The 01-14 Building heating and ventilation system is designed to provide at least seven air changes per hour in potentially contaminated areas of the building. Ventilation flow in the 01-14 Building is shown in Figure 5.4-4. A

minimum differential pressure of -0.125 kPa (-0.5 inches w.c.) is maintained between routinely occupied areas and potentially contaminated cell areas. Except for air infiltration, inlet air is filtered and, if necessary, heated for personnel comfort.

All heating and ventilation system components are designed to be maintained in areas free of airborne or surface contamination. Permanent or temporary air locks maintain proper air flow during maintenance operations involving the pump niche, Waste Dispensing Cell, or the Process Cell. During shutdown of the supply air system for regular maintenance or because of failure, gravity dampers in the clean drum storage area open and allow outside air to enter the area and the Process Cell. Air infiltration and induced air flow through the air supply unit provide air for the Off-Gas Cell.

01-14 Building Ventilation Supply and Distribution System

The 01-14 Building heating and ventilation system supplies outside air to the 01-14 Building operating aisles from the second floor supply fan and through infiltration. A portion of this air vents the operating aisles and is ultimately processed through a roughing and HEPA filter to a blower to be vented from a stack on the 01-14 Building. The remainder of the inflow is directed to the CSS Process Cell, the Waste Dispensing Cell, and directly to two HEPA filters. Air exiting the Process Cell is directed to the Waste Dispensing Cell. Air exiting the Waste Dispensing Cell is combined with air from the vitrification off-gas trench and 01-cell and exits through a series of two HEPA filters to a stack on top of the 01-14 Building.

01-14 Building Ventilation Exhaust System

The 01-14 Building ventilation exhaust system maintains two filtration systems, both located on the third floor of the 01-14 Building. The first system comprises two parallel trains consisting of a roughing filter and HEPA filter in series. Air originating in operating aisles and the filter change room is exhausted through these filters.

The second system provides filtration for air ventilated from other areas of the 01-14 Building, including the CSS Process Cell and Waste Dispensing Cell, the vitrification ammonia valve gallery, and the 01-cell. Air in this system is exhausted through six parallel sets of two HEPA filters in series. The first stage of HEPA filters is located in a glove box constructed of 1.3-cm (0.51-in) stainless steel and provides for both confinement of contamination and shielding to reduce radiation levels in the filter room. The second stage of filters is located in individual filter housings.

The primary 01-14 Building HVAC blower is driven by an electric motor. The back-up HVAC blower is driven by an electric motor that is tied into a standby power source. Air exhausting from the ventilation system blower is routed to a stack on top of the 01-14 Building. The configuration of 01-14 Building ventilation exhaust equipment is shown in Figure 5.4-1.

5.4.1.1.6 VF HVAC Systems

The VF HVAC systems maintain a suitable thermal environment and acceptable air quality to ensure personnel health, safety, and comfort. A primary function is to ensure that air flows from areas of less potential for contamination to areas with a higher potential for contamination. HVAC systems also contribute to proper equipment operation and to maintaining the integrity of structures. The HVAC equipment that services the Vitrification Cell is designed to minimize the release of radioactive and other hazardous materials via exhaust effluent during normal operations, anticipated off-normal operational

occurrences, and design basis accidents (DBAs), including severe natural phenomena and manmade events.

The release point from each ventilation system is located in such a manner as to minimize the possibility of the released air being drawn back into a fresh air intake. Exhaust from potentially contaminated areas is appropriately filtered and discharged.

Provisions are made to ensure continuous and uninterrupted air flow during normal operations including maintenance and stand-by conditions. These provisions incorporate the following features:

- Systems are designed with redundancy and/or diversity where required to improve reliability.
- Filtration train flow rates are limited to less than 11.8 m^3/s (25,000 cfm).
- Instrumentation is used to automatically control the volume through supply and exhaust systems in the event of shutdown or reduced exhaust flow.
- Parallel or redundant filtration trains are connected to common exhaust ductwork to improve reliability.
- Filter change-out is designed to be accomplished with minimum exposure to personnel and minimum release of contaminants outside the housing.
- Filter housings are readily accessible to assist in filter change-out.
- Access to and maintenance of HVAC equipment does not require removal of HVAC ductwork. Access is provided for maintenance and testing.
- Redundant fans connected to common ductwork use isolation valves to prevent recirculation through the idle fan and facilitate maintenance.
- Test sections and connections are provided for HEPA filters to confirm leak tight installation and efficiency.
- Component design and testing in accordance with ANSI/ASME N509 and ANSI/ASME N510, as applicable.

The following HVAC systems or components are associated with vitrification operations and are discussed in subsequent subsections.

- Vitrification Building HVAC
- In-Cell Coolers
- VF Control Room HVAC
- Diesel Generator Room HVAC
- Cold Chemical Building HVAC
- Pump Pit Ventilation.

5.4.1.1.6.1 Vitrification Building HVAC

The Vitrification Building HVAC system provides for area temperature control and is instrumental in confinement of airborne radioactivity by directing air flow from areas of low potential for contamination to areas of successively higher potential for contamination. Three confinement zones are defined for this purpose. Zone I consists of those areas that are expected to contain a significant amount of airborne activity during normal operations. This zone includes the Vitrification Cell, Transfer Tunnel, and CMR. Zone II consists of the operating areas and other potentially contaminated areas surrounding Zone I. Zone III designates areas inside the Vitrification Building that are

expected to be free of contamination (e.g., the Control Room). Figures 5.4-5 and 5.4-6 show the zones. The pressures in various rooms/cells/areas with respect to outside atmosphere and adjacent zones are shown in Table 5.4-1.

Figure 5.4-7 shows the key components of the Vitrification Building HVAC system. The Ventilation Supply system provides HEPA filtered and conditioned air (i.e., heated or cooled, as appropriate) to equipment and/or working areas. The Ventilation Exhaust system is a filtered system balanced to maintain potentially contaminated areas below atmospheric pressure and prevent unfiltered outleakage of airborne radioactive material.

As a result of zoning the air spaces, inside air flow is from Zone III into Zone II and then into Zone I, or is filtered and exhausted directly from Zone II. During normal plant operation, the Vitrification Building supply system provides filtered air directly to the Zone II or Zone III ex-cell areas. The filtered exhaust system filters the Vitrification Cell (Zone I) air through the in-cell primary HEPA filter units and ex-cell secondary filter unit prior to release. A filtered exhaust system also filters and exhausts air from building areas (Zone II) located outside of the Vitrification Cell prior to release.

The differential pressure to atmosphere of the Vitrification Cell is measured by one of two pressure differential transmitters either of which send its signal to one of two separate pressure controllers. The controller outputs control the position of the Variable Inlet Vanes (VIVs) in exhaust fans. If Vitrification Cell negative pressure cannot be maintained, differential pressure controls automatically isolate the Vitrification Cell by closing appropriate isolation valves and initiating automatic shut-off of the supply fan. These isolation valves can be manually opened at the direction of the shift supervisor to permit natural circulation ventilation.

The ventilation supply system distribution plenum has a pressure sensor to control the supply fan VIV to maintain constant flow. A system of duct louvers and dampers distributes the air during normal plant operation. When the main supply unit shuts down, the following occurs:

1. Exhaust from the ex-cell areas is isolated.
2. Back-up fresh air intake dampers are opened to provide make-up/transfer air for the continuously exhausted Zone I spaces.
3. Back-up stairway pressurization fans start to pressurize the respective stairways (only if supply unit is shut down due to tripped fire/smoke sensor).

Smoke/fire detection automatically initiates shutdown of the supply fan to prevent the spread of smoke and reduce the supply of air to the fire, in accordance with NFPA 90A.

The secondary filter unit is an internally partitioned housing with a section dedicated to the in-cell area and the other section to the ex-cell area. The secondary filter unit draws Zone I air from the in-cell primary HEPA filters (via dedicated ducts, each with a shutoff valve) and filters air from Zone II and Zone III areas directly. The section that services in-cell air consists of nine HEPA filters arranged in three isolable filter modules. Dampers are provided to allow isolation of one train of HEPA filters during off-line periods or filter replacement. The section that services ex-cell air draws air via a common plenum from the operating aisles, equipment rooms and other ex-cell areas. This section consists of twenty-one prefilter and HEPA sections grouped into nine isolable modules. Excess capacity and isolation dampers are provided to allow filter change-out and aerosol testing of the HEPA filters while the exhaust system remains operating. In addition, local

prefilters for each duct exhausting Zone II areas are provided to minimize loading of the ex-cell area secondary filter section. The inlet to the ex-cell area section is automatically isolated if either exhaust fan fails to operate (including loss of normal power) or upon shutdown of the Ventilation Supply system.

The in-cell and ex-cell sections of the secondary filter unit are connected to two (redundant) centrifugal fans through a common plenum. Each fan incorporates an isolation valve on its inlet and outlet to prevent reverse air flow through the inactive fan during stand-by mode or maintenance activities. These air-operated isolation valves also utilize an air accumulator to assure availability of motive power in case the normal air supply is not available. Each fan utilizes VIVs to control air flow based on predetermined desired pressures in the cell.

The stairways are equipped with back-up ventilation fans to maintain stairway pressurization and ventilation in the event of the ex-cell Ventilation Supply system being shut down due to a tripped fire/smoke detector. Each stairway is normally ventilated and pressurized by the conditioned supply air from the Vitrification Building air supply components, and exhausts to the outside via wall louvers located in the lower portion of the stairway. Each louvered opening is provided with a pneumatically operated fail-closed damper. Dedicated pressure-relief louvered wall openings with counter-balanced dampers are located high on the wall, under each stairway roof. The counter-balanced dampers are adjusted so that there is no flow when the normal ventilation system is in operation. When the back-up fans are energized, the normal relief openings are automatically closed and backflow dampers prevent reverse flow through the supply duct.

The chiller equipment room, designated HVAC Zone III, is ventilated by a dedicated axial fan. The chiller equipment room ventilation fan, activated via a local temperature switch, draws in outside air through a fail-open air-operated damper. The chiller equipment room is not supplied from the ex-cell Ventilation Supply system.

Local electric heater units are provided for HVAC Zone II and Zone III areas. They are provided with local on-off fan switches and local thermostats for controlled heating.

The valves isolating the cell, fan controls, and stair fans are supplied with stand-by as well as normal power.

The Vitrification Building HVAC system functions as a confinement barrier. An extensive discussion of the HVAC system from this perspective, i.e., as a confinement barrier, is provided in Section 5.2.2.9.

5.4.1.1.6.2 VF Control Room HVAC

The Control Room HVAC system maintains a predetermined environmental envelope for the control room during normal operation and abnormal events.

The Control Room HVAC system consists of two 100% capacity air handling units (one operating unit and one back-up). Each air handling unit is factory-assembled and includes (in the direction of air flow): an intake plenum, prefilter section, final filter section, access section, electric heating coil section, chilled water cooling coil section with insulated drain pan, and centrifugal fan. The air handling units are served by common supply and return ductwork. The air handling units are supplied with chilled water from the Chilled Water system.

The pressure within the control room is maintained at a positive pressure with respect to the outdoors and adjacent areas. This positive pressure feature precludes the introduction of contaminants into the control room.

During normal operation, HEPA filtered make-up air from the main building air handling unit mixes with the returned air before it is conditioned by the control room air handling units and resupplied to the control room. In addition, the air passing through the control room air handling units is filtered by pre-filters and final filters. Approximately 0.14 m^3/s (300 cfm) of HEPA filtered and conditioned make-up air is supplied from the main air handling unit. This fresh air replaces air lost through doors and other openings due to the higher than atmospheric pressure maintained in the control room. During an abnormal event, the system would continue to process a mixture of control room air and HEPA-filtered fresh air, and would maintain the control room environmental envelope. If smoke were detected in the air handling units, the system would automatically shut down.

5.4.1.1.7 Ventilation System Stacks

Main Plant Stack

Ventilation and off-gas systems that discharge to the Main Plant stack are shown in Figure 5.4-1. The ventilation stack extends to an elevation of 62 m (202 ft) above building grade. The stack is a self-supporting, guy wire-stabilized, gunnite cement-reinforced stainless steel structure. The three guy anchor assemblies are connected to the 40.5-m and 56.1-m (133-ft and 184-ft) level holding collars by 2.22-cm (7/8-in) cables. The stack base, from roof level to 15 m (50 ft) above the roof, was reinforced by application of gunnite cement over steel dowels and holding bolts.

There are two platforms on the stack, one at the top and one at the 24.4-m (80-ft) level, where the stack sampling ports penetrate the stack.

PVS and 01-14 Stacks

Effluents from the STS HVAC and 01-14 Building discharge to small stainless steel stacks atop the PVS and 01-14 Buildings, respectively. The PVS stack is approximately 4.9 m (16 ft) in height and is 48 cm (19 in) in diameter. The 01-14 Building ventilation stack is 4.7 m (15 ft 4 in) in height and is 61 cm (24 in) in diameter. Influents to the PVS stack and 01-14 Building stack are indicated in Figure 5.4-1.

5.4.1.2 Safety Considerations and Controls of WVDP HVAC Systems

IRTS and Main Plant ventilation systems have been designed to ensure confinement of radioactivity and to minimize discharges of radioactivity off-site. Key ventilation system components such as blowers and filter trains have been provided with installed spares. These systems and the associated redundant spares are provided with standby or back-up power. In the event of power loss, ventilation systems are designed so that operation will be restored either automatically or manually. The standby exhausters can be started and brought on line manually, thus overriding automatic system operation.

Airborne radioactive discharges from facilities at the WVDP are maintained within DOE guidelines by ventilating effluent through HEPA filter systems. These filter systems provide the primary barrier to airborne radioactivity release to the environment. Filter system efficiency at the WVDP is determined through an in-place leak test before new filters are operated and

through subsequent annual tests. HEPA filters used at the WVDP must meet requirements prescribed by the Department of Energy (October, 1988).

Instrumentation has been provided to monitor the integrity of ventilation system filters. A summary of filter monitoring instrumentation is given in Table 5.4-2.

Permanent Ventilation System

Differential pressure is measured across each filter holder in the PVS system. The primary filter holder has local low- and high-pressure alarms that sound a general trouble annunciator in the STS control room.

In response to low/high differential alarms, the parallel and redundant filtering train will be automatically activated. This redundancy ensures continuous and adequate air filtration and treatment should filter failures occur. The PVS dampers are designed to fail-safe in the event of loss of utility air pressure. The back-up blower will automatically come on-line should primary electrical power be lost or the primary PVS blower fail.

Main Plant Ventilation System

The two Main Plant ventilation system filter trains (primary and back-up) each consist of a roughing filter and a final HEPA filter in series. There are two differential pressure sensing systems for the filters in each train. One system senses the pressure across the filter train, the other senses the pressure across the HEPA filter bank. The train system contains high and low differential pressure alarms that annunciate in the Control Room to signal a plugged or ruptured filter(s). In addition to the alarms, there are high and low differential pressure controllers that will cause the operating filter/exhauster train to switch should the differential pressure become too high or too low. The differential pressure sensing system for the HEPA filter bank consists of a differential pressure recorder and high and low alarms that annunciate in the Control Room.

Head End Ventilation System

The controls for the HEV system are similar to the controls for the Main Plant ventilation system. The HEV filter train controls consist of isolation dampers and differential pressure monitoring. When this pressure exceeds the set point for high differential pressure the filter train isolation dampers are automatically activated such that the standby train is brought on-line and the operating train is taken off line. It should be noted that in the HEV system the filter trains can be switched without switching blowers, which cannot be done in the Main Plant ventilation system. The differential pressure across the HEPA filter is also monitored. Should the differential pressure get so low as to drop below the low differential pressure set point (indicating a ruptured filter) the filter trains are switched. In addition to filter train switching, there is a high- and low-differential pressure alarm for the HEPA filters and a high-differential pressure alarm for the filter train. These alarms annunciate in the East Mechanical Operating Aisle.

In the event that both the primary and back-up blowers in the HEV system fail, approximately 3.2 m^3/s (6,800 cfm) air may be drawn out of the HECs through the bypass valves in the CPC and PMC into the Main Plant ventilation system to maintain some negative pressure in the cells (-0.025 kPa [-0.1 inches w.c.]). The ventilation system in this configuration is the original Main Plant ventilation system configuration, and therefore the direction of air flow would continue to be from areas of lower contamination to areas of higher contamination.

FRS Building Ventilation System

An identical recirculation fan is maintained on standby to provide airflow through the system. Filter pressure differential is monitored and indicated on a panel in the Recirculation Ventilation Building. An alarm located in the East Mechanical Operating Aisle alerts operations personnel to an abnormal differential pressure situation.

01-14 Building Ventilation System

The standby electric motor-driven blower will automatically start should electrical power be lost or the electric fan fail. Differential pressure is measured across each filter compartment. Each filter compartment also has a local pressure alarm which will, upon sensing a low or high pressure, activate an annunciator in the CSS/LWTS Control Room.

If a first-stage HEPA filter fails, the activity and media will be caught on the second-stage HEPA filters. Single failure of a second-stage filter would not be expected to result in a significant release of activity as the bulk of the entrained activity will be on the first-stage filters.

The exhaust fans are controllable both from a locally mounted panel on the fourth floor, from the CSS Control Room, and from the Main Plant Control Room. Each fan is rated at 100% system capacity.

5.4.2 Electrical

Electric power for the WVDP is supplied from a 34.5-kV Niagara Mohawk Power Corporation loop system. A feeder line from a 34.5-kV switching station transmits power to the site substations where it is stepped down to 480V. See Figure 5.4-9. The lake pumps, which supply water to the site, the Drum Cell, the RHWF, and NDA facilities obtain power from a separate Niagara Mohawk 4,800V - 480V rural system. Site perimeter monitoring stations receive power from this same rural system through individual 4,800V - 120V transformers.

Electricity from the 34.5-kV line is routed through fused disconnect switches to the two 2,500-kVA transformers at the Main Plant and the URE, which deliver standby power to 480V, three-phase buses via a 4,000-amp main breaker in the Switchgear Room and at the URE substation switchgear. From the 480V, three-phase buses, power flows to main circuit breakers which, in turn, supply motor control centers through underground cables, conduits, and cable trays. The motor control centers are located throughout the site facilities and supply power to motors, lighting transformers, and other electrical loads.

The substation switchgears are interconnected through cables to provide backfeed capabilities in the event that any 34.5-kV - 480V substation transformer fails.

Three-phase, 60-Hz back-up power is produced at 480V by a 625-kVA standby diesel-driven generator (30-P-1) located in the UR, a 1,560-kVA standby diesel-driven generator (30-P-2) located in the URE, and a 750-kVA standby diesel-driven generator (50-P-1) located in the PVS mechanical room. Diesel fuel for the 625-kVA generator is supplied from a 1,000-L (275-gal) day tank in the UR, while a 1,500-L (400-gal) day tank supplies fuel for the 1,560 kVA generator diesel engine. This fuel supply is sufficient for eight hours of operation. Additional fuel is supplied to the diesel generators from a 38,000-L (10,000-gal) aboveground tank that has a capacity that is sufficient for a period of at least five days. The diesel fuel for the 750-kVA generator

is supplied from a 380-L (100-gal) day tank and is automatically filled from a 2,000-L (550-gal) underground tank.

A summary of WVDP utility supply capabilities and use requirements is given in Tables 5.4-3 and 5.4-4.

Back-up power is required only for IRTS and Main Plant equipment for which power failure could result in a reduction in the degree of confinement. This equipment is grouped on MCC E located in the Switchgear Room, E-1 located in the Waste Tank Farm Shelter, generator switchgear P-2/SG located in the URE, MCC 21 (which is also located in the URE), and the PVS MCC-A located in the PVS MCC room. Back-up power is supplied by three standby generators that have the capacity to supply power to additional equipment beyond those on the MCCs and switchgear and these would be connected at the discretion of the Shift Supervisor. In the event of failure of the 34.5-kV power supply, all diesel generators will start automatically and then the associated switchgears will disconnect the utility company line, disconnect noncritical loads, and supply power to MCC E, MCC E-1, MCC 21, and to the PVS MCC-A. Additional loads can be connected to the line as required. Back-up power for the STS may also be provided by automatic switching to a diesel generator with sufficient stored fuel for eight hours of continuous operations. Back-up power is supplied to the FRS Building to provide electricity for lighting and area radiation detectors in the event of a line power failure. Other FRS facility loads can receive power (if deemed necessary) by manual actions. A battery in each area radiation detector ensures that their operation is continuously supported until back-up AC power is available.

5.4.2.1 Vitrification Facility Electrical Distribution System

VF power is received at two 2000/2300/2240/2576 kVA, OA/FA, 55°C/65°C, 34.5 kV-480/277V step-down transformers. Each transformer provides power to associated low voltage 480V switchgear A or B. Switchgear A and B along with the associated transformer, make up one double-ended 480 volt substation A and B. Switchgear sections A and B are electrically connected via a normally open, 480V, 3200A rated power circuit breaker. The 480V Substations A and B are located east of the Vitrification Building.

The Vitrification Building, Load-In Building, and Cold Chemical Building Electrical Distribution System (EDS) is a 480V distribution system that supplies power to loads with acceptable voltage and frequency in accordance with code and standard requirements. Spare circuits are provided in the MCCs and panels for connection of future devices. The EDS design conforms to the National Electrical Code (NEC) and manufacturers' recommendations.

Power is normally supplied from 480V Substation A and B. The 480V Substation A supplies power to MCCs 1, 2, and 3, Cold Chemical MCC, 480V switchgears A1 and A2, Load-In Building Power Distribution Panel, and the SFCM. Power required for two Power Distribution Panels, the PVS, and STS is normally supplied via 480V Substation B.

MCCs 1, 2, Cold Chemical MCC, and 480V switchgear A1 and A2 have 600A buses. MCC 3 has an 800A bus. Except for MCC 1 and 480V switchgear A1, all are supplied from 800A feeder breakers located at 480V substation A. Outgoing breakers in the MCCs and 480V switchgear A1 and A2 distribution panel are 150A frame size.

All MCC buses, 480V switchgears A1 and A2 buses, power panels, and lighting panels and their associated transformers, have adequate capacity to supply the continuous loads connected to the systems with adequate reserve capacity and spare feeders available in MCCs and 480V switchgears A1 and A2 buses.

Loads for which 480V three-phase supply is either impractical or undesirable are supplied from 208/120V and 240/120V distribution panels. These panels are connected to 480-208/120V three-phase transformers and 480-240/120V single-phase transformers, respectively. Loads may be supplied at 208V three-phase, 208V single-phase, 240V single-phase, or 120V single-phase.

The transformer secondary wye winding has its neutral solidly grounded. 600V rated power and control cable are used for 240V AC, 208V AC, and 120V AC service.

5.4.2.2 VF Standby AC Power Supply

The standby (on-site) power source consists of a VF diesel generator located in the DGR, adjacent to the SFR, and a diesel generator located in the PVS building along with its associated switchgear, distribution cabling, and controls. The STS/PVS diesel generator has enough capacity to supply 400 kW at 0.8 power factor to PP-3.

The VF diesel generator in the DGR is designed to withstand the effects of the site DBT or the DBE without loss of power to components. The diesel generator is designed for starting and automatic acceptance of the largest single load (either HVAC exhaust fan) to maintain proper Vitrification Cell negative pressure. When required, other loads can be administratively loaded to the diesel generator. The essential loads are shown in Table 5.4-5.

The diesel-driven generator is rated at 600 kW, 0.8 power factor, 1800 revolutions per minute (rpm), 480/277V AC, three-phase, 4-wire, 60-Hertz (Hz) and is complete with its accessories. The generator has a drip-proof frame, Class F insulation and is wye connected synchronous type. The voltage regulator provides voltage regulation within 2.0% under varying loads from no-load to full load. The generator has a static, solid-state excitation system. The unit is capable of one-step load acceptance equal to 80% of its nameplate rating and is capable of operating at its nameplate rating during utility power interruptions.

Voltage and frequency sensing devices are provided to prevent loading the generator until the diesel engine has accelerated to rated speed, and rated voltage is available.

The components of the Diesel Generator Auxiliary system are:

- Prime mover (engine),
- Fuel Oil system,
- Cooling system,
- Starting system, and
- Combustion Air Intake and Exhaust.

The prime mover (engine) is designed to provide rated mechanical power output, using #2 fuel oil (diesel) as the primary combustion fuel, to enable the attached electrical generator to develop 600 kW rated power output.

The Fuel Oil system for the VF diesel generator consists of a 27.9 m^3 (7,370-gal) fuel storage tank, transport system, 0.76-m^3 (200-gal) day tank, and related equipment to supply #2 fuel oil to the diesel generator. It is designed to provide a seven day fuel supply, assuming constant operation at full load. The Fuel Oil system also supplies fuel for the PVS diesel generator and the diesel-driven fire water pump.

The diesel generator engine is equipped with a liquid cooling system with a radiator. The battery-driven starting system consists of a starter, battery, and battery charger. The starting system is designed to perform repeated hot and cold starts of the diesel generator.

The DGR is protected from potential tornado generated missiles. A diesel generator failure modes and effects analysis is outlined in Table 5.4-6.

5.4.2.3 VF Uninterruptible Power Supply

In the event of loss of normal (off-site) and standby (on-site) power, uninterruptible power is provided to essential control, instrumentation, and computer systems. The source of this power is provided by 67-UPS-1, located in the VF HVOS (elevation 34 m [111.5 ft]), and UPS 63-UPS-2 and 63-UPS-3, located at elevation 30.5 m (100.0 ft), in a northwest area of the Vitrification Building.

UPS 67-UPS-1 is sized to provide 10 kVA supply at 120V AC for a period of one hour upon loss of power. UPS 63-UPS-2 and 63-UPS-3 are each sized to provide 20 kVA supply at 120V AC for a period of one hour upon loss of power.

UPS 67-UPS-1 provides AC power to 480V switchgear A1 and A2 (for tripping and closing AC power circuit breakers), HVAC control panel 67-V019, the stack radiation monitoring control panel, the diesel generator battery charger, the CCTV control cabinet located in the CMR operating aisle, vertical shield door No. 2 control, pump VP-510, and miscellaneous loads. In the event of a loss of normal (off-site) power, the battery-inverter system supplies power during the interim period necessary for the VF diesel generator to attain the required voltage and frequency levels. When diesel generator voltage and frequency are established, the diesel generator supplies the UPS requirements via 480V switchgear A1 and at the same time recharges the UPS batteries. In the event the diesel generator is not connected to the 480V switchgear A1 and A2 buses, the batteries have been sized with sufficient ampere-hour capacities to maintain 10 kVA maximum load for a period of one hour. Loads (as shown in Table 5.4-7) from UPS 67-UPS-1 are supplied via power panel PP-6.

UPS 63-UPS-2 provides AC power to equipment located in the VF Control Room, including the DCS station, the shift engineer/supervisor DCS station, the CCTV control cabinet, the communication system, HVAC control panel 67-V020, and the Control Room radiation monitor rack. The UPS also supplies alternate power to the control panel 67-V019, located in the HVOS. In the event of loss of normal (off-site) power, the battery-inverter system supplies power during the interim period necessary for the STS/PVS diesel generator to attain the required voltage and frequency levels and be connected to the system. When voltage and frequency are established, the diesel generator supplies the UPS requirements, and at the same time recharges the UPS batteries. In the event the diesel generator is not connected to the system, the batteries have been sized with sufficient ampere-hour capacities to maintain 20 kVA maximum load for a period of one hour. Loads (as shown in Table 5.4-8) from 63-UPS-2 are supplied via power panel PP-10.

UPS 63-UPS-3 provides AC power to equipment located in the VF Control Room including the fire control panel, DCS panels 1, 2, and 4, and the operator DCS station. The UPS also supplies power to the instrument racks located in the Vitrification Building. In the event of loss of normal (off-site) power, the battery-inverter system supplies power during the interim period necessary for the STS/PVS diesel generator to attain the required voltage and frequency levels. When diesel generator voltage and frequency are established, the diesel generator supplies the UPS requirements and recharges the UPS batteries. In the event the diesel generator is not connected to the system,

the batteries have been sized with sufficient ampere-hours capacities to maintain 20 kVA maximum load for a period of one hour. Loads (as shown in Table 5.4-9) from 63-UPS-3 are supplied via power panel PP-11.

5.4.2.4 VF-Related Support Power and Interfaces

Power to the equipment associated with the 01-14 Building is supplied from the 480V Main Plant/utility room substations. The HVAC blowers and the off-gas blowers are fed from 480V MCC 1 located in the utility room and 480V MCC 1,2,3 located in the 01-14 Building. The 480V MCC 2 and 3 are backed by on-site diesel generators previously discussed to provide power for selective essential loads including one HVAC blower, and two off-gas blowers. In the event of concurrent loss of off-site and on-site power, UPS 64-B-010, located in the 01-14 Building, provides power to essential controls, instrumentation, and computer systems. This UPS can provide 20 kVA power at 120V AC for a period of one hour upon loss of power.

Power to the equipment associated with the EDR and HLWIS area is supplied from the existing EDS, which is fed from the 480V Main Plant/utility room substation.

5.4.3 Compressed Air

Three compressors are available to meet compressed air needs at the site. They include a 260-kW (350-hp) electric centrifugal compressor and two 149-kW (200-hp) screw compressors. The centrifugal compressor is normally operated with the screw compressors configured to start automatically on loss of air pressure (either from equipment or power failure). All compressors are of non-lubricated design. A carbon monoxide monitor is installed to ensure air is of suitable quality for breathing to support manned entry to areas of elevated airborne radioactive contamination.

Instrument air is provided from the utility air system using an air dryer and a pressure-reducing valve to reduce the air pressure to 380-kPa (55-psi).

IRTS, Main Plant, and FRS equipment is designed to fail-safe during loss of air pressure.

5.4.3.1 VF Compressed Air

The VF Compressed Air system consists of two air subsystems: the Instrument Air (IA) system and the Utility Air (UA) system. Both IA and UA for the VF are supplied from an electric-powered compressor located in the utility room of the Main Plant, as previously discussed. Standby power sources can supply the backup compressors. The backup compressors start automatically when header pressure drops to a preset value. Air from the running compressor splits into two lines, one for UA and the other for IA. The IA system delivers dry, filtered, oil-free compressed air at a reduced pressure to meet pneumatic instrument and control requirements. The high-pressure air system serves as a back-up to IA for HVAC confinement barrier control.

The IA compressor is not included in the Table 5.4-5 list of equipment on stand-by power because high-pressure bottled air is used to backup critical pneumatic controls for the Vitrification Building HVAC system. The High-Pressure Air system automatically provides bottled air to the pneumatic controls of key HVAC equipment.

UA system pressure is designed to be 793 kPag (115 psig) under static conditions. A booster pump in the third floor operating aisle of the Vitrification Building is capable of increasing UA pressure up to 1,034 kPag

(150 psig). IA system pressure to the VF is 379 kPag (55 psig) under static conditions.

5.4.4 Steam Generation and Distribution

The steam generation and distribution system comprises two natural gas fueled fire-tube boilers with a 15,660-kg/hr (34,520-lb/hr) combined steam generating capacity. Number 2 diesel fuel oil can be used as an alternate fuel source in the event of an interruption in the gas supply. Each boiler is designed to provide the full steady-state steam demand requirements. Therefore, one boiler is normally on standby. At these times, the intermittent steam demand is met by operating the standby boiler unit.

Cessation of nuclear fuel reprocessing operations resulted in a major reduction in steam usage, so that the demand load (without Vitrification Building or Cold Chemical Building loads) is 3,629 to 5,443 kg/hr (8,000 to 12,000 lb/hr). The normal operating pressure for Main Plant steam systems was approximately 1,034 kPag (150 psig); hence, the boilers provide steam at about 1,034 kPag (150 psig).

Return condensate is collected in a condensate receiver where it is sampled for radioactivity. It may then be returned to the boiler water makeup system or pumped to the interceptor. A radiation monitor is provided on the condensate return lines to the receivers.

5.4.4.1 VF Steam Supply and Condensate Return

The VF Steam and Condensate system receives steam from the Main Plant utility room and distributes the steam to various components/steam users within the Vitrification Building, Cold Chemical Building, and Load-In Building for heating and transferring operations. Steam is also provided to purge and flush certain lines and equipment. Most users deliver the resulting condensate to the Condensate system, which returns the condensate to the utility room for eventual reuse in the boilers.

Steam is delivered to the Vitrification Building at approximately 1,034 kPag (150 psig) in a 152-mm (6-in) header, and is then routed at this pressure (via a tap off the 152-mm [6-in] header) to the Waste Tank Farm Equipment Shelter. Pressure is then reduced to approximately 689 kPag (100 psig) prior to distribution within the Vitrification Building and Cold Chemical Building. Individual steam users then further reduce the pressure as needed for their particular applications. All steam supply lines to the Vitrification Cell have a remotely operated flow-control valve and a manually operated cell-wall block valve.

VF steam requirements varied between 249 and 4,990 kg/hr (550 and 11,000 lb/hr), depending on the time in the process cycle and the weather conditions.

The steam header branches off to utility stations, instrument racks, and the Cold Chemical Building. Utility stations are provided at various elevations, as well as in the Transfer Tunnel, CMR, and CMR operating aisle. Steam is used for heating purposes, and steam jets are used for various applications in-cell. In the Cold Chemical Building, steam at approximately 689 kPag (100 psig) is provided to eductors, while steam reduced to approximately 172 kPag (25 psig) is provided to heaters, tanks, and utility stations.

Most Vitrification Building and Cold Chemical Building steam users deliver the resulting condensate to the Vitrification Building Condensate system; however, steam used by the transfer jets, and in some cases the steam used for purging, flushing, or agitating, enters the process liquids/slurries. When

appropriate, after steam is shut off from the purge or jet, the line is blown through with utility air to displace the steam and dry out the line to prevent forming a vacuum. (A vacuum could draw contaminated liquid into undesirable locations, e.g., piping runs located out of cell.) When a designated level is reached in the condensate collection sump, one of two condensate pumps activates and directs the water to a return header running to the utility room Condensate system for reuse as boiler feed. The two electrically driven condensate pumps run alternately (or together if a high-high sump level is reached). Sump capacity is 4.4 m^3 (1,165 gal). Condensate is monitored for contamination, and the condition is alarmed in the VF Control Room. If contamination is detected, the valve in the condensate return line (i.e., valve HV-6075) remains closed to prevent the transfer of contaminated condensate to the utility room.

5.4.5 Water Supplies and Water Cooling Systems

Water is taken from two manmade, interconnected lakes created by the construction of two dams near the south end of the site. The two lakes receive runoff from approximately 3,100-acres of land and contain approximately 2,100,000 m^3 (560,000,000 gal) of water. The lakes have a combined surface area of 25 acres. The pump house, which contains two 25-L/s (400-gpm) pumps, is located just inside the northernmost dam and is connected to the plant by 1,800 m (5,900 ft) of 20-cm (8-in) pipe that runs along the railroad spur.

A clarifier/filter system is installed for raw water treatment. Treated water is transferred to a 1,800,000-L (475,000-gal) tank for storage. Utility water pressure is furnished by two 16-L/s (250-gpm) pumps that supply water at a minimum pressure of 520 kPag (75 psi).

Demineralized water is produced in the Main Plant utility room by passing water through a two-bed, cation-anion demineralizer. Demineralized water is stored in a 68.1-m^3 (18,000-gal) storage tank. Three pumps are available to provide water distribution. Demineralized water exits the utility room at approximately 345 to 414 kPag (50 to 60 psig) when pump 32-G-5A or 32-G-5B is in service, and at 1,034 kPag (150 psig) when pump 32-G-5C is used. The storage tank is not insulated, but is equipped with a steam coil to maintain the temperature of the water above the freezing point during cold weather.

The Domestic Water system is allocated on demand from the "plant" system and is chlorinated for potability (using sodium hypochlorite) as the water is delivered to a 3,800-L (1,000-gal) accumulator tank. Cooling tower makeup is taken from the "plant" system. The Demineralized Water system will normally produce 1 L/s (16 gpm) of demineralized water and may produce 2 L/s (32 gpm) maximum makeup to the 6,800-L (18,000-gal) demineralized water storage tank. Figure 5.4-10 is a functional flow diagram of the CLCW system.

An electrically driven back-up pump is provided in the event that the electrically driven primary pump becomes unavailable. The backup pump can be powered from the stand-by generator. Transfer to the back-up pump occurs automatically on low-discharge header pressure. The hold tank has a working volume of approximately 3.0 m^3 (800 gal), but the normal volume during operations is approximately 2.2 m^3 (570 gal). A commercially available chemical corrosion inhibitor is added to the cooling water hold tank, in accordance with the manufacturer's recommendations, via a valve with a funnel opening. Additional inhibitor is added, as needed, to allow for made-up water added to the system. Utility water is used to initially fill the CLCW system and provide make-up water.

The Cooling Tower Water (CW) system is an open cooling tower rated at 140 L/s (2,200 gpm), making approximately 24°C (75°F) cooled water available from approximately 29°C (85°F) water returned to the tower. Chemical feed equipment is installed to support this system. Additions have been made to the existing CW system so that the system may service components associated with the vitrification process. These additions allow the CW system to: a) serve as the ultimate heat sink for excess heat removed from components by the CLCW system, b) service two water chillers, and c) service several tanks in the Cold Chemical Building. Only that portion of the CW system that supports VF operations is discussed in this section.

Water demand for IRTS process operations is indicated in Table 5.4-4. Original vessels and heat exchangers in the Main Plant that were supplied with cooling water are still connected to the CW system. To prevent the migration of radionuclides into the cooling system, these cooling coils are maintained under positive pressure, but without circulation, by keeping supply valves open and return valves closed. Should a leak develop from the cooling system into a cell, it would be detected by a rising level in the cell sump. Operating personnel would then take action to isolate the leaking component.

As indicated in Chapter 8, radioactivity alarms are provided in the cooling water and condensate returns from the process facilities in order to detect any contamination that might enter these systems. The primary barrier against such contamination is the positive pressure differential that exists between the systems and the contaminated process areas. Monitors are located in the main condensate and cooling water return headers from the Main Plant.

No water can contact personnel through these systems without sample analysis, so that in the unlikely event that contamination occurs, the source of the problem can be researched by other means such as grab samples from individual suspect equipment.

5.4.6 Natural Gas Supply and Distribution

Natural gas service for the WVDP is supplied from a 15-cm (6-in) diameter 414-kPa (60-psi) National Fuel Gas Corporation supply line. The National Fuel Gas Supply is regulated from 414 kPa (60 psi) to 170 kPa (25 psi) at a pressure regulator station located south of the UR. From the pressure regulator station natural gas is distributed to supply the plant boilers and meet area heating requirements on-site.

Several areas on-site are supplied with natural gas for localized heating purposes. Gas is distributed to these locations at 170 kPa (25 psi) and regulated at usage points as required. The locations of natural gas lines on-site are shown in Figure 5.4-11. Natural gas is not routed through areas containing radioactive materials.

A disconnected natural gas supply line is provided to the Vitrification Building, but it is not used in any vitrification process or system. The natural gas line is routed from the Main Plant and enters the Vitrification Building in the southwest corner at the 30.5-m (100-ft) elevation. The 51-mm (2-in) diameter pipe emerges from the floor and is immediately valved off and capped. In addition, the natural gas line is physically disconnected from the supply of the Main Plant to assure natural gas is not brought into the Vitrification Building.

5.4.7 Wastewater Treatment Facility

The wastewater treatment facility at the WVDP treats sanitary sewage and nonradioactive industrial wastewater from the UR.

The sanitary sewage handling system at the WVDP is a dedicated system of piping, pumps, and distribution. The treatment system consists of a 151,000-L/day (40,000-gpd) extended aeration system with sludge handling in the form of wasting and off-site shipment for disposal.

There are no entry points into the sewage system other than the toilet facilities, washroom, kitchen sinks, and shower facilities. No process area or office building floor drains are connected to the sanitary sewer system other than the floor drains in the facility shower rooms and lavatory facilities.

Industrial wastewater from the UR enters the system through a dedicated system of pipes, tanks, and pumps. It is collected and pumped into the wastewater treatment facility, where it is mixed with the sanitary sewage and treated.

Entries to the system are dedicated lines from the UR water treatment equipment, boilers, and floor drains in the URE.

The Waste Water Treatment Facility liquid discharge is one of four WVDP outfalls where liquid effluents are released to Erdman Brook. These four outfalls are identified in the WVDP State Pollutant Discharge Elimination System (SPDES) permit, which specifies sampling and analytical requirements for each outfall.

5.4.8 Safety Communications and Alarms

WVDP site communications and alarm systems are discussed in Chapter 10 of this SAR and in WVDP-022, *WVDP Emergency Plan Manual*. WVDP-022 provides information on emergency response equipment, including communications and alarm equipment. Communications equipment listed in WVDP-022 include commercial telephones, the 812 "all page" system, the 222 plant page system, the Gaitronics system, the power fail telephone system, cellular telephones, portable radios, pagers, and telefax machines. WVDP-022 indicates that alarm features are associated with: the fire detection system, continuous air monitors, process radiation monitors, area radiation monitors, stack monitors, portal monitors, and personnel contamination monitors.

5.4.8.1 Safety Communications

Access to a paging system is available from all site telephones to notify WVDP personnel of an abnormal or emergency condition. When the extension "812" is dialed, a distinct tone is annunciated through the site paging system speakers. The alarm is then followed by an announcement of the type and location of the emergency.

On-site communications systems include telephones, beepers, and hand-held radios. The WVDP radio network consists of nets A and B. Net A is assigned to Security and net B is assigned to Operations, Radiation Protection, the Emergency Operation Center, and Security. The Project also maintains a radio link with the Cattaraugus County Sheriff's Department that can be used to request assistance or obtain information.

5.4.8.2 Alarms

Integrated Radwaste Treatment Systems are provided with instrumentation to monitor flow, pressure, fluid levels, temperature, and radiation levels to ensure system operations are controlled and system limitations are not exceeded. Major equipment is operated remotely from control panels located in the system control room. In the event of abnormal conditions, the process

equipment can be manually shut off. Safety-related systems (e.g., ventilation system) are designed to achieve a safe condition automatically should off-normal conditions occur (i.e., dampers close, backup fan starts, etc.) or redundant systems are activated. Automatic controls for subsystems are provided with manual override capabilities.

IRTS instrumentation and controls allow a system to be started, operated, monitored, and shut down from the control room. Control panels are equipped with dynamic graphic displays to reduce the likelihood of operator error. The instrumentation indicates or alarms (or both) upon abnormal and undesirable conditions that could adversely affect system or equipment performance or inadvertently affect interfaces with other systems. During emergency conditions, external communications can be through the plant telephone system.

Operational safety-related systems that provide control room alarm indications in IRTS facilities include:

- ventilation system differential pressures
- radiation monitoring systems
- effluent monitoring systems
- leak detection systems
- fire protection systems.

Alarms in the Main Plant indicate abnormal conditions in plant ventilation systems, facility vessels and cell sumps as well as abnormal operations in the Waste Tank Farm and FRS. Because reprocessing activities have been terminated, the Main Plant Control Room is no longer continuously manned. A video camera in the Control Room allows remote viewing of Control Room alarm panels from closed-circuit monitors in the Main Plant shift office and the UR. An audible alarm in these areas indicates an alarm in the Control Room. The shift office and UR are not continuously manned areas and therefore an additional audible alarm is provided in the main security guard house, which is a continuously manned area. Upon receipt of a Control Room alarm, a security inspector notifies the shift supervisor of the alarm condition.

Airborne effluents are discharged through the Main Plant ventilation stack, the PVS stack, and the 01-14 Building stack. There are two continuous air monitors (CAMs) for each stack: one that records beta/gamma-emitting radioactivity and another for alpha-emitting radioactivity. High airborne radioactivity of either type (beta/gamma, or alpha) will, as appropriate, activate the Main Plant stack alarms in the Main Plant Control Room, or the PVS stack alarms in the STS Control Room, or the 01-14 Building stack alarms in the CSS/LWTS control room.

Chapter 6 identifies the primary process alarms associated with vitrification operations. The DCS, which is the key instrumentation and control system for vitrification processes, is also discussed. Alarms, both area and process, related to vitrification operations are annunciated in the VF Control Room and, in some instances, locally. Alarms associated with the Radiation Monitoring system and Fire Protection system also annunciate on panels monitored by WVDP Security. VF continuous air monitors and area radiation monitors have a local alarm function to assure immediate personnel notification and action at the applicable location. The operation and response of specific types of detection and alarm equipment are further discussed in various sections of this SAR.

5.4.9 Maintenance Systems

WVDP waste processing systems have been designed for remote operation. Equipment not required to be located in radioactive process areas is located in "cold" areas to permit contact maintenance. Contact maintenance is performed on contaminated equipment only after sufficient decontamination in accordance with existing WVNSCO procedures. (See WVDP-010, Radiological Controls Manual). Where this is not feasible, equipment is remotely repaired or replaced.

Equipment and piping in radioactive service is drained and flushed to reduce radiation levels before personnel enter the process area. Instruments are designed to permit isolation for periodic maintenance. Equipment and components are arranged, located, and shielded to minimize radiation exposure to plant personnel should maintenance be necessary.

The Vitrification Cell is equipped with cranes and manipulators that can remotely perform the maintenance functions as well as dismantlement operations. HLWIS area maintenance is also provided by remote cranes and tooling. In general, the rest of the VF has been designed for hands-on maintenance. In all cases the equipment that requires hands-on maintenance must be inspected and appropriate action (e.g., by-passing, isolation, flushing, decontamination, etc.) taken to ensure the safety of the site personnel. Little to no maintenance is anticipated in the Transfer Trench. The need to perform hands-on maintenance or remote maintenance in the Transfer Trench is made on a case-by-case basis.

Chapter 6 of this SAR addressed some of the more significant features for performing maintenance activities (e.g., cell cranes, the transfer cart, and the CMR). Adequate space is available in the HLWIS area to accommodate the storage of process equipment removed during Vitrification Cell dismantlement.

5.4.10 Cold Chemical Systems

All components of the IRTS, with the exception of the Drum Cell, maintain a cold chemical system. The cold chemical systems for the LWTS is described below.

A chemical feed system located in the LXA of the Main Plant building provides for chemical additions in the LWTS. The feed system consists of an acid (HNO_3) and caustic (NaOH) storage tank with positive displacement pumps that reside in berms sufficient to contain potential leaks. Demineralized water is available to flush process lines of residual acid or caustic. The system is not currently used for routine operations but does provide the ability to add acid or caustic to Tanks 5D-15A1, 5D-15A2 and 5D-15B, if necessary.

REFERENCES FOR CHAPTER 5.0

American Institute of Steel Construction (AISC). 1980. *Manual of Steel Construction*, eighth edition. Chicago: American Institute of Steel Construction.

Barnstein, L.S. 1965. *Investigation of Atomic Waste Disposal Vaults at the Atomic Waste Disposal Plant, at Ashford, New York, for the New York State Atomic and Space Development Authority.*

_____. 1966.

Bechtel Associates. June 18, 1964. *Spent Fuel Processing Plant Electrical Specifications-Process Building*. Specification P-13. Rev. 1.

Dames & Moore. May 8, 1963. *Site Investigation: Proposed Spent Nuclear Fuel Reprocessing Plant Near Springville, New York, for Nuclear Fuel Services, Inc.*

_____. July 19, 1963. *Pile Load Tests and Pile Driving Criteria Spent Nuclear Fuel Reprocessing Plant Springville, New York, for Nuclear Fuel Services, Inc.*

_____. March 18, 1983. *Geotechnical Investigation: Proposed Component Test Stand, West Valley Demonstration Project, for West Valley, New York.*

_____. August 17, 1983. *Seismic Hazard Analysis, West Valley Demonstration Project.*

_____. June 1988. *Subsurface Investigation: Vitrification Facility, West Valley Demonstration Project, for West Valley Nuclear Services Company, Inc.*

_____. August 24, 1992. *Geotechnical Investigation: Waste Transfer Trench, West Valley Demonstration Project, for West Valley Nuclear Services Company, Inc.*

Ebasco Services, Inc. 1986. *Design Review Calculations for Zeolite Mobilization 8D-1 and Sludge Mobilization 8D-2 Pump Support Structure for West Valley Demonstration Project.* WVNS/W60.

_____. 1990. *Vault 8D-1/8D-2 Finite Element Analysis - Rebar Verification.* WVNS/W55, EBAR-1324 and 1324a.

Gates, W.E. August 11, 1989. *Progress Report, Primary Confinement Barrier Integrity Review Vitrification Facility for West Valley Nuclear Services Company, Inc.* Dames & Moore.

_____. January 25, 1994. *Confinement Barrier Integrity Review of Vitrification Facility, West Valley Demonstration Project, for West Valley Nuclear Services Company, Inc.* Dames & Moore.

_____. 1986.

REFERENCES FOR CHAPTER 5.0
(Continued)

Gates, W.E., and M.R. Gorman. September 19, 1994. *Confinement Barrier Integrity Review of Primary HVAC HEPA Filter Units, Vitrification Facility, West Valley Demonstration Project, for West Valley Nuclear Services Company, Inc.* Dames & Moore.

Hannum, W.H. October 20, 1983. *Seismic Hazard Analysis* (DW:83:0555). Letter to R.C. Mairson. West Valley Nuclear Services Co., Inc.

Lawrence Livermore National Laboratory. May 24, 1977. *Seismic Analysis of the Nuclear Fuel Service Reprocessing Plant at West Valley, N.Y.* UCRL-52266. Prepared for U.S. Department of Energy.

_____. May 1978a. *Seismic Analysis of High-Level Neutralized Liquid Waste Tanks at the Western New York State Nuclear Service Center, West Valley, New York.* UCRL-52485.

Los Alamos National Laboratory. March 1978. *Seismic Investigation of the Nuclear Fuel Services, Inc.* Reprocessing Plant at West Valley, New York. LA-7087-MS. Prepared for U.S. Department of Energy.

National Fire Protection Association. August 14, 1992. *NFPA 12A: Standard on Halon 1301 Fire Extinguishing Systems.*

_____. February 11, 1994. *NFPA 13: Standard for the Installation of Sprinkler Systems.*

_____. August 17, 1990. *NFPA 15: Water Spray Fixed Systems for Fire Protection.*

_____. August 20, 1993. *NFPA 20: Standard for the Installation of Centrifugal Fire Pumps.*

_____. February 12, 1993. *NFPA 22: Standard for Water Tanks for Private Fire Protection.*

_____. February 10, 1992. *NFPA 24: Standard for the Installation of Private Fire Service Mains and Their Appurtenances.*

_____. February 12, 1993. *NFPA 90A: Standard for the Installation of Air Conditioning and Ventilating Systems.*

_____. February 11, 1994. *NFPA 101®: Code for Safety to Life from Fire in Building and Structures.* (See also *Life Safety Code® Handbook.*)

_____. February 12, 1993. *NFPA 110: Standard for Emergency and Standby Power Systems.*

_____. 1997. *NFPA 780: Standard for the Installation of Lightning Protection Systems.*

New York State Code Manual for the State Building Construction Code. New York State.

Nicholas, G.W., and R.C. Eagan. January 1983. *Meteorological Program for West Valley Demonstration Project.* Dames & Moore. (See also Knabenschuh, J.L. February 10, 1993. WD:83:0074.)

REFERENCES FOR CHAPTER 5.0
(Concluded)

Pomerening, D. J., et. al. April 1993. *Seismic/Tornado Analysis Review for the Vitrification Facility at West Valley.* CNWRA 93-007. Prepared for Nuclear Regulatory Commission, Contract NRC-02-88-05. San Antonio, TX: Center for Nuclear Waste Analysis.

Riethmiller, G.E. June 12, 1981. History of Decontamination: Nuclear Fuels Services, Inc., West Valley, New York.

Rockwell. August 1985. *West Valley Tank Riser Installation.* 65620-WWS-85-161 (ZW:86:0020). Letter from W. W. Smith to D. W. Scott.

U.S. Department of Energy. October 13, 1995. Change 3 (November 22, 2000). DOE Order 420.1A: *Facility Safety.* Washington, D.C.: U.S. Department of Energy.

West Valley Nuclear Services Co., Inc. *WVDP-010. WVDP Radiological Control Manual.* (Latest Revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-022: *WVDP Emergency Plan.* (Latest Revision.) West Valley Nuclear Services Co., Inc.

_____. WVDP-177: *WVDP Fire Protection Manual.* (Latest Revision.) West Valley Nuclear Services Co., Inc.

_____. WVNS-FHA-013: *Fire Hazard Analysis Cross-Reference STS/PVS Facilities* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. July 2003. *Tank Farm Lay-up and Supernatant Treatment System Deactivation Plan.* Letter Log WV:2003:0311. West Valley Nuclear Services Co.

TABLE 5.1-1

OUTSIDE STORAGE TANKS AND IMPOUNDMENTS

Vessel/Impoundment Identification	Location	Volume	Stored Material	Remarks
15D-6	East of Remote Manipulator Repair Shop	5,700 L (1,500 Gal)	Drains from Remote Manipulator Repair Shop	Stainless steel
7D-13 CSS Sumps and Analytical Drain Catch Tank	Yard - Underground west of southwest stairwell	7,600 L (2,000 Gal)	Analytical drains	Stainless Steel
North Interceptor South Interceptor	Yard - east of former reprocessing building	87,000 L (each) (23,000 Gal (each))	Liquids collected from plant drains and sumps	Concrete - stainless steel lined
Old Interceptor	Yard - east of former reprocessing building	57,000 L (15,000 Gal)	Temporary storage of off-spec plant effluents	Concrete
Neutralization Pit	Yard - east of former reprocessing building	1,900 L (500 Gal)	Low-level liquid plant effluents	Concrete - stainless steel lined
Lagoon 2	South of LLW2	9,500,000 L (2,500,000 Gal)	Low-level liquid plant effluents	Silty till
Lagoon 3	Southeast of LLW2	12,000,000 L (3,300,000 Gal)	Liquids transferred from lagoons 4 & 5	Silty till
Lagoon 4	East of LLW2	777,000 L (204,000 Gal)	LLWTS effluents	Synthetic liner
Lagoon 5	East of LLW2	630,000 L (166,000 Gal)	LLWTS effluent	Synthetic liner
31D-2 Oil Storage Tank	Yard - east of utility room	38,000 L (10,000 Gal)	No. 2 Fuel Oil	Carbon Steel

TABLE 5.1-1
(Concluded)
OUTSIDE STORAGE TANKS AND IMPOUNDMENTS

Vessel/Impoundment Identification	Location	Volume	Stored Material	Remarks
31D-4A, 31D-4B Condensate Receivers	Yard - southwest of utility room	66,200 L (17,500 Gal)	Steam condensate	Stainless steel
32D-1 Clarified Water/Fire Water Storage Tank	Yard - southeast of utility room	Total Cap. [Fire Cap.] 1,800,000 L [1,140,000 Gal]	Plant utility water/fire water	Coated carbon steel
32D-2 Demineralized Water Storage Tank	Yard - south of utility room	68,000 L (18,000 Gal)	Demineralized process makeup water	Aluminum
32E-1 Cooling Tower	Yard - south of former reprocessing building	300,000 L (80,000 Gal)	Cooling water	Coated carbon steel
32V-2 Clarifier	Yard - south of utility room	45,000 L (11,900 Gal)	Clarified water	Coated carbon steel
G-1 G-2 Gasoline/Diesel Fuel Tanks	East of new warehouse	3,750 L (991 Gal) 7,500 L (1,982 Gal)	Diesel Fuel Gasoline	Concrete with double steel liner
Equalization Basin (34D-14)	East of old warehouse	470,000 L (125,000 Gal)	WWTF effluent	Synthetic liner
Sludge Ponds	East of old warehouse	N/A	Backwash from water softeners, sand filters, and clarifier blowdown	Silty till
Equalization Tank (34D-20)	North of Equalization Basin	37,900 L (10,000 Gal)	WWTF effluent	Concrete

TABLE 5.2-1

DESIGN CODES AND STANDARDS FOR VITRIFICATION FACILITY

Activity	Confinement Barrier	Design Code or Standard	Seismic Design Basis
VITRIFICATION PROCESS	Reinforced Concrete Cell	ACI 318-77 Building Code Requirements NRC Reg. Guide 1.60/1.61	0.1g Horz (DBE)[1, 2, 3, 5]
	Special Doors	AISC NRC Reg. Guide 1.60/1.61	0.1g Horz (DBE)[4, 5]
	Shield Windows	AISC NRC Reg. Guide 1.60/1.61	0.1g Horz (DBE)[5]
	Roof Hatches	AISC NRC Reg. Guide 1.60/1.61	0.1g Horz (DBE)[5]
	Pipe Penetration Seals	AISC NRC Reg. Guide 1.60/1.61	0.1g Horz (DBE)[5]

FOOTNOTES:

(1) Design codes and standards for the vitrification of high-level wastes are referenced in WVNS-DC-022.
(2) Design codes and standards for the Vitrification Facility are referenced in EBASCO Civil Design Criteria Vitrification Facility, June 1987, EBAR 837A.
(3) Design codes and standards for the Vitrification Cell Walls and Roof are referenced in WVNS-DC-029.
(4) Design codes and standards for the Special Doors are referenced in WVNS-EQ-264.
(5) Design Basis Earthquake (DBE) 0.1g Horizontal ground acceleration.

TABLE 5.2-2

ENGINEERING CODES/STANDARDS FOR VITRIFICATION FACILITY

System	Code/Standard
Structural	ACI 318-77 AISC 1980 Edition ANSI A58.1-1982 UBC, 1982 and 1985 Edition NRC Reg. Guide 1.60, 1.61
Ventilation	ERDA 76-21, Nuclear Air Cleaning Handbook
Structural Welding	AWS D1.1, 1984 Edition
Vessels	ASME Section VIII, Division I, 1983 Edition
Piping	ANSI B31.3, 1980 and 1987 Edition
Electrical/Instrumentation	National Electrical Code, ANSI/NFPA-70 NFPA National Fire Codes ANSI Standards NEMA Standards Institute of Electrical and Electronics Engineers (IEEE) Standards Underwriters Laboratories, Inc. (UL) Standards and Product Directories Department of Labor, "Occupational Safety and Health Standards," Title 29, Code of Federal Regulations (CFR), Part 1910 Electrical and Electronics Graphic Symbols and Reference Designations, ANSI/IEEE Y32E National Electric Safety Code, ANSI-C2 Instrumentation Society of America, ISA-S5.1-73 ANSI B46.1, 1978 Edition
Material Specification	ASME Section II
Nondestructive Examination (NDE)	ASME Section V
Qualifying Welders and Welding Procedures	ASME Section IX
Design	INEL Architectural Engineering Standards, Rev. 6, October 1986 DOE 6430.1A, "General Design Criteria Manual," April 6, 1989 Operational Safety Design Criteria Manual, ID-12044
Quality Assurance	ANSI/ASME NQA-1-1986

TABLE 5.2-3

IRTS EQUIPMENT DESIGN CODES AND STANDARDS

Equipment	Design and Fabrication	Materials[1]	Qualification and Procedures	Welder Inspection and Testing
Pressure Vessels	ASME Code Section VIII, Div 1	Section II	ASME Code Section IX	ASME Code Section VIII, Div 1
Atmospheric Tanks	ASME Code Section VIII, Div 1	Section II	ASME Code Section IX	ASME Code Section VIII, Div 1
Heat Exchangers	ASME Code Section VIII, and TEMA "C"	ASME Code Section II	ASME Code Section IX	ASME Code Section VIII, Div 1
Piping	ANSI B31.3	ASTM and ASME Code Section II	ASME Code Section IX	ANSI B31.3
Valves	ANSI B16.34 ANSI B16.11	ASTM and ASME Code Section II	ASME Code Section IX	ANSI B16.34
Pumps	Manufacturer's Standards[2]	ASME Code Section II or Manufacturer's Standard	ASME Code Section IX (as required)	Hydraulic Institute

1 Manufacturers' material certificates of compliance with material specifications may be provided in lieu of certified material.

2 Manufacturers' standard for the intended service. Hydrotesting should be 1.5 times the design pressure.

TABLE 5.2-4

DESIGN CODES AND STANDARDS FOR KEY IRTS EQUIPMENT

IRTS Component	Design Code or Standard	Seismic Factor
Tanks 8D-3/8D-4		
Stainless Steel Tanks	ASME, Sect. VIII	None
Reinforced Concrete Vault	1961 UBC	Zone III
Tanks 5D-15A/ 5D-15B	ASME, Sect. VIII	None
LWTS Evaporator 31017	ASME, Sect. VIII & TEMA C	None

TABLE 5.2-5

ORIGINAL DESIGN CODES AND STANDARDS FOR THE MAIN PLANT AND FRS

Main Plant
AISC Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, 1961, 5th Edition.
Pacific Coast Building Officials Conference, Uniform Building Code, 1961 Edition.
American Concrete Institute Building Code Requirements for Reinforced Concrete, 318-56.
American Standard Building Code Requirements for Minimum Design Loads in Buildings and Other Structures, A 58.1-1955.
American Welding Society - Standard Code for Arc and Gas Welding in Building Construction, AWS DI.0-46.
New York State Building Construction Code - Prefix C, 1961 Edition.
Codes and specifications for steel structures:
All structural steel and steel plate conform to ASTM Specification A-36, of latest adoption, Steel for Bridges and Buildings.
All standard bolts conform to ASTM A 307, Grade B.
FRS
Structural Design Codes[1]
New York State Building Code, 1961 Edition.
Pacific Coast Building Officials Conference Uniform Building Code, 1961 Edition.
American Concrete Institute Building Code Requirements for Reinforced Concrete, ACI 318-56.
American Welding Society Standard Code for Arc and Gas Welding in Building Construction, AWS D1.0-46.
Specification for Design, Fabrication, and Erection of Structural Steel for Buildings, 1961, 5th Edition.

(1) As cited by Bechtel in the design specifications for the original reprocessing plant.

Table 5.2-6

SUMMARY OF MAJOR EQUIPMENT IN THE WTF AND STS

Vessel/Component	Volume (L)	Construction
Equipment in WTF Yard		
8D-1 PUREX HLW Tank	2,800,000	Carbon Steel
8D-2 PUREX HLW Tank	2,800,000	Carbon Steel
8D-3 THOREX HLW Tank	57,000	Stainless Steel
8D-4 THOREX HLW Tank	57,000	Stainless Steel
Equipment in Tank 8D-1		
50C-001 STS Ion-Exchange Column	7,200	Stainless Steel
50C-001 STS Ion-Exchange Column	7,200	Stainless Steel
50C-001 STS Ion-Exchange Column	7,200	Stainless Steel
50C-001 STS Ion-Exchange Column	7,200	Stainless Steel
50D-001 STS Supernatant Feed Tank	6,535	Stainless Steel
50D-004 STS Sluice Feed Tank	8,110	Stainless Steel
50E-001 STS Supernatant Cooler	N/A	Stainless Steel
50F-001 STS Prefilter	N/A	Stainless Steel
50F-002 STS Postfilter	N/A	Stainless Steel
50G-004 Sluice Lift Water Pump	N/A	N/A
Zeolite Pumps	N/A	N/A

TABLE 5.2-7

DESIGN CODES AND STANDARDS FOR HLWTS CONFINEMENT SYSTEMS

Structure	Confinement Barrier	Design Code or Standard	Seismic Design Basis
Tank 8D-1 and 8D-2	Carbon steel tank	API (1961 version)	None
	Reinforced concrete vault	1961 UBC 1956 ACI, Building Code Requirements for R/C, 318-56	Z=III[1]
	Soil excavation and backfill	Bechtel Construction Specifications - 1963	
Tank 8D-3 and 8D-4	Stainless steel tank	API 650	
	Reinforced concrete vault	1961 UBC	
	Soil excavation and backfill	Bechtel Construction Specifications - 1963	
Riser	Carbon steel pipe	1982 UBC ANSI B31.3, 1980	Z=3 IF=1.0 [2,3,4]
	Shield plug	ANSI B31.3, 1980	None
	Stainless steel pump column	1985 UBC ASME Section VIII	Z=3 IF=1.5

Footnotes:

(1) Seismic zone, Z=III, of the 1961 Uniform Building Code (UBC) is slightly different from the 1982 and 1985 UBC, seismic zone Z=3. IF is the importance factor.
(2) Design codes and standards for the Remote and Manual Riser Penetrations of Tank 8D-2 are referenced in WVNS-DC-026.
(3) Tornado wind and missile loading was not a design requirement for the Mobilization pump equipment.
(4) Design codes and standards for the Pump Column are referenced in WVNS-EQ-273.

TABLE 5.2-8

SUMMARY OF MAJOR ACTIVE VESSELS IN THE MAIN PLANT

Vessel/Component		Volume (L)	Construction
Equipment in Extraction Cell 3			
71D-001	Organic IX Column	535	Stainless Steel
71D-002	Zeolite IX Column	1,820	Stainless Steel
71D-003	Zeolite IX Column	1,820	Stainless Steel
71C-004	Evaporator (31017)	5,680	Stainless Steel
71D-005	Distillate Surge Tank	3,785	Stainless Steel
71D-006	Spent Resin Tank	4,650	Stainless Steel
71D-007	Spent Zeolite Tank	4,650	Stainless Steel
71D-008	Filter Backwash Tank	2,950	Stainless Steel
71D-009	Sample Tank	380	Stainless Steel
71D-011	Low TDS Feed Tank	380	Stainless Steel
71E-001	Reboiler	N/A	Stainless Steel
71E-005	Concentrates Cooler	N/A	Stainless Steel
Equipment in the General Purpose Cell Crane Room Extension			
35104	LLW Collection Tank	22,000	Stainless Steel
Equipment in the Uranium Product Cell			
5D-15A1/ 5D-15A2	Evaporator Concentrates Tank	38,000 19,000	Stainless Steel
5D-15B	Evaporator Feed Tank	56,950	Stainless Steel
Equipment in the Liquid Waste Cell			
3D-2	Sample Collection Tank	3,785	Stainless Steel
3Y1	Flow Diverter for 3D-2	N/A	Stainless Steel
4D-8	Plutonium cycle waste catch/Hold Tank	4,540	Stainless Steel
4D-10	First Uranium Cycle Waste C/H Tank (GPC/LWC Sump Receiver)	11,360	Stainless Steel
4D-13	Second Uranium Cycle Waste Catch Tank	22,710	Stainless Steel
7D-2	LLW Collection Tank	32,220	Stainless Steel
7D-8	Rework Evaporator Feed Tank (Tank 6D-3 Overflow Receiver)	11,360	Stainless Steel
7D-14	Hot Analytical Cell Drain Catch Tank	1,900	Hastelloy "C"
13D-7	Solvent Waste Catch Tank	3,785	Stainless Steel
13D-8	Cell Sump Receiver	2,570	Stainless Steel
Equipment in the Lower Extraction Aisle			
14D-7	HNO_3 Addition Tank	375	Stainless Steel
14D-18	NaOH Addition Tank	375	Stainless Steel

TABLE 5.2-9

SUMMARY OF MAJOR EQUIPMENT IN THE OFF-GAS CELL

Vessel/Component	Volume (L)	Construction
Equipment in the Off-Gas Cell		
6C-3 VOG Scrubber	1,500	Stainless Steel
6D-3 VOG Condensate Catch Tank	860	Stainless Steel
6D-6 VOG Knockout Pot	240	Stainless Steel
6E-3 VOG Cooler	N/A	Stainless Steel
6E-4 VOG Heater	N/A	Stainless Steel
6C-1 Dissolver Off-Gas Silver Reactor	N/A (OOS)	Stainless Steel
6C-1A Dissolver Off-Gas Silver Reactor	N/A (OOS)	Stainless Steel
6C-6 Dissolver Off-Gas Scrubber	N/A (OOS)	Stainless Steel
6E-1 Dissolver Off-Gas Heater	N/A (OOS)	Stainless Steel
6E-2 Dissolver Off-Gas Cooler	N/A (OOS)	Stainless Steel

OOS - out-of-service

TABLE 5.2-10

SUMMARY OF MAJOR EQUIPMENT IN EXTRACTION CELL NO. 1

Vessel/Component	
4C-1	Partition Cycle Extraction Column
4C-2	Partition Cycle Partition Column
4C-3	Partition Cycle Pu Scrub Column
4C-13A	Partition Cycle Feed Pump Pot
4C-13B	Partition Cycle Feed Pump Pot
4D-1	Partition Cycle Feed Tank
4D-2	Partition Cycle Waste Catch Tank
7D-1	High-level Waste Evaporator Feed Tank
4E-1	Column 4C-4 Organic Feed Preheater
4Y-1	Column 4C-1 Aqueous Decanter
4Y-5	HAP (4C-1, Product) Surge Tank
4Y-6	HBU (4C-2, U) Surge Tank
4Y-13	Phase Separator for 4D-1
4Y-14	Measuring Head Pot for 4C-1 Feed
4Y-15	Level Control Pot for 4C-1
4Y-17	Level Control Pot for 4C-2
4Y-19	Level Control Pot for 4C-3
4Y-48	Sample Pot for 4C-4
4Y-49	Sample Pot for 4C-8
7Y-1	Phase Separator for 7C-1 Feed
7Y-3	Decanter for 7C-1 Feed

TABLE 5.2-11

SUMMARY OF MAJOR EQUIPMENT IN THE ACID RECOVERY CELL

Vessel/Component
7C-5 General Purpose Evaporator
7E-13 GPE Condenser
7E-14 GPE Reboiler
7C-3 Acid Fractionator
7D-3 Acid Fractionator Feed Tank
7E-1 Acid Fractionator Vaporizer
7Y-5 Acid Fractionator Vaporizer Separator
75-2 Acid Fractionator Reboiler
7E-3 Acid Fractionator Condenser
7E-9 Acid Fractionator Vacuum Inter-condenser
7E-10 Acid Fractionator Vacuum After-condenser

TABLE 5.4-1

AREA PRESSURE DIFFERENTIAL

Area	Approximate Range Pressure Differential[1] with Respect to Atmosphere
Vitrification Control Room, Stairtowers, and Chiller Room, Zone III	0 to 0.10 positive
Ex-Cell Areas, Zone III (typical)	0 to 0.10 positive
Cell Roof, Zone II	0 to 0.10 negative
UNOA, Zone IIA (Air Handling Unit 67-V001 Location)	0 to 0.10 positive
Ex-Cell Areas, Zone II (minimum)	0.03 negative
Crane Maintenance Room (CMR), Zone I	0.95 to 1.45 negative
CMR Operating Aisle, Zone II (minimum)	0.03 negative
Transfer Tunnel, Zone I	0.95 to 1.45 negative
Secondary Filter Room, Zone II	0.25 to 0.50 negative
Cell (Vitrification), Zone I	1.00 to 1.50 negative
Cold Chemical Equipment Room and Cold Chemical Pump Room	slight negative
Cold Chemical Building Dry Chemical Handling/Scale Room	slight negative
Cold Chemical Building Control Area	slight positive relative to the process support areas

(1) Units of pressure are inches of water gauge

TABLE 5.4-2

SUMMARY OF FILTER MONITORING INSTRUMENTATION

Ventilation System	Filter Instrumentation						Plenum or Header PAH
	PDR	PDAH	PDCH	PDAL	PDCL	PR	
Permanent Ventilation System	X	X		X			
Main Ventilation	X	X	X	X	X	X	X
Head End Ventilation	X	X	X	X	X	X	X
01-14 Building	X	X		X			
Vessel Off-Gas (Upstream)	X					X	
Vessel Off-Gas (Downstream)	X	X					
Waste Tank Farm	X	X					

PDR = Pressure Differential Recorder
PDAH = Pressure Differential Alarm High
PDCH = Pressure Differential Control High
PDAL = Pressure Differential Alarm Low
PDCL = Pressure Differential Control Low
PR = Pressure Recorder
PAH = Pressure Alarm High

TABLE 5.4-3

SUMMARY OF UTILITY SUPPLY CAPABILITIES

Utility Supply System	Units	Peak Demand in Normal Operation	Installed Capacity
Raw Water Supply and Treatment	gpm	75	400
Demineralized Water	gpm	16	20
Cooling Water - Open System	gpm	1,785	2,250
Cooling Water - Heat Transfer	MBTU	5	31
Steam Generation - 150 psig 25 psig	lb/h	15,000	35,000
Fuel Gas	MBTU/hr	20	110
Fuel Oil	gpm	0	15
Compressed Air	scfm	1,500	3,500
Instrument Air	scfm	550	800
Electric Power	kVA	2,700	11,500

TABLE 5.4-4

IRTS UTILITY REQUIREMENTS

Utility	Flow or Power	Pressure or Voltage
Electricity		
STS	190 to 200 kW	480 V, 3 phase
LWTS	45 kW	480 V, 3 phase 120 V, single phase
DC	Not Specified	480 V, 3 phase 120 V, single phase
Utility Air		
STS	1,400 L/m	690 kPa
LWTS	560 L/m	690 kPa
Instrument Air		
STS	8,500 L/m	725 kPa
LWTS	1,200 L/m	345 kPa
Steam Supply		
STS	Intermittent	1050 kPa
LWTS	545 kg	170 kPa 1050 kPa
Utility Water		
STS	95 L/m	350 kPa
Demineralized Water		
STS	150 L/m	275 kPa
LWTS	20 L/m	---
Cooling Water		
LWTS	950 L/m	---

TABLE 5.4-5

STANDBY POWER LOADS ON VF DIESEL GENERATOR
(480V Switchgear A1 and A2 - Drawing #905D-200)

Equipment[3]	Source (480V Switchgear)	Standby Load (kVA)	Power (kW)[1]
Exhaust Fan (67-K-001A)[2]	A1	150	120
UPS, 67-UPS-1	A1	10	8
AHU Fan, 67-V003A[2]	A1	5	4
Crane Op. Aisle Htr. (67-V028)	A1	12.5	10
Off-Gas Htr. (63E-034)[2]	A1	62.5	50
Process Crane Control Station	A1	30	24
CMR Roof Hoist	A1	30	24
Diesel Fuel Storage PP-14	A1	70	56
Exhaust Fan (67-K001B)[2]	A2	---	---
Lighting Panel, LP-6	A2	15	15
Power Panel, PP-5	A2	30	24
Off-gas Htr. (63E-032/63E-037)[2]	A1/A2	---	---
CMR Crane Control Station	A2	2	1.6
Cell Shield Door No. 2	A2	92	73.6
Shield Door No. 1	A2	1	0.8
Condensate Pump Control Station SC-CP-01	A1	15	12
Load-In Building (Lighting & Misc. Load)	A1	20	20
Backup CLCW Pump 66-G-11	A1	40	32
AHU Fan 67-V003B[2]	A2	---	---
TOTAL[4]		585	475

NOTES:
1) Values based on an assumed power factor of 0.8. Power factor is not applicable to Lighting Panel LP-6 and Load-In Building lighting.
2) Only one unit is running at a time. Thus load of redundant component is not shown.
3) Except for the exhaust fan (67-K001A or 67-K001B), UPS 67-UPS-1, Load-In Building lighting, condensate pump, backup CLCW pump, and LP-6, all other loads need supervision for restarting the units.
4) The diesel generator is rated, 3-phase, 4-wire, 480/277 VAC, 600 kW, continuous rating (750 KVA @ 0.8 pf).

TABLE 5.4-6

DIESEL GENERATOR FAILURE MODES AND EFFECTS ANALYSIS

Component	Function	Failure Mode	Failure Detection and Effect/Corrective Action
Diesel Generator Support Systems (Fuel Oil, Lube Oil, Cooling Water, and Starting Systems)	To start the diesel engine and maintain the engine temperature lubrication and fuel oil at optimum levels	Failure to carry out required function	Detected by affected support system parameter monitors. Diesel engine fails to start or is shut down automatically.
Diesel Generator Breaker	Connects diesel generator with 480V switchgear A1 and A2 buses.	Failure to close, or overheating (poor contact)	Locate fault and repair.
480V Cable Inter-tie	Connects diesel generator breaker with 480V switchgear A1 and A2 buses.	Short circuit	Failure trips generator breaker, diesel generator cannot supply power. Locate fault and repair.

TABLE 5.4-7

UPS 67-UPS-1 POWER REQUIREMENT
(Drawing No. 900C-2991)

Equipment	Standby Load (VA)
HVAC Control Panel (67-V019)	740
480V Switchgear, A1	400
480V Switchgear, A2	400
Pump VP-510	300
Shield Door No. 2	1,450
Distribution Cabinet (63-CCTV-05)	1,200
Stack Rad Monitor Control Panel	500
Diesel Generator Battery Charger	375
Miscellaneous Loads	1,800
TOTAL[1]	7,165

NOTE:

1) The UPS (67-UPS-1) is rated single-phase, two-wire, 120V, 10 kVA for one hour on complete loss of on-site and off-site power.

TABLE 5.4-8

UPS 63-UPS-2 POWER REQUIREMENT
(Drawing No. 900C-2996)

Equipment	Standby Load (VA)
Operator Station No. 1, DCS/CCTV	1,310
Operator Station No. 1, Desk/ILDS	360
ALPHA Terminal and Dot Printer	660
Shift Engineer Station DCS/CCTV	1,215
Shift Engineer Desk/ILDS	360
CMS-1	1,440
CMS-1 Leg No. 2	600
CMS-1 Leg No. 4	360
Control Panel 67-V020	475
Control Panel 67-V/020	300
Distribution Cabinet 63-CCTV-12	1,200
Glass Pour Viewing System Cabinet	660
Control Room Rad. Monitoring Desk	600
CCTV Supervisor Desk, Distribution Cabinet	1,200
Shift Supervisor Station	814
CMS-1 Leg No. 1	780
CMS-1 Leg No. 3	540
Chiller Lead/Lag Control Cabinet	500
DS-67-V019 (Alternate Power to 67-V019)	740
CMS-1 Leg No. 5	---
Miscellaneous Load	660
TOTAL[1]	14,774

NOTE:

1) The UPS (63-UPS-2) is rated single-phase, two-wire, 120V, 20 kVA for one hour on complete loss of on-site and off-site power.

TABLE 5.4-9

UPS 63-UPS-3 POWER REQUIREMENT
(Drawing No. 900C-2996)

Equipment	Standby Load (VA)
Melter Viewing System (MVS) Camera	12
Instrument Rack (I.R.), 2W2, 2W3	10
I.R., 2N6, 3E8, 2E9, 2E10	40
Instrument Cabinet IC-1	122
I.R., 3W8, 3W7, 3W1, 3W6, 2W5, 3W5	120
Operator Station No. 2, DCS/CCTV	1,215
Operator Station No. 2, Desk/ILDS	360
ILDS Control Room Rack	720
I.R., 2N7, 2W4, 3E9, 3E10, 3W2, 3W3, 3W4, 66-IR-01, C/P 63-V041C, C/P 63-VO41D	95
DCS Panel No. 1	1,681
DCS Panel No. 4	120
DCS Panel No. 2	1,099
I.R., 2N8, C/P 65-CP-02	35
MVS & ALPHA Interface Cabinet	1,200
Fire Control Panel (VFFCP)	1,200
TOTAL[1]	8,029

NOTE:

1) The UPS (63-UPS-3) is rated single-phase, two-wire, 120V, 20 kVA for one hour on complete loss of on-site and off-site power.

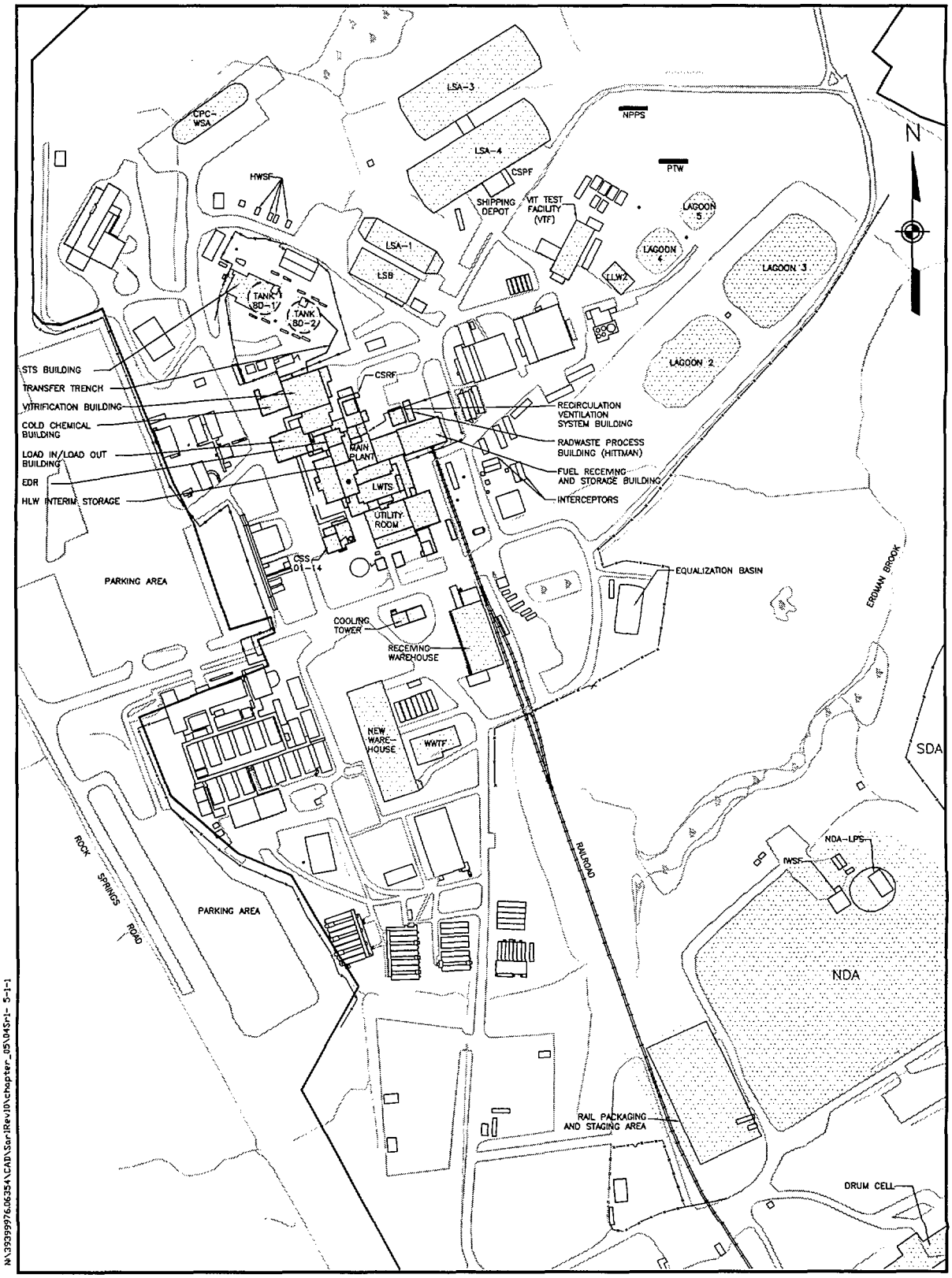


Figure 5.1-1 Location of Facilities.

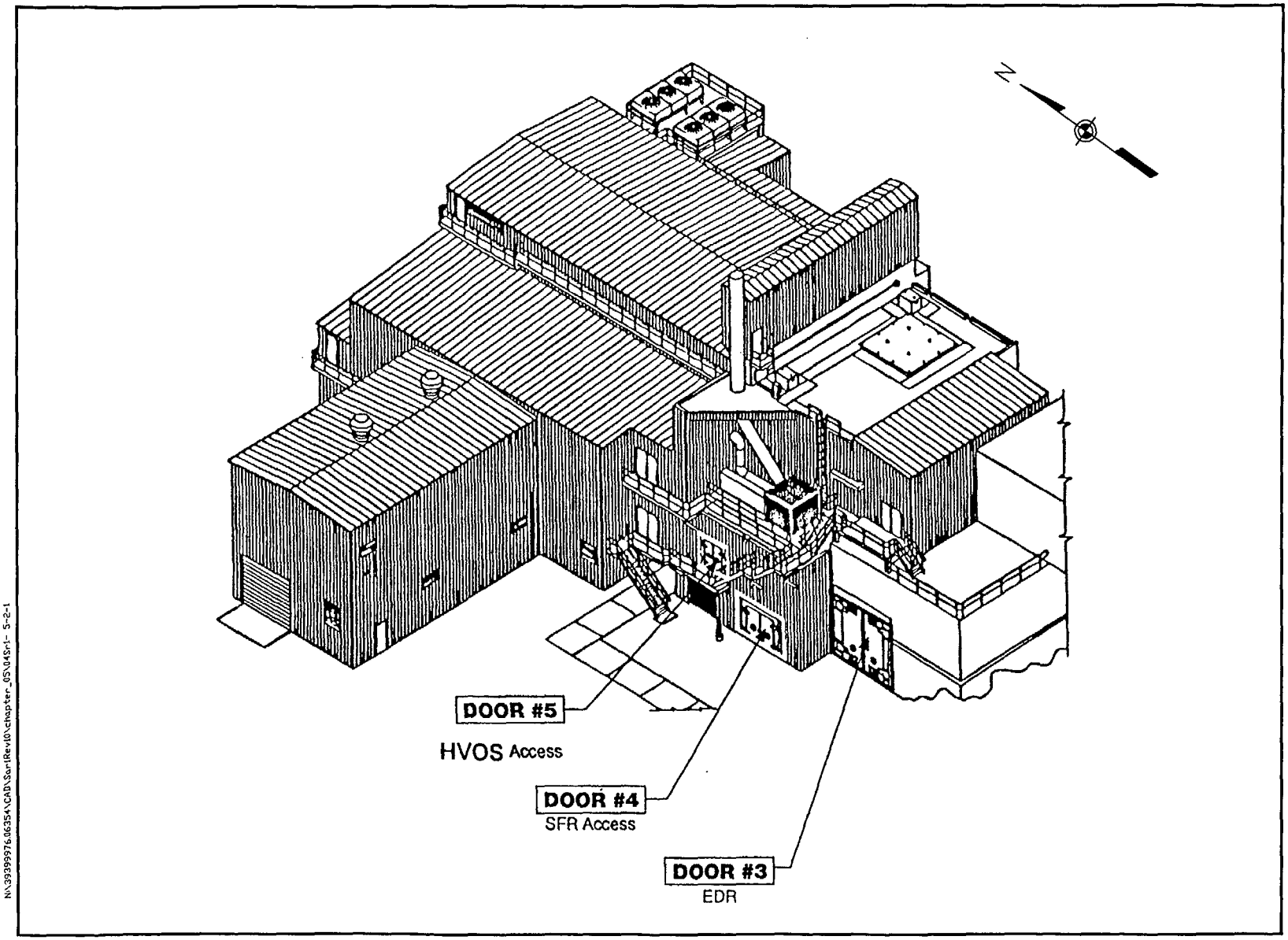


Figure 5.2-1 Sheet Metal Enclosures and Exterior Special Doors Associated with the Vitrification Building and Cold Chemical Building.

N:\3939997\063541\CAD\SarrRev10\chapter_05\04Sr1- 5-2-1

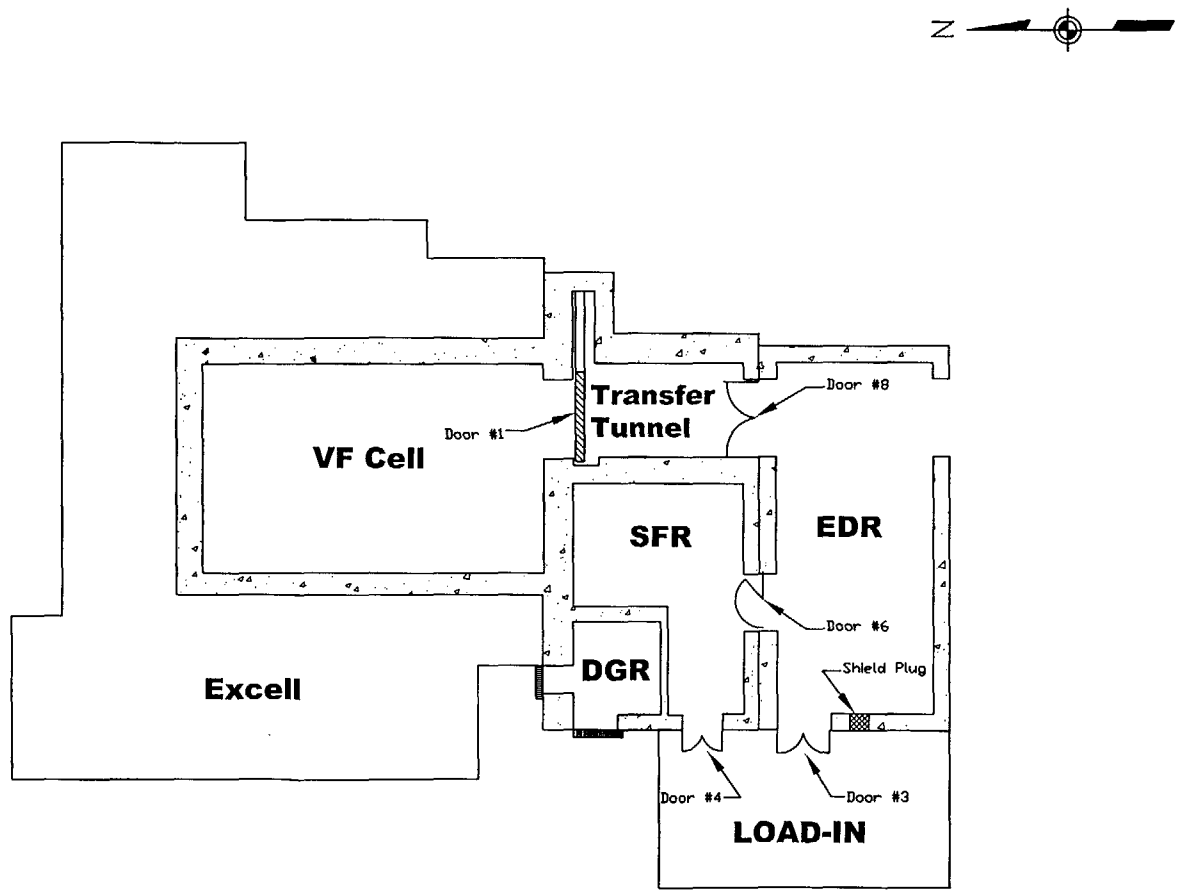


Figure 5.2-2 Vitrification Building and EDR at EL. 100' and 110'.

N:\39399976.06354\CAD\SarlRev10\chapter_05\04Sr1- 5-2-2

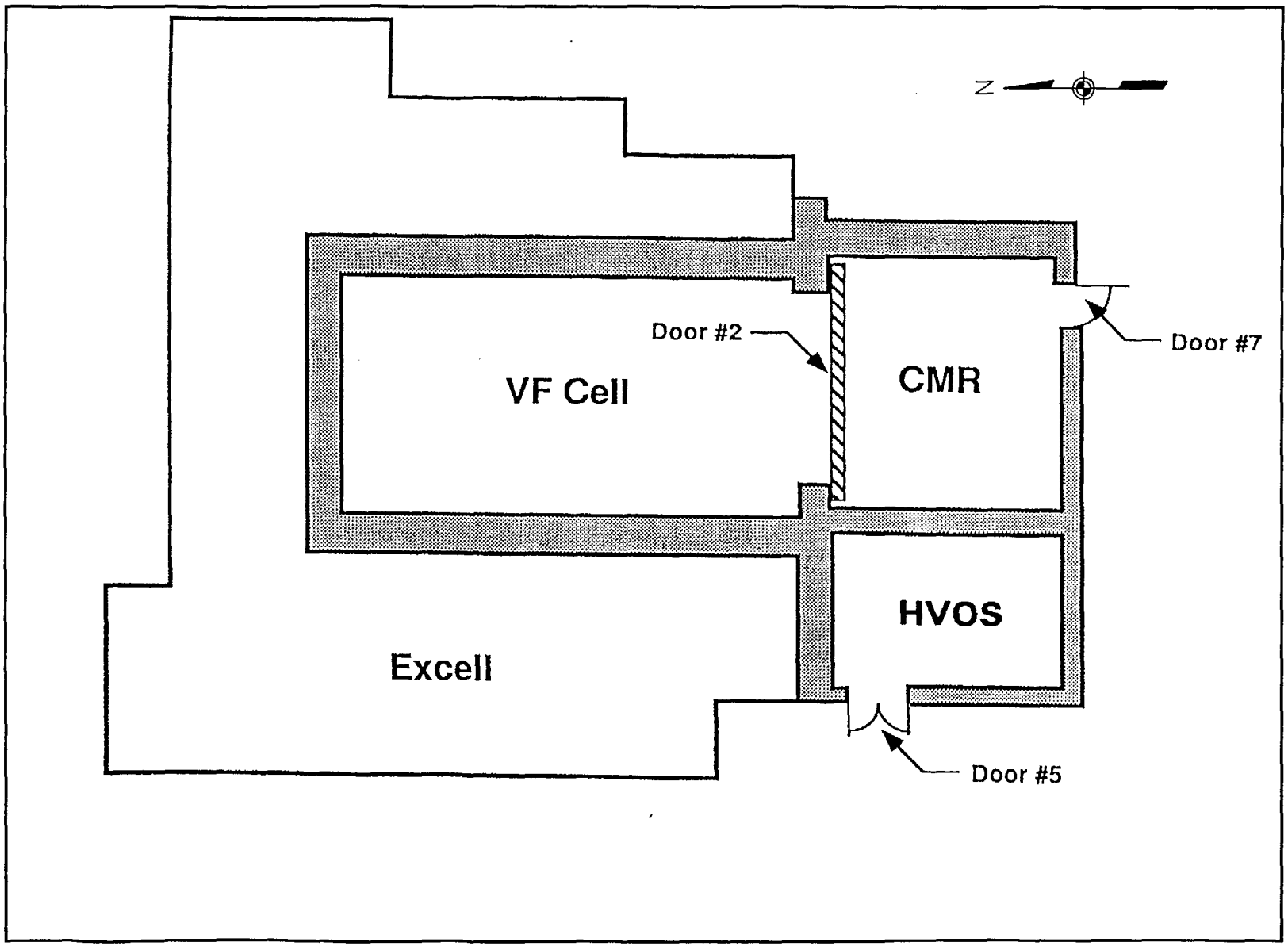


Figure 5.2-3 Vitrification Building Plan at EL. 120' and 127'.

N:\39399976.06354\CAD\Sar1Rev10\chapter_05\04Sr1- 5-2-3

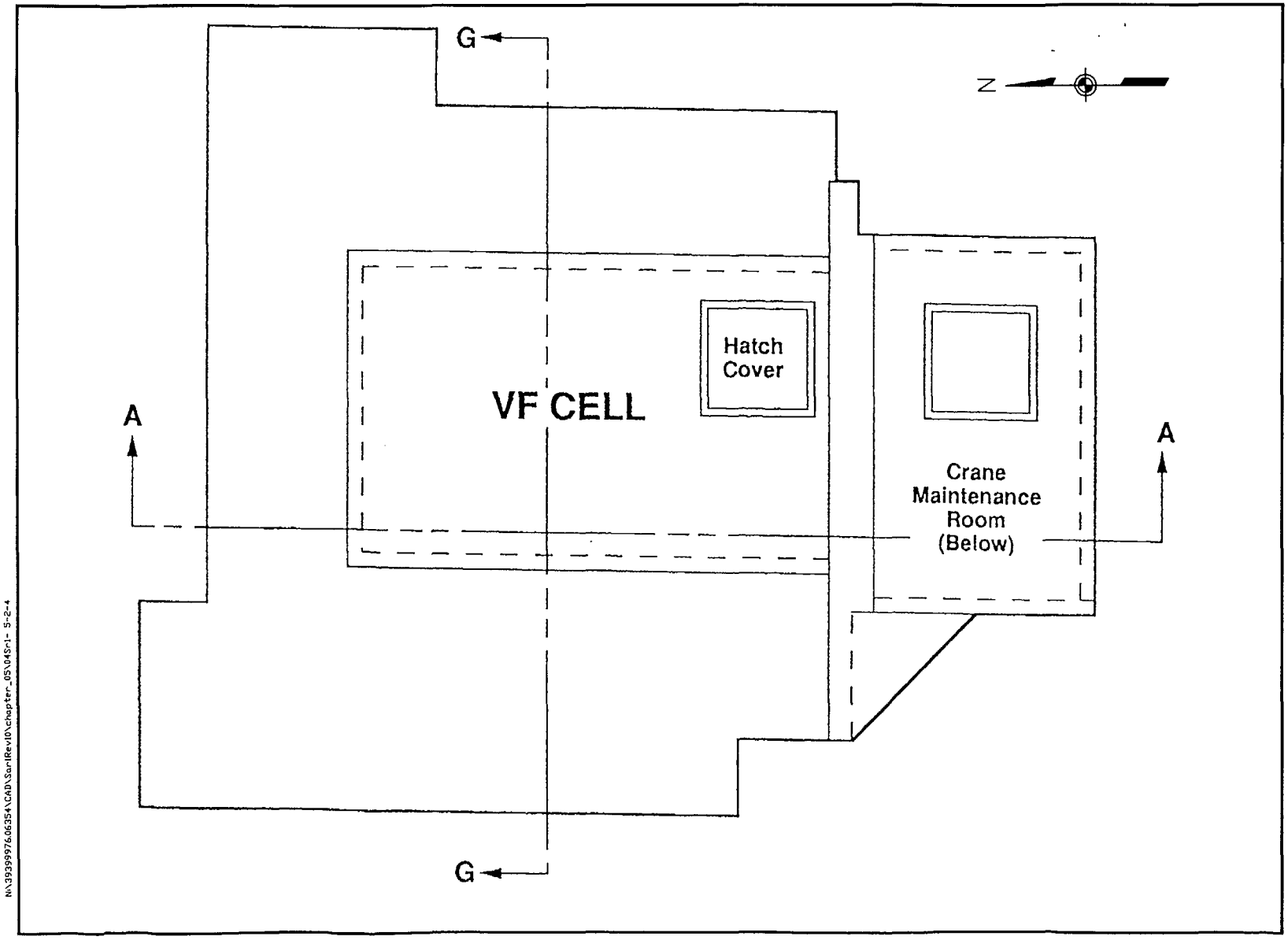


Figure 5.2-4 Vitrification Building Plan at Roof EL. 146.25'.

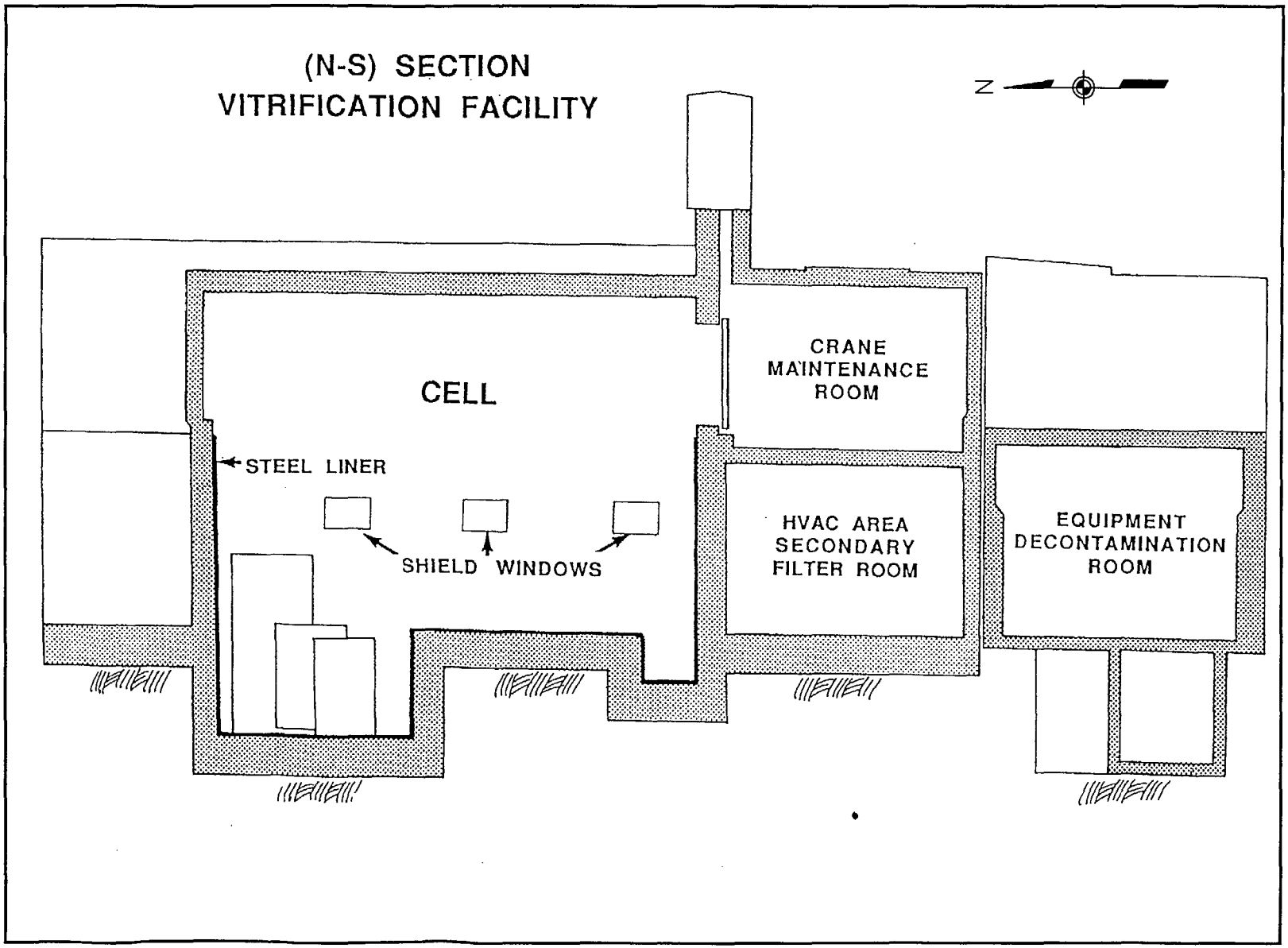


Figure 5.2-5 Section A–A' – Vitrification Building.

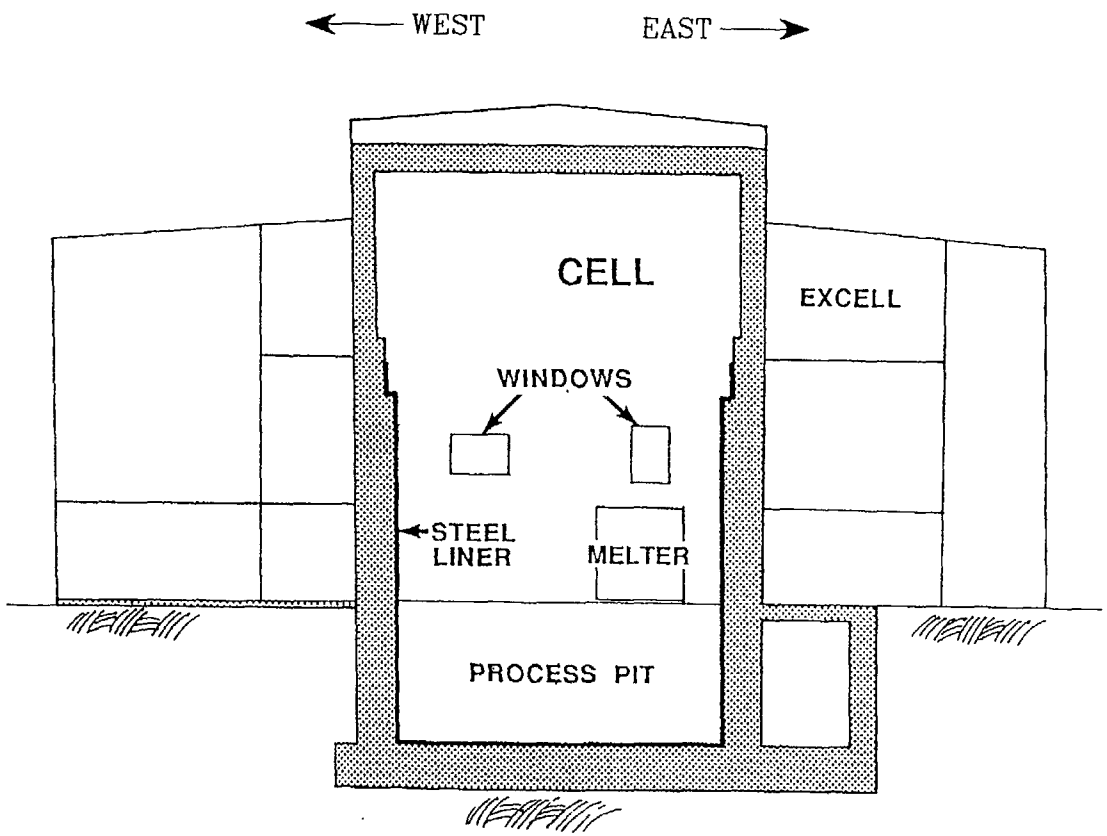
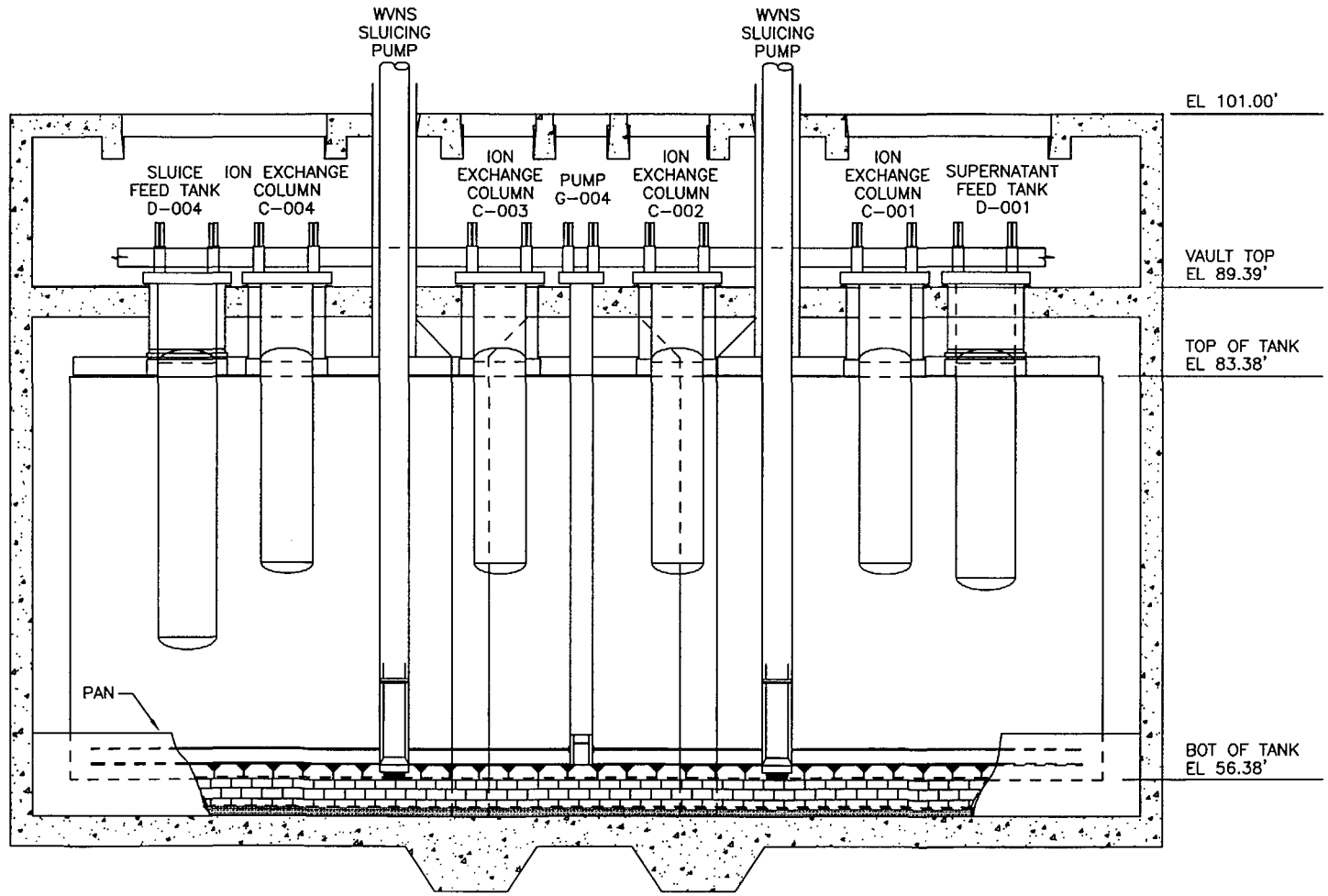


Figure 5.2-6 Section G–G' – Vitrification Building.

N:\39399976\06354\CAD\Sar\Rev10\chapter_05\043rl- 5-2-6



FOR REFERENCE ONLY - NOT TO SCALE

Figure 5.2-7 General Arrangement – STS Tank 8D-1 Section

N:\39399976.06354\CAD\SarlRev10\chapter_05\04Sr1- 5-2-7

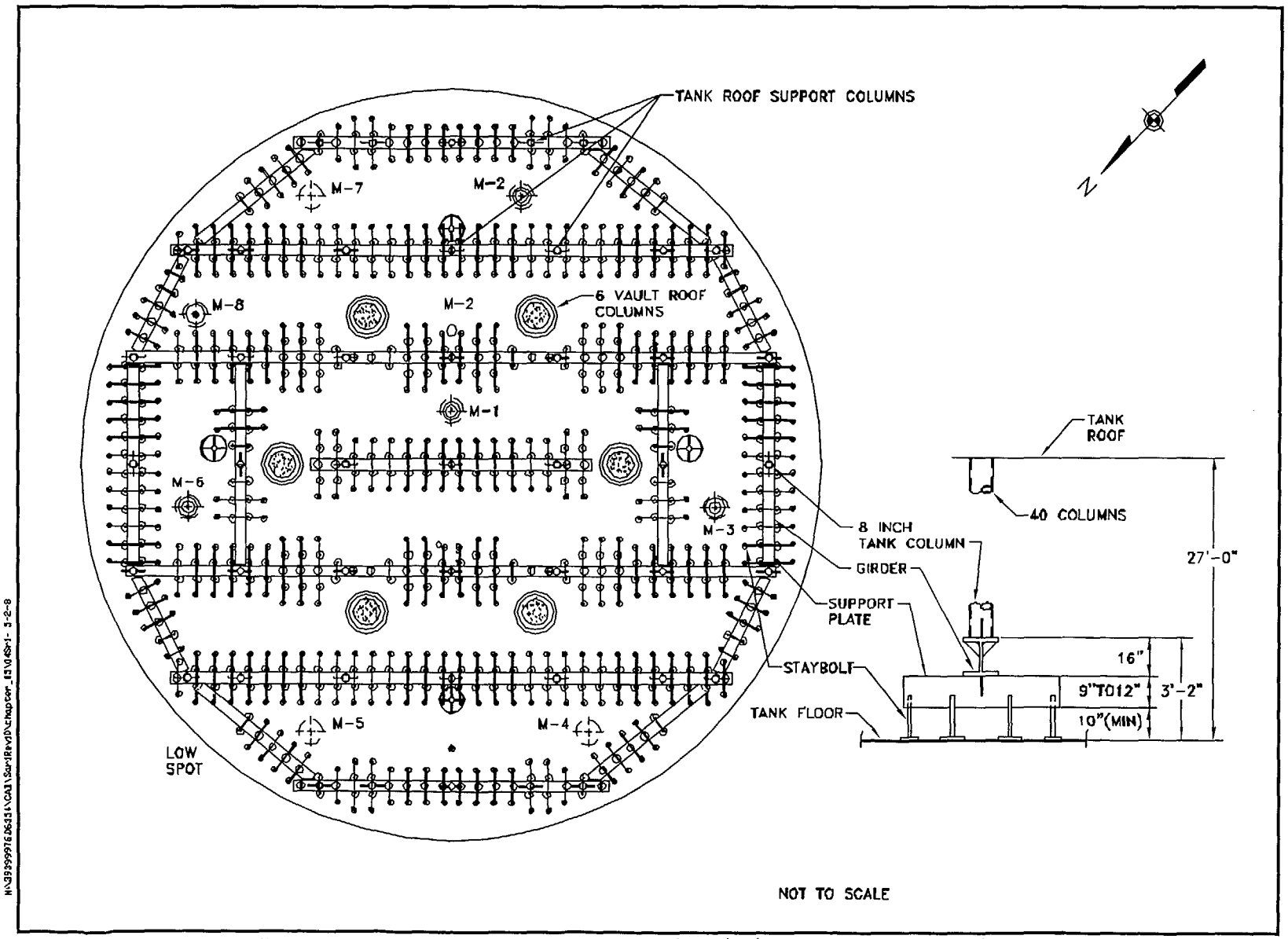


Figure 5.2-8 Purex HLW Tank Internal Floor Structure (Typ.) (Tank 8D-1 Shown)

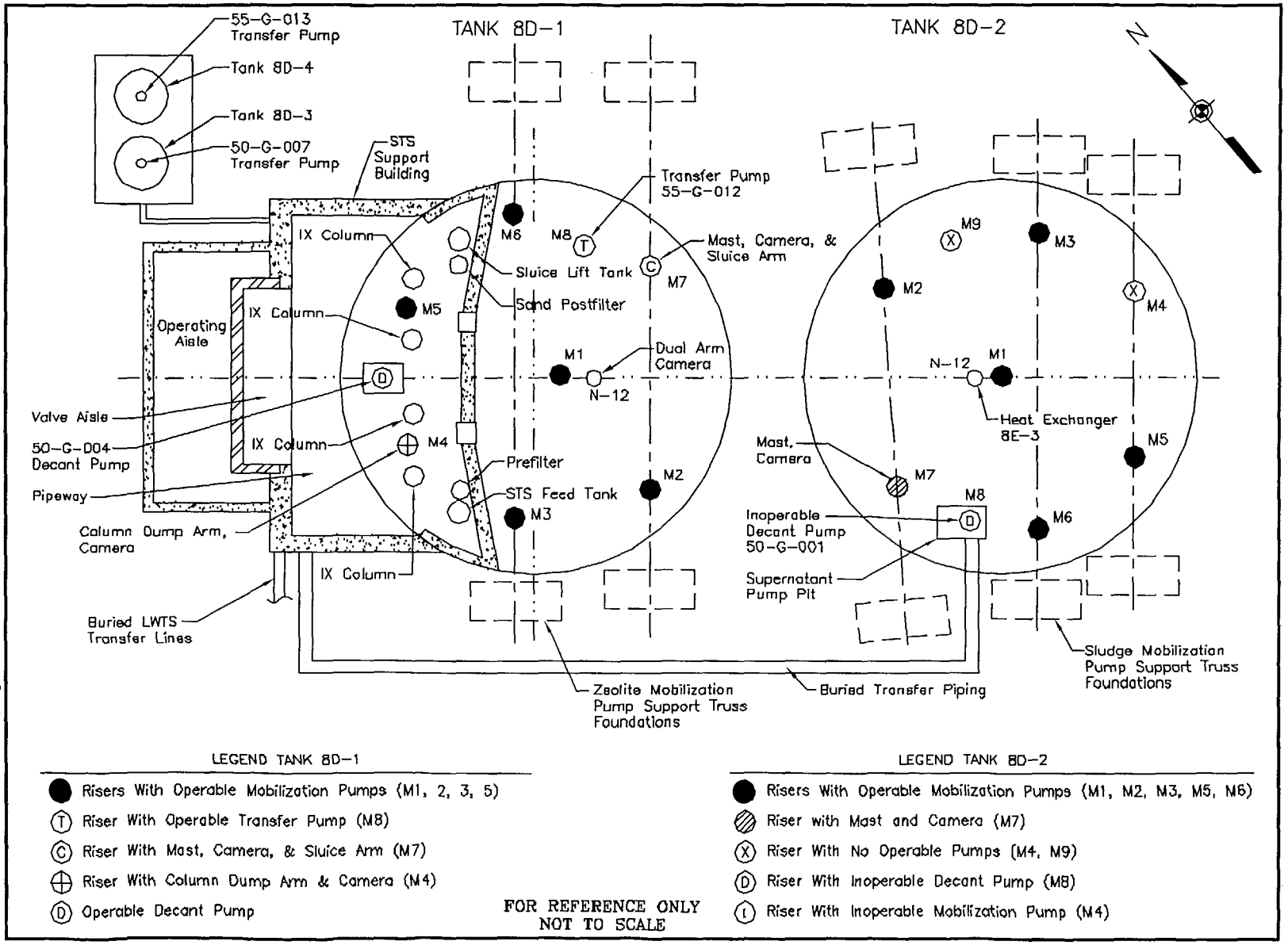


Figure 5.2-9 Plan View – HLW Tanks 8D-1 and 8D-2

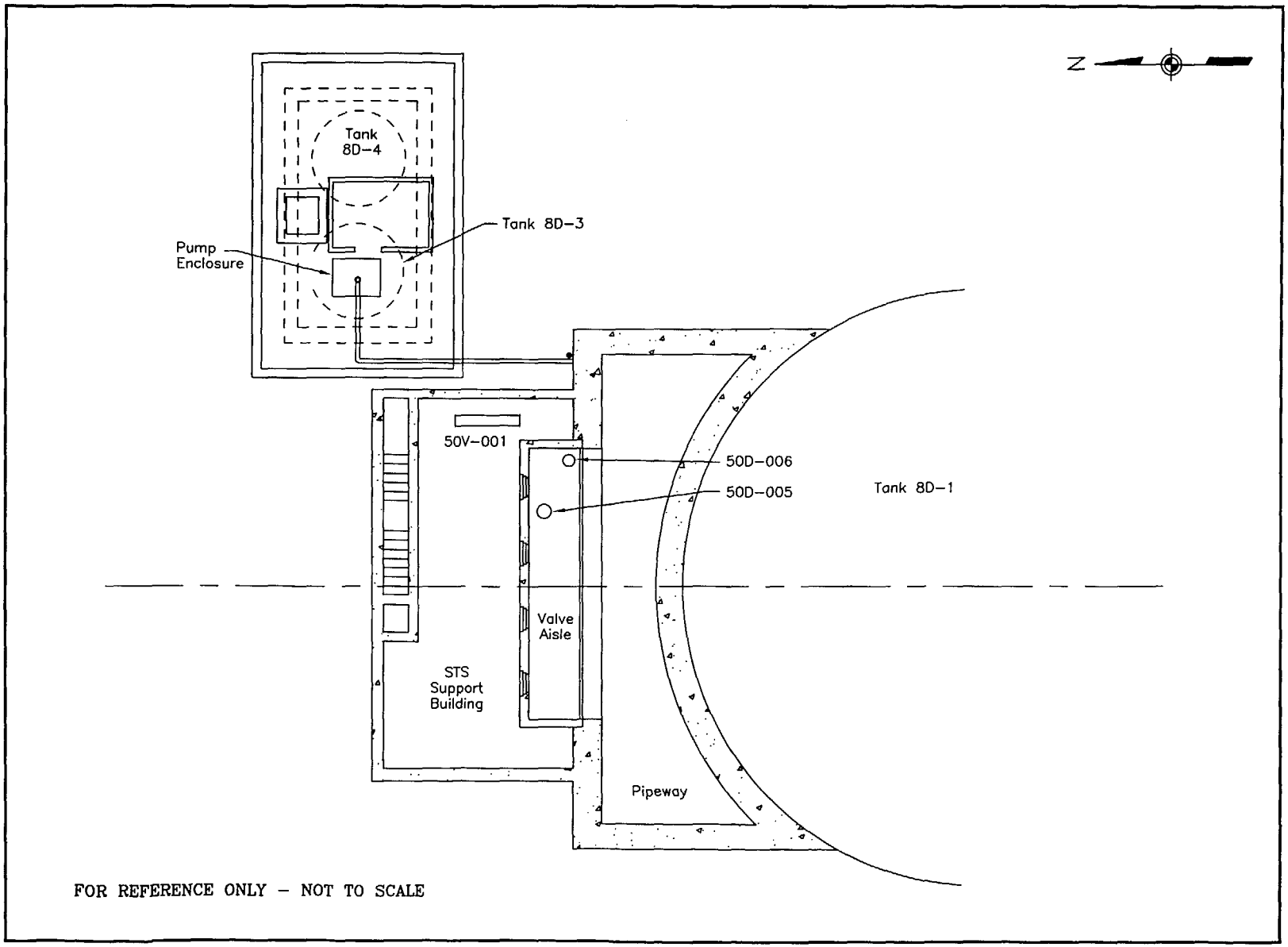


Figure 5.2-10 General Arrangements STS Building and 8D-3 & 4 Tanks - Plan Elevation 92.0'

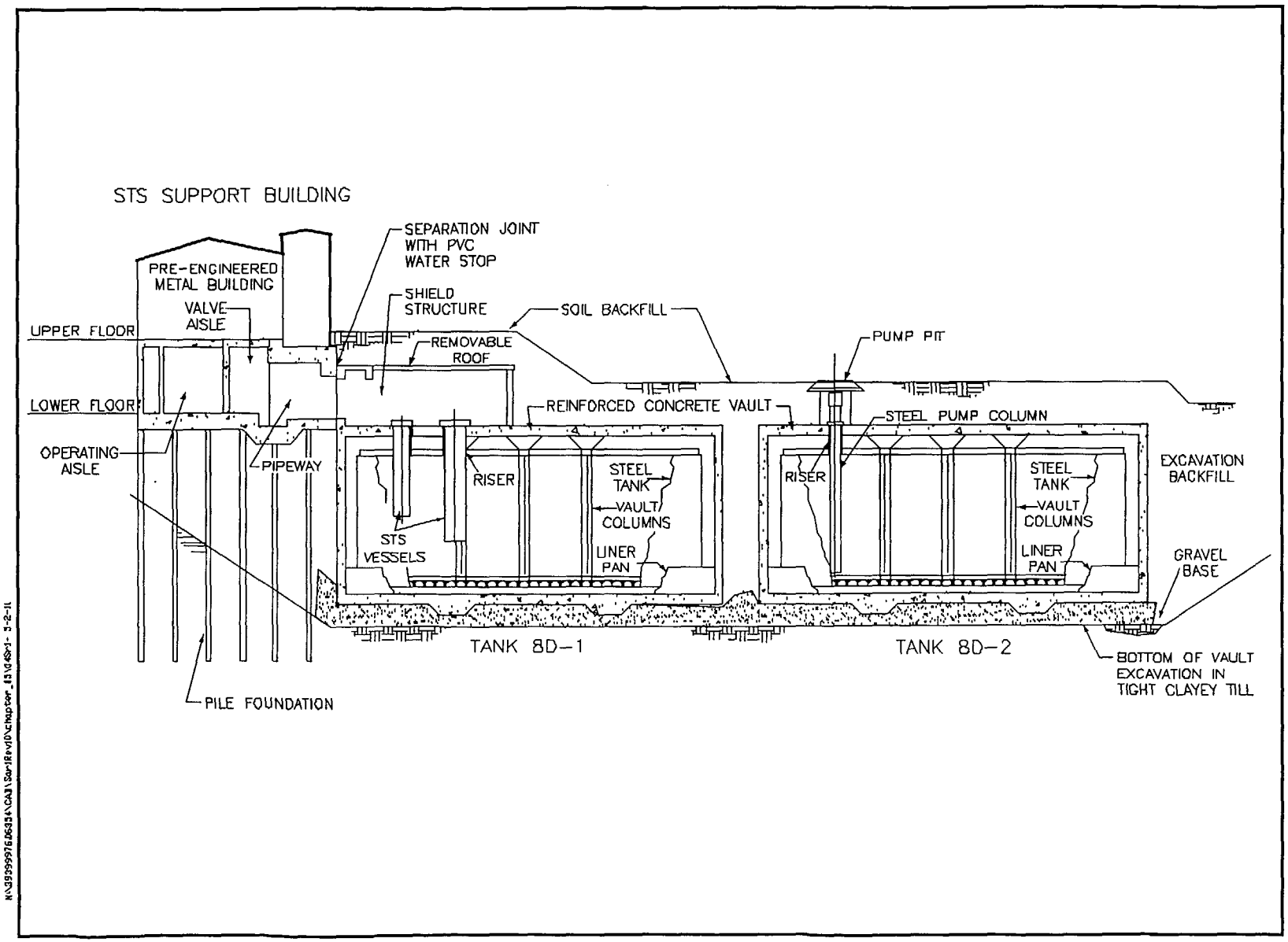


Figure 5.2-11 STS Process Facilities Section

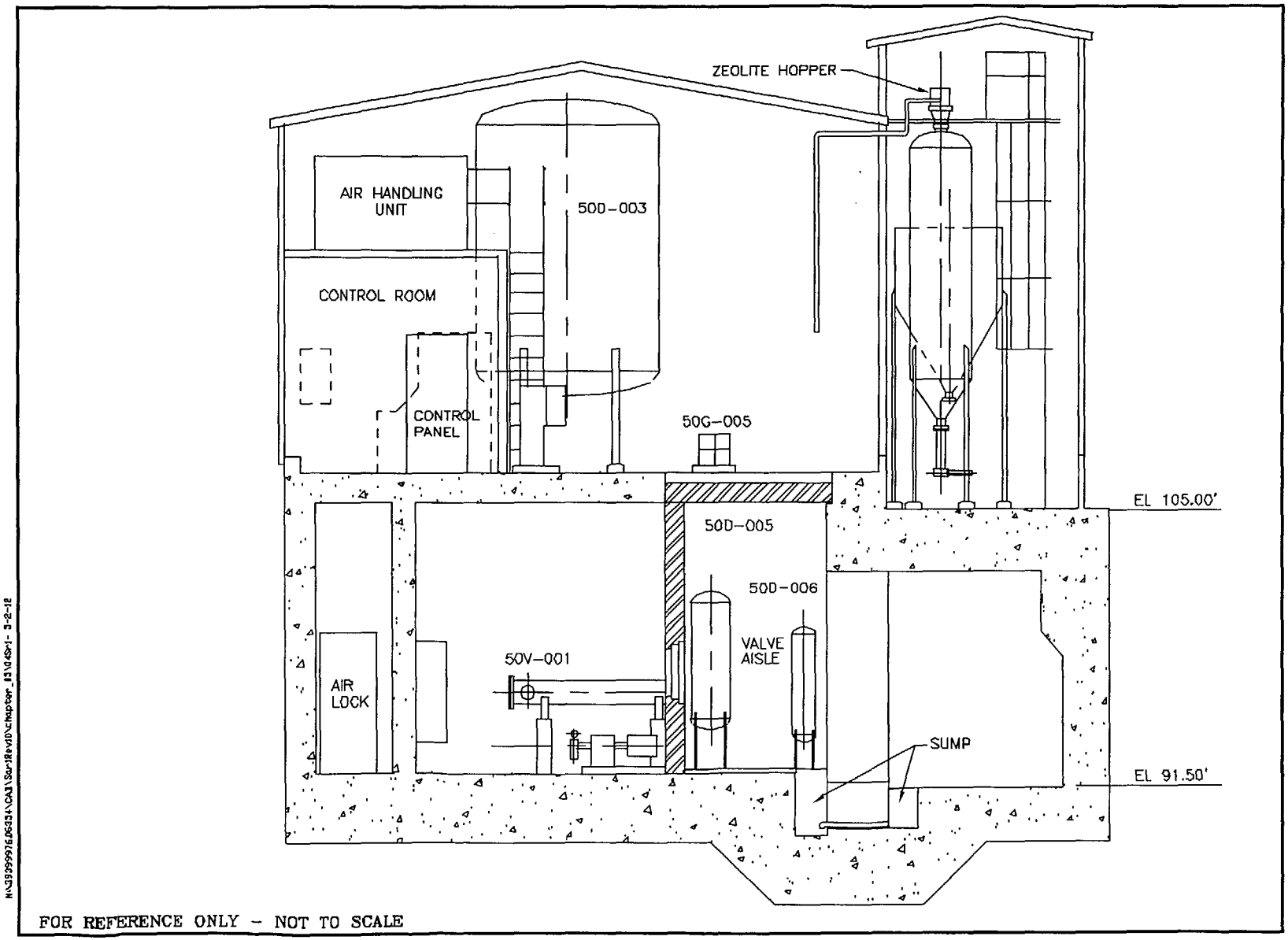
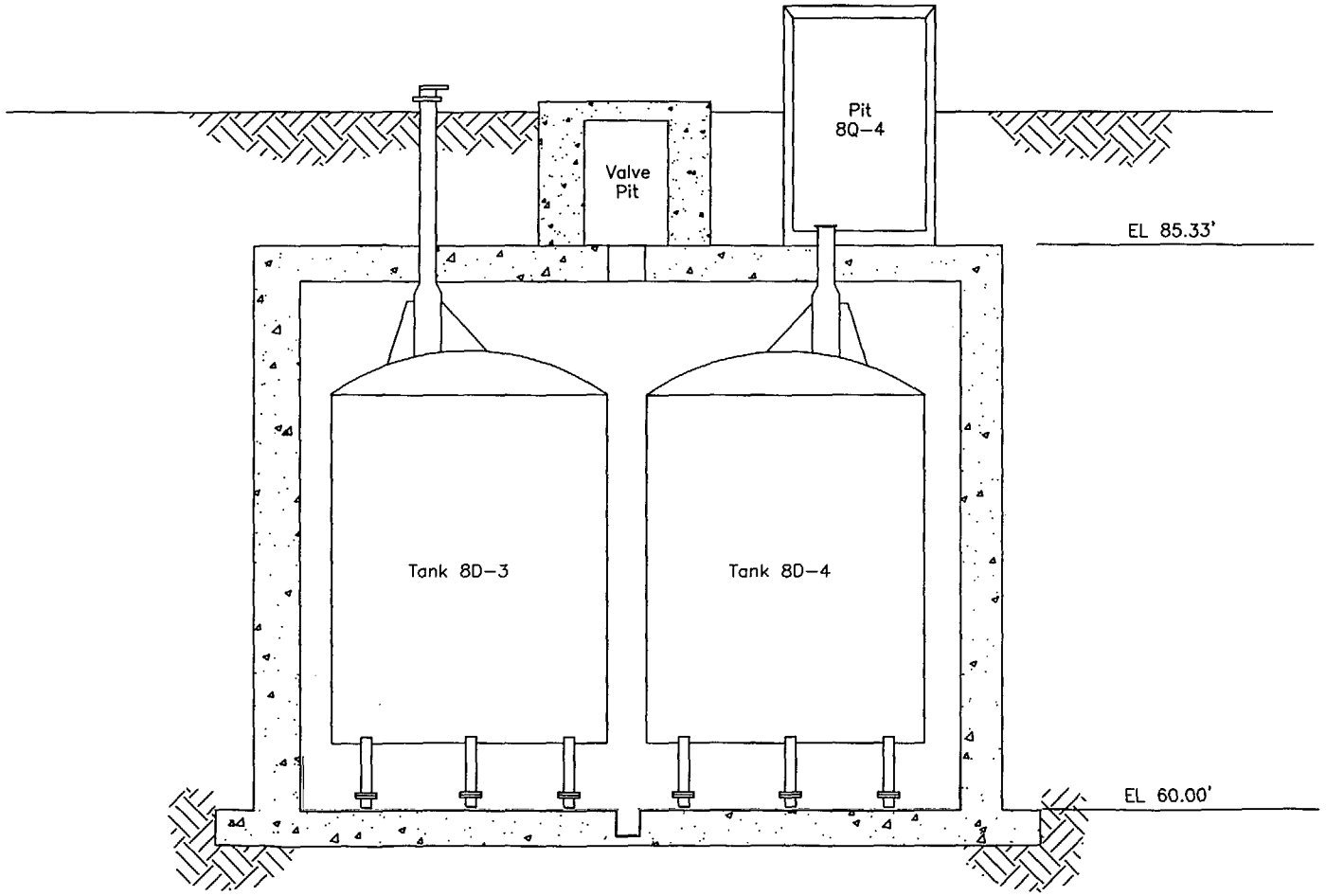


Figure 5.2-12 General Arrangement – STS Building Sections



FOR REFERENCE ONLY - NOT TO SCALE

N:\39999976.06354\CAD\Sar1Rev10\chapter_05\04Sr1- 5-2-13

Figure 5.2-13 HLW Tank 8D-3 and Tank 8D-4 Section

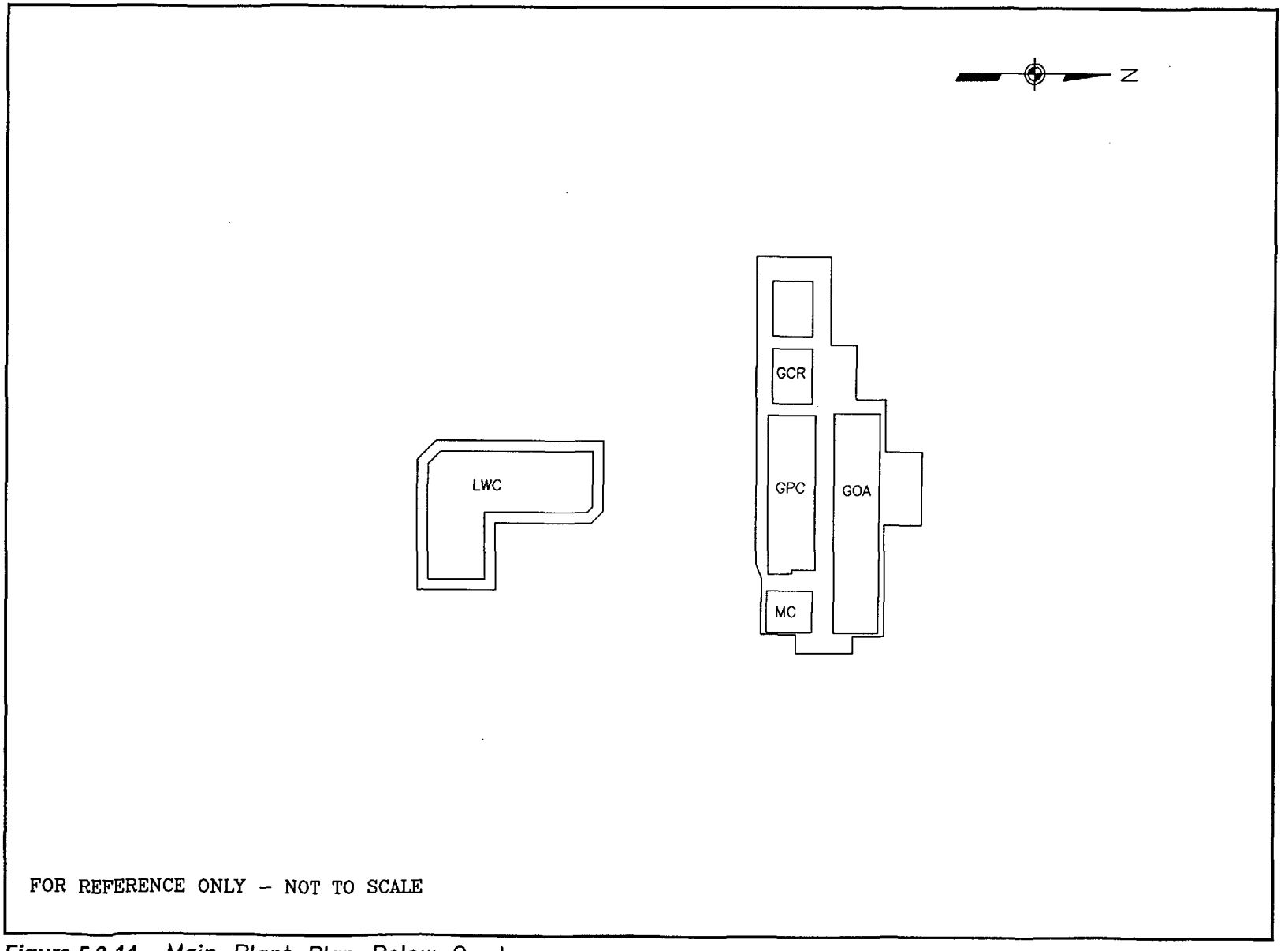
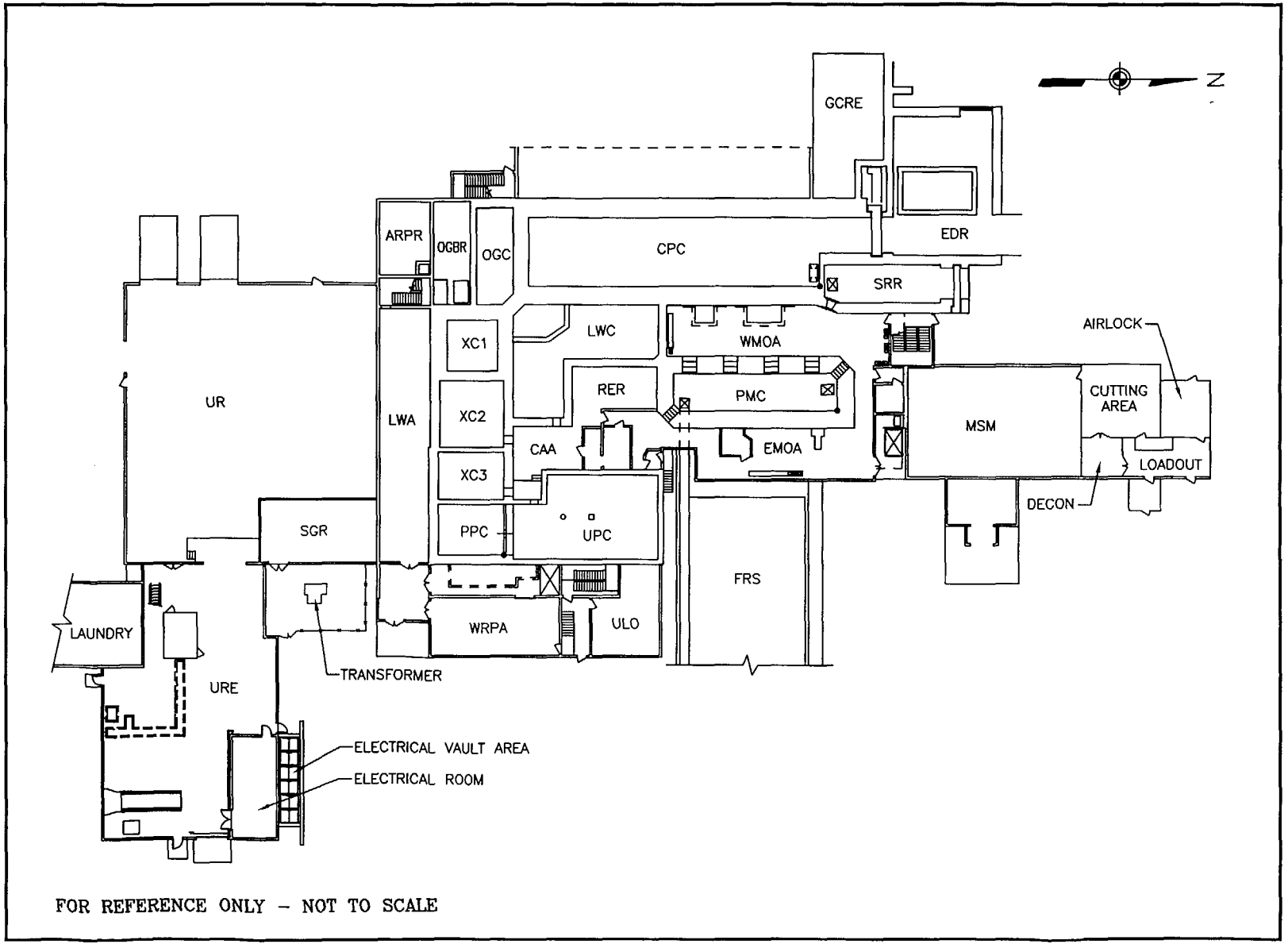
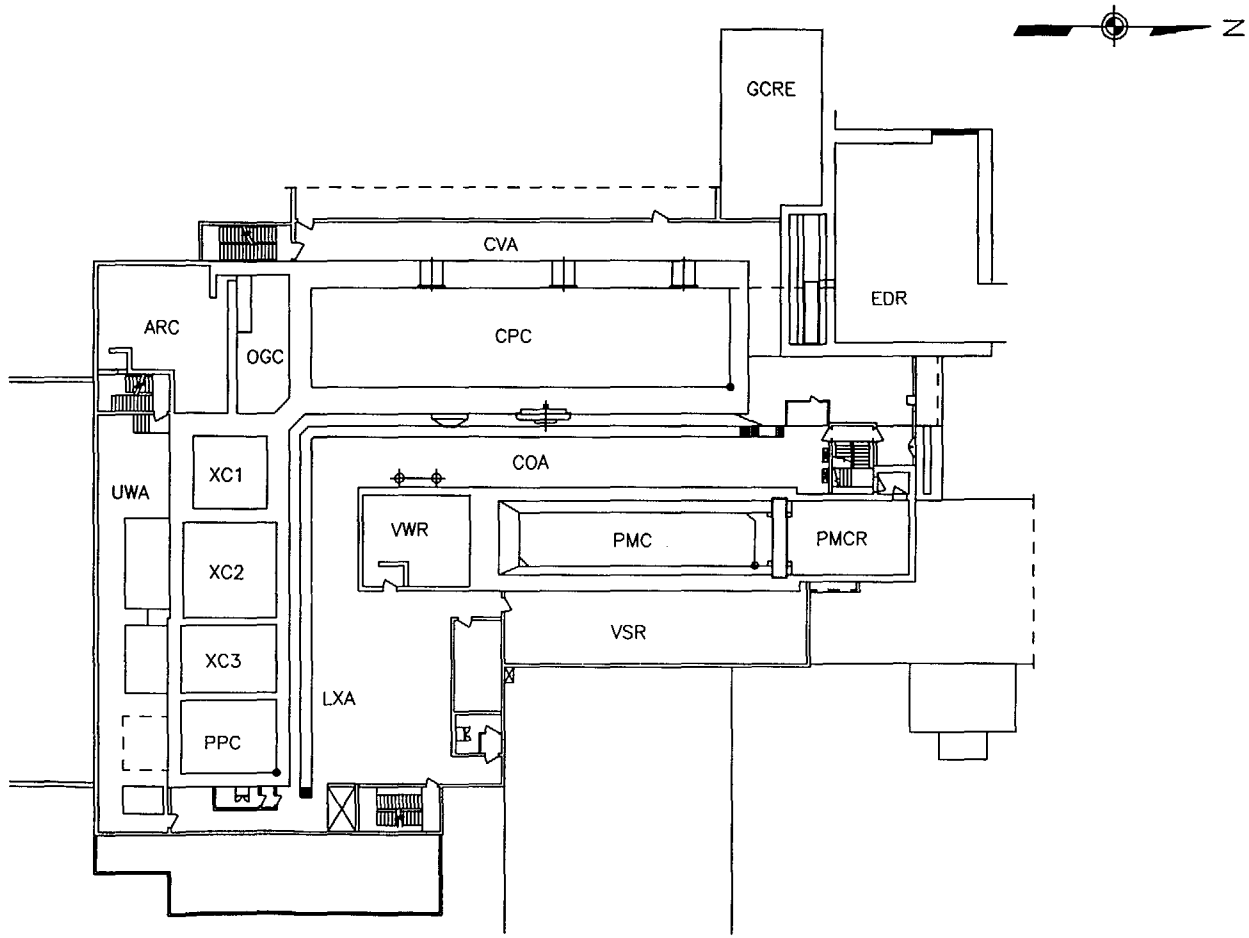


Figure 5.2-14 Main Plant Plan Below Grade



N:\39399976\06354\CAD\SarIRevi0\chapter_05\04Sri- 5-2-15

Figure 5.2-15 Main Plant Plan at Elevation 100.0'



FOR REFERENCE ONLY – NOT TO SCALE

N:\39399976\063S4\CAD\SarRev10\chapter_05\04Sr1- 5-2-16

Figure 5.2-16 Main Plant Plan at Elevation 114.5'

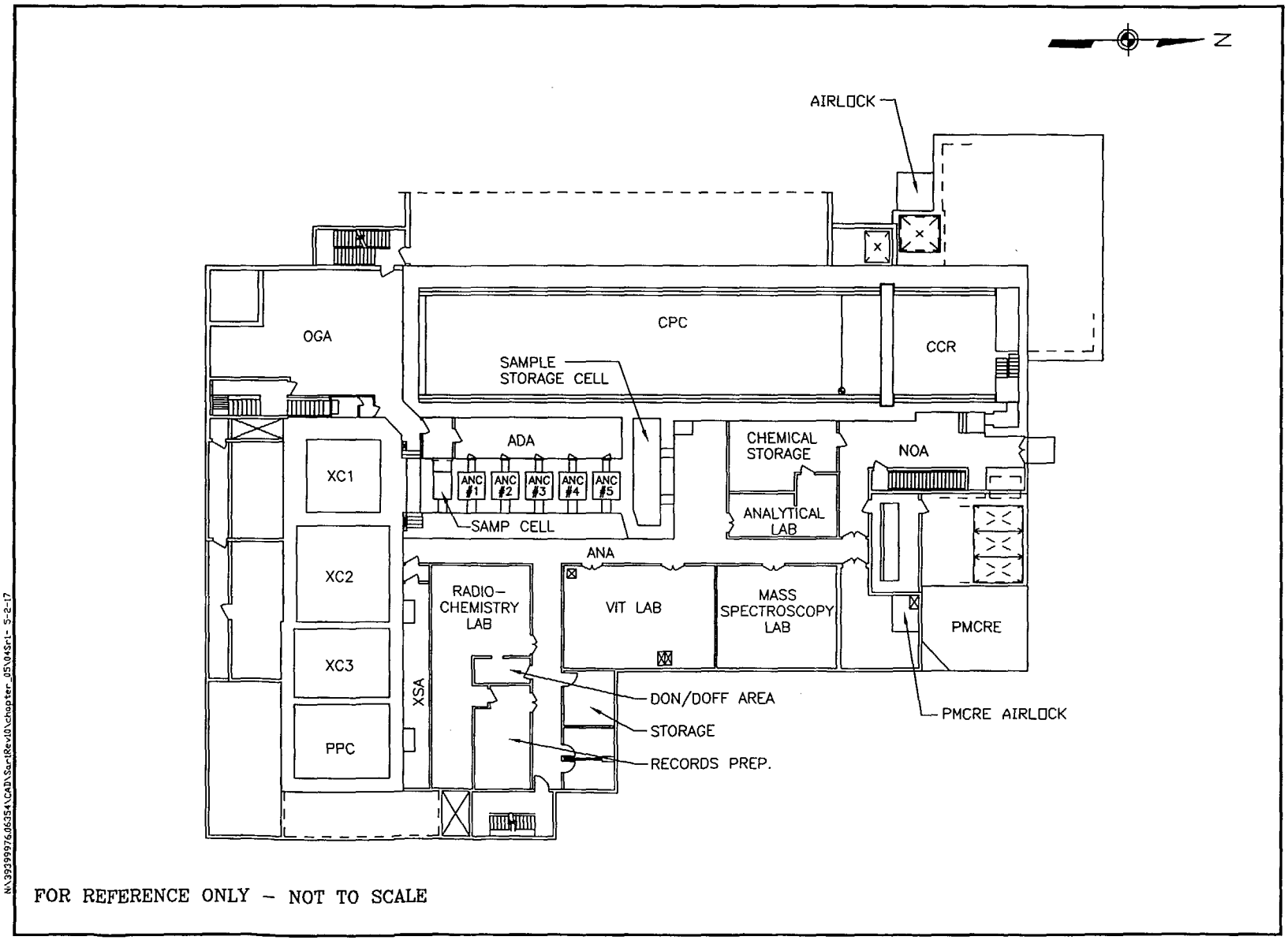


Figure 5.2-17 Main Plant Plan at Elevation 131.0'

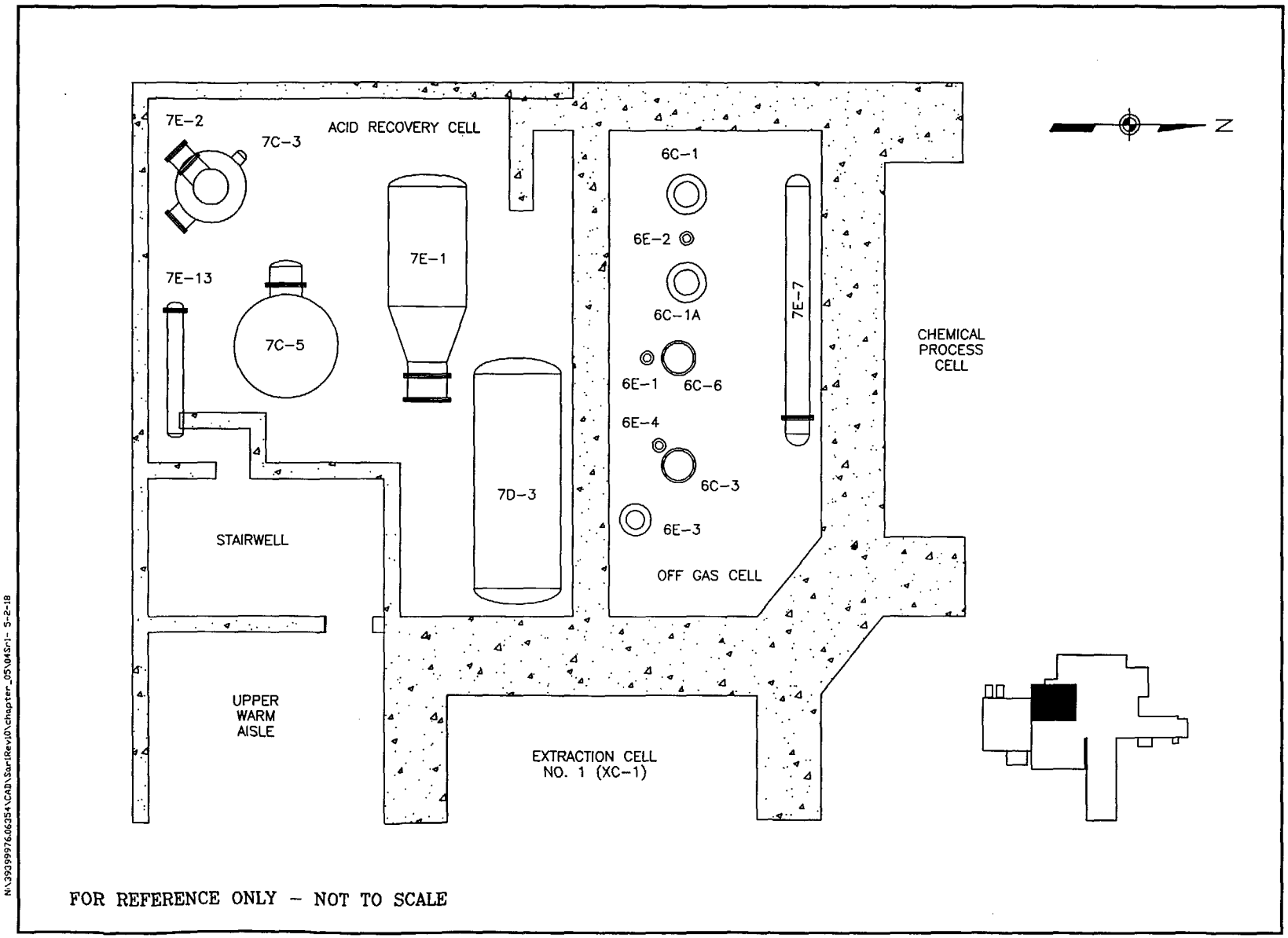


Figure 5.2-18 Equipment Arrangement – Off Gas and Acid Recovery Cells – Plan Elevation 111'–6" to 128'–3"

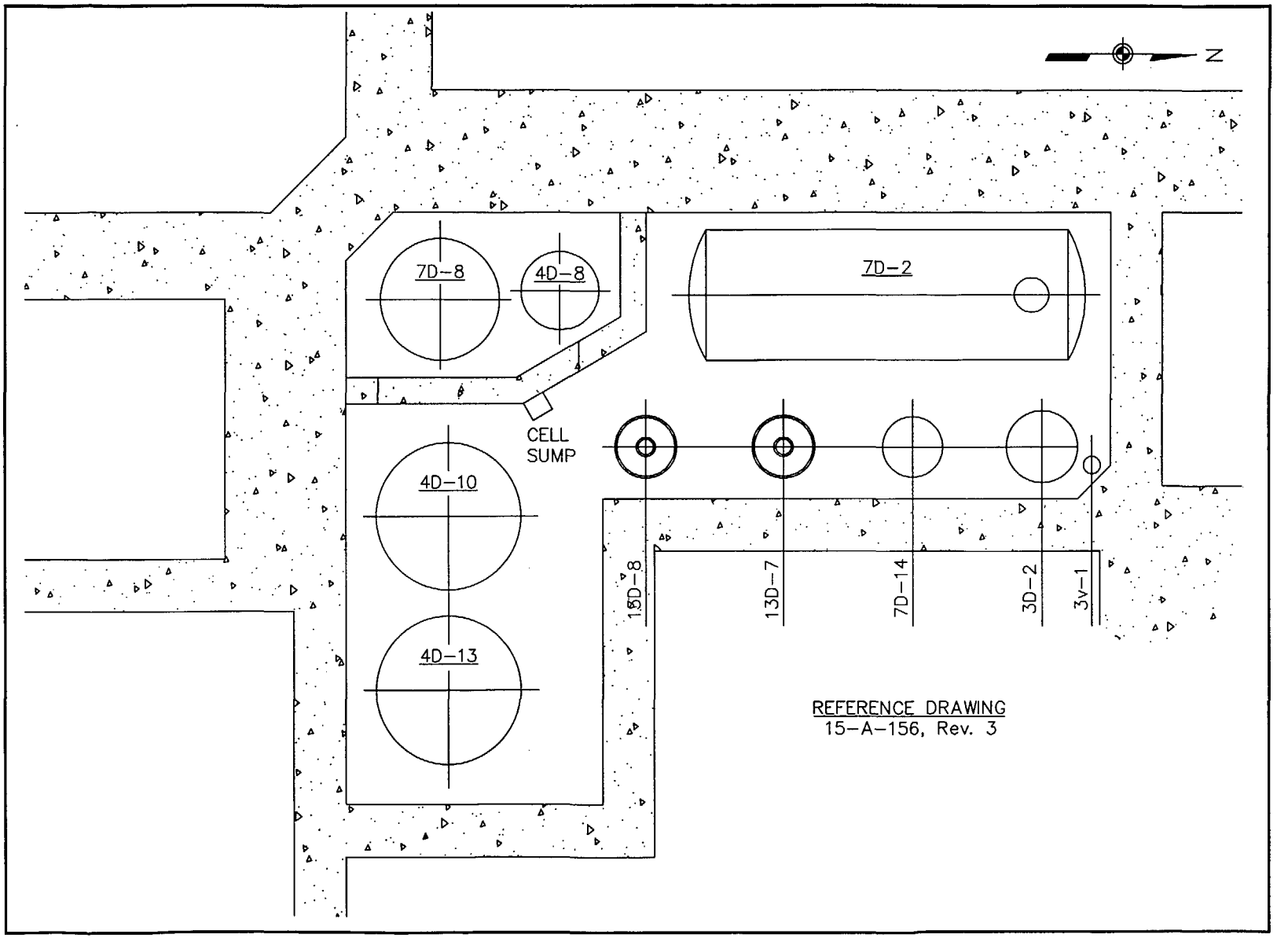


Figure 5.2-19 Equipment Arrangement – Liquid Waste Cell Plan.

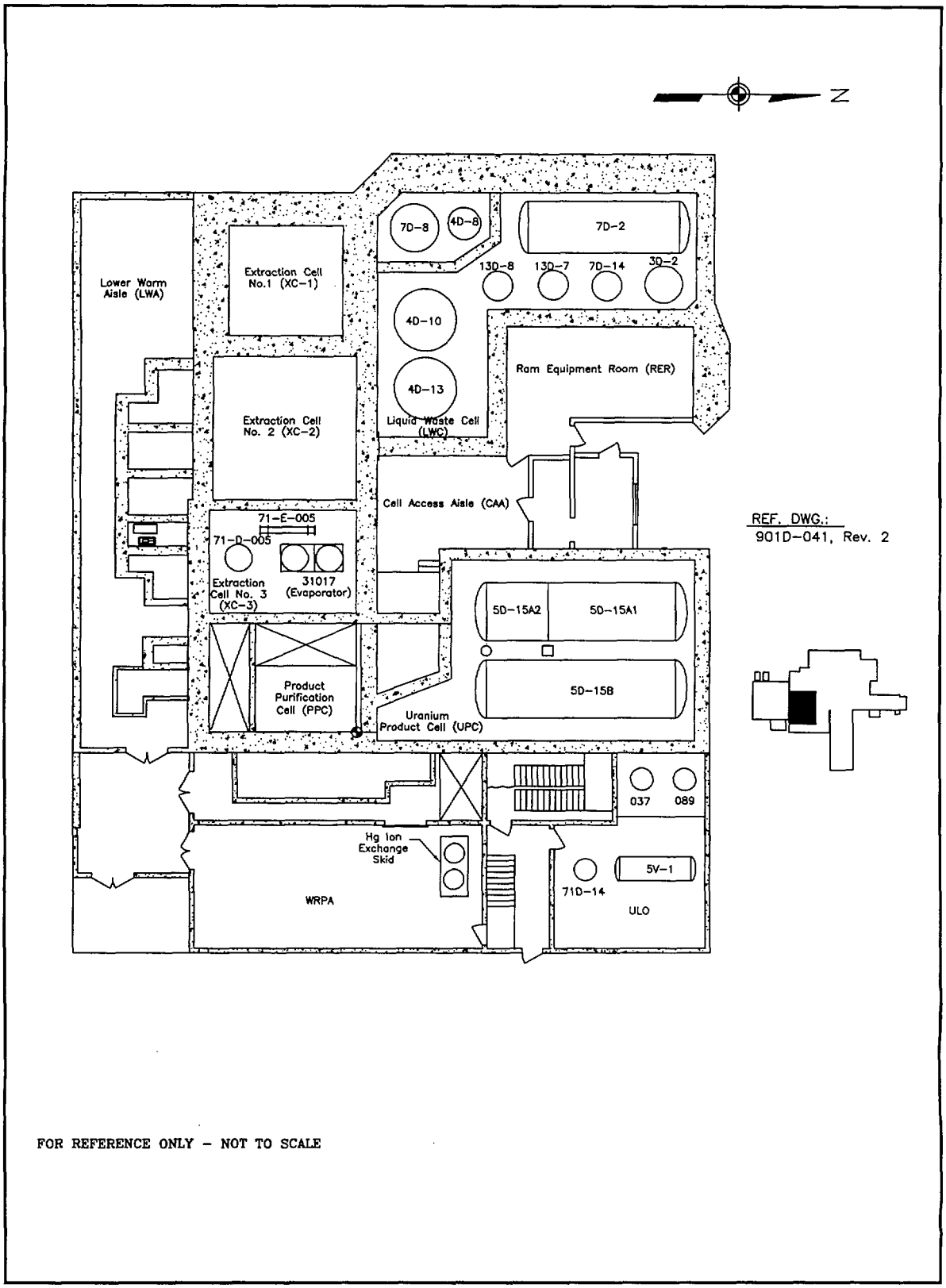


Figure 5.2-20 LWTS Plan at Elevation 100.0'

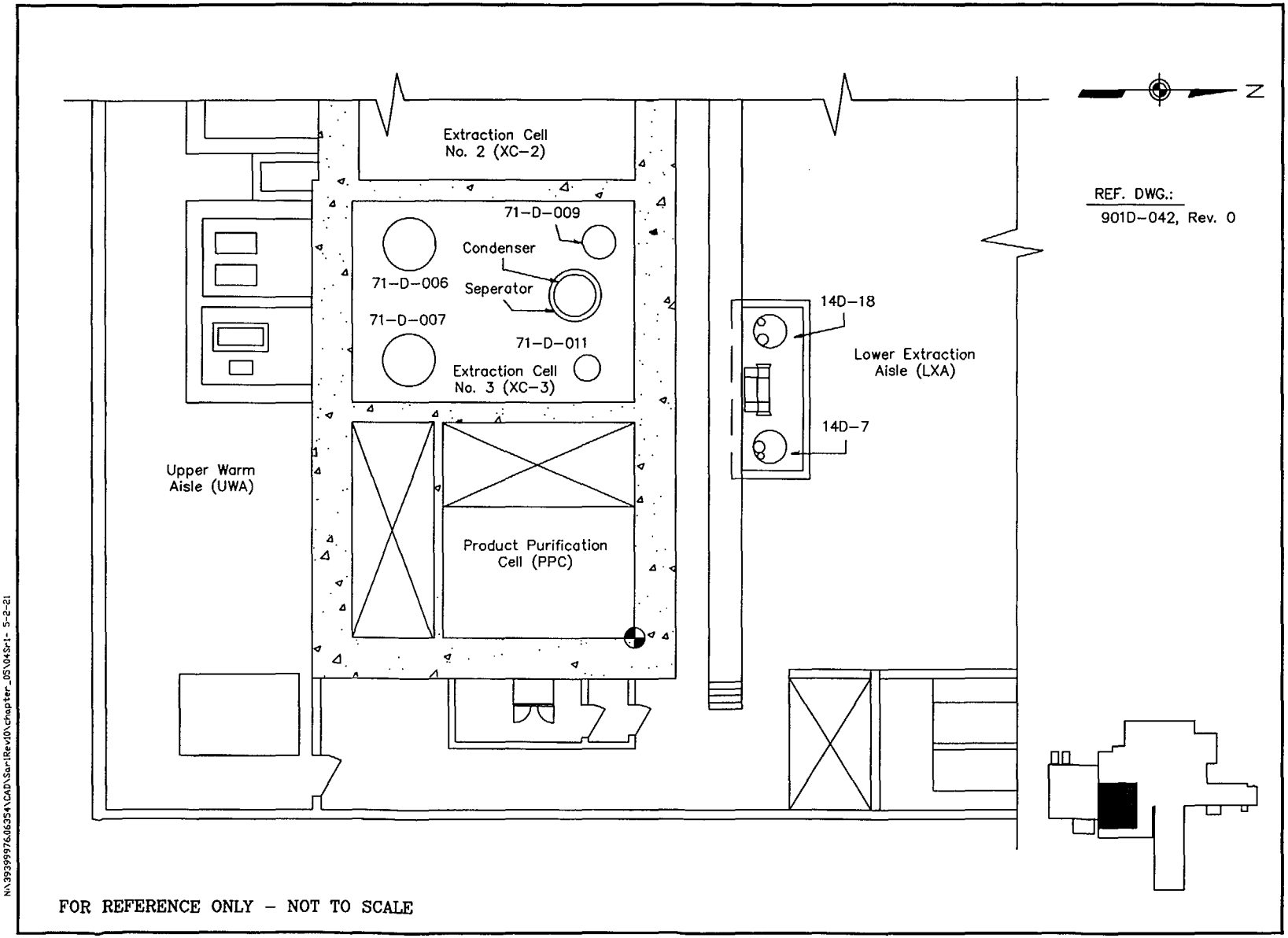


Figure 5.2-21 LWTS Plan at Elevation 114.5'

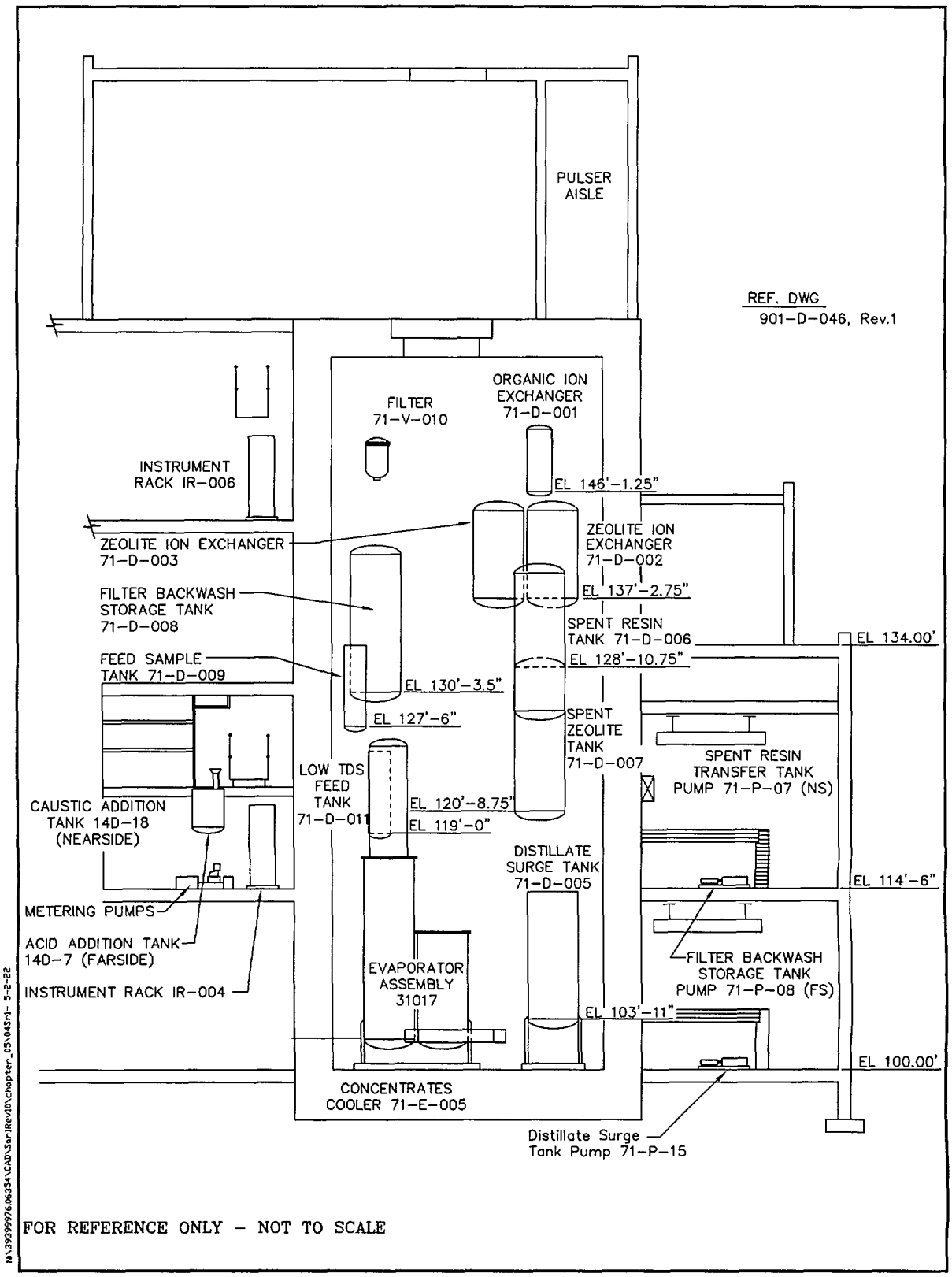
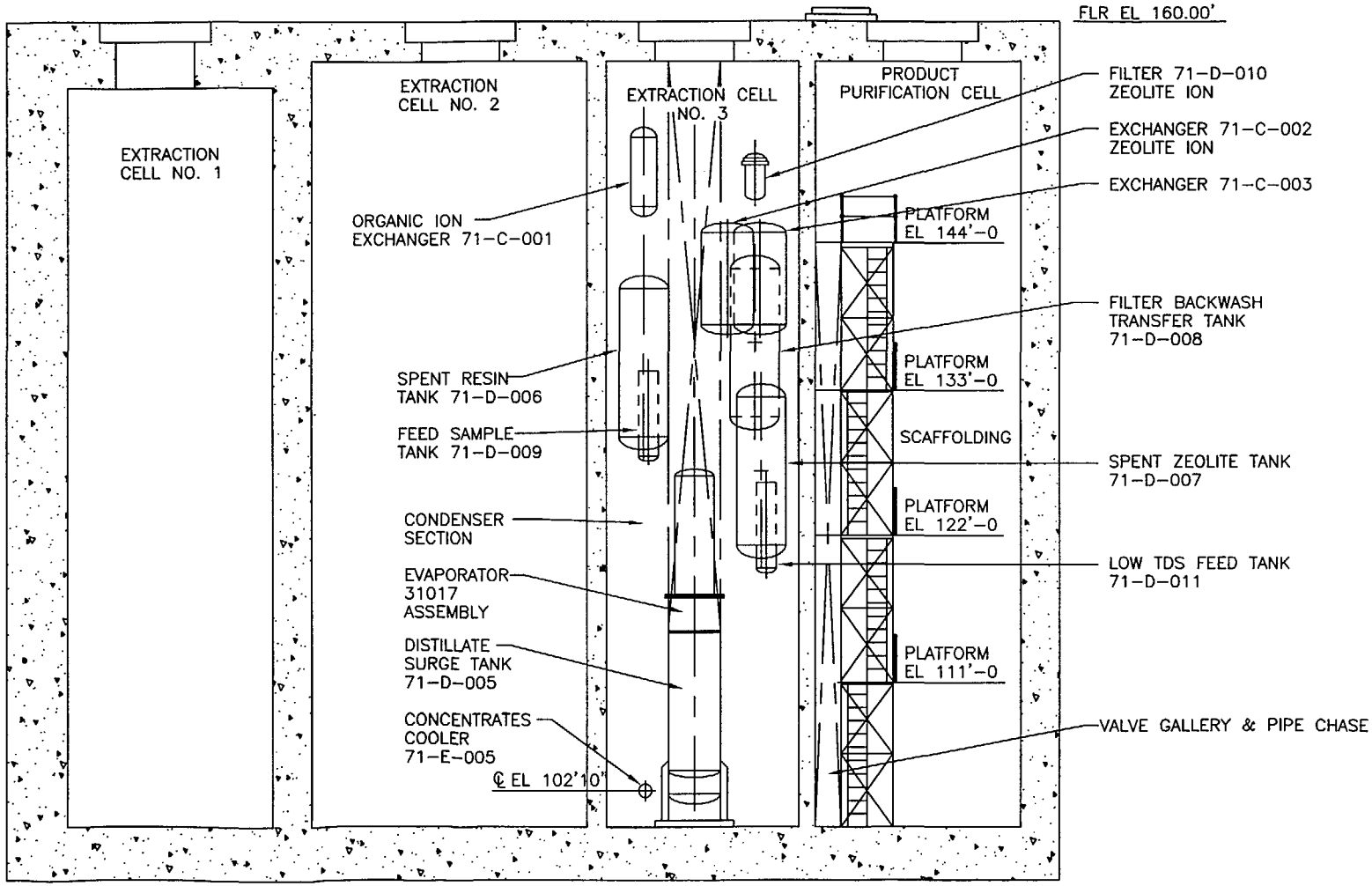


Figure 5.2-22 LWTS Elevation View.



FOR REFERENCE ONLY – NOT TO SCALE

Figure 5.2-23 General Arrangement – LWTS Sections

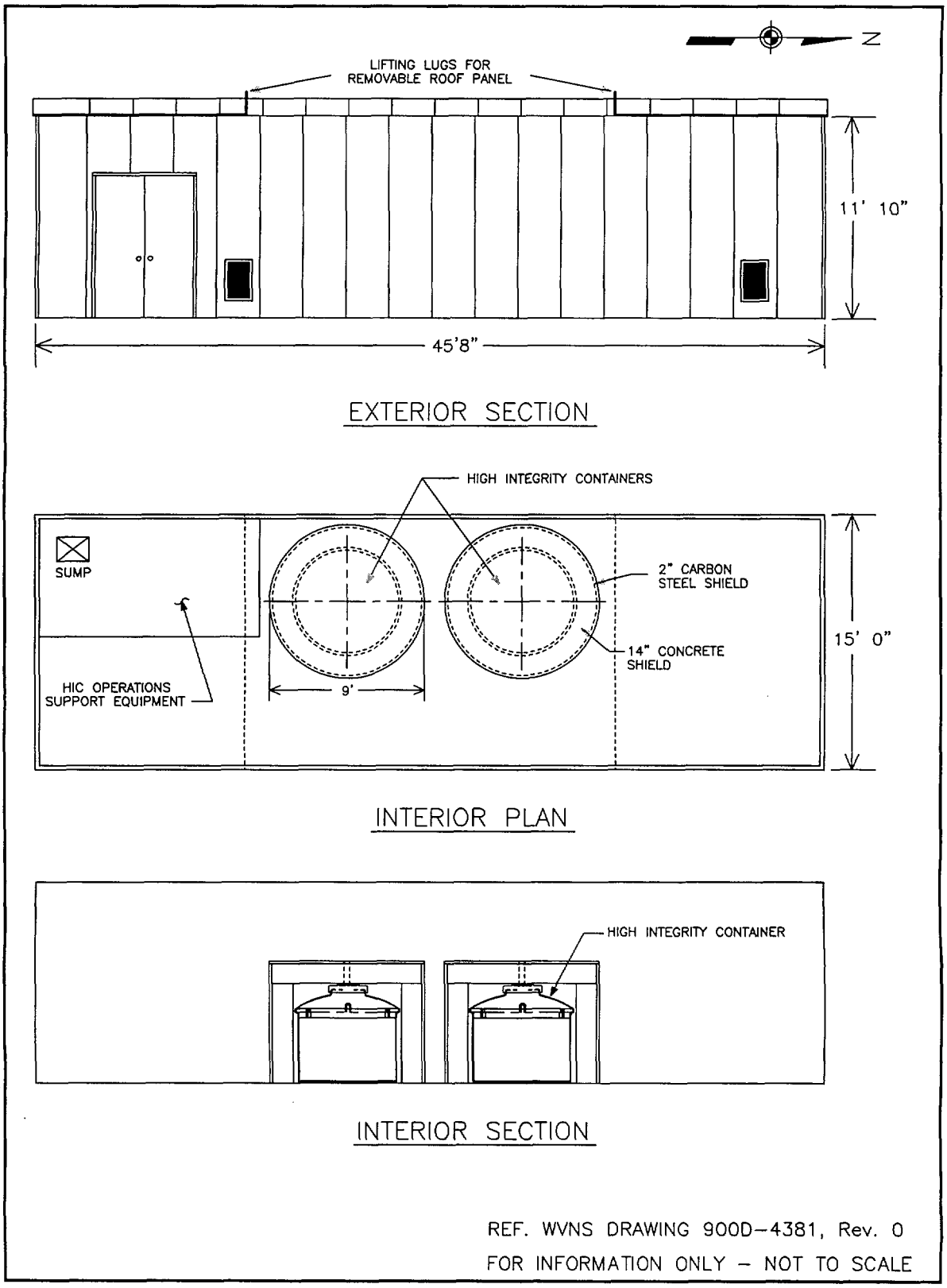


Figure 5.2-24 Radwaste Process Building Plan and Sections.

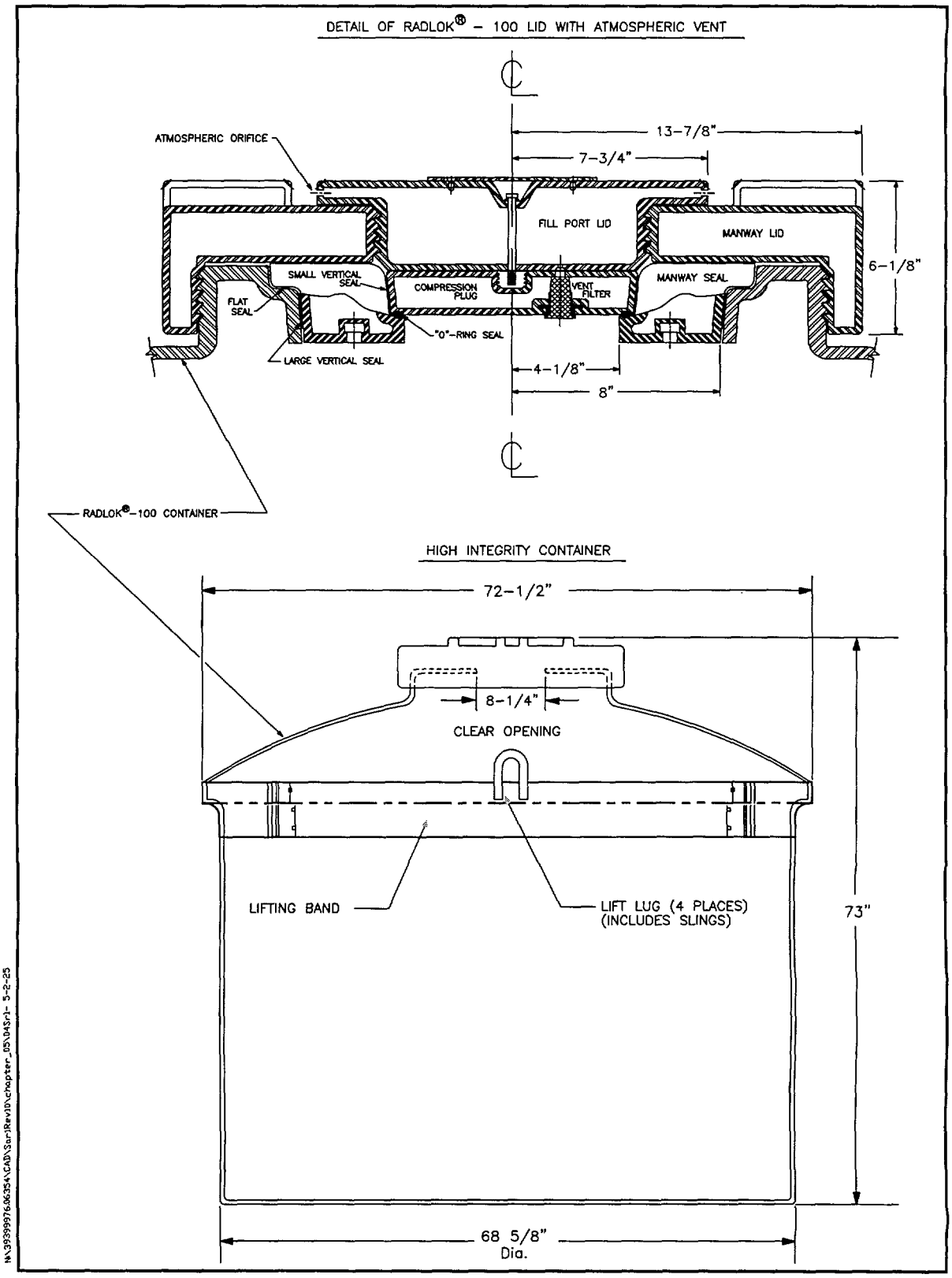


Figure 5.2-25 High Integrity Container.

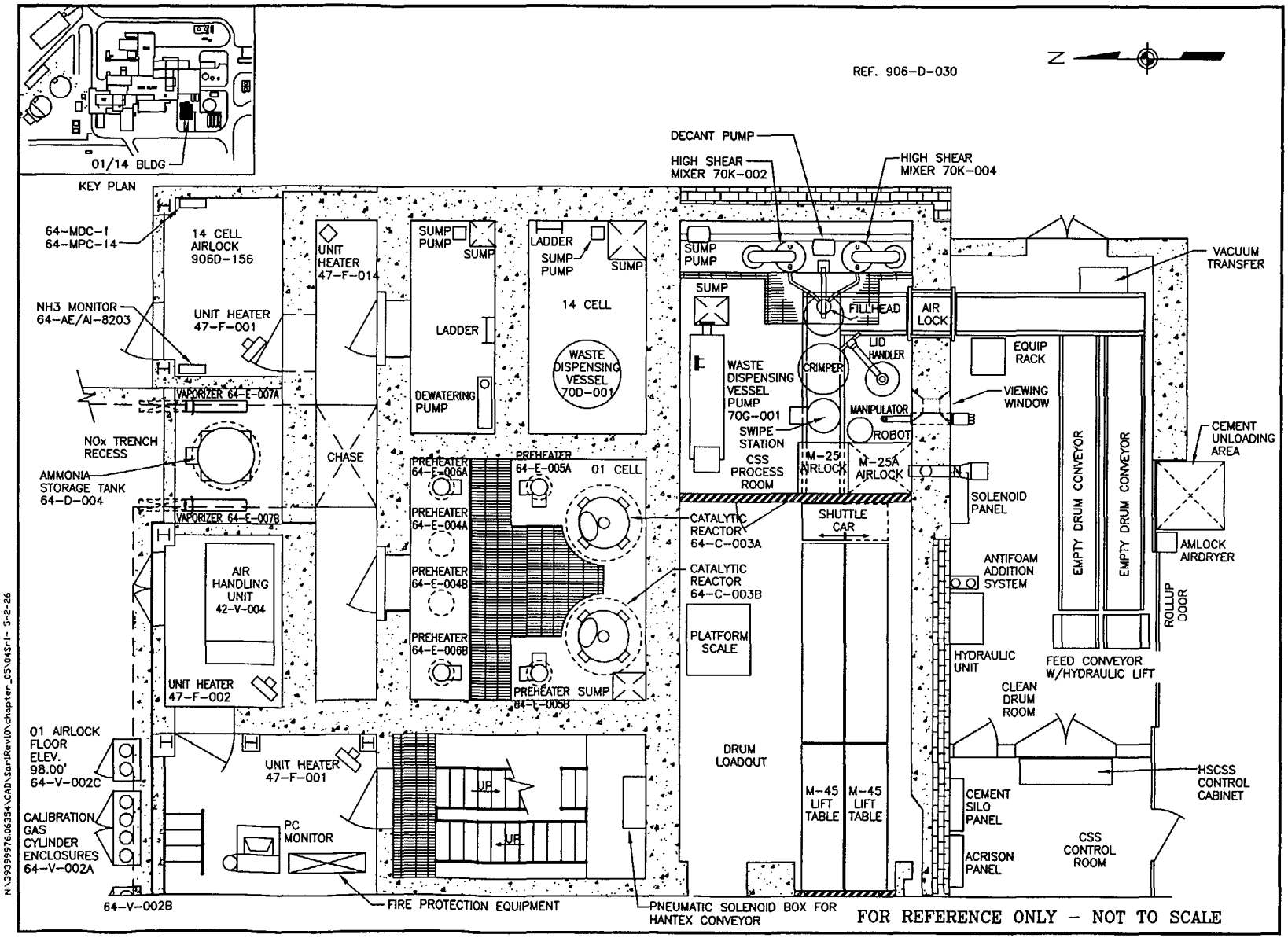


Figure 5.2-26 General Arrangement – 01–14 Building Plan Elevation 98.0'

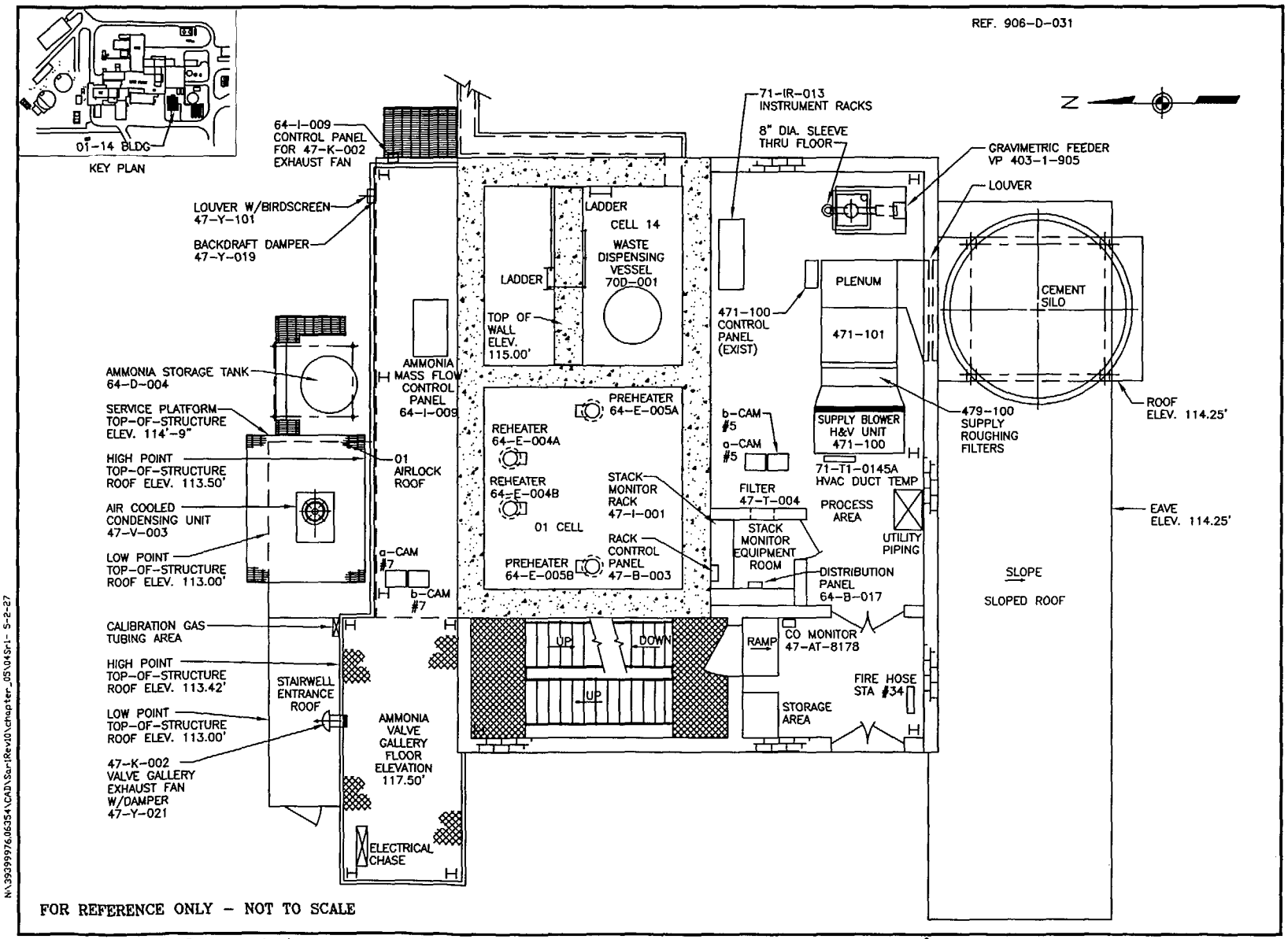


Figure 5.2-27 General Arrangement – 01–14 Building Plan Elevation 116.5'

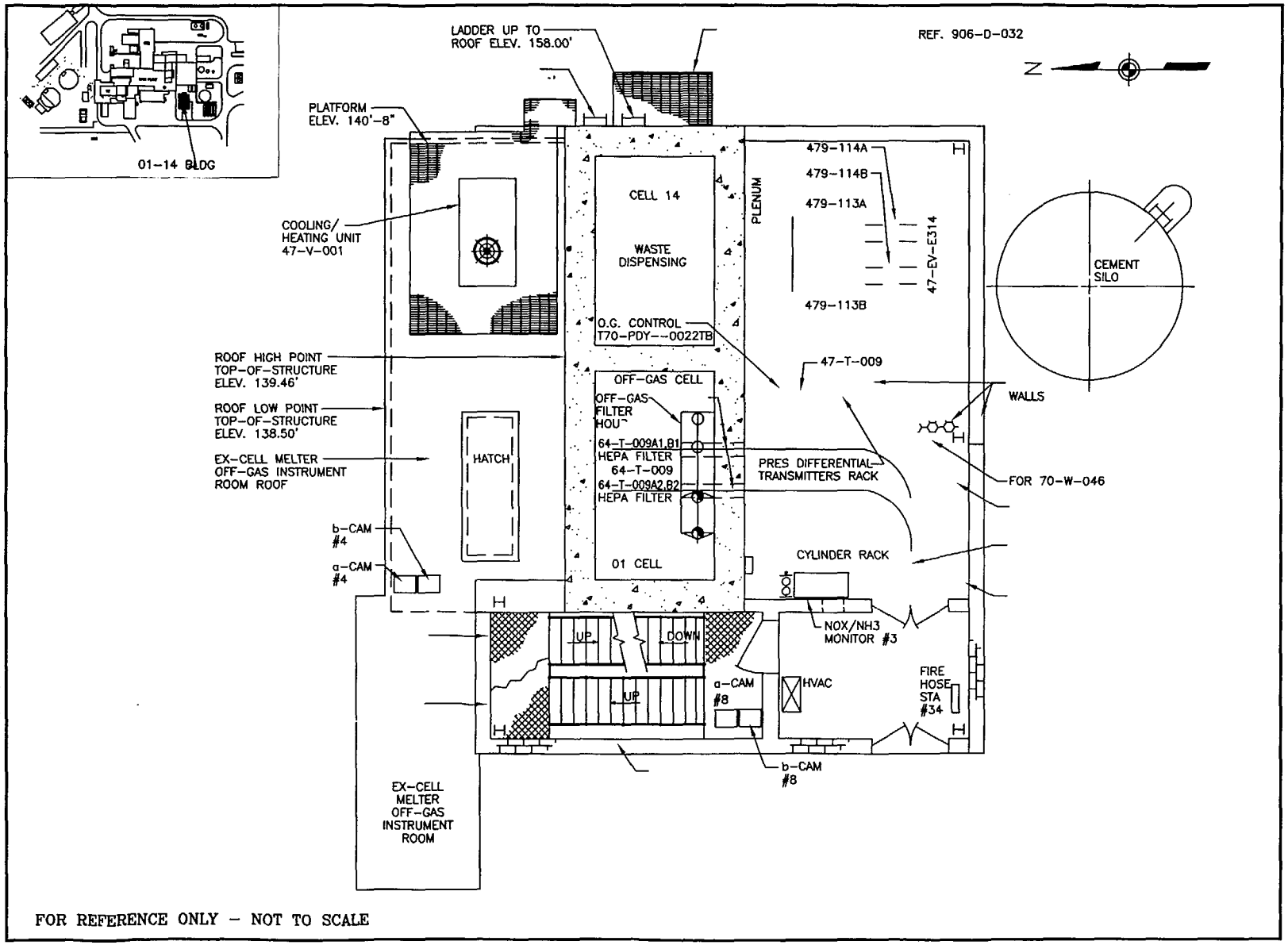


Figure 5.2-28 General Arrangement – 01–14 Building Plan Elevation 130.0'

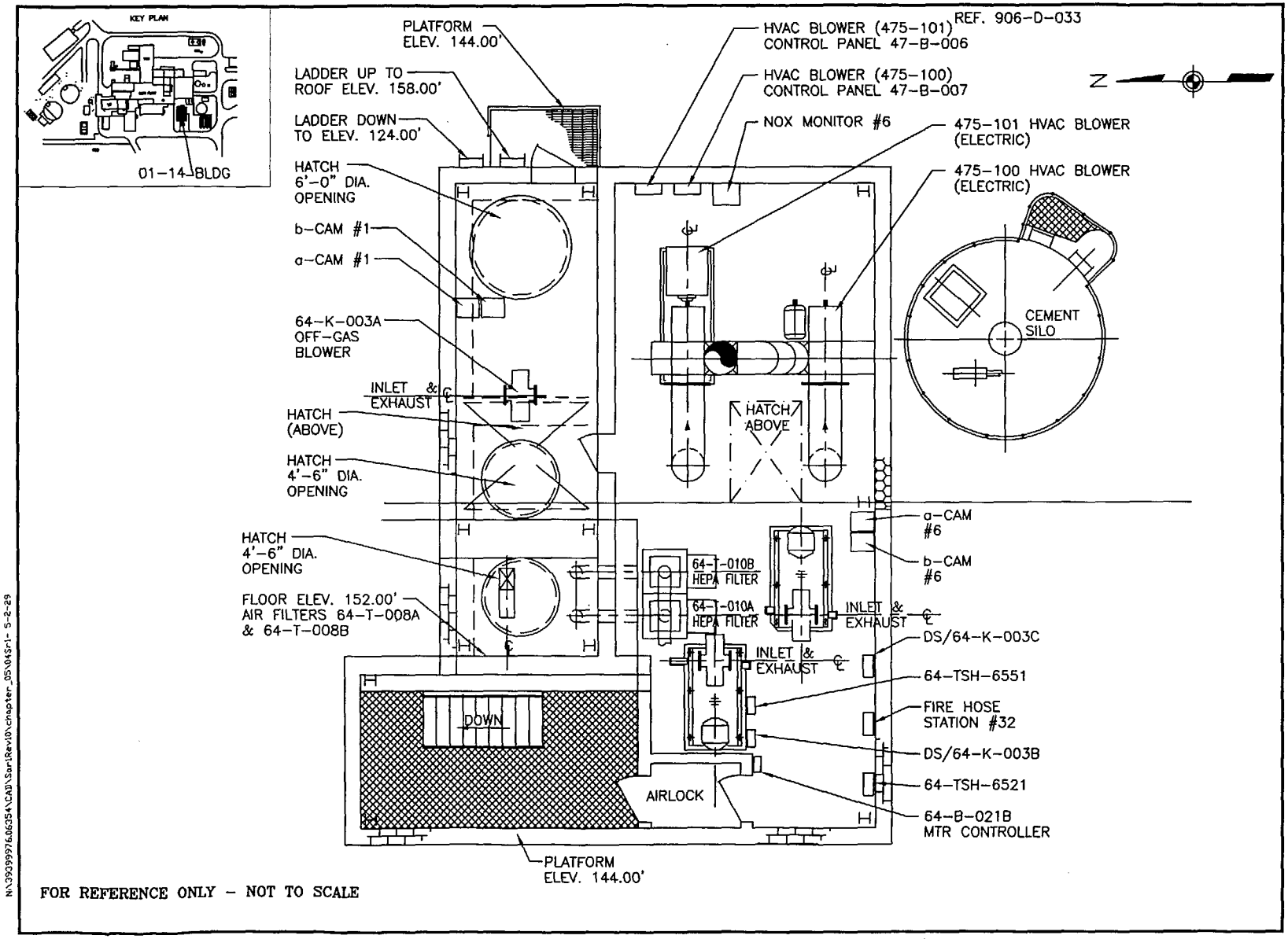


Figure 5.2-29 General Arrangement – 01–14 Building Plan Elevation 144.0'

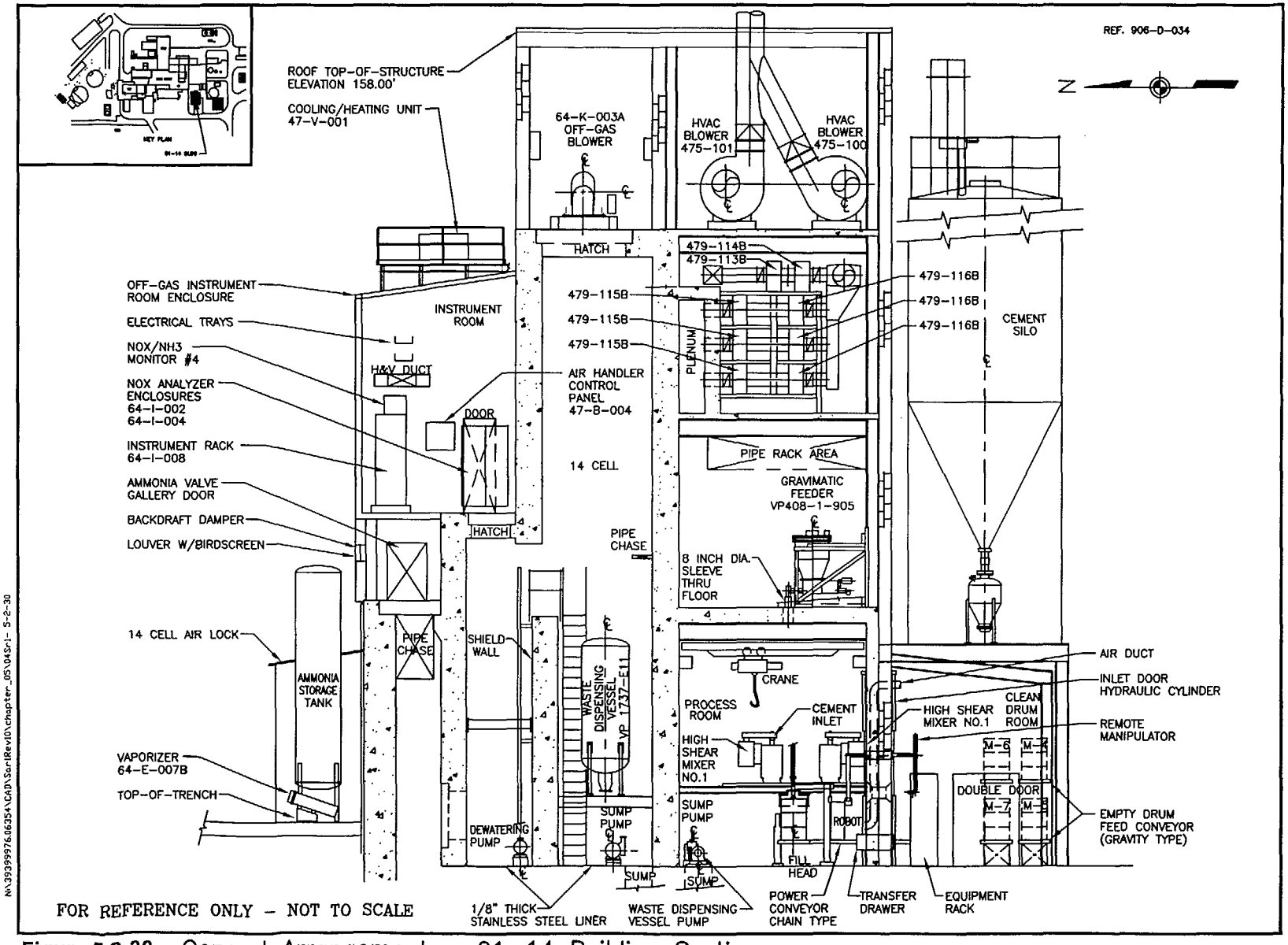


Figure 5.2-30 General Arrangement – 01–14 Building Sections

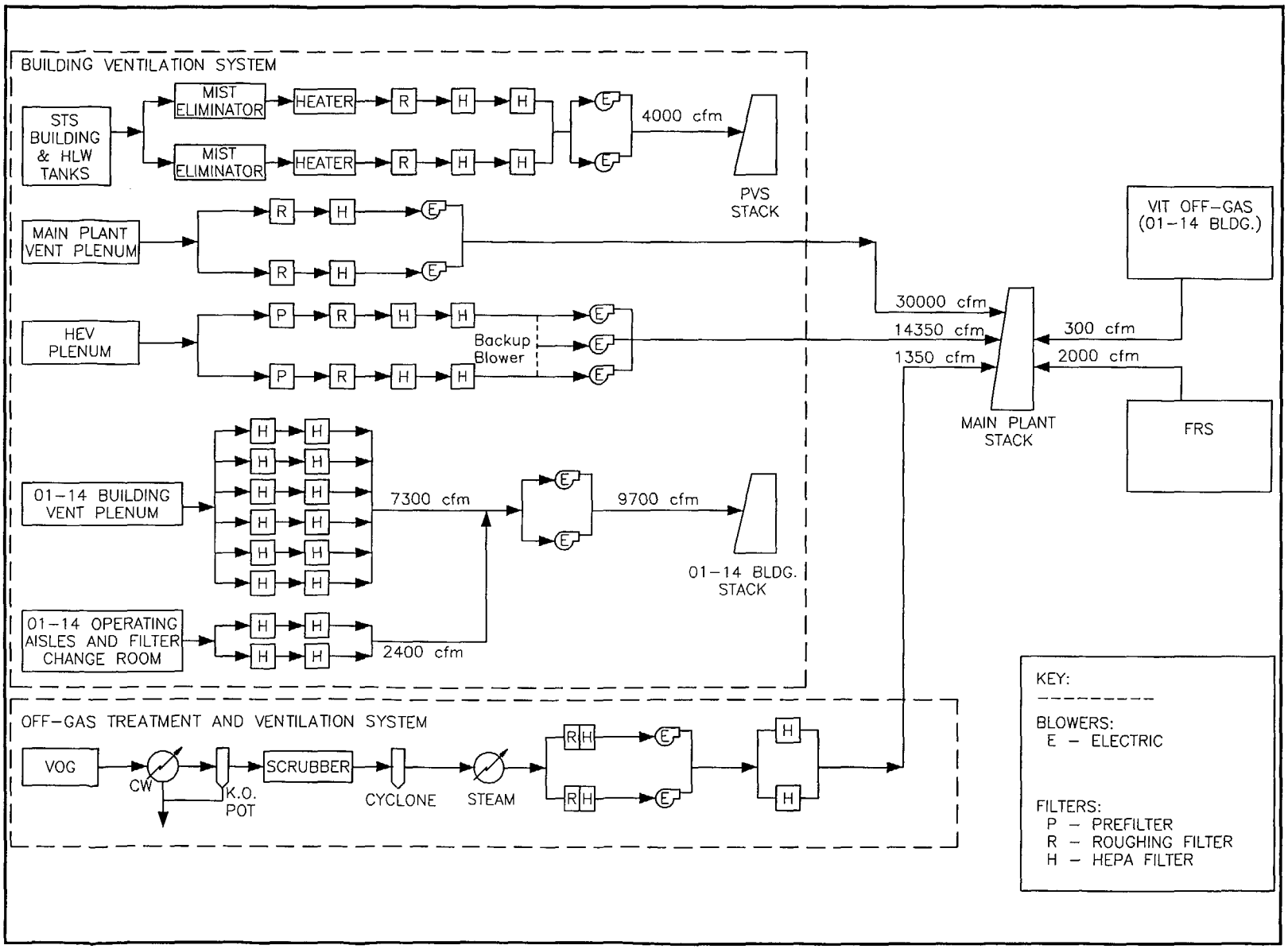


Figure 5.4-1 Building and Off-gas Treatment Ventilation Systems.

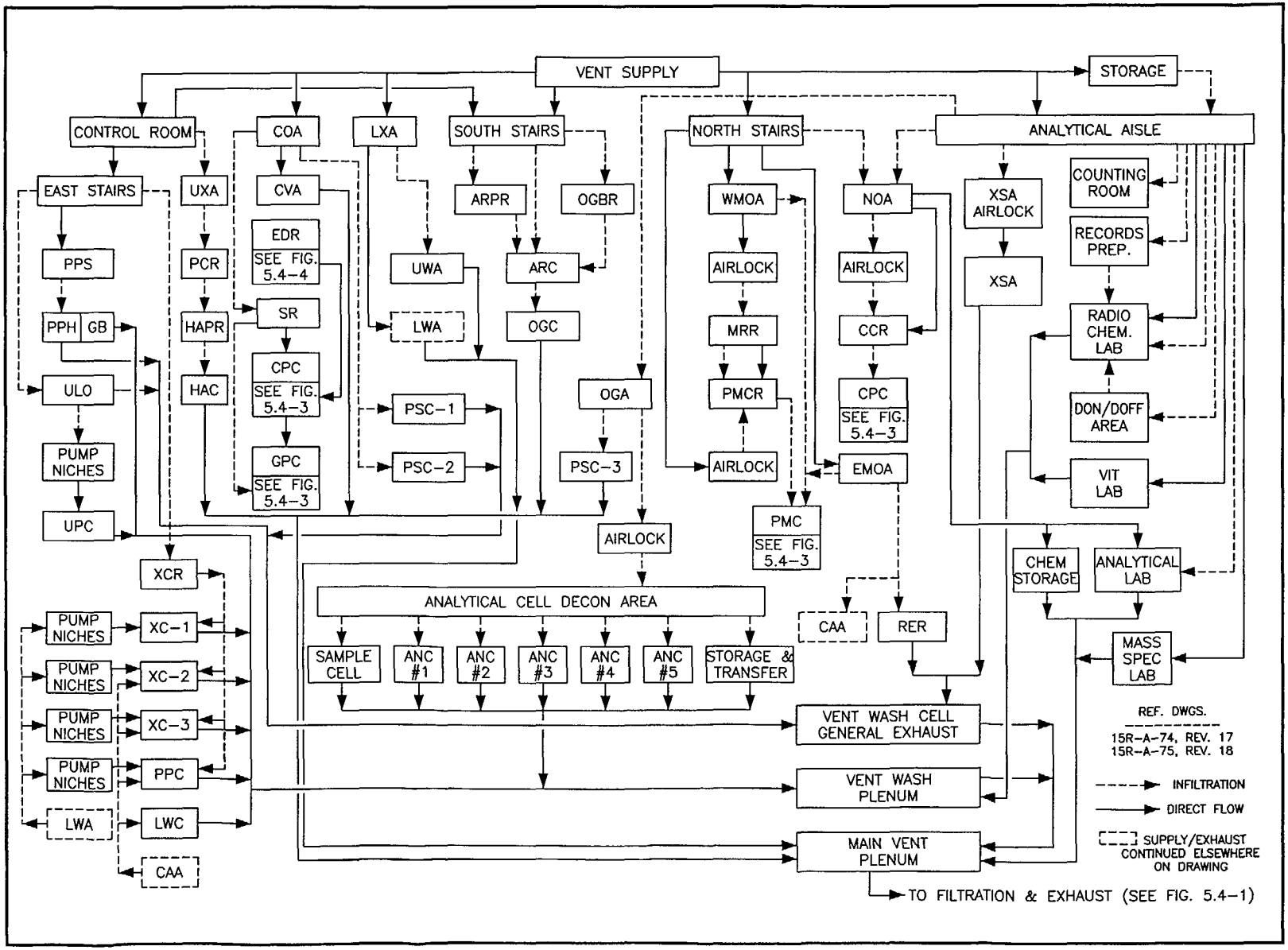


Figure 5.4-2 Main Plant Ventilation System Flow.

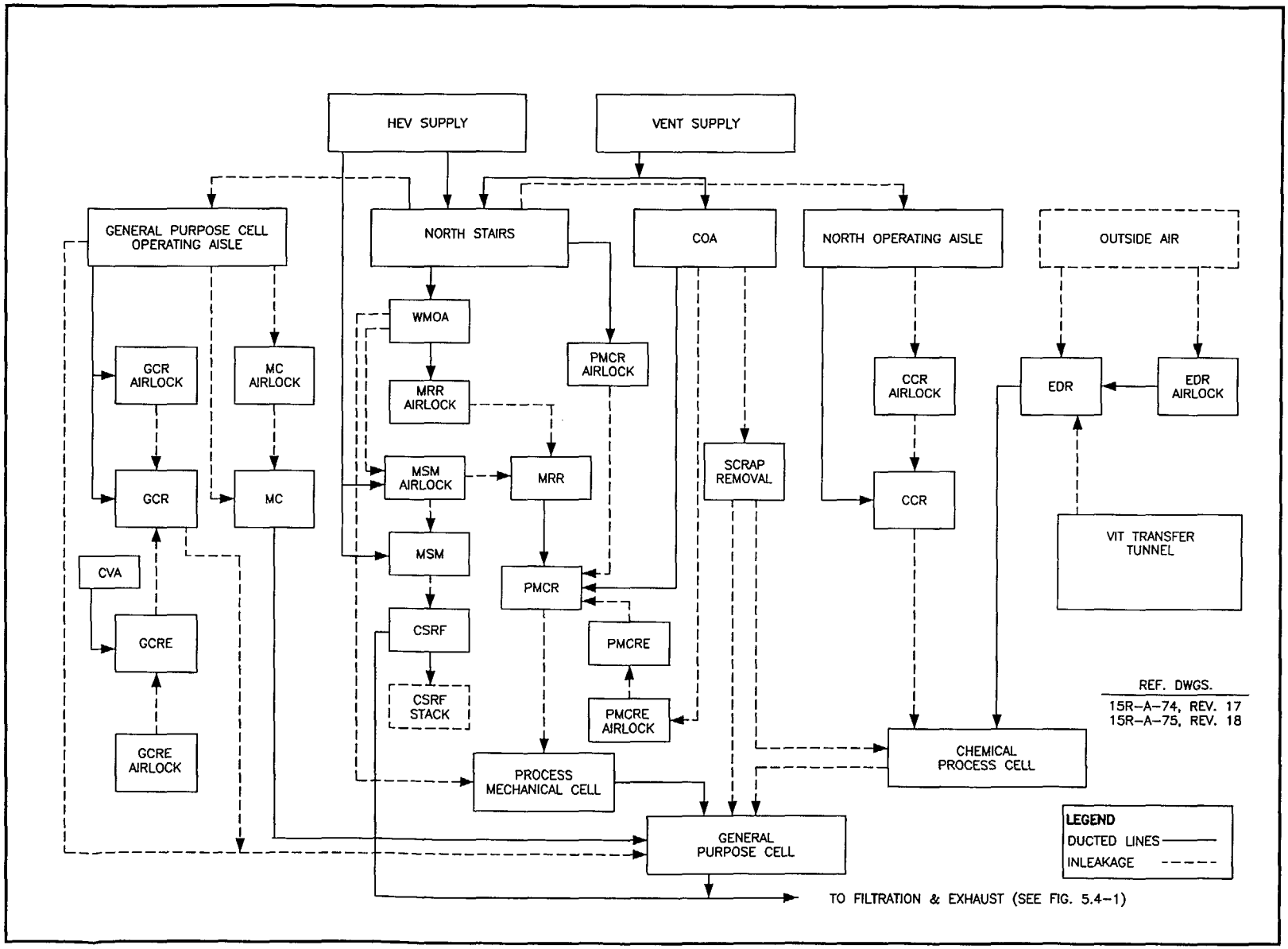


Figure 5.4-3 Head End Ventilation System Flow.

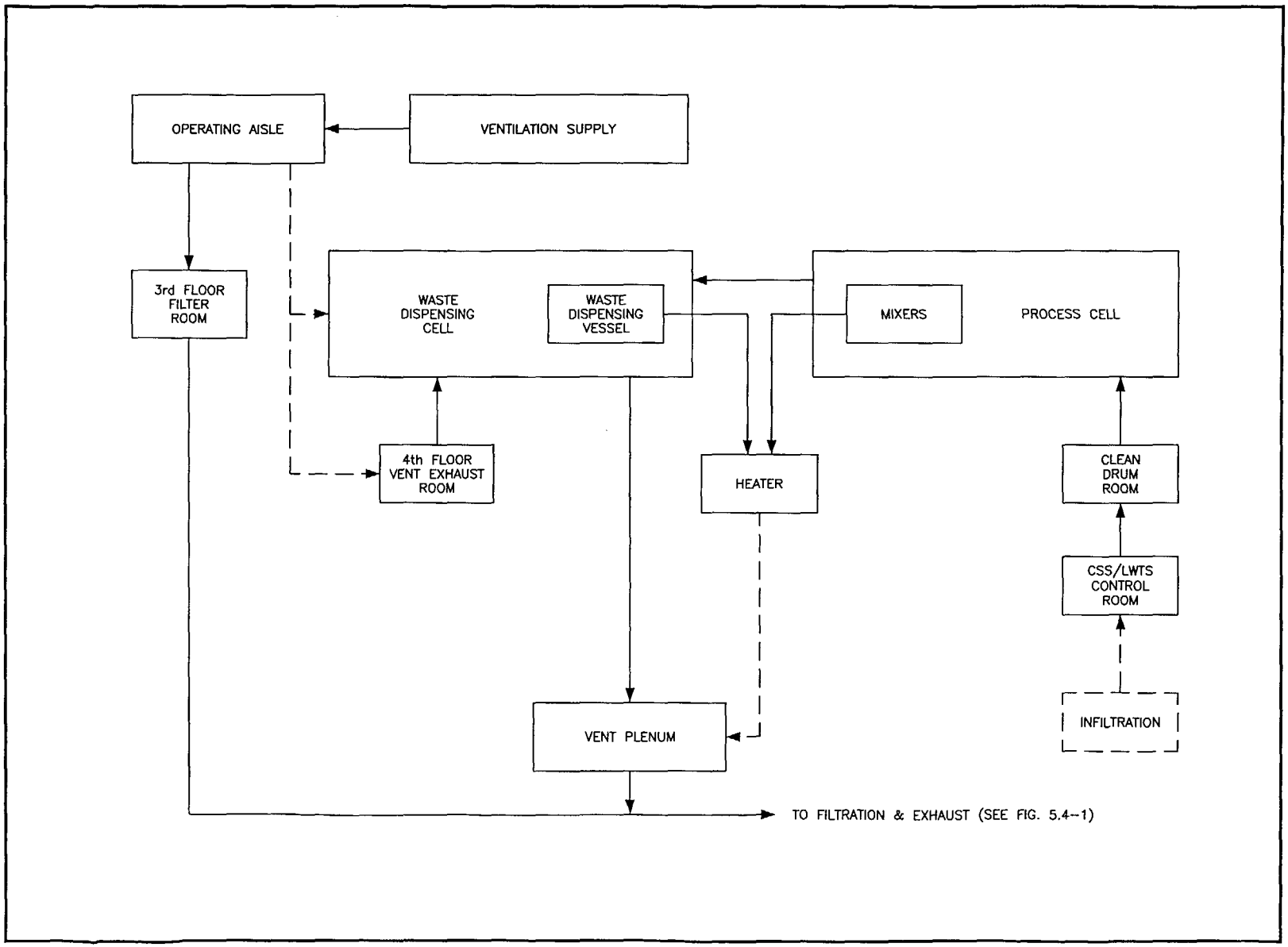


Figure 5.4-4 01–14 Building Ventilation Flow.

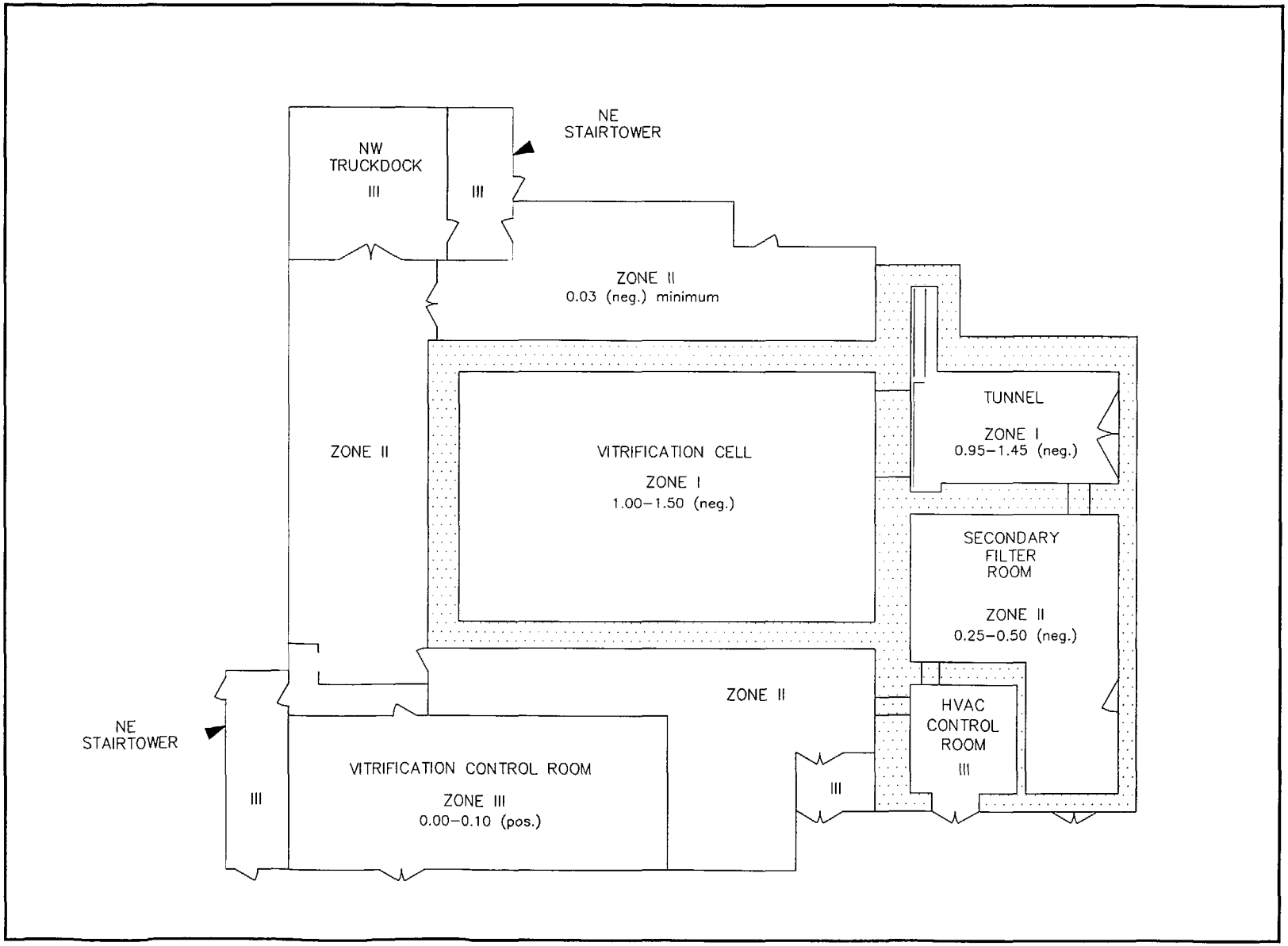


Figure 5.4-5 Vitrification Building HVAC Zones El. 110.00'.

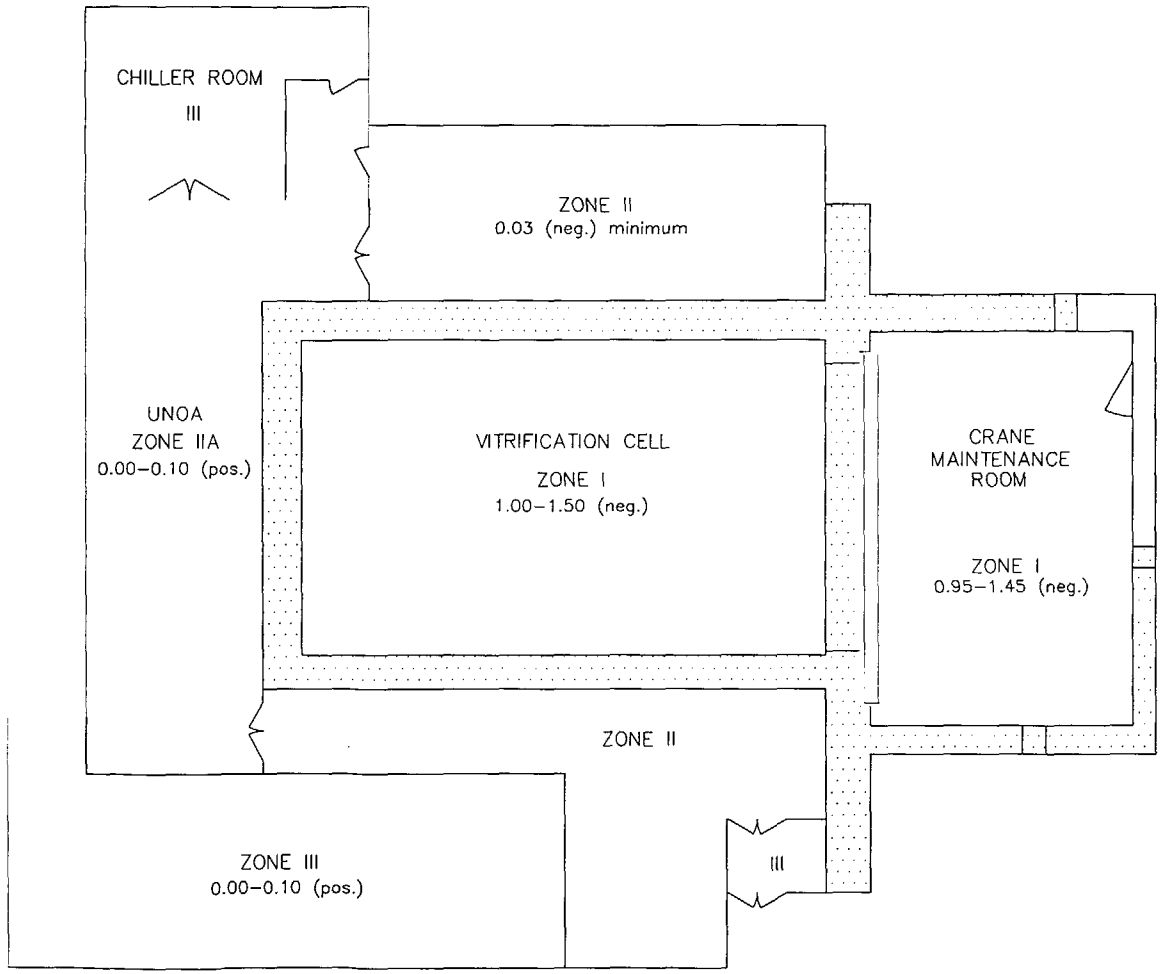


Figure 5.4-6 Vitrification Building HVAC Zones El. 125.00'.

N:\39999976.06354\CAD\SarIRev10\chapter_05\045r1- 5-4-6

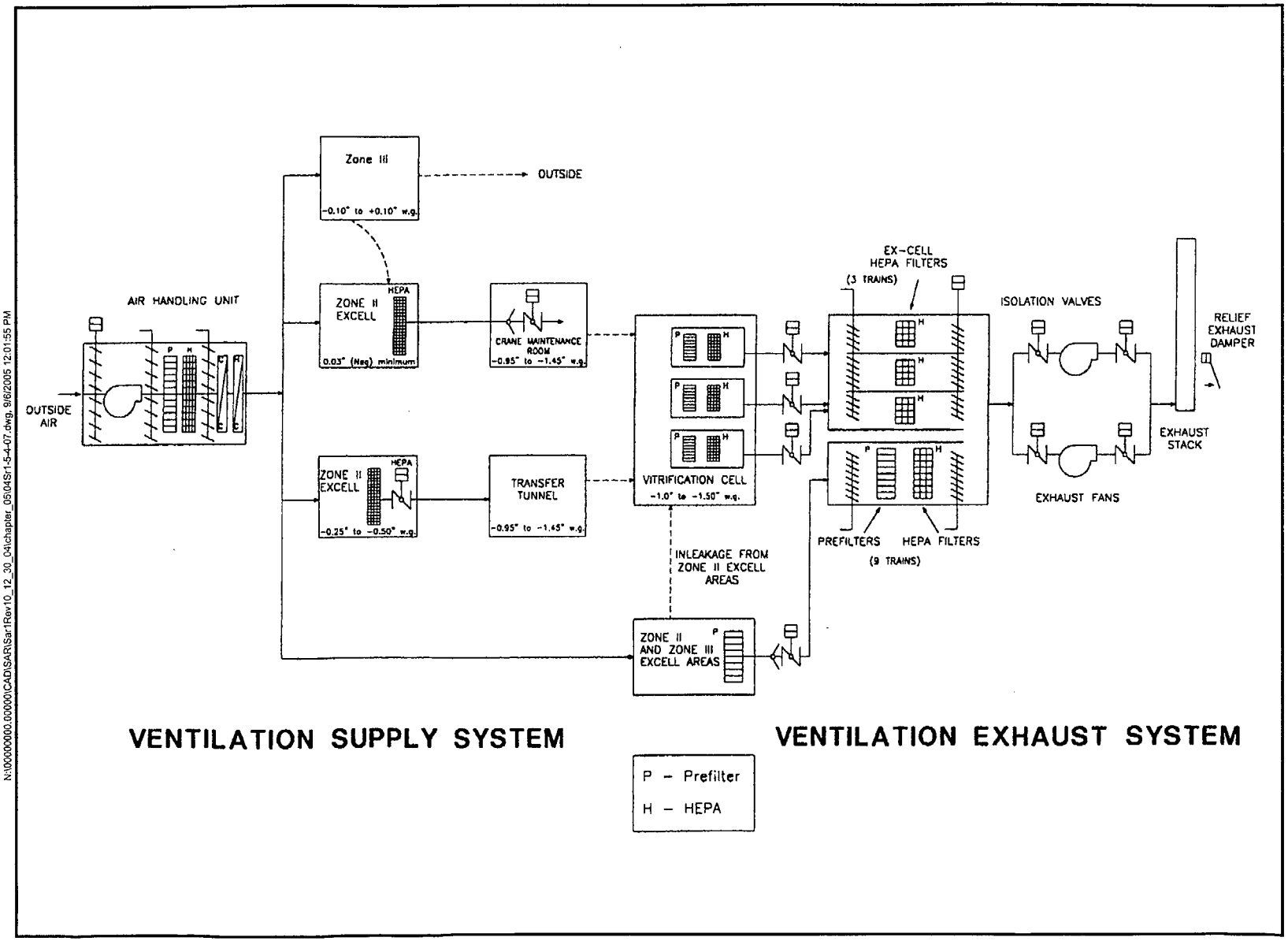


Figure 5.4-7 Vitrification Building Ventilation Supply/Exhaust Systems.

N:\00000000.00000\CAD\SAR\Sar-1Rev10_12_30_04\chapter_05\04Sr1-5-4-07.dwg, 9/6/2005 12:01:55 PM

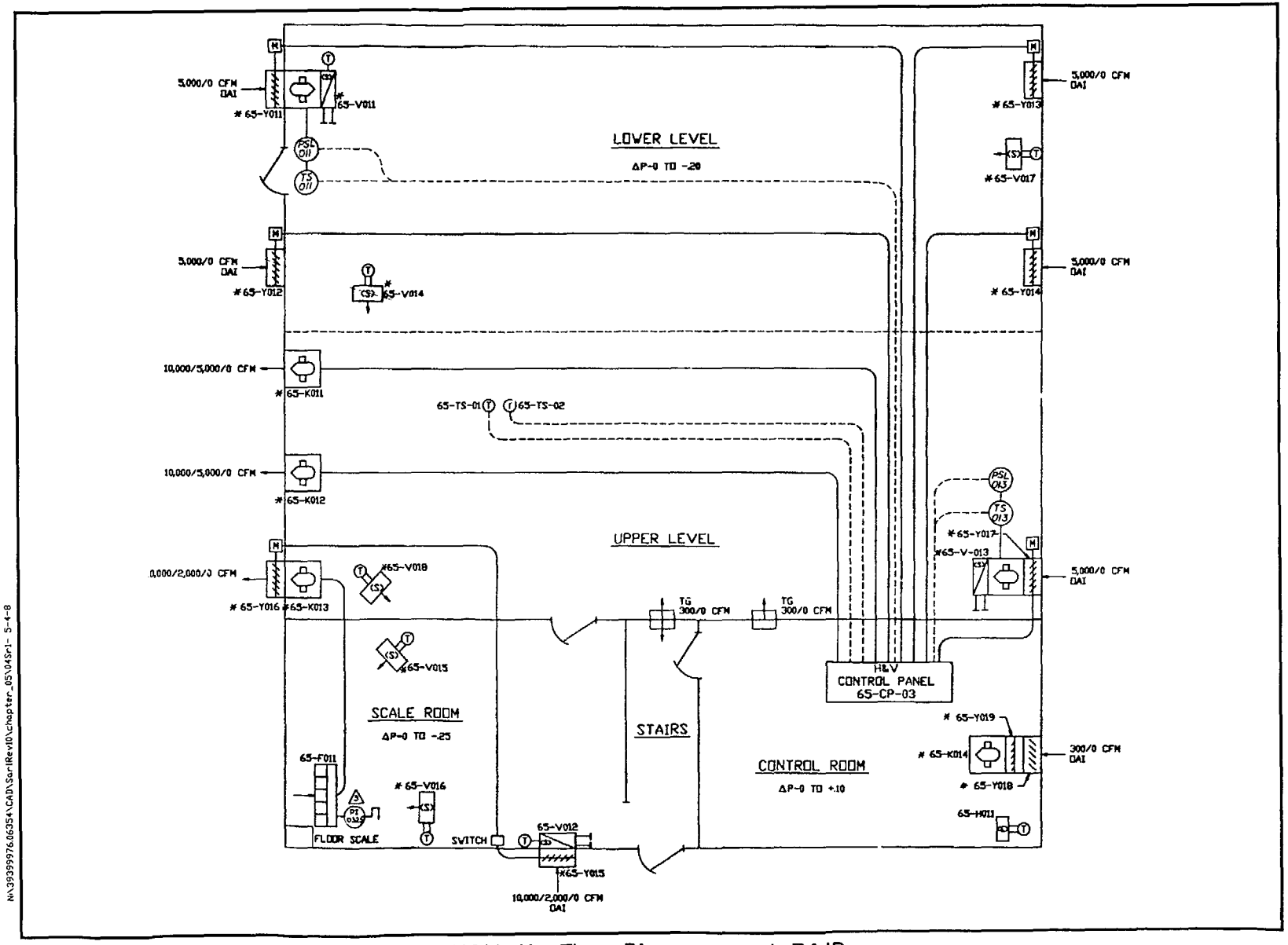


Figure 5.4-8 Cold Chemical Building H&V Air Flow Diagram and P&ID.

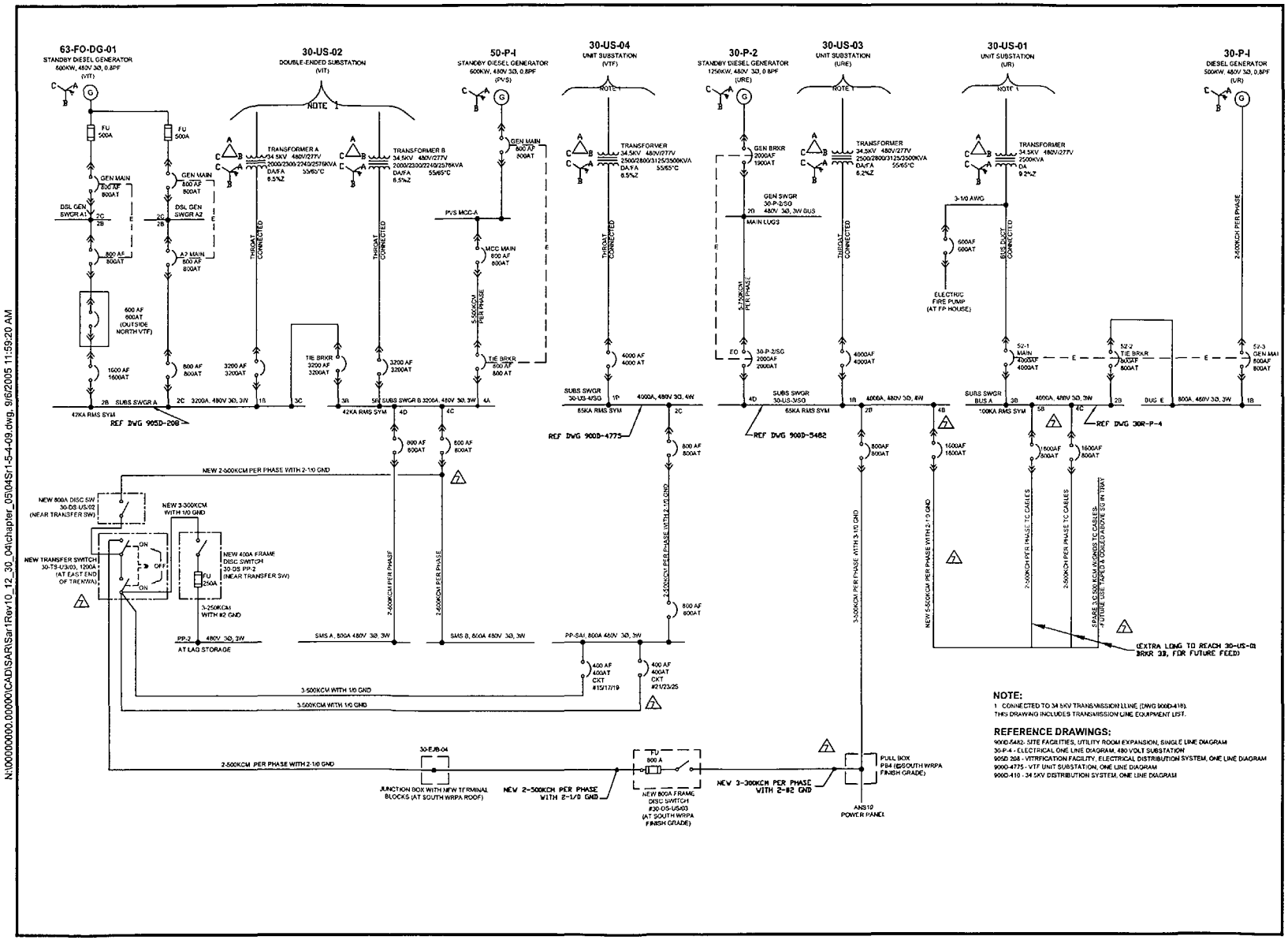


Figure 5.4-9 WVDP Primary Blower System Expansion One–Line Diagram

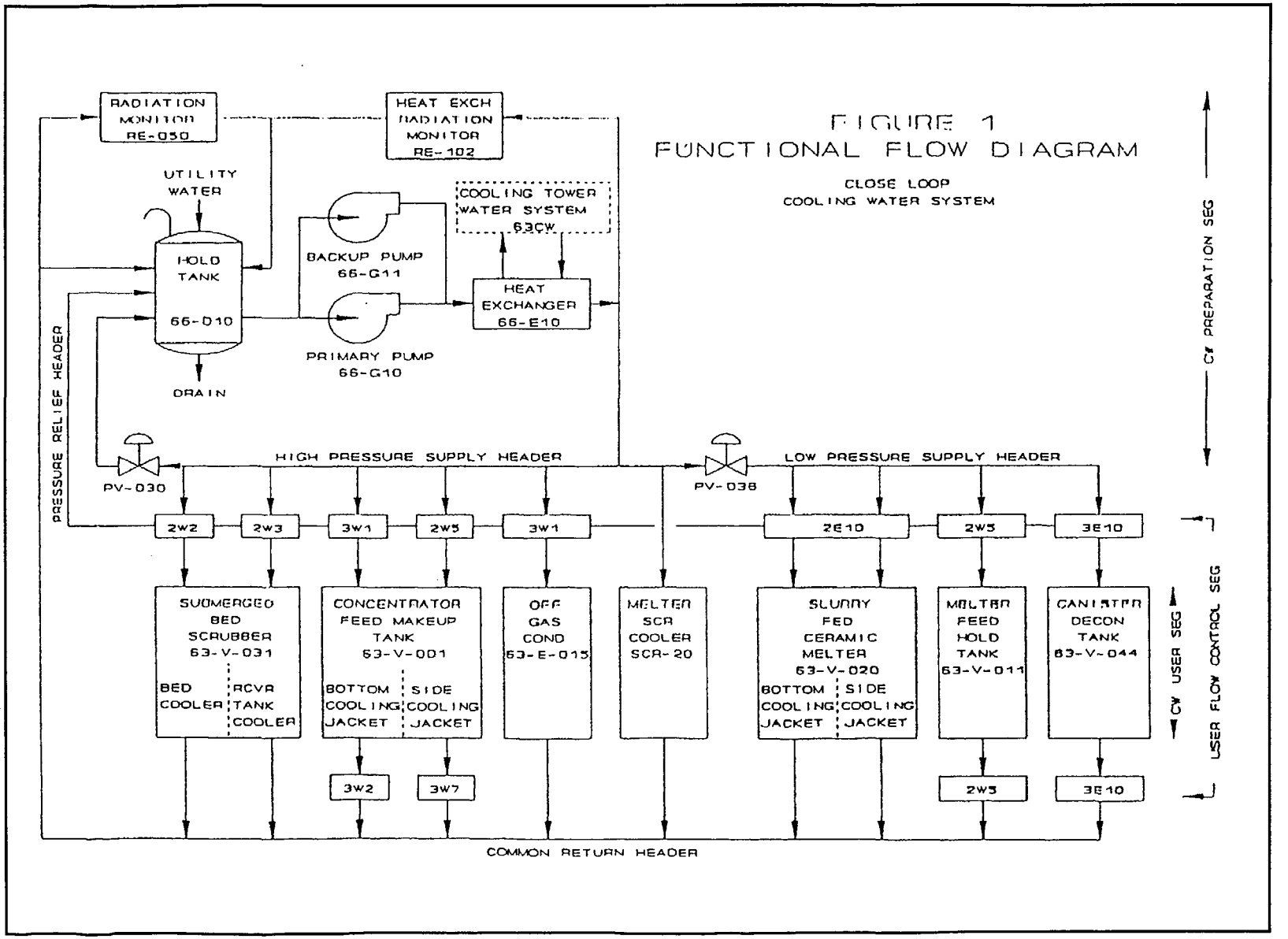


Figure 5.4-10 Closed–Loop Cooling Water (CLCW) System.

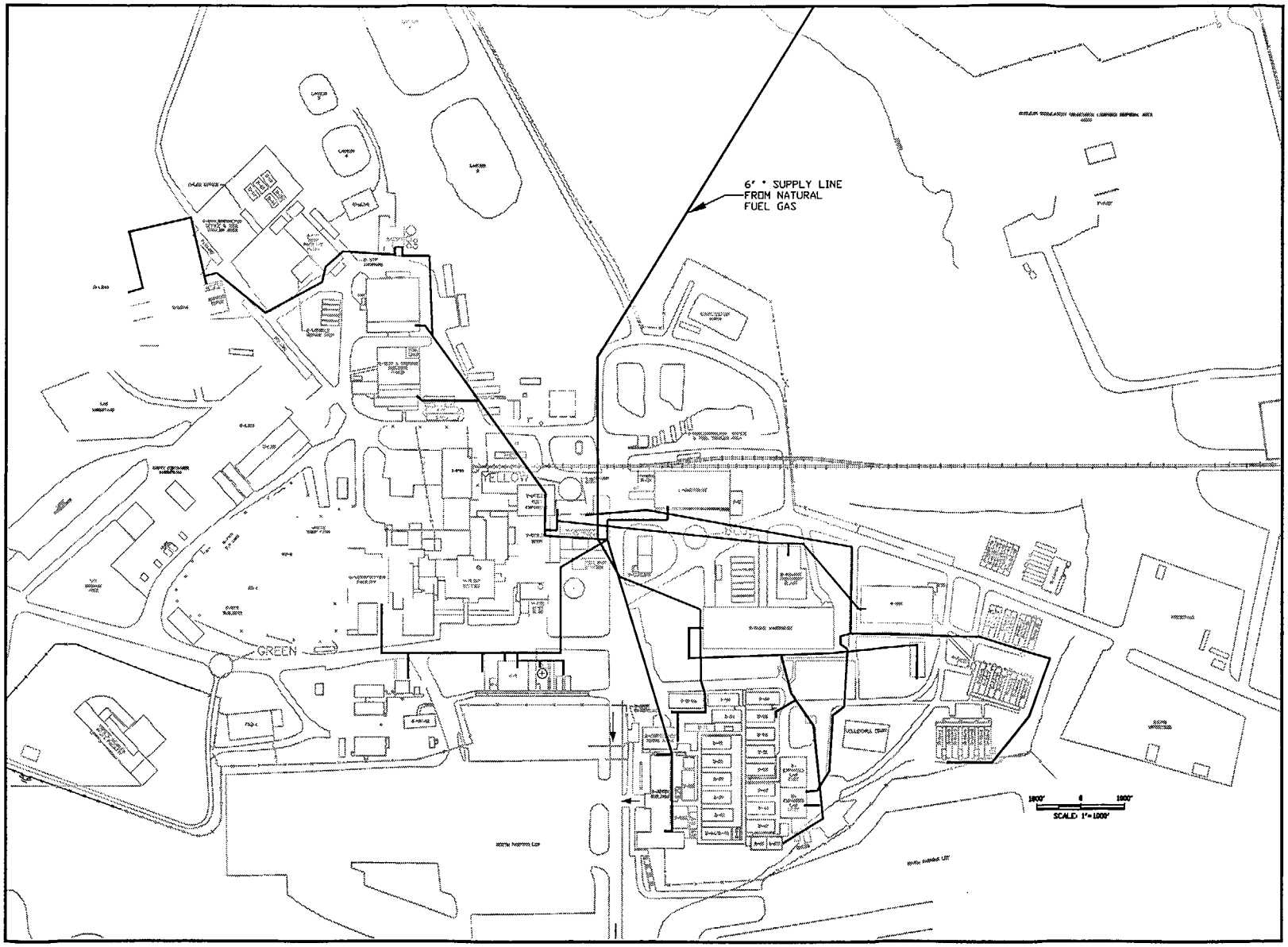


Figure 5.4-11 Natural Gas Distribution System On-site

6.0 PROCESS SYSTEMS AND FACILITY DECONTAMINATION

6.1 Process Description

This Safety Analysis Report (SAR) has been prepared to document the analyses of the Vitrification Facility (VF) process systems, operations; Integrated Radwaste Treatment System (IRTS) facilities and operations; site support facilities and operations; and the decontamination and decommissioning of site facilities.

The process mission of the VF was to convert the high-level radioactive waste from its initial sludge/liquid form into borosilicate glass in stainless steel canisters. Filled canisters are stored temporarily in the High-Level Waste Interim Storage (HLWIS) area.

The VF consisted of several associated structures, including the Transfer Trench, the Vitrification Building (which includes the Vitrification Cell, operating aisles, and Control Room), the Cold Chemical Building, the 01-14 Building, the Transfer Tunnel, the Load-In Building, the Equipment Decontamination Room (EDR), the HLWIS area, the Off-Gas Trench, and the Diesel Fuel Oil Storage Tank Building. The relative locations of several of these structures are shown in Figure 5.1-1.

The IRTS, which is comprised of the Supernatant Treatment (STS), Liquid Waste Treatment System (LWTS), Cement Solidification System (CSS), and Drum Cell, was designed for the decontamination, concentration, and solidification of liquid high-level waste. The process flow diagram for the LWTS is provided in Figure 6.1-3. Site activities are supported by utility room operations, analytical laboratory operations, Low-Level Waste Treatment System (LLWTS) operations, and operations in the Lag Storage Facility.

Other activities at the WVDP that are documented in Section 6.0 include the decontamination activities required to deactivate contaminated cells and areas in site facilities.

6.1.1 Narrative Description

6.1.1.1 Vitrification Operations

VF process operations included the following functions:

- High-Level Waste (HLW) transfer from the Waste Tank Farm to the Vitrification Building.
- Preparation of cold (i.e., nonradioactive) chemicals in the Cold Chemical Building.
- Load-In Building operations (for introduction of empty canisters and interim storage racks into the EDR).
- Melter feed preparation in the Concentrator Feed Make-up Tank (CFMT).
- Feed transfer from the CFMT to the Melter Feed Hold Tank (MFHT).
- Transfer from the MFHT to the Slurry-Fed Ceramic Melter (SFCM).
- SFCM operation and transfer of molten HLW glass to canisters.
- Off-gas collection, quenching/scrubbing, treatment, filtering, and monitoring before Main Plant stack release.
- Filtering and monitoring of Vitrification Cell ventilation exhaust air before Main Plant stack release.

Canisters produced in the VF were transferred to HLWIS area for interim storage. Operations in the VF were completed in 2002 and the facility is currently undergoing dismantlement. Detailed discussions of VF systems and processes are presented in Section 6.2.

6.1.1.2 IRTS Operations

The IRTS is comprised of four systems: the STS, LWTS, CSS, and Drum Cell. The initial objective of the IRTS was to process supernatant and sludge wash solutions generated during preparation of the high-level waste sludge in Tank 8D-2 for vitrification. This was completed in 1995, resulting in 19,877 drums of cement-stabilized waste placed in the Drum Cell for safe storage. Operations in the STS and CSS have been terminated and the facilities are currently awaiting final deactivation. Portions of the LWTS remain in service to support current liquid management needs including RHWF, (see WVNS-SAR-023). The Drum Cell is also serving as the interim storage location of the cemented waste form received from the CSS.

All waste handling and processing activities associated with the LWTS are conducted in cells located in the Main Plant. The LWTS feed Tank, 5D-15B is located in the Uranium Product Cell (UPC). From the feed tank, waste is processed through a high-efficiency evaporator that reduces the volume of water in the process solution. Evaporator concentrates are cooled and pumped to the LWTS product Tanks 5D-15A1 or 5D-15A2. From there, concentrates are sent to 5D-15B and subsequent solidification.

6.1.1.3 Cleanup of the Head End Cells

The HECs contain a heterogeneous mixture of debris ranging from large objects such as drums and shear gags to fine particulate material such as fuel and saw fines. A variety of methods and tooling are being employed to collect, size-reduce, decontaminate, dry, package, and place this debris into safe storage. An overview of the operations required to accomplish decontamination and deactivation of HEC areas is provided in Section 6.7.

6.1.2 Identification of Items for Safety Analysis Concern

The levels of radioactivity in site facilities requires that activities be conducted in a manner that minimizes doses to both occupational personnel and off-site individuals. Additional hazards associated with the handling and storage of bulk chemicals and hazardous materials require that these activities be conducted in a manner that prevents the release of hazardous materials. Thus, the major items of safety analysis concern are:

- protecting workers from direct radiation and confinement of radioactivity;
- avoiding nuclear criticality accidents;
- protecting workers from hazardous materials;
- minimizing the risk of accidents through adherence to established policies and procedures.

6.1.2.1 Radiation Protection

Protection from direct radiation is achieved through shielding, work planning, remote handling of highly radioactive materials, and decontamination. Confinement barriers and systems in the VF, IRTS, and Main Plant preclude the uncontrolled release of radioactive contamination. These systems and barriers are summarized in Chapter 4. The primary confinement systems for airborne

radioactivity are the VF Off-Gas System and the IRTS and Main Plant building ventilation systems. These systems are described in detail in Chapter 5. Radioactively contaminated liquid is collected in facility sumps and drains for transfer to the LLWTS, which is described in Chapter 7. Effluent radioactive releases are maintained well within the limits specified in DOE Order 5400.5, *Radiation Protection of the Public and the Environment.*

6.1.2.2 Criticality Prevention

The occurrence of an inadvertent criticality during facility decontamination is prevented through engineered features and adherence to administrative controls. All IRTS systems have been evaluated for criticality safety during normal and abnormal operating conditions; no credible critical condition has been identified. The potential for criticality in the General Purpose Cell (GPC) of the Main Plant has been identified. A comprehensive assessment of criticality controls in place at the WVDP is given in Section 8.7.

6.1.2.3 Management, Organization, and Institutional Safety Provisions

All personnel at the WVDP receive extensive training in safety aspects associated with their responsibilities. Operations involving radioactive or hazardous materials are conducted in a manner consistent with the requirements of Title 10, Code of Federal Regulations, Part 835, *Occupational Radiation Protection* and DOE Orders 420.1A, *Facility Safety,* and 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees.* Additionally, an overall safety culture has been developed at the WVDP through comprehensive implementation of the principles of the DOE Conduct of Operations philosophy as given in DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities.* The implementation of DOE Order 5480.19 at the WVDP, as given in WVDP-106, *West Valley Demonstration Project (WVDP) Conduct of Operations,* is summarized in Chapter 10 of this SAR. Operations personnel are trained per the requirements of DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities,* which is also discussed in Chapter 10. In accordance with DOE P 450.4, *Safety Management System Policy,* WVNSCO has established an Integrated Safety Management System (ISMS) to ensure a safe workplace for the worker, the public, and the environment. The ISMS is discussed in detail in Chapter 10.

6.1.2.4 Hazardous Material Protection

Nonradiological hazardous materials at the WVDP are stored in special facilities in the New Warehouse (described in Chapter 5). Hazardous wastes are stored in facilities described in Chapter 7. Operations associated with these materials are conducted per the guidance of WVDP-011, *WVDP Industrial Hygiene and Safety Manual* and WVDP-073, *Hazardous Waste Management Plan.*

6.2 Vitrification Process Systems

The process mission of the VF was to convert the high-level radioactive waste from its initial sludge/liquid form into borosilicate glass in stainless steel canisters. This original mission was accomplished in 2002 and the filled canisters are stored temporarily in the High-Level Waste Interim Storage (HLWIS) area.

The VF consists of several associated structures, including the Transfer Trench, the Vitrification Building (which includes the Vitrification Cell, operating aisles, and Control Room), the Cold Chemical Building, the 01-14 Building, the Transfer Tunnel, the Load-In Building, the EDR, the HLWIS area,

the Off-Gas Trench, and the Diesel Fuel Oil Storage Tank Building. The relative locations of these structures are shown in Figure 5.1-1.

Following the shutdown of operations in the Vitrification Facility, several support systems were placed in standby deactivation while other specific components were identified for re-use for purposes other than originally intended. A summary of important interfaces of the Vitrification Facility in its current state with other systems and facilities is discussed below.

The Vitrification Cell interfaces to and from the HLWIS area and Load-In Building:

- Transfer Cart to storage racks in the HLWIS area
- Canister port, mandoor, and shield doors at the Load-In Building/EDR interface to transfer mechanisms (e.g., the Transfer Cart and EDR bridge crane)

The utilities provided to the VF by the Plant systems and internal supply functions can be summarized as:

- Demineralized Water
- Electrical Distribution
- Instrument Air
- Potable Water
- Steam and Condensate
- Utility Air
- Utility Water
- Drains

The VF also has internal systems and interfaces with the WVDP site systems or functions. The interfaces are as follows:

- Fire Detection and Protection system
- Radiation Monitoring system
- External and Internal Communication systems (radios, telephones and intercom)
- Personnel Protection Equipment such as showers and eye washes and emergency medical equipment and supplies

6.2.1 Vitrification Cell

The "heart" of the vitrification process was the Vitrification Cell. The Vitrification Cell is undergoing dismantlement. Vitrification Cell dismantlement is performed remotely by operators situated at control consoles in the Operating Corridor. Remotely operated equipment includes, but is not limited to, in-cell system valves, pumps, jets, cranes, electro-mechanical manipulators, hydraulic manipulators, and closed-circuit television (CCTV). Operations are also observed through shield windows from the Operating Aisles.

The Operating Aisles are located around the Vitrification Cell and allow viewing of Vitrification Cell operations through shielded windows and in-cell CCTV with pan-and-tilt capabilities, and control of operations through control consoles and related remote manipulators, electro-mechanical manipulators, and in-cell cranes with specially designed remote handling fixtures and grapples. The VF Control Room, located off the Operating Corridor, provides a central

area where operating documents, drawings, and overall process monitoring equipment is located.

The CFMT, MFHT, SFCM (melter), CLCW and other Vitrification vessels and processes are being actively removed from the cell and transferred to the appropriate storage or disposal facilities. The CFMT, MFHT, and melter are (or will be) removed through the EDR and placed in heavily shielded containers at the EDR/Load-In facility interface. In the Load-In facility the MFHT, CFMT and perhaps the melter will be grouted in their containers.

6.2.2 Off-Gas Treatment, Facility Vent, and Liquid Waste Systems

This system is out of service and will be removed from the cell during the Vitrification Cell dismantlement project.

6.2.2.1 Ex-Cell Off-Gas Treatment and Filtering

The Ex-Cell Off-Gas system, shown schematically in Figure 6.2-3, provides final HEPA filtration of any radioactive particulates not captured by the in-cell system. The ex-cell processes include moisture removal, reheating, and HEPA filtration. Ex-cell Off-Gas system features are described in Chapter 5.

Items of equipment located within the 01-14 Building are designed for remote manual switch-over. These include the off-gas reheater, HEPA filters, filter housings, converter preheaters, and catalytic converters.

The insulation on the duct and an entrainment separator within the duct are used to minimize and remove condensate from the off-gas enroute from the Vitrification Cell to the 01-14 Building. Liquid accumulated in the entrainment separator is collected in a condensate tank for subsequent transfer to the south sump of the Vitrification Cell. Liquid in the south sump was cycled back to Tank 8D-4 via the Waste Header system.

The entrainment separator employs baffles to eliminate maintenance requirements. It is located at the low point in the duct, so that the entrainment separator drain serves to drain the entire duct.

6.2.2.2 Final Off-Gas Reheating and Filtration

Following entrainment separation, the gas was routed through reheaters, located inside the 01 cell of the 01-14 Building, to raise the dew point of the off-gas before final HEPA filtration. Electrical energy delivery to the reheater was modulated, based on an off-gas temperature measurement downstream from the reheaters, to maintain a preset temperature. The reheater trains are arranged and valved for remote manual switch-over, should one reheater train become unable to maintain the desired temperature.

Each of two parallel filter trains contain two HEPA filter units connected in series. The gases pass through one HEPA filter train and the other is a back-up. The differential pressure across each unit is continuously monitored. Should the pressure drop across a filter become excessive, the installed backup prefilter train would be automatically valved into service. The HEPA elements are changed by a bag-out/bag-in procedure, followed by in-situ aerosol testing to confirm the integrity and filtering efficiency of the newly installed filter element and seals.

Following filtration, the off-gases pass through one of three redundant positive-displacement off-gas blowers installed in parallel. One blower operates and the others are back-ups. The blower provides the motive force to

maintain all upstream vitrification equipment under a slight negative pressure for purposes of contamination control. The blower also provides the motive force to discharge the treated off-gases to the Main Plant stack for release to the atmosphere. An air in-bleed valve is located in the duct leading to the blowers to control the vacuum at the blower inlet. A pressure (vacuum) measurement at the blower suction is used as the basis for modulating the position of the control valve in the in-bleed line. The pressure (vacuum) set point is established at a value that ensures that the overall system can provide the necessary vacuum in the melter and Vessel Vent Header.

6.2.2.3 Off-Gas Discharge Duct

After processing, the off-gas is routed through an insulated duct to the exhaust stack. The duct is insulated to maintain off-gases above their dew point.

6.2.2.4 Facility Ventilation Systems

All areas of the VF that have a potential for becoming contaminated are ventilated in a controlled manner to ensure confinement of radioactive materials. Pressure differentials are maintained between contamination control zones to ensure that air flow is from zones of less potential for contamination to zones of greater potential for contamination. Ventilation of the EDR and HLWIS area is provided by the existing Main Plant Ventilation and Head End Ventilation systems. Ventilation systems are discussed in detail in Chapter 5.

The Transfer Tunnel vents into either the Vitrification Building Ventilation system or existing Main Plant Ventilation system, depending on the positions (open or closed) of the shield doors separating the Vitrification Cell and the Transfer Tunnel, and separating the Transfer Tunnel and EDR. When both shield doors are closed, the Transfer Tunnel air vents into the Vitrification Building Ventilation system. This is also the case when the Vitrification Cell/Transfer Tunnel shield door is open and the Transfer Tunnel/EDR shield door is closed. However, when the Transfer Tunnel/EDR shield door is open and the Vitrification Cell/Transfer Tunnel shield door is closed, the Transfer Tunnel vents to the Main Plant Ventilation system.

6.2.2.5 Waste Header System

The Waste Header system received liquid wastes from the Vitrification Cell sumps that collect any liquids spilled or directed on the cell floor. The necessary auxiliary equipment, such as sump steam jets, instrumentation, and service jumpers, are part of the system. A schematic of the system is provided in Figure 6.2-6.

Pressurization of the header could result in back-up of wastes into various locations. To prevent such pressurization, flow into the header is limited. These limitations include the jets listed below:

- North Sump to Waste Header Jet
- South Sump A to Waste Header Jet
- South Sump B to Waste Header Jet

The Waste Header system is vented to the Vessel Vent Header to maintain the Waste Header system under a slight vacuum. A restrictive orifice in the jumper to the Vessel Vent Header protects the header from excessive air flow,

and from a transfer of contaminated liquids or slurries in the event of a momentary, unplanned pressurization of the Liquid Waste Header system.

The Vitrification Cell contains three sumps to collect and allow transfer of spilled liquids from the cell. The north sump collects liquids and slurries from the Vitrification Cell pit. It is 25 cm (10 in) in diameter and 40 cm (16 in) deep, and has a capacity of 20 L (5 gal). It is lined with stainless steel. The steam jet used to evacuate the contents of the north sump to the Waste Header system is rated at 95 L/min (25 gpm). The suction line is covered by a 6.4-mm (0.25-in) screen mesh. The jumper used to provide level detection in the north sump extends to 12.7 mm (0.5 in) from the bottom of the sump, and includes a spare level tap that extends close to the bottom of the sump.

The south sump-A and the south sump-B collect liquids from the Vitrification Cell apron drains, Transfer Tunnel drains, Crane Maintenance Room (CMR) drains, Secondary Filter Room (SFR) sump, and Off-Gas Trench sump. The two sumps are 1.1 m (3.5 ft) by 1.2 m (4 ft) by 1.8 m (6 ft) deep, and each has a capacity of 2.38 m^3 (628 gal). They are lined with stainless steel and covered by a removable plate. Each has a jet used to empty the sump to the Waste Header system at a rate of 95 L/min (25 gpm). The suction line is covered by a 6.4-mm (0.25-in) screen mesh. Each jet discharge is equipped with a check valve to prevent back-flow of liquid waste into the sump, should the liquid waste header become pressurized. Both sumps are equipped with level detection. Sump-A also has specific gravity detection.

Cell sump design features are described in Chapter 5.

6.2.3 Mechanical Process Systems

To achieve the vitrification process various mechanical systems were needed. Some of these systems/components will be removed from the cell during the Vitrification Cell dismantlement project.

6.2.3.1 Cell Cranes

The Vitrification Cell process crane is a twin 4.08-MT (4.5-ton) hoist/trolley mounted on a bridge. The twin hoists are positioned 813 mm (32 in) from each other on a turntable that allows the hoists to rotate 359 degrees. This allows either hoist to reach closer to the Vitrification Cell wall than would be possible with only a single hoist and also makes load orientation possible. In its normal configuration, the process crane had a canister grapple and an impact wrench linked from a hook. A remote manipulator-operated release mechanism is used to remove the impact wrench and the grapple from the hoist.

A back-up Vitrification Cell crane is also provided on a bridge identical to that of the process crane. The hoist/trolley on the back-up bridge has a 22.68-MT (25-ton) capacity. This capacity would be required only for major equipment change-outs or final decommissioning. The back-up crane is normally stored in the CMR on the same runway rail system used by the process crane.

In the event that the process crane fails, a failed hoist recovery module is available to lower suspended loads present on the crane hoist when the failure occurred. This module, which is situated on the back-up crane bridge, would be maneuvered to couple with the inoperational crane and lower and unload the stranded load on the process crane. The defective process crane would then be towed back to the CMR by means of towing latches on the back-up crane for repair.

Power and control for both cranes are provided by cable carrier systems that originate in the CMR. Portable operator control stations are located throughout the Operating Corridor at various shielded viewing windows. The control system includes "soft" start on all motions to avoid movement shock. Bridge and trolley drives have rubber-cushioned shaft-mounted gearboxes to further reduce shock. All motions on the cranes are two-speed and are relatively slow compared to movement of non-remote cranes to reduce the possibility of lifting mishaps. The crane motion speeds are given in Table 6.2-3.

A Remote Manipulator System (RMS) has been installed into the Vitrification Cell to facilitate the dismantlement process. The RMS consists of a bridge, two telescoping masts, two manipulator arms, and various effectors such as tool grippers, radiation survey heads, decontamination heads and torque wrenches. The RMS bridge is mounted on the pre-existing crane rails between the process crane and the maintenance crane.

The EDR 18.14-MT (20-ton) crane was used to load empty canisters into the transfer cart. The crane has two 9.07-MT (10-ton) hoist trolleys mounted on a common set of girders. Crane motion speeds are given in Table 6.2-1. The crane is controlled by a control pendant at the EDR window. All power and control is supplied by festoons. The contactors are outside the EDR in the EDR viewing aisle.

The HLWIS area 14.51-MT (16-ton) crane was used to remove canisters from the transfer cart and place them onto the interim storage racks. The crane has a 14.51-MT (16-ton) trolley/hoist on the south girders and a 1.81-MT (2-ton) auxiliary hoist on the north girders. Crane motion speeds are given in Table 6.2-1. The crane is controlled by a portable control station from any of the HLWIS area windows or from the Chemical Crane Room (CCR) window. The control system is multiplexed, with motor contactors mounted on the bridge. Redundant programmable logic controllers (PLCs) are mounted above shielding blocks to increase reliability. PLC life is maximized by storing the crane in the CCR when not in use. The 14.51-MT (16-ton) hoist has redundant wiring that bypasses the entire control system and allows lowering of loads in the event of a control system failure.

In the event of a total crane cable reel or hoist motor/mechanical failure, a secondary "load-lowering module" is mounted between the HLWIS area 14.51-MT (16-ton) hoist and the grapple. This module allowed the power manipulator bridge to be used to lower a canister to allow bridge retrieval. A towing mechanism is installed on the manipulator bridge so that a towing cable from a winch mounted on the CCR platform can be connected to the 14.51-MT (16-ton) bridge. The bridge can thus be pulled back to CCR for repair behind the CCR/HLWIS area shield door.

6.2.3.2 Crane Maintenance Room

A shielded Crane Maintenance Room (CMR) is provided for parking the Vitrification Cell crane for decontamination and subsequent hands-on maintenance. Hatches are provided in the roof of the CMR so that the crane, trolleys, and components can be removed. A shielded viewing window is also provided.

6.2.3.3 Transfer Cart

A battery-powered radio-controlled transfer cart was used to move empty canisters into the Vitrification Cell from the EDR and move filled canisters to the HLWIS area. The cart can be controlled from either the north viewing window of the Vitrification Cell or from the north window of HLWIS area.

The transfer cart is normally stored at the battery charging station, located in a low-radiation area in the EDR to minimize total integrated dose to the cart control system. Four antennas are provided to ensure line-of-sight control transmission at all times. The cart has two antennas with a diversity detection system that continually checks signal strength and uses the antenna with the highest signal strength. The dual antennas assure continuous control even if signal nulls occur due to multi-path reception from the signal bouncing on stainless steel cell liners.

The transfer cart has four independent drive trains, any one of which is sufficient to drive the cart. The cart travels at approximately 4.6 m/min (15 ft/min). The control/battery enclosure can be replaced with a spare using an overhead crane in the EDR. In the event of a total cart failure, a previously existing tethered cart is available in the EDR to push or retrieve the failed cart. A removable canister rack held four canisters in the center of the cart, approximately 102 mm (4 in) above the transfer cart rails.

6.2.3.4 Transfer Tunnel Shielding Doors

The shield doors are operated from control stations at the north viewing window of the Vitrification Cell or from the north window of the HLWIS area. There are two Transfer Tunnel related doors: a 33-cm (13-in) thick steel door at the Vitrification Cell-Transfer Tunnel interface opens to the east, and, at the EDR-Transfer Tunnel interface, a 5.1-cm (2-in) thick steel twin-leaf ventilation control door opens to the north. A 1.2-m (4-ft) thick concrete-filled shield door opens to the west between the EDR and HLWIS area. The EDR-Transfer Tunnel door uses two linear actuators, whereas the other two doors along the transfer cart track open using ball screw drives.

The shield doors are interlocked with the transfer cart control system software to assure that doors are not operated when the transfer cart is moving and that the transfer cart cannot be moved when doors are moving. In addition, the cart controller only allows one door to be open (i.e., fully closed limit switch not tripped) at a time. This interlock can be overridden at the cart engineering station at the EDR viewing window in the event that more than one door needs to be opened to support a special remote operation such as cart retrieval.

6.2.4 Process Support Systems

6.2.4.1 Cold Chemical Building

The Cold Chemical Building is a 17.2 m x 10.4 m (56.5 ft x 34 ft) building located on the west side of the Vitrification Cell. It served the following functions:

- Batch preparation of decontamination solutions for equipment decontamination to accomplish system maintenance and for final VF decontamination and decommissioning.

The equipment in the Cold Chemical Building includes:

- 3 slurry mix tanks
- 3 solution preparation tanks
- 2 day tanks (nitric acid and caustic soda)
- 1 drain tank for waste collection
- 2 material delivery subsystems (solid and liquid)
- The tank ventilation subsystem.

This equipment is described below.

6.2.4.1.1 Slurry Make-up and Transfer

Most equipment in the Cold Chemical Building (CCB) is not currently in use but may be used in future D&D operations.

The three slurry tanks (65-D-02,65-D-03, and 65-D-04), which were originally used for VF cold chemical make-up, are constructed of 304L stainless steel and are vertical cone-bottomed and equipped with integral cooling jackets. The tanks are designed and fabricated in accordance with the methods and practices of the ASME Boiler/Pressure Vessel Code Section VIII, Division I, and have been "U" stamped.

The system has a maximum single batch slurry working volume of 19,000 L (5,000 gal), and is designed to handle up to a 60 weight percent total solids slurry without plugging.

Transfer of cold chemical materials into and out of mix tanks is designed for complete movement (i.e., essentially zero tank heel and residual material). Each slurry tank is equipped with a grinder, which may be used in both recirculation and transfer modes. At the end of each transfer, metered flush water is used to completely clean the slurry tank and recirculation and transfer piping.

6.2.4.1.2 Decontamination Solution Make-up and Transfer

The three cold chemical tanks (65-D-07, 65-D-08, and 65-D-09) were used to prepare decontamination solutions for the vitrification process. These tanks are currently not used, but may be used in the future for D&D operations.

Decontamination Tank 65-D-07 was used to store and transfer demineralized water for various uses. For reasons of operational safety, the following capabilities have been disabled (lock and tag) from the vessel: nitric acid fill, caustic soda fill, liquid eductor fill, cooling water supply and return, steam supply and condensate return, and agitator motor. The density instrument has been removed. These functions can be reinstalled if the need arises.

Decontamination tank 65-D-08 was used for preparation and transfer of dilute nitric acid for the Nitric Acid Hold Tank (63-D-048). As with Tank 65-D-07, for reasons of operational safety, the condensate return and liquid eductor fill capabilities have been removed from the vessel. The caustic soda fill, steam supply, air supply to the steam control valve, and density instrument have been removed. These functions can be reinstalled if the need arises. In addition, Tank 65-D-08 has been "hard piped" to 63-D-048 via the transfer pump 65-G-08.

Demineralized water (for flush or fill) can be metered into Tanks 65-D-07, 65-D-08, or 65-D-09. Nitric acid and sodium hydroxide can be separately metered into the tanks from day tanks 65-D-05 and 65-D-06, respectively. Miscellaneous liquid chemicals can be weighed and transferred into the tanks via a steam jet Transfer system.

After preparation, the decontamination solution can be sampled and then transferred via a pump and flexible transfer hoses to various locations.

For all transfers, notification of and coordination with the PSOSS is made prior to initiating the transfer to set the required conditions for and to monitor the status of the transfer.

6.2.4.1.3 Drain Tank

Tank 65-D-01 was used as a hold tank for truck disposal of rinse and waste solutions, and non-recoverable off-specification batches from the slurry mix tanks and other tanks in the Cold Chemical Building. The tank (capacity 41,000 L [11,000 gal]) can hold up to two batches from the 19,000 L (5,000-gal) slurry mix and hold tanks.

Solutions sent to Tank 65-D-01 for truck disposal are evaluated prior to pick-up to determine if they are subject to Resource Conservation and Recovery Act (RCRA) regulations as hazardous wastes (as defined in 40 CFR 261) and subject to treatment and disposal requirements of 40 CFR 268. The hazardous waste determination is made based upon process knowledge when well documented, quantified data is available concerning the contents of the tank. If sufficient process knowledge is not available to determine the hazardous characteristics of the solution, representative samples are taken and analyzed to make the hazardous waste determination.

The most likely parameters which would result in classification of a solution as a RCRA hazardous waste are corrosivity (pH less than or equal to 2 or greater than or equal to 12.5) or toxicity (due to the presence of heavy metals such as chromium or potassium dichromate). If the solution is determined to be RCRA hazardous, it will be transported via a commercial contractor to an Environmental Protection Agency (EPA) permitted treatment/storage/disposal facility and the truck load will be manifested as a hazardous waste shipment as required in 40 CFR 262. Otherwise, the solution will be disposed of as an industrial waste.

6.2.4.1.4 Pneumatic Subsystem for Solids Transfer

The Vac-U-Max pneumatic Transfer system was employed for the transfer of ingredient powders into the slurry mix tanks (65-D-02, 65-D-03, and 65-D-04). Powdered (dry) chemicals needed for decontamination tank use were mixed in 65-D-04 to take advantage of the Vac-U-Max. Drums containing slurry ingredient powders are staged in the drum handling and weigh-out bay on the west end of the Cold Chemical Building. This area is known as the Cold Chemical Scale Room (CCSR). The drums are placed on weigh scales and their contents transferred into the slurry mix tanks per recipe requirements using the Transfer system.

The pneumatic Transfer system consists of a common blower (65-H-01) to provide the motive vacuum to three transfer subsystems (one for each tank). Each transfer subsystem consists of a pick-up wand, transfer tubing, and a receiving hopper from which the powder is fed directly into the slurry tank by

means of a dump and isolation valve. The system is operated from the Vac-U-Max control panel, also located in the drum CCSR. The subsystems can only be operated sequentially, so that slurry preparation occurs in one tank at a time.

6.2.4.1.5 Steam Jet Subsystem for Liquids Transfer

The steam jet subsystem is employed for transfer of ingredient liquid chemicals to the slurry tanks (65-D-02, 65-D-03, and 65-D-04) and decontamination tanks (65-D-07, 65-D-08, and 65-D-09) from containers such as drums. The configuration consists of two subsystems, one for the slurry tanks and the other for the decontamination tanks. The two subsystems are not operated simultaneously.

Each subsystem consists of a liquid eductor and associated pick-up wand connected to a 689 kPa (100 psi) saturated steam supply for motive force, air supply for line flush, and piping to the serviced tanks. The decontamination system is capable of conveying at a rate of approximately 106 L/min (28 gpm). The slurry system has a conveying rate of approximately 18.9 L/min (5 gpm).

The steam jet subsystem is located in the CCSR. During former operations drums containing the liquid ingredient chemicals were staged here, placed on weigh scales, and their contents transferred to the chosen receiving tank per recipe requirements using the liquid eductor material pick-up wand.

6.2.4.1.6 Vessel Ventilation Subsystem

All tanks are vented to the Cold Chemical Building Vessel Ventilation subsystem, which maintains a negative pressure of up to -254 mm (-10 in) WC in the tanks. The Vessel Ventilation subsystem consists of two venturi scrubbers in series with associated scrub solution tank and pumps to provide the motive force for creation of the vacuum. The total solids and pH of the scrub solution are monitored on a periodic basis, and maintained within operating range by bleed off and addition of fresh demineralized water.

6.2.4.2 Equipment Decontamination Room

The EDR, can be used to transfer removed equipment and waste boxes from the Vit Cell or HECs. Using the EDR crane, the above equipment is placed on the canister transfer cart for delivery to HLWIS or through the Load-In Facility to other storage areas.

The EDR has two 9.07-MT (10-ton) hoist trolleys and three confinement and shielding doors. These doors connect to the HLWIS area, the Transfer Tunnel leading to the Vitrification Cell, and to the Load-In Building, which is used to bring in new equipment or to transfer materials out.

The EDR also has a soaking pit previously used in the decontamination of equipment. This pit is currently full, but not in use.

The VF Load-In Building, shown in Figure 6.2-8, was designed to utilize the EDR as the primary access for moving canisters and replacement equipment into the Vitrification Cell or HLWIS area. The Load-In Building provides for the off-loading of containers from a tractor trailer rig. Material handling equipment provides for the movement into the EDR where they can be accessed by the EDR bridge crane.

Except for the common use of the transfer cart, which had the function of transporting filled canisters through the EDR to the HLWIS area, handling of radioactive materials is not part of the load-in function. In the event a piece of contaminated equipment needs to be replaced, the load-in function is used to move in the replacement equipment.

Contamination control is accomplished by balancing air flows from external sources and directing this air into the EDR when any exterior air passage is opened. To the extent possible, ALARA concepts are accomplished in the EDR, HLWIS area, and the Vitrification Cell by using remote techniques.

6.2.4.3 High-Level Waste Interim Storage

The HLWIS area is located in the former Chemical Process Cell (CPC). It has been converted to support the following functions for vitrification activities:

- Off-loading the canister transfer cart using the cell crane with grapple attachment and placing canisters in the storage rack.
- Storage of equipment which has been removed from service in the Vitrification Cell or waste boxes from the VC or HEC.
- Size reduction activities to process used (expended) components to fit within available drums and boxes.
- Removal of decay heat from the stored canisters by means of the HVAC system.

All of these activities are performed remotely by operators utilizing the cell shielded viewing windows and CCTV cameras. The Main Plant/Head End Ventilation system provide HEPA filtered supply and discharge HVAC services to the HLWIS area that are monitored and operated by the Main Plant operators.

Primary HLWIS area equipment includes storage racks for the product waste canisters, the cell crane and handling fixtures, shielded viewing windows, CCTV cameras, canister transfer cart, chop saw, the HLWIS area/EDR shielding door, and the HVAC system components.

6.2.4.4 Cell Viewing and Lighting Systems

Six CCTV units are located in the Vitrification Cell to aid in viewing. The vitrification process crane also has five video cameras mounted on it. In addition, one CCTV camera is located in the Transfer Tunnel, two are mounted on the EDR bridge crane, one is mounted on the CCR platform, one is on the HLWIS area wall, and one is mounted on the 14.51-MT (16-ton) trolley/hoist in the HLWIS area. Each crane control station has pan and tilt and telephoto zoom capabilities controlled from the work stations to allow the maximum viewing of cell and processing operations.

The Vitrification Cell has six oil-filled lead glass viewing windows for shielded viewing of remote operations. The CMR also has an oil-filled lead glass viewing window to observe the cranes as they are being moved into the CMR and to monitor contact maintenance operations in the CMR. The HLWIS area has four original oil-filled lead glass viewing windows. The CCR and the EDR had zinc bromide windows that have been converted to oil-filled windows to provide observation of contact maintenance operations in these rooms.

The Vitrification Cell is illuminated with thirty-two high-pressure sodium (HPS) 400-watt bulbs with ballasts located in the Operating Corridor. These light fixtures are remotely replaceable using the process crane. The process

crane also has six HPS lights with ballasts built into the fixtures. The Transfer Tunnel is illuminated with six HPS 100-watt fixtures which is sufficient for CCTV transmission. There is no direct (shield window) viewing into the Transfer Tunnel.

6.3 Integrated Radwaste Treatment System

The Integrated Radwaste Treatment System (IRTS) was comprised of four independent systems constructed for the decontamination, concentration, solidification, and storage of low-level wastes that were generated during the decontamination of liquid high-level waste originally in Tank 8D-2. Systems designed for these functions included the STS, LWTS, CSS, and the Drum Cell. None of these component systems except for the Drum Cell currently perform the function for which they were originally designed. Furthermore, the STS/SMWS and CSS have been placed in lay-up condition and are awaiting possible re-use or decommissioning. A description of these systems is provided in the following sections.

6.3.1 Supernatant Treatment System/Sludge Mobilization and Wash System

The STS/SMWS is deactivated. The power to the mobilization pumps is locked out and most inputs to the tank have been disconnected. Filtered and decontaminated solution from the STS process was transferred to Tank 8D-3. This 57,000-L (15,000-gal) tank served as both intermediate storage and as a sampling tank. Decontaminated solution was batch-transferred to the LWTS from Tank 8D-3 via a doubly contained stainless steel pipe that passes from the tank vault through the STS. From the STS the pipe is routed to a transfer trench that passes in front of the Main Plant and into the Liquid Waste Cell (LWC), through a shielded pipe chase in the Product Purification Cell (PPC), and into the Uranium Product Cell (UPC) and then to Tank 5D-15B.

6.3.2 Liquid Waste Treatment System

The Liquid Waste Treatment System (LWTS) was designed to concentrate process solutions received from the STS as well as byproduct solutions from vitrification operations. The system is currently utilized to concentrate various low-level liquid waste such as Analytical Lab wastes.

The primary evaporator feed tank, 5D-15B, is located in the UPC and has a capacity of 57,000 L (15,000 gal). A series of valves and piping in the Uranium Loadout Pump Niche in the Main Plant allow the contents of Tank 5D-15B to be pumped directly to the evaporator.

Operation of the LWTS evaporator generates two separate streams: a concentrates stream that is pumped to Tank 5D-15A1 or 5D-15A2 and an overheads stream that is decontaminated and transferred to the LLWTS for processing.

Solution to be concentrated in the evaporator is fed to the evaporator from Tank 5D-15B at a nominal rate of 23-30 lpm (6-8 gpm). In start-up mode, evaporator condensates flow to the start-up side of the evaporator distillate surge tank. The evaporator remains in recirculation mode while an overheads sample is analyzed to ensure that alpha/beta levels are acceptable for discharge to interceptors, at which point the distillate is sent to the run side of the distillate surge tank. The evaporation rate in the evaporator is regulated by a flow valve that controls steam supply to the evaporator. A constant concentrates level in the evaporator is maintained through the use of a specific gravity controller that controls operation of the evaporator concentrates pump.

Evaporator overheads pass through three reflux-inactive bubble cap trays and a high efficiency de-entrainer wire mesh to extract liquid mists. An internal water spray is available to wash down the wire mesh to prevent a high differential pressure from developing across the mesh. Collected distillate is sent to the run side of the distillate surge tank where it is pumped to the zeolite ion-exchanger (71-D-003). This ion-exchanger is equipped with a differential pressure transmitter and an effluent radiation monitor. Instrument readout and alarms are located on the LWTS Control Panel.

The distillate continues to the mercury-abatement system (see Figure 6.1-3). This system consists of two mercury-specific ion-exchange columns downstream of the zeolite ion-exchanger. During the routine operational mode, the two columns operate in series in a lead/polishing configuration. Installation of these two columns was a system refinement needed to meet anticipated environmental release limits.

Following monitoring, the liquid is routed to the LLWTS interceptors for treatment at the LLW2 and subsequent release to the environmental. Off-specification solutions (solutions having gross beta concentrations greater than 5E-03 μCi/mL) are diverted to Tank 5-15B.

When the specific gravity set point is reached, concentrate flow from the evaporator to the collection tank is established. Evaporator concentrates leave the evaporator at approximately 105 C (220 F). Concentrates are cooled to approximately 35 C (95 F) by a concentrates cooler (71-E-005), then pumped to Tank 5D-15A1 or Tank 5D-15A2.

6.3.3 Cement Solidification System

The CSS provided for the solidification of concentrates received from the LWTS evaporator. The CSS has not been operated since the completion of Tank 8D-2 supernatant/sludge wash solution processing in 1995. The truck bay in the 01-14 Building has also been used to stage a mobile sodium-bearing waste solidification project.

The Sodium-Bearing Waste Disposition Project involved the disposition of approximately 11,500 gallons of Sodium-Bearing Waste currently stored in Tanks 5D-15A1 and 5D-15A2. This wastewater was treated by in-container stabilization/solidification performed by an outside contractor. The contractor solidification equipment was set up in the Truck Bay of the Cement Solidification System (01-14 Building).

In support of the project, modifications were made to the 01-14 Ventilation and to the Truck Bay layout. These modifications included rerouting or extending air and electrical utility lines, sealing and painting the Truck Bay floor, in-kind replacement of the Waste Dispensing Vessel (WDV) pump and valves, modifying the Waste Dispensing Cell (WDC) piping to bypass the WDV and routing it into the Truck Bay, installing a rail and cart system in the Truck Bay and out into the roadway (includes leveling the roads incline), and installing a hoist and containment tent in the Truck Bay.

Vendor equipment consisted of the following:

Plant Connection Skid - houses the valves and piping for the waste, dewatering, service air, and service water; a dewatering pump, and an automatic waste isolation valve.

Bag break station with an integral auger to transfer dry chemicals.

Batch chamber and auger to transfer the chemicals to the fill head.

Fillhead - housed a CCTV camera, level controls, and ports for addition of chemicals, a dewatering port, off-gas vent port, air and water ports, a hydraulic connection (for the mixer) and a float switch to prevent container overflow.

The disposable container (IP-2 Solidification/Stabilization container) - a steel container to hold the waste, solidification/stabilization chemicals, and the mixer. The mixer remains in the solidified waste. Two containers and fill heads were located on a shielded rail cart.

Shielded rail cart - the motorized rail cart was provided with steel walls for containment and shielding. It has the capacity to hold the entire contents of the IP-2 container.

Hydraulic skid - provided the motive force to turn the in-container mixing blade. The skid consists of a hydraulic pump and motor, control valves and regulators, reservoir, and oil cooler.

Off-Gas Ventilation System - the Off-Gas system was capable of providing an in-line dust removal filter mounted on a 55- gallon drum. A HEPA vacuum blower cleaned the air discharge to less than 0.03% air particulate discharge. An activated charcoal filter was also provided for iodine absorption. This filter was located in the Drum Loadout Room. The Off-Gas system discharged to the Process Cell.

Portable Ventilation Unit - a PVU was installed in the Clean Drum Room as a back-up for the normal 01-14 Building ventilation.

The actual process of stabilization/solidification entailed pumping the waste from Tanks 5D-15A1 and 5D-15A2 located in the Uranium Product Cell to the plant connection skid in the Truck Bay. The operation from the skid to the fill head and subsequent solidification operation were controlled by the contractor. The stabilization container/fill head and mixer were located on a shielded rail cart in the 01-14 Building Truck Bay. Solid ingredients were added from a bag-in station located outside the Truck Bay door and transferred via an auger to the fill head and into the container. The small amount of liquid ingredients were pumped from containers in the control room. The solidification ingredients were silica fume, furnace slag, cement, and sodium hydrosulfide. Hydraulic driven mixer blades mixed the waste and other ingredients and were left in the container after solidification. Samples of the waste prior to chemical addition and of the stabilized/solidified mixture were taken. After the mixture cured, the fillhead was removed and the container lid installed. The rail cart was moved out of the bay and the containers removed to temporary on-site storage.

6.3.4 Drum Cell

A final component of the IRTS, the Drum Cell, provides storage for the 269-L (71-gal) square drums of Class-A and Class-C low-level cemented waste produced in the CSS. Currently, approximately 19,877 drums of low-level waste are stored in the Drum Cell or in Lag Storage.

At the Drum Cell, the shielded truck engaged a conveyor and transferred the drums from the shielded truck to the Drum Cell conveyor. Following loadout, a bridge-mounted crane was used to lift the drums from the conveyor and transport them to their stacking location.

Operations in the Drum Cell were conducted remotely from a control room located on the east end of the Drum Cell building. Operations within the Drum Cell are indicated on a control panel and are visually verified through the use of a CCTV.

6.4 Control Systems

6.4.1 Process Instrumentation and Controls

The data collection and control system for the vitrification process is a computerized system called the Distributed Control System (DCS). The DCS allowed monitoring, control and supervision of vitrification processes from the VF Control Room, and monitoring of vitrification processing in the process engineering and system engineering office areas. The four DCS work stations in the VF Control Room are redundant with each other (i.e., each can be used to implement the full set of functions available to the vitrification operators). Control of process and support equipment can also be performed from four local cabinets located in the Operating Corridors around the Vitrification Cell, from one cabinet in the instrument room of the 01-14 Building, and in the PSO office.

The DCS provides data collection and/or control functions for the following remaining structures, systems, and activities:

- Cold Chemical Building
- Ex-Cell Off-Gas System
- Continuous NO_x Analyzers
- HVAC
- Steam System
- Utility Air and Instrument Air System
- Utility Water System
- Waste Header System
- Electrical Backup Systems (UPS, diesel generator).

DCS data displays and control functions are provided through computer-driven cathode ray tube (CRT) systems that provide process information and status in graphical process flow diagram form to facilitate interpretation and operations. The data displays include key operating parameters such as vessel levels, temperatures, valve positions, pressures, flows, etc., in real time.

Manual process operation is also possible in the event of loss of computer function. Operable backup components are designed to assume control of failed components for control and monitoring functions.

Key process inputs to the DCS are audibly and visually alarmed to highlight changes from a normal process set point condition or to designate the timing for the next process operation. Restricted access (key-operated or of similar design) is provided for certain functions such as functional control changes, alarm setting changes, and interlocking set point changes, where required.

Interlocks are provided to control many key processes. The DCS is designed such that various plant processes are interlocked and require certain permissives prior to implementation. Processes such as material transfers are interlocked to prevent overfilling of receiving vessels. The interlocks are also listed in Table 6.2-10.

For control loops in the automatic mode, operations are performed according to programmed operating parameters without operator assistance. A variety of visual displays inform operators of process parameters. CRT displays include process variables, set points, alarm points, and other required operating information. Audible alarms are provided where needed. Control loops have a manual mode that allows the VF Control Room operator to directly control field devices through the DCS. In addition, field devices may be operated from the Operating Corridor, outside of the Control Room after putting the controller into local mode. In the event that the Vitrification Building is evacuated, special coding is available to enable the stations in the process and system engineering office areas to be used for control, in addition to monitoring.

DCS power is fed from an uninterruptible power supply (UPS). The UPS is a self-contained battery-driven alternate power source with a diesel generator back-up. The UPS is designed to float on the line and automatically pick up the load if loss of normal off-site power occurs.

6.4.2 DCS Architecture

The DCS components include twenty-four Micon controllers, three sets of PLCs, and three printers. Communication capability is provided to the site's Digital Equipment Corporation computer for analytical and actuarial purposes.

PLCs that interface with the DCS are provided for the Vitrification Building HVAC system (panel 67-V-019), the 01-14 Building (panel 64-B-002) and the SMS (panel 55-B-12). Panels 67-V-019, 64-B-002 and 55-B-12 have back-up (redundant) processors.

6.4.3 Detection System and Locations

Provisions are included to allow for performance of diagnostic tests on equipment, provide malfunction alarms, and identify locations and types of malfunctions. Process instrumentation is designed to allow for easy maintenance, calibration, and testing during operation, without process interruption. Process loop redundancy is maintained through the use of multiple sensors in important applications.

Where practical, process signal cabling and wiring used to transfer signal energy from the in-cell processes are terminated in low-radiation or clean areas with the use of jumpers.

Process control devices are not located in harsh environments that could adversely affect their accuracy or create excessive maintenance problems. Instrument air to the process and control components is supplied from the Instrumentation Air system.

Routine maintenance that has an impact on continuous operation processes is minimized by redundant instrumentation that allows processes to continue while maintenance or equipment change out is conducted.

6.4.4 Cold Chemical Instrumentation and Controls

Level elements were employed to monitor liquid level in the Cold Chemical Building tanks. Slurry tanks (65-D-02, 03, 04) and the Drain Tank (65-D-01) utilize bubbler type probes, while the other process tanks (65-D-05, 06, 07, 08, 09) utilize capacitance probes. There is an agitator trip at low liquid level in all tanks equipped with an agitator. This prevents the agitator from turning when blades are not adequately submerged, protecting the shaft from uneven thrust.

All tanks are equipped with a high-level alarm. In addition, all slurry and decontamination tanks have a trip at high level to prevent addition of caustic soda (from Tank 65-D-06) or nitric acid (from Tank 65-D-05) to a full tank. The caustic and nitric tanks (65-D-06, 05) have an automatic trip on the supply line at high level to prevent overfilling the tanks.

Control panel 65-CP-01 houses the system alarms and switches for turning on equipment and valves. Control panel 65-CP-02 is used to activate automatic valves in the various transfer lines to the Vitrification Cell.

The cold chemical equipment is operated from the control panels described above. The system is run in an unsupervised and unmanned mode. Should an alarm condition develop at the Cold Chemical control panel 65-CP-01, it is relayed to the VF Control Room via a common Cold Chemical system alarm. This alarm sounds in the VF Control Room if the local Cold Chemical Building alarm is left unacknowledged for a preset period of time.

6.4.5 High-Level Waste Transfer System Instrument and Control

Instrumentation is provided for the High-Level Waste Transfer System (HLWTS) to monitor process variables and provide both automatic and manual control of the processing equipment. The majority of instruments are connected to a PLC to provide local read-out and automatic control of key process variables at the HLWTS control station. Valve position switches indicating "open" or "closed" provide electrical signals to the PLC for interlock controls. Removal pumps may be operated with variable speed motor controllers to control the waste transfer. In-line pressure switches and flow meters are used to monitor the transfer.

At the control station, the operator can remotely monitor major aspects of the transfer operation. The control station provides an alarm system that alerts operators to an abnormal condition. Process conditions are monitored from panel-mounted instrumentation, including a panel-mounted graphic display flow diagram that indicates the position of valves and the status of motors and storage tanks. Various electrical interlocks additionally ensure safe operation during any transfer operation.

6.4.6 LWTS Instrumentation and Control

LWTS process instrumentation and control systems are designed to provide the primary indications of off-standard operating conditions. Instruments used for process control are designed to fail-safe. LWTS instrumentation and controls have been designed to:

- ensure that the LWTS can be started, operated, monitored, and shut down from a single, centralized remote control area;
- provide remotely operated valves that have position indicators on the control panel when the panel is energized;
- provide indication and/or annunciation (alarm) of abnormal conditions;
- provide for process signals, alarms, interlocks, automatic process control, specific access, redundancy, and means for calibration (e.g., pressure taps or procedures for instrument removal).

6.4.7 CSS Instrumentation and Control

The CSS is out of service.

6.5 System and Component Spares

Due to the relatively short duration of the IRTS process (<15 years), problems associated with major component failure due to factors such as fatigue and corrosion expected to be minimal. Therefore, on-site storage of spares for most major IRTS processing components is not provided. However, spares for selected components particularly susceptible to failure such as pumps, valves, and jumpers are maintained on-site as backups.

6.6 WVDP Control Areas

6.6.1 VF Control Room

Normal operation of the vitrification chemical process was monitored and supervised from the Control Room located within the Vitrification Building at elevation 34.9 m (114.6 ft). The Control Room equipment provided:

- Centralized monitoring, alarm and data recording functions for the vitrification process, including feed transfer and make-up, glass formulation, off-gas treatment and filtering, and auxiliary systems required by the vitrification and off-gas processes (e.g., Cooling Water system).
- Interlocks (via permissives) with various local control panels for processes that do not require centralized control (e.g., sludge mobilization, cold chemical transfer to the Vitrification Cell).
- Status indication, alarm and data recording functions related to the Radiation Monitoring system, Fire Detection and Protection systems, HVAC systems, and the Infrared Level Detection System (ILDS).

Vitrification systems that provide information to the DCS are listed in Section 6.2.11.1. Data signals are sent to the VF Control Room CRTs from the following process area control panels:

- Vitrification DCS Cabinets 1, 2, and 4
- Ex-Cell Off-Gas Instrument Room DCS Cabinet 3 and Control Panel
- HV Operating Station Control Panel
- SMS Control Room Control Panel.

Many of the mechanical support systems, such as the transfer cart, crane, and grapple, are controlled from control stations located in the cell Operating Corridors. These operations are observed, but are not controlled, from the VF Control Room.

The basic control, monitoring, and alarm functions in the VF Control Room are provided by the following equipment:

- Two operator work stations, enabling Control Room operators to monitor and supervise all operations in the VF that are interconnected with the DCS.
- One shift engineer work station, serving as back-up for operator work stations, a process engineering work station, and a work station for configuring/programming inputs.
- One monitoring station (in the shift supervisor office), enabling the shift supervisor to monitor all operations in the VF interconnected with the DCS.

- Fire control panel, providing power and annunciation, supervision, and control capabilities for the fire detection and alarm capabilities.
- Control Room radiation monitoring rack, for polling the radiation monitor communication network that gathers readings and alarm status for display, annunciation, alarm acknowledgment, and data storage.
- CCTV distribution cabinet, providing interface between Control Room CCTV stations and field CCTV stations and cameras.

The DCS is an automated system that allows the vitrification process to be performed to programmed operating functions and parameters. Various displays such as process variables, set points, alarm points, levels, and other operating information inform the operators of process parameter status. Alarms are annunciated in the Control Room, on the operators' screens, and on the alarm printers if parameters go beyond operating limits. Unexpected status inputs produce alarms on the screens and printers. Status alarms are wired in a fail-safe mode, to the extent possible; that is, a closed circuit is required to consider an input in its normal state.

Three sets of PLCs and 24 DCS controllers are provided. If control cannot be accomplished from the VF Control Room for any reason (e.g., communication failure, failure of all four work stations, fire, etc.), many control and monitoring functions can be maintained from non-VF Control Room locations. The PLCs can be operated from local CRT based operator interfaces, and the DCS controllers from front-of-panel devices. In the event that the Vitrification Building must be evacuated, the monitoring stations in the process and system engineering office areas can be configured for control of vitrification processes.

The CCTV system includes seven stations within the Operating Corridors at which a portable monitor could be plugged in for viewing. The ILDS has a local monitor at its control station in the operating aisle (with reduced graphics capability). The Radiation Monitoring system includes local alarms at each monitoring station, in addition to the alarms annunciated in the VF Control Room. These consist of both flashing lights and audible alarms. In case access is unavailable to the Control Room, the Fire Protection system would still sound warning horns in the aisles and in the guard house. Water extinguishing components are triggered locally, rather than from the Control Room.

The Emergency Lighting system is automatically activated and available upon failure of the normal Control Room Lighting system. The power source is independent of any Lighting system that is available in the VF Control Room. The source of power for the emergency lighting is battery packs. These are designed to provide one-half hour of lighting for safe shutdown of select components and evacuation of the VF Control Room. To ensure reliability and operability, battery packs are tested monthly.

6.6.2 IRTS and Main Plant Control Rooms

IRTS and Main Plant operations are conducted from several individual control rooms located throughout the site, as shown in Figure 6.3-1. HLWTS operations are conducted from a shared control room located in the Permanent Ventilation System (PVS) Building. Similarly, operation of the LWTS and any future operations are from a shared control room in the CSS 01-14 Building addition. Drum Cell operations are conducted from a control room on the east side of the Drum Cell building as shown in Figure 5.2-24. Vessel, sump, and ventilation operations associated with the Main Plant are conducted from a control room located on the fourth floor of the Main Plant building.

All control rooms have been designed for continuous occupancy and are provided with operation and alarm panels that are clearly labeled. Programmatic and human factors considerations associated with control room operations are discussed in Chapter 10.

6.7 Facility Decontamination and Deactivation

Decontamination and deactivation of radiologically contaminated WVDP facilities is required to place these facilities in a stable condition prior to final disposition. Several facilities are undergoing decontamination/dismantlement including XC-2 and the Vitrification Cell. Several areas within these facilities contain mobile sources of contamination that could be dispersed in the event of a severe abnormal event or accident. This contamination is in the form of residual heels in plant vessels and small particulate debris on cell surfaces.

Significant sources of mobile contamination presently exist in the HECs of the Main Plant. The HECs are being cleaned up to place loose debris in the cells into a safer storage configuration. Cleanup, as used in this instance, refers to the retrieval, packaging, and storage of the loose debris located in the cell.

Cleanup also includes size-reduction and decontamination of select waste pieces as necessary for proper packaging. Removal of fuel reprocessing equipment and components secured to cell walls or floors will be conducted as necessary to gain access to the loose debris. Due to the high radiation and contamination levels in these areas, cleanup operations will be conducted remotely. Contact-handled activities (e.g., repair activities) may be performed in the cell Crane Room or Crane Room Enclosure. Contact-handled activities in support of PMC operations may also be conducted in adjacent cells (e.g. Manipulator Repair Room (MRR)) as consistent with ALARA practices.

The HECs contain a variety of contaminated bulk materials such as drums, drum lids, lifting equipment, and hoses; activated equipment and materials such as fuel assembly hardware and saw fines; and fissile-bearing materials such as fuel hulls and fuel fines. Equipment in the cells that will be necessary to support decontamination activities includes manipulators (both power and manual), cranes manipulator and crane tooling (end effectors), and collection equipment such as scoops, shovels, or vacuums.

Particulate debris in the HECs includes fuel hulls and fine particulate material consisting primarily of saw fines and sheared fuel particles. This debris is collected through the use of scoops or shovels as well as with a vacuum system that includes a hose, a particulate debris collection container, and a fine particulate filter. In such a vacuum system, the bulk of the vacuumed debris is collected in the particulate debris-collection container. Particulate material passing through the vacuum exhaust is collected in the fine-particulate filter before the exhaust air is discharged into the HEC.

Steps are taken prior to the collection of debris that may contain liquid to ensure that the liquid is not carried into the collection container. Although individual drums of moderated HEC fissile debris have been demonstrated to be critically safe, transfer of a moderated container of HEC fissile debris material into a storage array would adversely affect the criticality safety of the storage array. Steps are therefore taken to maintain the amount of moderator in a debris collection drum to less than 5 volume percent water. Dry fissile-bearing debris collected from the HECs will be stored in 114-L (30-gal) carbon steel drums that are approximately 46.0 cm (18.1 in) in

diameter and 72.4 cm (28.5 in) in height (outside). The dimensions of the drums allow them to be placed in a shielded overpack, if necessary, to allow for transport to a storage area outside the Main Plant.

Drums containing fissile-bearing debris will be vented to release hydrogen and other gases that originate through radiation-related processes. Each of the 114-L (30-gal) drums containing fissile-bearing debris will be vented with a HEPA filter that can withstand at least 121.9-cm (48-in) WC without allowing water entry into a container (such as the Nuclear Filter Technology Incorporated NucFil 013 filter with Gore-Tex). A limit on the number and size of fissile-bearing debris containers that may be present in various cell locations has been stipulated in WVNS-NCSE-002 Nuclear Criticality Safety Evaluation for the Handling and Storage of Fissile-bearing Debris in the Head End Cells. Criticality design and administrative controls for these components are discussed in Section 8.7.

Bulk contaminated debris collected from the HECs will be packaged into standard waste containers(i.e., drums or boxes); however, fissile-bearing debris must be packaged into either 114-L (30-gal) carbon steel drums or packaged per WVNS-NCSE-001 mass limits. After packaging, fissile-bearing debris from the HECs may be stored in the Main Plant or may be transferred to an interim storage facility such as the Lag Storage Building prior to off-site shipment for disposal.

In addition to concerns regarding criticality safety for the collection, packaging, and storage of fissile debris waste from the HECs, other concerns exist during the decontamination of plant areas. These are discussed below.

Extraction Cell 2 (XC-2) was part of the NFS fuel cell, and the vessels in the cell contained process solution of Uranium and Plutonium. Decontamination and Deactivation efforts are currently being conducted in XC-2 and are near completion as well. Currently all vessels have been removed from XC-2. Any fissile bearing waste removed from SC-2 will be packaged to the requirements of NCSE-001 and stored in a criticality control zone. Any waste packaged from XC-2 that is TRU waste will be packaged in an approved container.

The Vitrification Cell is also undergoing Decontamination and Deactivation, with the Melter, CFMT and MFHT removed from the cell. Future work includes the removal of the Vessel Vent Header. Vitrification waste has been determined to be critically safe, and is exempted from criticality controls.

Decontamination and Deactivation activities may be carried out at any facility as determined by future work scope.

6.7.1 Size-Reduction

Some of the larger debris may need to be size-reduced to allow this material to be packaged. Size-reduction of larger debris may be done in-place at the point of collection or the debris may be transferred to an in-cell size reduction area. Depending on the type of material to be size-reduced, mechanical or thermal size-reduction equipment may be used.

Cutting operations introduce the potential for an in-cell fire or explosion due to the generation of sparks during certain sawing operations or due to the generation of sparks or hot slag during torch cutting. WVNS-FHA-011, *Fire Hazard Analysis Addendum - Main Process Plant (Head End Cell)*, acknowledges that these activities present the potential for a fire incident or related event in-cell, and recommends minimizing the potential of this risk by eliminating the combustibles in-cell before size-reduction and by establishing

a "hot work area" in the cell in which size-reduction activities would be performed. Cutting operations that employ hydraulic equipment (such as nibblers or shears) or saws that use toothed-blades (versus abrasive discs) do not present an increased potential for a fire in the cell.

6.7.2 Decontamination

Bulk contaminated debris may require decontamination to meet waste management or ALARA objectives. This equipment will be decontaminated as necessary using technologies such as high pressure water, steam, detergent, and C02 that have been previously deployed for equipment or cell decontamination at the WVDP.

Mechanical or water-based decontamination methods have been evaluated for their effectiveness in removing surface contamination from larger debris and equipment in-cell. Mechanical methods include C02 pellet or compressed air systems that decontaminate debris by mechanically dislodging removable surface contamination. Dislodged contamination is then collected and packaged. Water-based methods, including water washes, steam cleaning, and water-based detergent or caustic washes, may be used to remove surface contamination from equipment or debris. Liquid decontamination will be performed in a stall or booth that will isolate the decontamination solution from areas containing fissile-bearing debris to minimize the potential for material moderation. Should a liquid decontamination system be used, a liquid collection, transfer, and treatment system will be installed to manage the spent decontamination liquids.

Once the loose debris is removed, the interior surfaces of the cell may be decontaminated using mechanical or water-based decontamination methods. Spent wash water will be collected and transferred out of the cell for management in the LLW2, LWTS, or a vendor-supplied wastewater treatment unit.

At times, mechanical or water-based decontamination may not be feasible. In these cases, surface fixatives may be applied to waste or equipment being removed, as well as to permanent portions of the cell such as walls or floors.

6.7.3 Assurance of Decontamination Safety

Decontamination of the HECs requires the handling, packaging, and storage of fissile materials. These materials may include entrained water or other moderators that may increase the reactivity of collected materials. A detailed analysis of the criticality safety of decontamination activities is presented in Section 8.7.

Addendum 1 to WVNS-FHA-011, *Fire Hazard Analysis Main Process Plant*, provides the fire hazards analyses necessary to support the decontamination and deactivation activities discussed above. Addendum 1 to WVNS-FHA-011 states that there "is no fixed fire suppression system coverage of the HECs" and recommends under the "requirements" portion of the document that a Class D fire suppression agent (e.g., FEM-12) be placed in the HECs so as to be available for manual application on a fire or around a fire (using remotely controlled equipment such as a bridge-mounted power manipulator). Addendum 1 to WVNS-FHA-011 contains several other recommendations under the "improvements" portion of the document. "Improvements" are those items that "recognize an industrial standard or a best practice, improve protection and risk associated with proposed activities, and further safety comparable to the identified hazards."

6.8 Sampling-Analytical

6.8.1 Sampling

6.8.1.1 LWTS Sampling Capabilities

Samples of LWTS feed may be collected from Tank 8D-3 in the Waste Tank Farm or 5D-15B in the UPC in the Main Plant building. LWTS product (concentrates) are sampled from Tank 5D-15A1 or 5D-15A2. Tank 7D-2 is sampled from Tank 3D-2.

6.8.1.2 Nonroutine Sampling Activities

Nonroutine sampling is required for waste or site characterization purposes and to support facility or area deactivation and decontamination activities. Nonroutine sampling activities are performed per approved work procedures that incorporate worker health and safety requirements given in WVDP-010, *WVDP Radiological Controls Manual,* and WVDP-011, *Industrial Hygiene and Safety Manual.*

6.8.2 WVDP Analytical Capabilities

WVNSCO has a well-equipped analytical laboratory to support general operations at the WVDP site. The facilities are located on the third floor of the Main Plant Building, the east side of the Main Warehouse, and the east side of the Environmental Analytical Annex. Facilities in the Main Plant include six analytical hot cells for the preparation of radioactive samples; two radiochemical laboratories, equipped with fourteen fume hoods for the preparation or separation of radioactive samples; seven gloveboxes for the preparation, analysis and transfer of samples; and several nonradiological laboratories and hoods used for the storage, preparation, and analysis of nonradiological samples.

Analytical equipment in the laboratory facilities includes the following: two inductively coupled plasma atomic emission spectrophotometers; four high purity intrinsic germanium photon detectors; a planar high purity intrinsic germanium photon detector; two single-chamber, low-background, alpha/beta counters; twenty-four silicon charged-particle detectors; a liquid scintillation counter, sample oxidizer, ion chromatograph, and other general analytical equipment required for elemental, ionic, and physical characteristic analysis (e.g., densitometer, pH meter).

All aqueous radioactive laboratory wastes are routed to Tank 7D-2 or the LLWTS interceptors (depending on activity) via drains in the hoods of the radiochemistry laboratories and the floors of the hot cells. Hazardous organic radioactive laboratory wastes are collected in approved satellite accumulation areas before disposal. Solid radioactive wastes are double-bagged and turned over to WVNSCO Waste Management for disposal.

REFERENCES FOR CHAPTER 6.0

American Society of Mechanical Engineers/American National Standards Institute. 1992. *ASME Boiler and Pressure Vessel (B/PV) Code*. Section VIII, Division I. New York: American Society of Mechanical Engineers.

U.S. Department of Energy. 1993. *Waste Acceptance Product Specifications for Vitrified High-Level Waste Forms*, Rev. 0, EM-WAPS. Office of Environmental Restoration and Waste Management.

_____. February 8, 1990. Change 2 (January 7, 1993). DOE Order 5400.5: Radiation Protection of the Public and the Environment. Washington, D.C.

_____. July 9, 1990. Change 1 (May 18, 1992). Doe Order 5480.19. Conduct of Operations Requirements for DOE Facilities. Washington, D.C.

_____. November 15, 1994. DOE Order 5480.20A. Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities. Washington, D.C.

_____. October 13, 1995. Change 3 (November 22, 2000). DOE Order 420.1. Facility Safety. Washington, D.C.

_____. October 15, 1996. DOE P 450.4. Safety Management System Policy. Washington, D.C.

_____. March 27, 1998. DOE Order 440.1A. Worker Protection Management for DOE Federal and Contractor Employees. Washington, D.C.

_____. January 1, 2001. Occupational Radiation Protection. *Code of Federal Regulations* Title 10, Part 835. Washington, D.C.

U.S. Environmental Protection Agency. *Identification and Listing of Hazardous Waste*, 40 CFR 261, as amended.

_____. *Standards Applicable to Generators of Hazardous Waste,* 40 CFR 262, as amended.

_____. *Land Disposal Restrictions,* 40 CFR 268, as amended.

West Valley Nuclear Services Co. WVDP-010: WVDP Radiological Controls Manual (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-011: Industrial Hygiene and Safety Manual (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-073: WVDP Hazardous Waste Management Plan (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-NCSE-001: Nuclear Criticality Safety Evaluation for the Packaging and Storage of Fissile-Bearing Wastes at the WVDP.

_____. WVNS-NCSE-002: Nuclear Criticality Safety Evaluation for the Packaging and Storage of Fissile-Bearing Debris in the Head End Cells.

REFERENCES FOR CHAPTER 6.0
(Concluded)

_____. WVDP-106: *West Valley Demonstration Project (WVDP) Conduct of Operations Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-FHA-011: Fire Hazard Analysis Addendum - Main Process Plant (Head End Cell) (latest revision). West Valley, NY: West Valley Nuclear Services Co.

TABLE 6.2-1

CRANE MOTION SPEEDS

Crane	Bridge Travel Rates [fast/slow] (ft/min)	Trolley Travel Rates [fast/slow] (ft/min)	Hoist Lift Rates [fast/slow] (ft/min)	Hoist Rotation Rates [fast/slow] (revolutions/min)
Cell Process	12/4	12/4	15/5	1.5/0.5
Cell Back-up	12/4	12/4	6/2	N/A
HLWIS	9.5/3.2	9/3	6/2	N/A
EDR	12/4	9/3	6/2	N/A

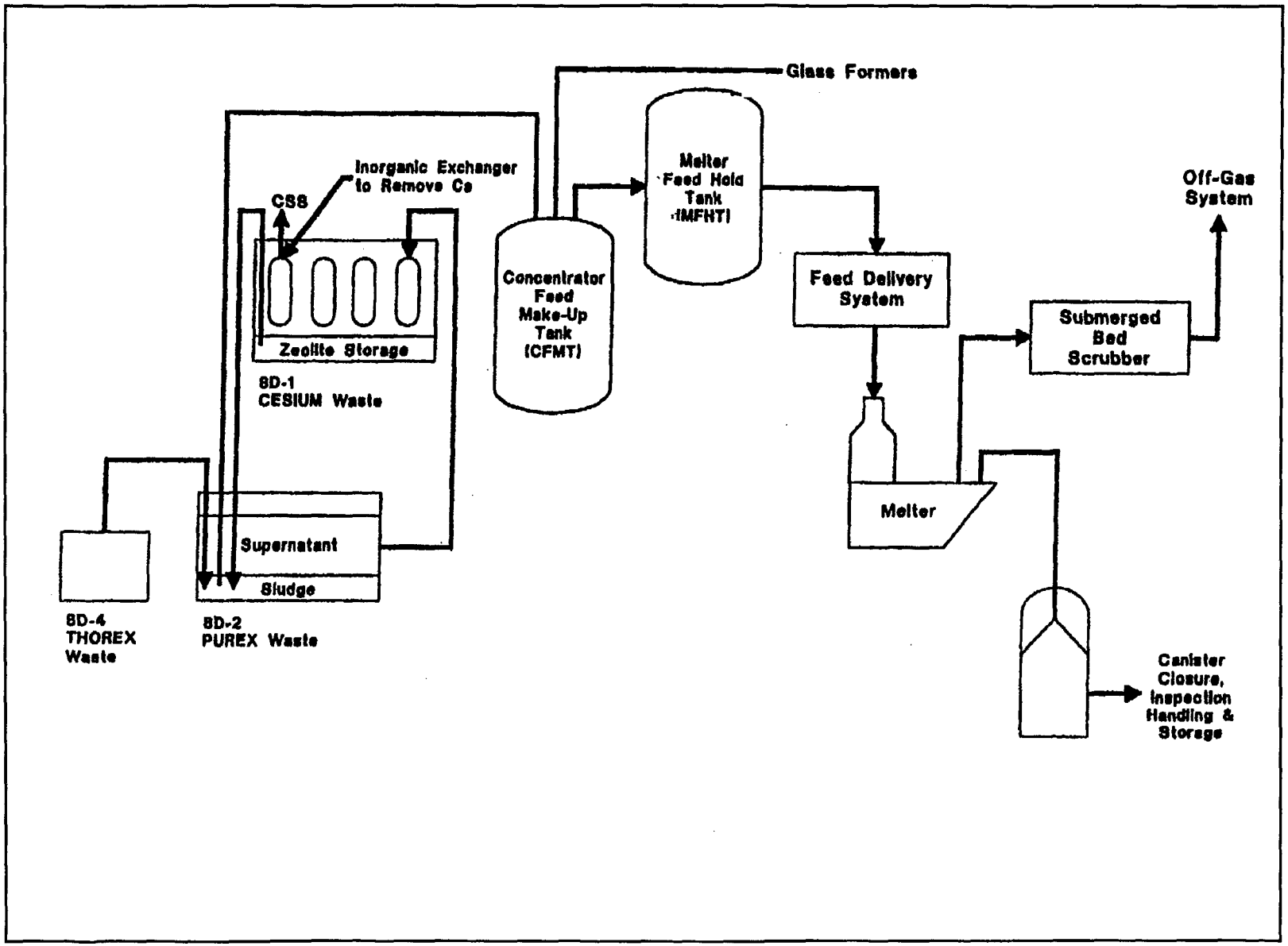


Figure 6.1-1 Former Vitrification Facility Flow Diagram.

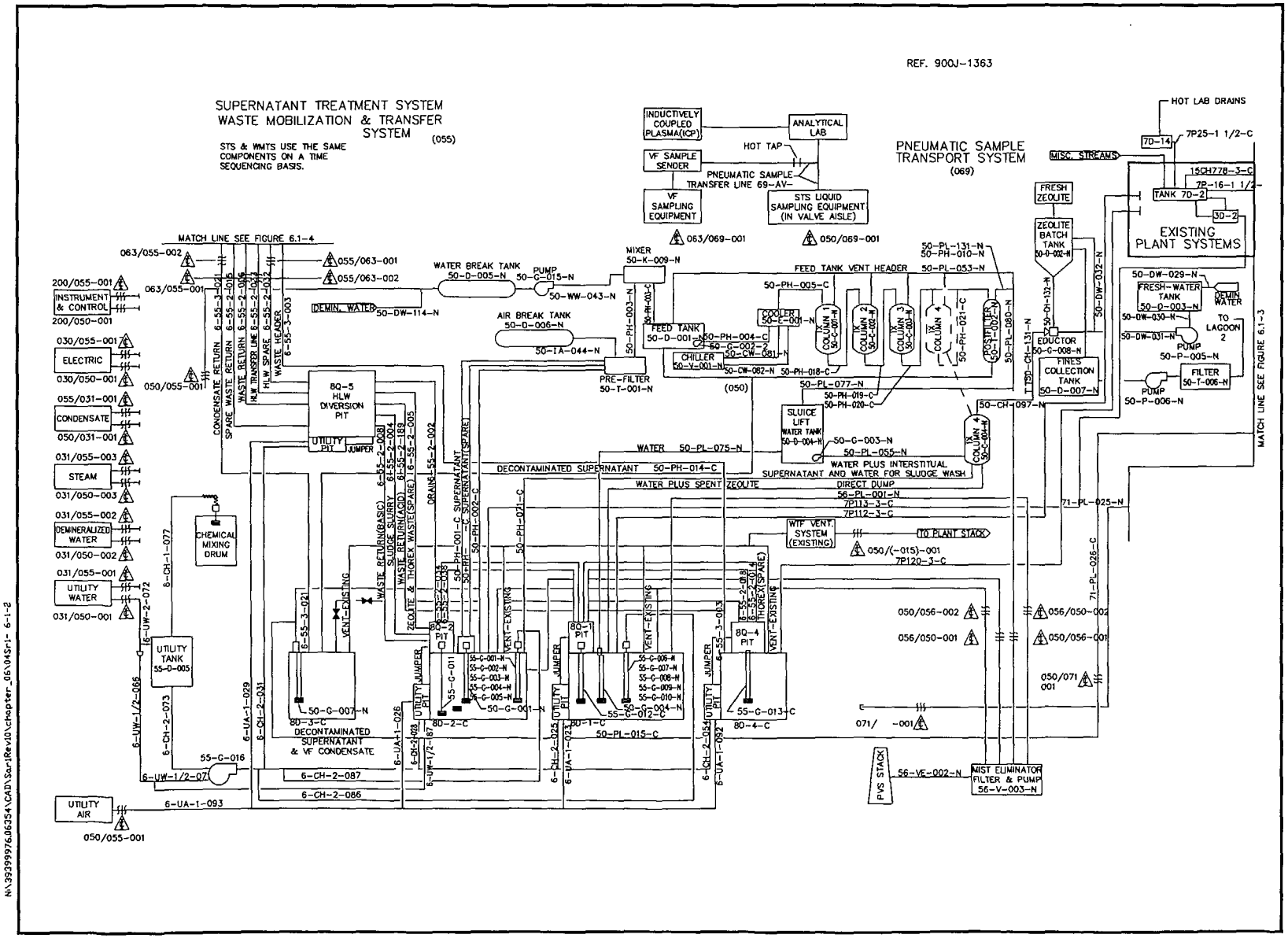


Figure 6.1-2 IRTS Process Flow Diagram – Supernatant Treatment, Waste Mobilization & Transfer, and Pneumatic Sample Transport Systems.

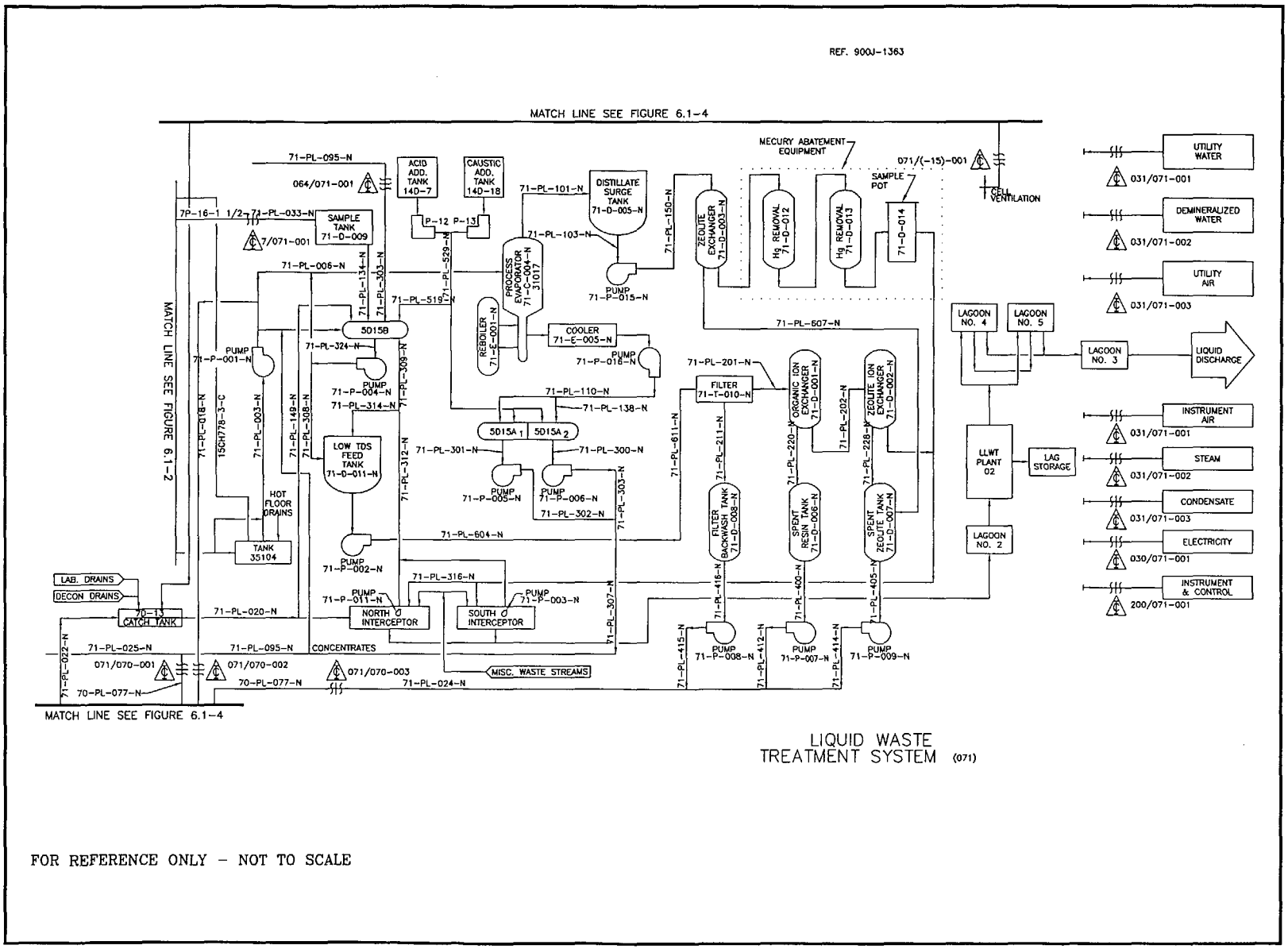


Figure 6.1-3 IRTS Process Flow Diagram – Liquid Waste Treatment System.

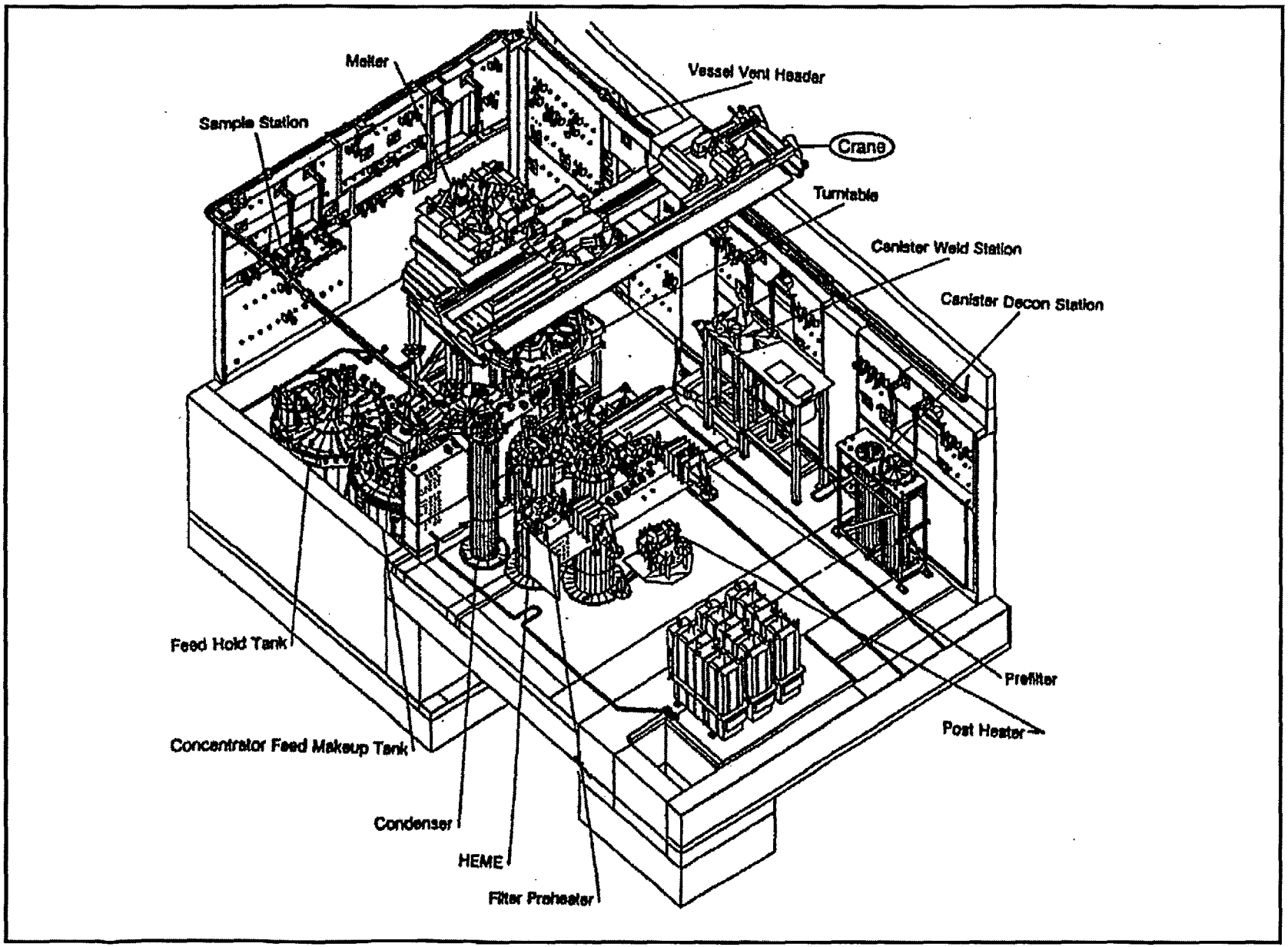


Figure 6.2-1 Former Vitrification Cell.

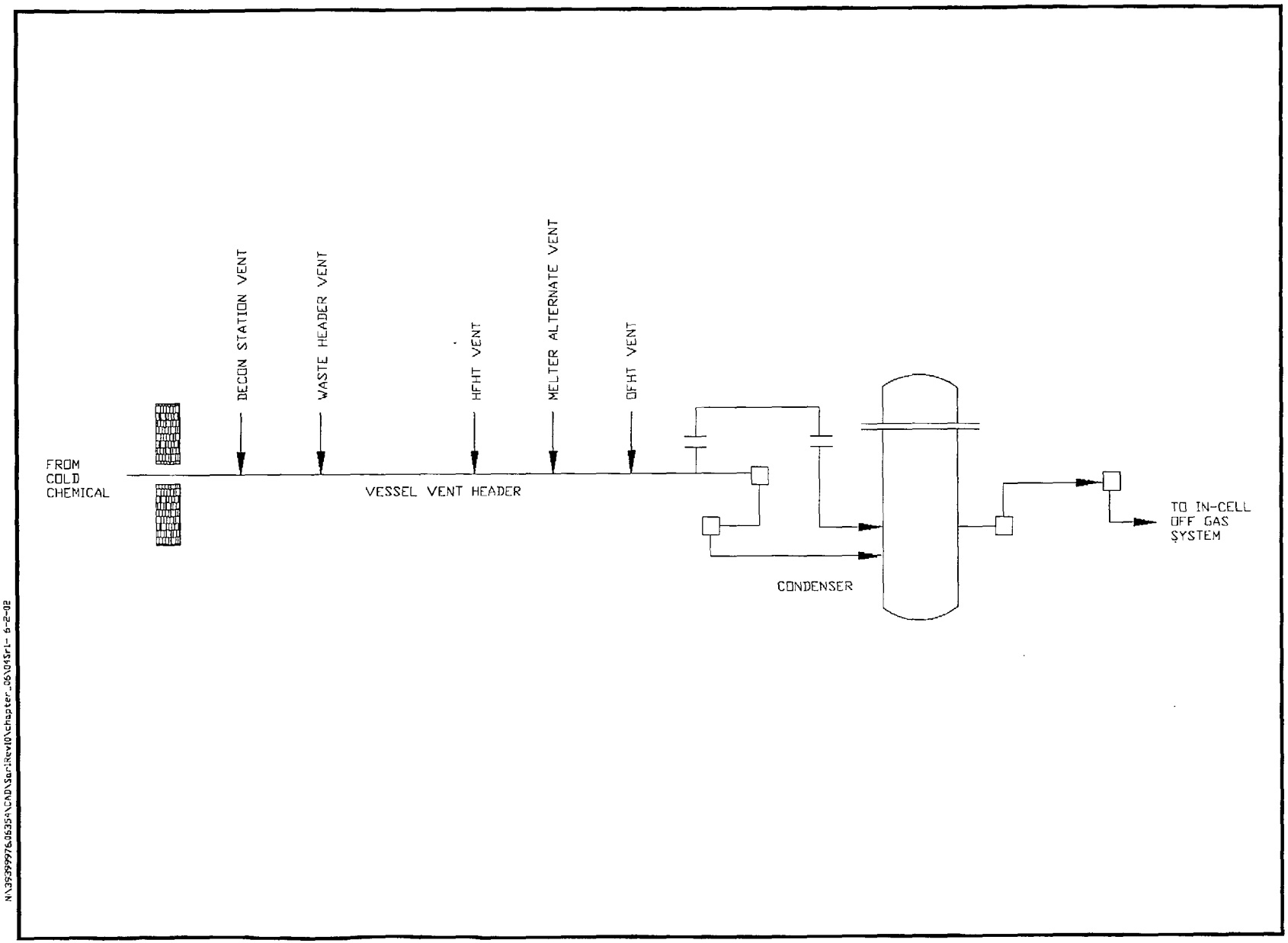


Figure 6.2-2 Former Vitrification Facility Vessel Vent Header Inputs.

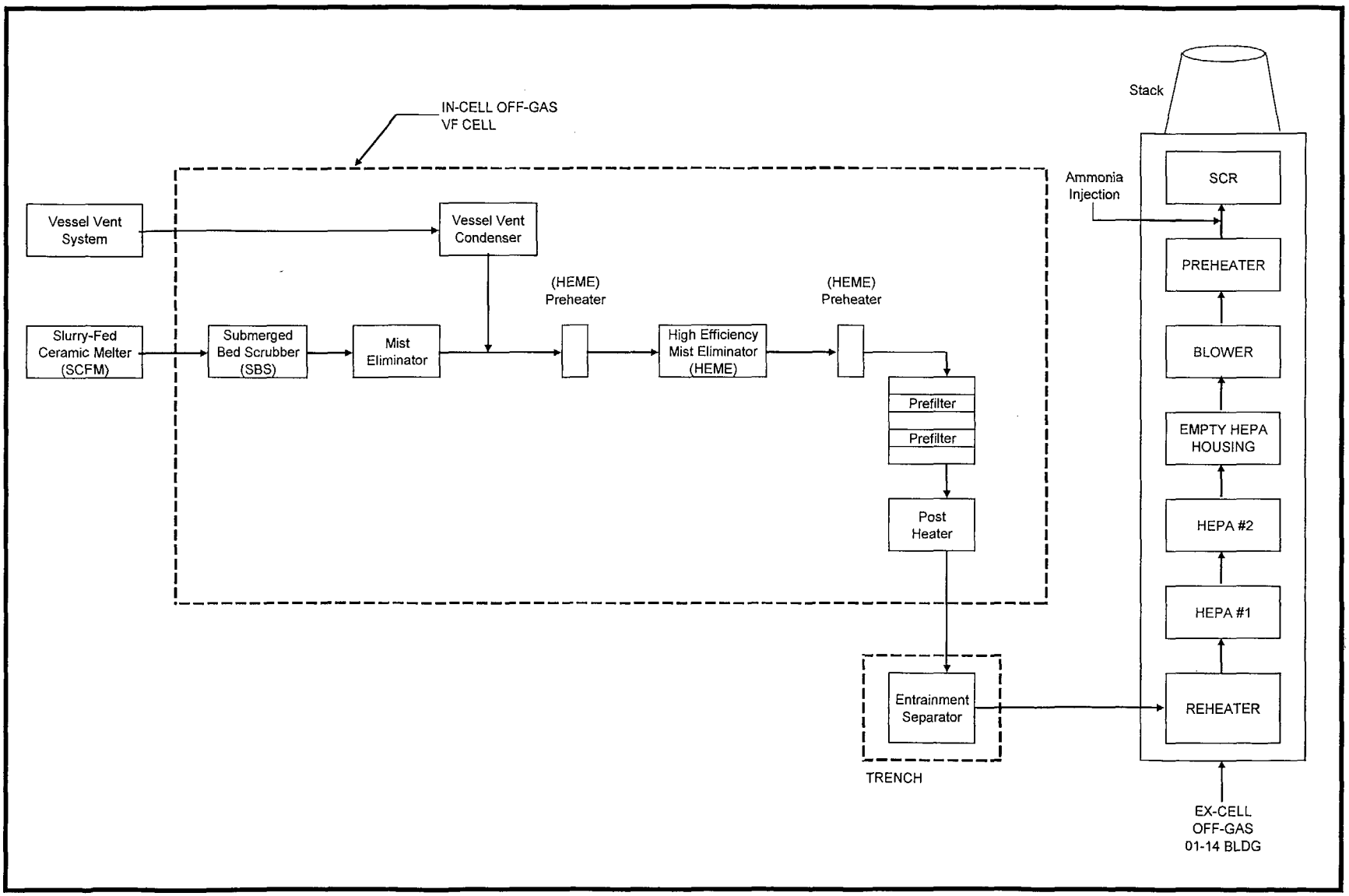


Figure 6.2-3 Former Vitrification Process Off-Gas Flow Diagram

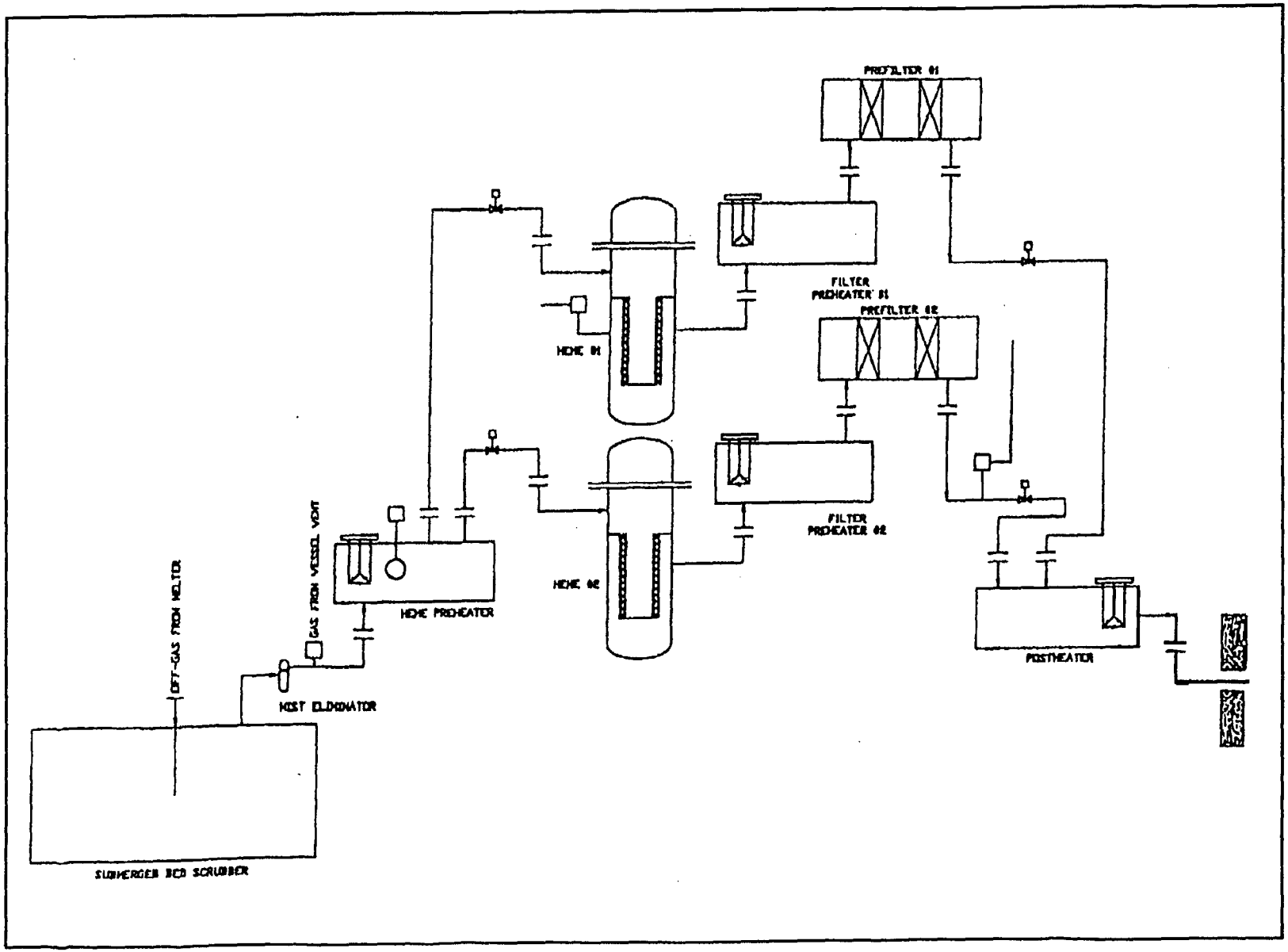


Figure 6.2-4 Former Vitrification Primary Off-Gas Vessel Flow Diagram

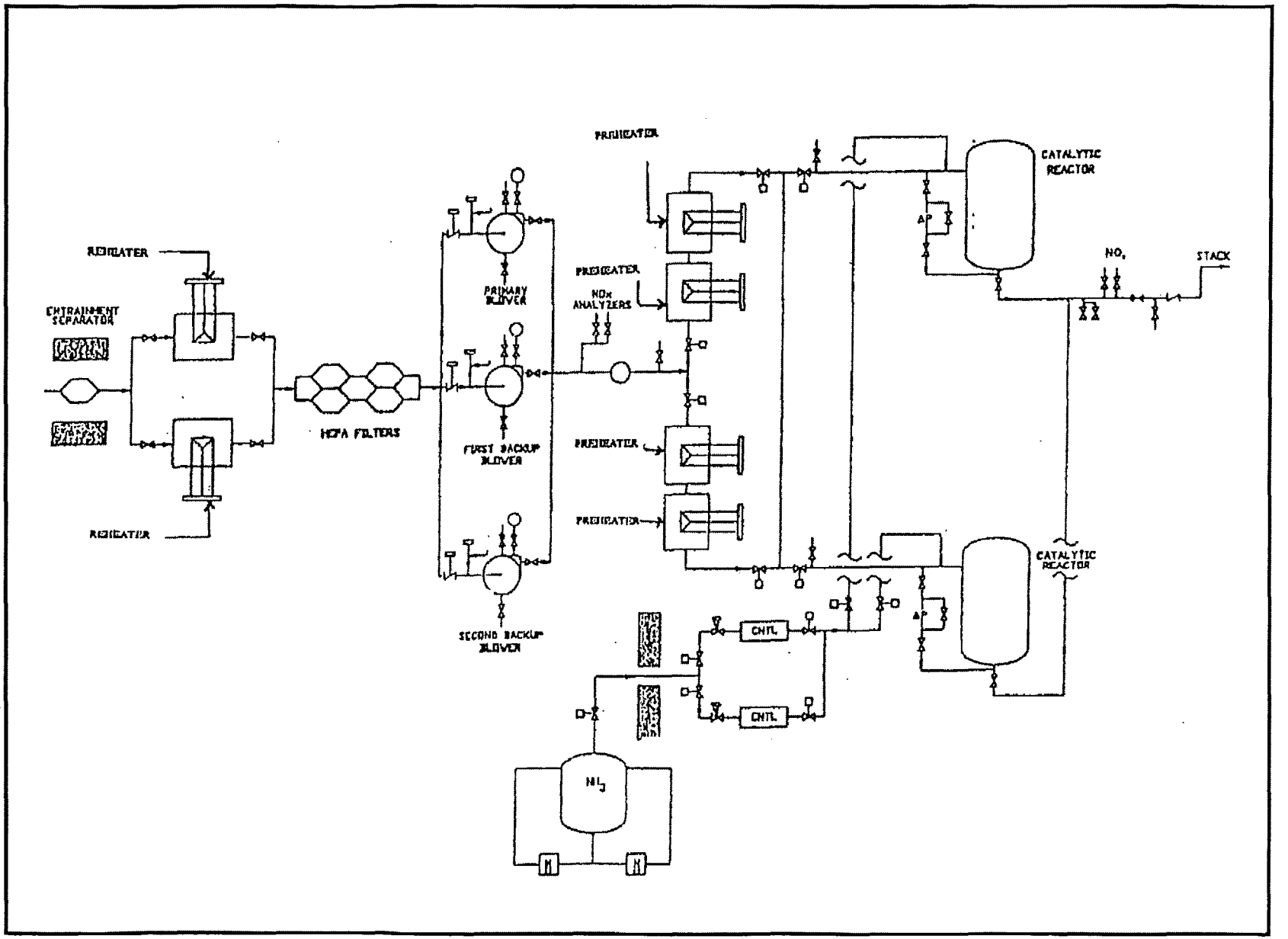


Figure 6.2-5 Vitrification Facility Ex-Cell Off-Gas System Flow Diagram.

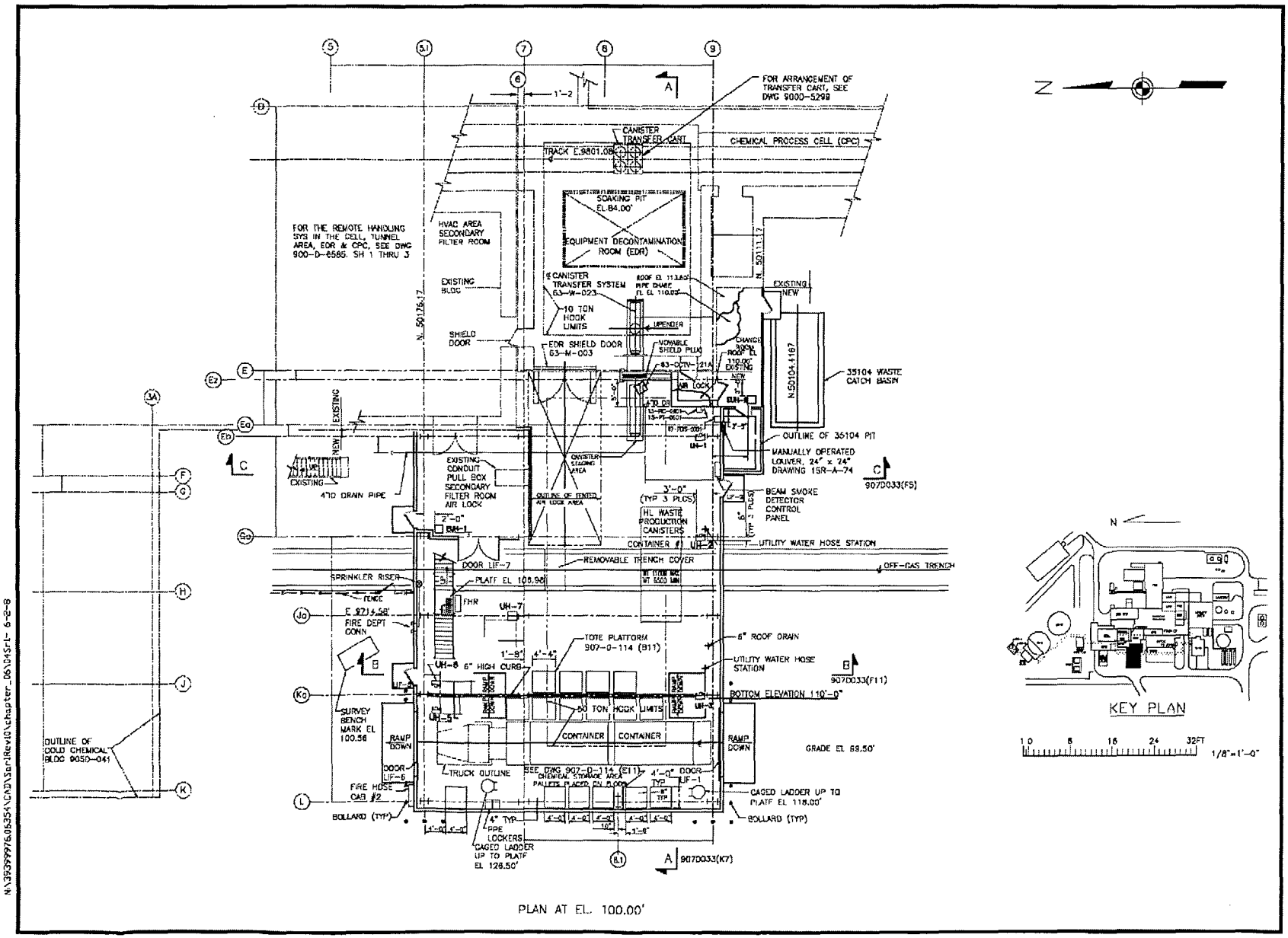


Figure 6.2-6 Former Vitrification Facility Load-In Building at El. 100.00'.

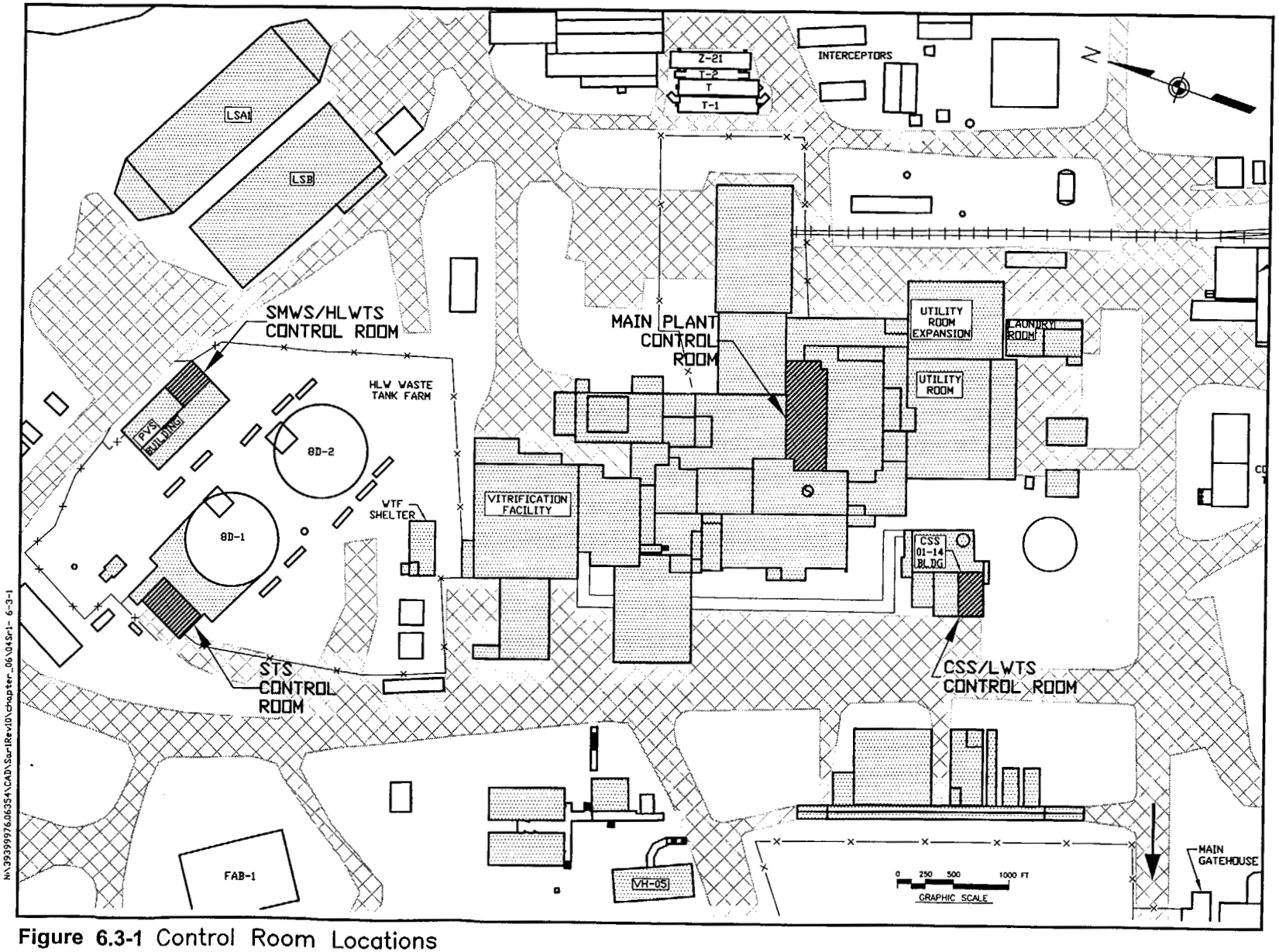


Figure 6.3-1 Control Room Locations

7.0 WASTE CONFINEMENT AND MANAGEMENT

7.1 Waste Management Criteria

This chapter addresses the policies and guidelines for the generation, handling, treatment, storage, and disposal of radiological and hazardous wastes at the West Valley Demonstration Project (WVDP). Radioactive wastes resulting from WVDP operations include gaseous, liquid, and solid low-level waste (LLW), low-level mixed waste (LLMW), high-level waste (HLW), solid transuranic (TRU) waste, and mixed TRU. In addition, both hazardous and nonhazardous nonradioactive (i.e., industrial and sanitary) wastes are generated as a result of WVDP activities. Waste handling and processing facilities have been designed to ensure that environmental effluent releases are maintained well within discharge guidelines given in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*.

The WVDP has developed comprehensive waste management plans to ensure that radioactive, hazardous, mixed, and industrial wastes are handled and stored in compliance with applicable state and federal regulations. A summary of WVDP waste management plans is given in Table 7.1-1.

Fundamental waste management objectives are considered prior to the design and operation of all WVDP facilities or systems for handling, treatment, storage, and disposal of waste. These objectives include:

- Protection of the worker, public health, and the environment;
- Conformance to applicable federal and state laws, rules and regulations, and DOE orders;
- Application of the ALARA philosophy;
- Waste minimization including volume reduction, segregation, and preferential use of less toxic materials; and
- Provision of flexibility in facility design to accommodate future needs.

Certain hazardous and mixed waste streams generated at the WVDP are also treated, packaged, and stored on-site. (Mixed waste contains both radioactive and hazardous constituents as defined by the Resource Conservation and Recovery Act [RCRA]). Other effluent streams are treated and subsequently released to the environment. Hazardous and mixed waste is either neutralized on-site or treated and disposed of off-site in licensed hazardous waste treatment and disposal facilities. Nonradioactive and nonhazardous waste is disposed of off-site in licensed commercial facilities.

The management (e.g., handling, packaging, storage, etc.) of radioactive, hazardous, non-hazardous, industrial, and radioactive mixed wastes is conducted at the WVDP according to approved policies and procedures. Consistent with the waste minimization stipulations contained in DOE Order 435.1, *Radioactive Waste Management*, and the implementation guidance for DOE Order 450.1, *Environmental Protection Program*, a waste minimization plan for the WVDP, WVDP-087, *Waste Minimization/Pollution Prevention Awareness Plan*, has been prepared. Waste minimization and pollution prevention activities are conducted according to this plan and standard operating procedures. Waste generation managers are required to plan for waste disposal by demonstrating that the waste was preliminarily characterized prior to the commencement of work, preparing an estimate and documentation of the volume of waste to be generated, and showing that waste minimization techniques were evaluated to avoid or reduce the volume of waste generated.

7.2 Low-Level, Low-Level Mixed, and TRU Wastes

The WVDP is currently using the NRC waste classification system prescribed in 10 CFR 61 for Class A, B, and C wastes. Based on this classification system, the primary form of solid LLW generated during WVDP operations is classified as Class A. This waste consists of anti-contamination clothing, bags, paper products, rags, analytical sample bottles, and other miscellaneous items. Other solid LLW includes spent ventilation filters, dewatered sludge and resin from LLWTF operations, contaminated wood products, small-diameter piping and sheet metal, and failed processing components that have been removed from radioactive service and overpacked before disposal. A summary of waste volumes typically stored at the WVDP is presented in Table 7.2-1. The radiological content of high-integrity containers (HICs) used to store contaminated resins and filter media from the fuel storage pool water treatment system is shown in Table 7.2-2.

Solid and liquid low-level, TRU, and mixed wastes are also generated during facility decontamination and decommissioning (D&D), maintenance, and construction activities. Small quantities of liquid LLMW are generated during analyses in the WVDP Analytical and Process Chemistry (A&PC) laboratories.

WVDP mixed waste management operations are conducted in accordance with the Federal Facility Compliance Act. Pursuant to this legislation, the WVDP has developed a mixed waste "Site Treatment Plan" that provides plans and schedules for treatment of LLMW either on or off-site, to meet Land Disposal Restriction standards.

Solid radioactive wastes at the WVDP are generated during facility operation and maintenance activities, and decontamination and construction activities. Low-level and TRU wastes generated during routine site activities include anti-contamination clothing and other personal protective equipment; ion-exchange resins and filters resulting from operation of the LLW2 facility; glassware, counting equipment, and other materials resulting from operation of the A&PC laboratory; and contaminated soil excavated during site-support and construction activities. Solid low-level and TRU wastes are also generated during facility decontamination and deactivation activities.

A significant amount of solid LLW currently in storage in WVDP Lag Storage facilities was generated during the decontamination of existing WVDP facilities and will continue to be generated during future D&D activities. These wastes include personal protective equipment, original process equipment including pipes, tanks, vessels, and other non-compressible wastes; solidified simulant waste forms generated during preoperational testing of IRTS component facilities; cement debris generated during demolition and waste stabilization activities; A&PC wastes; and dirt excavated from contaminated areas of the WVDP site.

HLW is defined in DOE Order 435.1 as "the highly radioactive waste material resulting from the reprocessing of spent nuclear fuel, including liquid waste produced directly in reprocessing and any solid material derived from such liquid waste that contains fission products in sufficient concentrations; and other highly radioactive material that is determined, consistent with existing law, to require permanent isolation." This definition includes the vitrified waste. HLW does not include other wastes resulting from reprocessing plant operations and does not include wastes generated incidental to the management or treatment of HLW. The waste in Tanks 8D-1 and 8D-2 is classified as a mixed waste by virtue of its toxicity characteristic (related primarily to the content of heavy metals). Therefore, this waste is also managed in accordance with applicable hazardous waste regulations.

Confinement of contaminated air in WVDP facilities is provided by facility ventilation and off-gas systems. Airflow in these plant cells and systems is from areas of low contamination to areas of progressively higher contamination. Contaminated air in these systems is HEPA-filtered prior to exhausting to the environment through stacks located on the Main Plant, 01-14, and Permanent Ventilation System Buildings. Gaseous effluents from these systems are monitored per the requirements of the site NESHAP (National Emission Standards for Hazardous Air Pollutants) permit. Ventilation system equipment and facility ventilation flows are detailed in Section 5.4.

Liquid LLW at the WVDP is generated during area or equipment decontamination, system flushing, filter backwashes, dewatering activities, and laundry operations. Wastewater with a gross beta concentration less than 5E-3 µCi/mL is directed to the Low-Level Waste Treatment System (LLWTS), which uses an ion-exchange process to decontaminate liquid radioactive waste.

TRU waste currently in storage at the WVDP was generated primarily during decontamination of the Main Plant. Per the requirements of DOE Order 435.1, only TRU waste categorized as defense waste is acceptable for disposal at the Waste Isolation Pilot Project (WIPP). Since WVDP TRU waste resulted from reprocessing of spent fuels from both commercial and defense sources, TRU waste is not presently scheduled to be shipped to WIPP. The WVDP is currently developing a TRU waste program.

7.3 Nonradiological Wastes

Nonradiological wastes generated at the WVDP are of the following basic types:

(1) hazardous liquid and solid wastes (e.g., oils and wipes from maintenance activities)
(2) nonhazardous, solid wastes (e.g., construction and demolition debris, non-construction debris, scrap equipment, maintenance wastes, office trash, packing material)
(3) nonhazardous, nonradioactive effluent (e.g., sewage, utility room effluent).

A small amount of hazardous waste is generated at the WVDP primarily as a result of maintenance, analytical, and printing activities. These wastes are handled in accordance with WV-996, *WVDP Hazardous Waste Management Program.* There is no on-site disposal of hazardous waste at the WVDP. Hazardous waste is shipped off-site for treatment and disposal by licensed and approved transporters to permitted commercial treatment, storage, and disposal facilities.

Nonradiological constituents in Project effluents are regulated by the New York State Department of Environmental Conservation. The combined liquid effluents from the LLWTS (described in Section 7.5) and wastewater (sanitary sewage) treatment facility (described in Section 5.4.7) are monitored to assure compliance with discharge limits identified in the State Pollutant Discharge Elimination System (SPDES) permit. These waste streams are also monitored for radioactivity.

Maintenance and miscellaneous activities generate some nonradiological, nonhazardous wastes (e.g., office trash, packing materials, scrap equipment, sewage). Nonhazardous, nonradioactive solid wastes are disposed of off-site at a licensed landfill facility.

7.4 Off-Gas Treatment and Ventilation

Gaseous waste streams associated with WVDP facilities and activities are processed through various types of treatment equipment so that releases to the environment are below applicable DOE, EPA, and NYSDEC limits. Off-gas treatment for vessels in the Waste Tank Farm (WTF) is provided by the Primary Ventilation System (PVS), which is discussed in Section 5.4. The Vessel Off-Gas System (VOG), which provides ventilation for vessels in the Main Plant is discussed in Section 7.4.1. Ventilation air from the VOG system is exhausted to the Main Plant stack.

The monitoring program for all stacks is described in other DOE-approved WVDP reports including the Annual Site Environmental Reports, the annual NESHAP reports, Monthly Trend Analysis Reports, and WVDP-098, *Environmental Monitoring Program Plan*.

7.4.1 Vessel Off-Gas System

The VOG system provides ventilation of exhaust gases from the LWTS evaporator and condenser as well as from a number of other vessels in the LWTS and Main Plant. A summary of vessels ventilated by the VOG is given in Table 7.4-1.

Off-gas ventilated from LWTS and Main Plant vessels passes through the VOG condenser 6E-3 where it is cooled. Airflow is then routed through Tank 6D-6 where the condensate generated in 6E-3 is collected and gravity-fed to Tank 6D-3. The stream then passes to the VOG scrubber 6C-3. During normal operation, the VOG scrubber contains a minimum level of water and the recirculation pump is off. If off-gas scrubbing is required, however, 6C-3 may be charged with a scrubber solution with the off-gas flowing through a cascade of liquid to remove and/or neutralize any chemical vapors. Off-gas leaving scrubber 6C-3 passes into the VOG cyclone 6V-1 to remove any entrained water and then to heater 6E-4 to raise the dew point temperature before filtration.

There are two upstream-filter/fan trains ducted in parallel that provide filter/fan train redundancy. The two final filter trains downstream of the blowers are ducted such that either train can be used with either fan (contrary to the upstream filter ducting configuration). Both upstream and downstream filter trains are arranged such that filter change-outs can be accomplished without interrupting system air flow. Upstream (primary) HEPA filters and blowers are located in the Off-Gas Blower Room (OGBR), next to the Off-Gas Cell. Downstream (secondary) HEPA filters are located on the Off-Gas Aisle (OGA) roof. After leaving the final filters, the gases are exhausted at a rate of 0.28 m^3/s (600 cfm) to the Main Plant stack, where they are discharged to the atmosphere.

The primary VOG filters located in the OGBR consist of a roughing filter and HEPA filter in a common frame. The frame is stainless steel and has a 1.3-cm by 1.3-cm (0.5-in by 0.5-in) stainless steel screen on the downstream face. This design precludes bulk filter media from falling into the discharge plenum in the event the filter media fails.

7.4.2 Safety Criteria and Assurance

Main Plant off-gas treatment and ventilation systems maintain redundant HEPA filters and blowers to ensure ventilation system operability during abnormal operating conditions. Treatment-system efficiency is continuously monitored through sampling and monitoring of exhaust air in the Main Plant stack. Effluent air samples are collected weekly and analyzed in the WVDP

Environmental Laboratory for gross alpha/beta and tritium activity. In addition, weekly gamma isotopic analyses are performed if gross activity rises significantly. Weekly filter samples are composited quarterly and analyzed for specific radionuclides of interest. The airborne effluent monitoring program is described completely in Section 8.3.

7.5 Liquid Waste Treatment and Retention

Operation of WVDP facilities generates wastewaters that contain traces of activation and fission product radionuclides. The purpose of the LLWTS is to intercept radioactive wastewater from site facilities; remove and confine radioactivity to the greatest extent practicable; and discharge the treated water at controlled rates to the environs. Figure 7.5-1 shows a simplified schematic of the LLWTS. Sources of radioactive wastewater include, but are not limited to, wastewater from the laundry; miscellaneous low-level process wastes including wastes from Main Plant operations; LWTS evaporator overheads; groundwater intrusion into the HLW pans and vaults; and contaminated waters from the NDA Treatment System, the Contact Size-reduction Facility (CSRF), and monitoring well development and/or purging. Wastewater is also extracted from the groundwater plume northeast of the Main Plant.

Low-level liquid wastes from the IRTS, Main Plant, and FRS facilities are collected in batches in one of the three interceptors (one old interceptor, two new interceptors [North and South]). Following radiological analysis, batches with gross alpha plus gross beta concentrations below 5E-3 µCi/mL are transferred to Lagoon 2. Lagoon 2 water is pumped via transfer pumps to the sump in the LLW2, which is located west of Lagoon 4 (see Figure 7.5-2). The LLW2 houses two skid-mounted equipment trains: Skid A and Skid B. Under the current configuration, Skid B treats water from the North Plateau, while Skid A treats water from Lagoon 2. Both skids are capable of preferential removal of strontium-90 and cesium-137 depending on the choice of ion-exchange resin used. Skid A is designed to treat approximately 220,000 L/day (58,000 gpd), while Skid B is designed to treat approximately 113,000 L/day (30,000 gpd). Spent resin from both skids are sluiced directly to shipping containers, dewatered, packaged, and transferred to temporary storage for eventual disposal. The treated liquids are collected in batches in Lagoon 4 or 5, where further sampling and analyses are conducted. If the treated liquid meets discharge specifications, it is transferred to Lagoon 3. If the treated liquid does not meet discharge specifications, it is either transferred back to Lagoon 2 for recycling through the LLW2, reanalyzed and, if specifications are met, transferred to Lagoon 3. Confirmatory measurements are performed on liquid transferred to Lagoon 3 before controlled discharge to the environment via Erdman Brook.

7.5.1 Design Objectives

The LLW2 is currently configured to process 189,000 L/day (50,000 gpd) of low-level liquid wastes. A comparison of the 2000 LLWTF discharge effluent isotopic concentration to the eight-year average discharge isotopic concentration is provided in Table 7.5-1. The estimated annual water balance for the LLWTS for CY2000 is shown in Figure 7.5-3.

The process systems in the LLW2 have been authorized by the New York State Department of Environmental Conservation (NYSDEC) for treatment of influent and discharge of effluent to the environment via SPDES-permitted outfall 001. The LLWTS is operated in a manner that ensures that effluent concentrations of radionuclides from Lagoon 3 do not exceed the derived concentration guides (DCGs) for nuclides specified in DOE Order 5400.5. Effluent from Lagoon 3 is

also monitored at outfall 001 for nonradiological parameters to demonstrate compliance with limits set forth in the SPDES permit for the LLWTS.

Liquid wastes in the LLWTS are contained in the interceptors, lagoons, LLW2 building sump, and process vessels. Protection from overflow or spills in LLW2 is ensured through the use of high-level cutoffs, a sloped building floor, moisture/leak sensors, skid catch basins, and drains to the LLW2 sump. These system components are discussed in the following section.

7.5.2 Equipment and Systems Description

7.5.2.1 Neutralization Pit and Interceptors

Liquid LLW from WVDP process areas first enters the LLWTS at a neutralization pit located west of the LLWTS interceptors (see Figure 7.5-1). Wastes entering the neutralization pit may be treated on a seasonal basis with sodium hydroxide (NaOH) or potassium hydroxide (KOH), which is added through floor drains in the utility room, to maintain a pH of greater than 10 in Lagoon 2 for insect larvae control. As an alternative to transfer to the neutralization pit, effluent liquid waste streams from the Main Plant that may contain elevated levels of contamination may be transferred to the original NFS (old) interceptor to prevent contamination of more mildly contaminated system components. The original NFS interceptor, which is located northwest of the stainless steel-lined interceptors that are used for routine receipt of liquid LLW, is an unlined concrete pit used to receive plant liquid effluents suspected of having elevated radioactivity contamination levels and other suspect liquids. Upon verification of acceptable radioactivity levels and other parameters of concern, the contents of this interceptor are transferred to the new interceptors via a submersible pump.

Interceptors used for the routine receipt of liquid LLW from site areas are dual 87,000-L (23,000-gal) stainless steel-lined concrete pits situated in the silty till clay. These pits, referred to as the north and south interceptors, collect wastewater in batches for sampling and release to Lagoon 2. High-level alarms locally annunciate the potential for over-filling of an interceptor. The interceptors are constructed so that one interceptor will overflow to the other if overfilling occurs. Hydrogen peroxide (H_2O_2) is added to the interceptors in the summer months, when necessary, to control the growth of algae in Lagoon 2. Wastewater that has been sampled and approved for release is drained by gravity to Lagoon 2. Air spargers in the interceptors are used to keep wastewater mixed to minimize the settling of any material.

7.5.2.2 Lagoon System

There are four storage lagoons associated with the LLWTS: Lagoons 2 through 5. Lagoons 2 and 3 are large holding basins constructed in the silty till with capacities of approximately 9,100,000 L (2,400,000 gal) and approximately 12,000,000 L (3,300,000 gal), respectively. This silty till has a low hydraulic conductivity and thus provides a level of confinement for the liquid wastes. Lagoons 4 and 5 are synthetic-lined holding basins with capacities of approximately 910,000 L (240,000 gal) and 700,000 L (185,000 gal), respectively.

Lagoon 2 is fed directly from the new interceptors and serves as the feed point for the process skid equipment in LLW2. LLW2 removes groundwater containing Sr-90 from the North Plateau Pump and Treat System. In addition, effluents from the NDA Liquid Pretreatment System (LPS) are discharged to Lagoon 2 for treatment in LLW2. Lagoon 2 also serves as an equalizing basin

for recycle streams from the LLW2. Lagoon 3 is a surge basin for treated waste and is the point of discharge to the surface waters via Erdman Brook. Lagoons 4 and 5 alternate receiving and discharging LLW2 effluent water to Lagoon 3. Batch collection and sampling is used to monitor water quality. Lagoons 4 and 5 discharge to Lagoon 3 normally but can be routed to Lagoon 2 to retreat the water if required.

An improvement in the system configuration includes the ability to add a measured amount of sulfuric acid to Lagoon 3 from the LLW2. (The pH in the unbuffered open water of Lagoon 3 rises due to algae growth.) The pH range for discharge from Lagoon 3 is between 6.5 and 8.5.

7.5.2.3 Low-Level Waste Treatment Replacement Facility

The LLW2 is a pre-engineered, single-story, metal-sided building 12 m by 18 m (40 ft by 60 ft), located west of Lagoon 4, which houses two skid-mounted process equipment modules. The floor is pitched to a longitudinal drain (running along the east wall of the building) that slopes to the sump located in the southeast corner of the Packaging Room. The sump overflows via gravity to Lagoon 2. The LLW2 has HEPA filtration for the Packaging Room, which is typically used to handle resin. Air leaving the resin-handling area passes through a HEPA filter and the associated Portable Ventilation Unit (PVU) before being exhausted through a short stack on the roof of the building. This stack flow is sampled to obtain periodic confirmatory information on radionuclide emissions for the annual NESHAP Report required by 40 CFR 61 Subpart H (U.S. Environmental Protection Agency July 1, 2001).

The LLW water stored in Lagoon 2 is transferred to the 3,400-L (900-gal) sump in the southeast corner of the Packaging Room in the LLW2 building via two pumps housed in a shelter located on the berm between Lagoons 2 and 3. From the sump, feed water is pumped via the transfer sump pump to the 3,000-L (800-gal) surge tank.

The North Plateau well pumps remain unchanged. These pumps discharge to the 4,200-L (1,100 gal) surge tank that remains in the trailer associated with the North Plateau ground-water. Transfer pumps in the trailer are used to transfer the North Plateau well water from the surge tank in the trailer to the 3,000 L (800 gal) surge tank in the LLW2 associated with the Skid B.

7.5.2.3.1 Liquid Waste Handling

Low-level wastewater is treated in the LLW2. The initial design and installation configuration requires the operation to process Lagoon 2 wastewater through Skid A and North Plateau wastewater through Skid B. Due to the design of the ion-exchange (IX) columns, the spent resin waste that will be generated via this process will be less than the previous waste volume generated. It is permissible for both waste streams to be processed though one skid (assuming proper ion-exchange media is present) since subsequent sampling and analysis determines whether the treated liquids are transferred to Lagoon 3 for discharge to the environment or transferred to Lagoon 2 for recycling. The following sections discuss the independent operation of Skids A and B.

7.5.2.3.1.1 Skid A

The water in the surge tank is pumped via an IX feed pump through the mechanical filter to the process skid for the Lagoon 2 water. The design flow rate is 76-190 lpm (20-50 gpm) based on the current total flow rate of approximately 26,000,000 L per year (7,000,000 gal per year). The maximum

flow rate is expected to be approximately 150 lpm (40 gpm) for the Skid A equipment. The skid has three identical carbon steel ion-exchange vessels with a non-metallic polymer liner; each ion-exchange column is capable of being charged with 1.4-m^3 (50-ft^3) of dry mixed ion-exchange resins. The skid-mounted equipment has been designed to allow maximum flexibility in the operation of the process such that the ion-exchange columns can be used in series or parallel or bypassed in any order relative to one of the skids. The columns are designed for downflow loading and upflow elution. The pH of the influent to the ion-exchange columns is adjusted before entering the columns. A chemical feed pump drips concentrated sulfuric acid into the influent stream to adjust the pH to between 6.0 and 8.0. Sulfuric acid used in neutralization is supplied from a 380-L (100-gal) tank (located on the sloping floor of the LLW2), which is filled via a drum pump from 208-L (55-gal) drums. Receipt and distribution of the concentrated acid is controlled by standard operating procedures. The treated effluent flows to Lagoons 4 and 5 for subsequent radiological and biochemical analyses before further transfer. If the effluent meets the requirements for discharge to the environment, the liquid is transferred to Lagoon 3 for discharge; otherwise, the effluent is returned to Lagoon 2 for further processing.

7.5.2.3.1.2 Skid B

The North Plateau wastewater in its associated surge tank is pumped via an IX feed pump through the process equipment on the skid. The design specifications for Skid B equipment are similar to those for Skid A. However, based upon the SPDES permit performance, the maximum flow rate is set at 76 lpm (20 gpm). Operation of Skid B is the same as operation of Skid A, with the same parameters being monitored and controlled. As shown in Figure 7.5-1, the effluent from Skid B is combined with the effluent from Skid A.

7.5.2.3.2 Resin Removal and Handling

The process skids do not have to be shut down for an ion-exchange column to be sluiced out. Only the column with the spent resin needs to be isolated. Soft water is used to push the resin out of the column and into a shipping container (i.e., a HIC or B-25 box) located in the Packaging Room. Here, the container is dewatered and prepared for interim storage. The process skids have to be shut down to conduct the resin-loading operation. Resins in storage from the old LLWTS may be repackaged in the Packaging Room.

7.5.2.3.3 Low-Level Waste Treatment Replacement Facility Ventilation

There are three HVAC systems in the LLW2. The main heating system includes four gas-fired radiant heaters located near the ceiling throughout the building. The heater dedicated to the Packaging Room uses outside air for combustion and discharges to the outside, that is, the combustion air and combustion products are isolated from the Packaging Room air. These units are designed to provide enough heat for all normal operations.

The second system consists of the PVU stationed outside the south wall of the packaging area. This unit is used whenever personnel are in the Packaging Room during resin-handling activities. The PVU draws air from the Packaging Room and provides controlled vessel-ventilation, as appropriate, during resin-handling activities. Air leaving the resin handling area passes through a HEPA filter and the associated PVU before being exhausted through a short stack on the roof of the building. Contamination levels in the water treatment area of LLW2 are sufficiently low such that HEPA filtration is not necessary.

The third system is a forced ventilation unit for the office area that provides year-round climate control. Air from the outside is heated or cooled and distributed to the office area such that positive pressure is maintained in the office area.

7.5.2.3.4 Instrumentation and Control

Controls on the LLW2 process consist of process sampling, standard operating procedures, and process instrumentation. Samples of ion-exchange effluent provide information on process operation and form the basis for changes in the types and quantities of chemical additives. Primary control parameters are radionuclide concentrations and calcium hardness in the feed stream.

Instrumentation is used in the treatment system to monitor the system feed rate, surge tank level, and flow rate through the ion-exchange beds. The Skid A influent stream is controlled to a pH range of 6.0 to 8.0. Alarms are indicated on the computer in the LLW2 office.

7.5.3 North Plateau Groundwater Recovery System

The WVDP installed a groundwater pump-and-treat system on the North Plateau (northeast of the Main Plant) to mitigate the movement of Sr-90 near the leading edge of a plume of groundwater contamination. The pump-and-treat system consists of three 4.6-m (15-ft) recovery wells equipped with transfer pumps, which collect contaminated groundwater from the underlying sand and gravel unit. The groundwater is treated by ion-exchange columns housed in the LLW2. Ion-exchange columns are used to reduce the gross beta concentration of the groundwater. The treated groundwater is then transferred to Lagoon 4 or 5 or, as needed, to Lagoon 2. The treated groundwater is ultimately discharged from Lagoon 3 in accordance with the site SPDES permit.

In addition, a pilot permeable treatment wall has been constructed to test this technology and provide in-situ treatment of Sr-90-contaminated groundwater across the eastern lobe of the north plateau beta plume. This passive treatment process, which consists of treatment media in an excavated trench, relies on the natural flow of the contaminated groundwater and is intended to intercept and remove Sr-90 from the groundwater. Evaluation of the pilot permeable treatment wall is still underway and additional soil borings and monitoring wells were installed in the fall of 2001 to support this evaluation.

7.6 Solid Wastes

Solid LLW generated at the WVDP includes Class A, B, and C wastes and TRU waste. Temporary storage for these wastes is provided by Lag Storage Facility buildings and hardstand areas while waste volume-reduction is performed in facilities such as the Waste Reduction and Packaging Area (WRPA) compactor, Contact Size Reduction Facility (CSRF), and Container Sorting and Packaging Facility (CSPF). WVDP solid LLW storage and volume- reduction facilities are fully described in the following sections. Locations of these facilities are depicted in Figure 7.5-2. Most of the following facilities handle solid wastes, but may also handle solid or liquid LLW, TRU, or mixed wastes.

Fulfillment of the WVDP Act requires the off-site shipping of radioactive wastes generated in support of project activities. Preparation of wastes for off-site shipping may require the handling, sampling, compositing, repackaging, consolidation, analysis and physical stabilization of low-level wastes in a variety of site facilities. An evaluation of these activities in Section 9.2.2.3 has shown that the risk associated with accidents involving a

single TRU waste drum bounds accidents associated with several low-level waste containers. Nevertheless, since the presence of a significant number of open containers of combustible waste may present a fire loading that was not considered in the original fire hazards analysis, consideration must be given to the combustible loading of these containers to ensure that the activities do not affect the facilities in which the activities are conducted. These risks will be evaluated as part of the planning for waste handling activities in site facilities not typically used for waste management activities prior to the conduct of the activities.

7.6.1 Design Objectives

Waste storage facilities at the WVDP have been designed for the safe storage of wastes packaged to meet the requirements of 10 CFR 61. These facilities provide interim storage for wastes generated at the WVDP before final disposal off-site; no radioactive wastes produced at the WVDP are disposed of on-site.

7.6.2 Equipment and Systems Description

Facilities providing interim storage for wastes generated on-site are discussed in Section 7.6.6. Equipment and facilities used to reduce the volume of solid LLW are discussed in the following sections.

7.6.2.1 Waste Reduction and Packaging Area Compactor

A small compactor located on the WRPA dock is used for compacting low-activity LLW. This waste, consisting primarily of anti-contamination clothing and paper products, is collected in polyethylene bags throughout the site. Parcels are transferred to boxes stored in Lag Storage facilities, and then transported to the WRPA dock where the bagged waste is transferred from the boxes to a 2.5-m^3 (90-ft^3) rectangular steel box and compacted by a 45-MT (50-ton) box compactor. The compactor is vented by a HEPA-filtered ventilation system to provide contamination control.

7.6.2.2 Contact Size-Reduction Facility

The CSRF has been designed to reduce the volume of large, low-dose rate (<100 mR/hr) equipment resulting primarily from WVDP decontamination activities in the Main Plant. This equipment consists of process piping, vessels, and other equipment formerly housed within shielded cells that were adapted for use in the IRTS. As a result of the nature of this waste, a considerable volume-reduction can be realized if this material is cut into pieces that can be packed more efficiently.

The CSRF uses plasma arc cutting torches for size-reduction and a high-pressure water spray system for decontaminating large items. This equipment is installed in the north room of the Master-Slave Manipulator (MSM) repair shop.

Low dose rate, LLW packages to be processed in the CSRF are staged in the north airlock pending a preliminary radiation survey to verify that the exposure rate is acceptably low. Wastes that are determined to be acceptable for processing are then transferred to the cutting room. Following safe storage or removal of flammable material from the cutting room, equipment is size-reduced through the use of a plasma arc torch.

Size-reduced materials may be decontaminated before packaging for assay and storage. Decontamination capabilities in the CSRF include foam application high pressure water spray, and a liquid abrasive decontamination system.

The Liquid Abrasive Decontamination System (LADS) is designed to decontaminate material sectioned in the cutting room. This system uses a mixture of abrasive particles, water, and air to clean the surfaces of contaminated material. Material to be decontaminated by this system is loaded onto a turntable and transferred into the system decontamination booth for application of the abrasive spray. Currently Tank 15D-6, which receives liquid effluents from the LADS, is incapable of being jetted. Consequently, LADS is out-of-service.

Following decontamination, material is air-dried and transferred to an airlock for final survey. It is then packaged for return to the Lag Storage Facility for waste classification assay and interim storage pending final disposal off-site.

Ventilation for the CSRF is provided by a room ventilation system and backed up by the Head End Ventilation (HEV) system of the Main Plant. Room ventilation is provided by a system mounted on the roof of the cutting room. Room ventilation system air flows at a nominal rate of 2.8 m^3/s (6,000 cfm) from the south MSM, vestibules, and decontamination room into the cutting room where it is exhausted through an in-cell spark arrestor and roughing filter, and a roof-mounted filter train consisting of a roughing filter and two HEPA filters in series, before discharge to a locally-mounted stack. Ventilation for the MSM decontamination shower booth and LADS decontamination booth/survey glove box is provided by the HEV system. The HEV also provides back-up ventilation to the various rooms when the room ventilation system is shut down. A source-capture system that provides localized ventilation in the cutting room discharges to the room ventilation system.

CSRF ventilation system atmospheric discharges are isokinetically sampled and continuously monitored for alpha and beta activity.

7.6.2.3 Container Sorting and Packaging Facility

The CSPF has been designed to support the sorting, segregation, and repackaging of LLW. This facility is also used to sort mixed and non-mixed wastes and to inspect container contents. Future uses of the facility may involve segregating higher contamination items from lower contamination items.

The CSPF is a stand-alone facility measuring 12 m by 8.5 m (40 ft by 28 ft) and located within Lag Storage Area-4 (LSA-4). It is constructed of prefabricated, interlocking modular 22-gauge stainless steel panels that form the outside walls, ceiling, and inner partition walls. Some wall and ceiling panels contain Plexiglass™ windows for viewing and external lighting purposes. The concrete floor of LSA-4 serves as the floor of the CSPF. The CSPF consists of a sorting room, drum/box load-in room, drum load-out room, and two airlocks. The box/drum load-in and load-out rooms provide safe and efficient movement of waste containers in and out of the facility, while the airlocks allow personnel access to the sorting room.

Unsorted and unsegregated waste packages entering the CSPF are moved into the drum/box load-in room before being moved to the sorting area. Packages are subsequently moved into the sorting area, placed on a lift-and-tilt table, and opened. The lift-and-tilt table elevates and tips the container, making the contents easily accessible. The waste is then sorted and segregated. Full drums or boxes containing sorted waste are later moved from the sorting room to the load-out room, covered, decontaminated as needed, and placed back into storage in the Lag Storage Facilities. Other equipment in the sorting room

consists of a sorting table with liquid catch basin, drum roller, and an overhead bridge crane.

Next to the CSPF is a stand-alone blower room that houses the ventilation system and other components essential to sorting operations. The CSPF ventilation system consists of a double-stack 0.94-m^3/s (2,000-cfm) system with two nominal 0.47-m^3/s (1,000-cfm) blowers. This configuration permits one blower to be taken off-line for a filter change while still maintaining ventilation flow at an adequate level. The filter housings are manufactured from 14-gauge T-304 stainless steel, adequately reinforced to withstand a negative or positive pressure of 10-in water gauge.

The discharge side of the ventilation system from the filter to the discharge point at the exterior of LSA-4 has approximately 3.7 m (12 ft) of 36-cm (14-in) diameter stainless steel duct. Two sections of 15-cm (6-in) diameter stainless steel duct direct ventilation air from the blowers to the locally mounted stack. The stack penetrates the LSA-4 weather structure before discharging ventilation air to the atmosphere. Air ventilated by the system is monitored through the use of continuous air monitors.

If electrical power to the two ventilation blowers is lost, an auxiliary blower powered by a dedicated natural gas generator will provide adequate ventilation to the facility. Therefore, failure of both the exhaust blowers or loss of off-site power will not prevent the system from maintaining sub-atmospheric pressure in the CSPF.

7.6.3 Operating Procedures

Operating procedures for the handling and storage of radioactive waste at the WVDP have been developed per the requirements of DOE Order 435.1 and 10 CFR 61. Update of the waste management program is given in WVDP-019, *Low-Level Waste Management Program Plan*. Development of facility procedures is consistent with the development of other procedures at the WVDP, as noted in Section 10.2.

7.6.4 Characteristics, Concentrations, and Volumes of Solid Waste

Radiological wastes stored in the Lag Storage Facility include Class A, B, and C LLW and TRU waste. A representative summary of waste types and volumes generated at the WVDP is presented in Table 7.2-1. This table is an example and does not provide comprehensive information. Estimates of the average radiological inventory of Lag Storage waste containers are provided in Table 7.6-1.

Approximately 459 m^3 (16,200 ft^3) of TRU waste was generated at the WVDP during the period 1984-2001. This volume is being stored pending processing. It is expected that the volume of TRU waste requiring storage will be reduced by decontaminating much of this waste to below the TRU waste-classification threshold. TRU waste remaining after final decontamination will be stored and eventually shipped to a federal repository once it becomes available.

Solid LLW that contains >0.5% liquid by volume may be stored on hardstands, provided that it is double-contained. This waste is stored pending development of draining, remediation, repackaging, or overpack operations. Upon completion of these operations, the waste packages would then be transferred to the appropriate storage structure.

7.6.5 Packaging

Solid and liquid LLW stored in the Lag Storage Facility is packaged, at a minimum, to meet the requirements of 49 CFR Parts 100 to 178. As LLW is prepared for off-site shipment/disposal, the criteria of 10 CFR 61 is evaluated and some repackaging may be required.

For the purposes of criticality control, fissile content administrative limits and waste container stacking limits for TRU waste containers exist. As a best management practice, and as directed in WVDP-SER-001, *Safety Evaluation Report for Waste Processing and Support Activities and the Remote Handled Waste Facility*, Revision 2, "approved containers" shall be cited as "design features" in WVDP-146. "Approved containers" provide an important confinement function and support minimizing the propagation of fire. "Approved containers" are containers that satisfy the following requirements: 1) are fabricated from a non-combustible material such as carbon steel, stainless steel, or galvanized steel; 2) have a lid in place with all bolts, snap rings, clips, or other fastening devices in place; and 3) have been procured per an approved Quality Assurance program. "Approved containers" include 55 gallon steel drums, standard waste boxes (per Waste Isolation Pilot Plant [WIPP] Specification E-I-343, latest revision), ten drum overpacks (per WIPP Specification E-I-430, latest revision), Department of Transportation (DOT) strong tight containers, and DOT Type 7A packages. The WVNSCO Radiation and Safety Committee (R&SC) may also approve other "special containers" as "approved containers" so long as they satisfy the above described requirements.

7.6.5.1 TRUPACT-II Mobile Loading Unit Operations

Off-site shipment of WVDP TRU wastes requires the packaging of these wastes in TRUPACT-II containers using a Mobile Loader Unit (MLU). The TRUPACT-II is a DOT Type B shipping cask on a tractor-pulled trailer. Up to three casks can be placed on a single trailer for transportation. The TRUPACT-II casks are specifically designed for the safe transport of TRU waste from generating sites to the WIPP long-term storage site.

TRU wastes contained in 55-gallon drums that are to be shipped from the WVDP will be relocated to a staging area near the TRUPACT-II casks. In order to load drums of waste into the TRUPACT-II casks, the drums are bundled together into a single payload and lifted by a crane into the casks.

The Mobile Loader Unit (MLU) is an assembly of equipment, housed and transported on a trailer, and specifically designed for performing the loading and unloading operations associated with the TRUPACT-II. This equipment can be used indoors or outdoors depending on the loading area. The MLU is operated in conjunction with a minimum of 5-ton mobile or fixed crane. Drums are staged and a forklift is used to move the drums, fixtures for bundling and lifting the payload. A crane is then used to lift the payload into the TRUPACT-II and then move full TRUPACT-II casks on their trailer.

A payload consists of fourteen 55-gallon drums, two Standard Waste Boxes (SWBs), or a ten-drum overpack. The staging of drums, assembling the payload, and loading of the payloads into the TRUPACT-II casks can be performed on outdoor hardstand areas. During loading operations, no other activities are permitted in the loading area. Furthermore, the application of traffic controls in the area will serve to reduce the likelihood of a vehicle impacting staged drums.

7.6.6 Storage and Disposal Facilities

The Lag Storage Facility, which provides interim storage of WVDP wastes before final off-site disposal, consists of the Lag Storage Building (LSB)(including the Sample Sorting and Packaging Facility [SSPF]), Lag Storage Areas 1, 3, and 4, the LSA-4 Shipping Depot, hardstands, shielded storage vaults, and the Rail Packaging and Staging Area (RPSA), as discussed in following sections. Types of wastes and available storage locations are summarized in Table 7.6-2. The IWSF also serves as a storage facility.

7.6.6.1 Lag Storage Building

The LSB is used primarily for the storage of TRU wastes; however storage is also provided for LLW and LLMW. It protects waste containers from wind and precipitation. The LSB is a pre-engineered metal structure supported by a clear span frame and anchored to a 42.7-m long by 18.3-m wide (140-ft by 60-ft) concrete slab foundation. The eave height of the LSB is 4.8 m (15.7 ft). The siding and roofing are constructed of 26-gauge steel. There are three personnel doors and two metal roll-form slat roll-up doors. A concrete curb encloses the inner perimeter of the LSB. The concrete slab is 25.4 cm (10 in) thick at its high point and slopes downward on all sides to a thickness of 20 cm (8 in). The slab surface was originally coated with an acid-resistant two-coat application of epoxy sealer. The LSB is not heated.

Fire detection and alarm capability in the LSB is documented in FFA-9, *Lag Storage Area - Facility Fire Assessment*. FFA-9 states that the LSB has manual pull stations at each exit and heat detection throughout. As documented in WVNS-FAM-001, *Keltron System Alarm Code Listing and Guidelines*, the activation of fire detection devices or manual pull stations leads to an alarm in the Main Gate House.

TRU waste drums in the LSB are stored on steel pallets and are segregated from other waste containers. Furthermore, administrative controls require that the lids the waste container be secured using a fastening device.

DOE Order 420.1, *Facility Safety*, addresses natural phenomena mitigation design requirements for structures, systems, and components (SSCs). Various DOE Standards are used to implement the design requirements stipulated in DOE Order 420.1A, including DOE-STD-1020-94, *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*, and DOE-STD-1021-93, *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components*. Based upon these guidelines, it has been determined that the LSB should comply with the natural phenomena mitigation design requirements associated with performance category 2, because of the potential for a natural phenomena-induced release of radioactive material. Such a release could occur if the LSB collapsed due to an earthquake or experienced substantial structural damage from high winds. The release of radioactive material could significantly impair certain site functions related to the safety and health of site personnel and could have significant cost and mission impacts.

The LSB meets the design criteria stipulated in DOE-STD-1020-94 for a performance category 2 SSC. Based on design and construction specifications, the LSB is capable of withstanding a snow loading of 1.92 kPa (40 lbs/ft^2), and a wind loading of 0.96-kPa (20-lbs/ft^2), which correlates to a wind speed of approximately 160.9 km/hr (100 mph). Per DOE-STD-1020-94, the seismic design criteria for a performance category 2 facility is an earthquake with a magnitude that corresponds to a return period of once every 1,000 years. Section 3.6.2.9.5 states that a 0.053-g horizontal peak ground acceleration

seismic event corresponds to a frequency of occurrence of 1E-03/yr. Design and construction specifications for the LSB have been reviewed to assess the structural integrity of the LSB under seismic stresses. Evaluation of the LSB determined that the facility will retain structural integrity in the event of a 0.053-g horizontal peak ground acceleration seismic event. Information from other sources such as the Metal Building Manufacturers Association and metal building manufacturers (e.g., Butler Manufacturing Company) reinforce this conclusion, which is consistent with the evaluation for the FRS Building, also a clear span frame metal building.

7.6.6.2 Lag Storage Area-1

LSA-1 is a clear span structure with a pre-engineered frame and fabric enclosure that covers an area of 58 m by 17 m (191 ft by 55 ft) with a height of 7 m (23 ft). The usable area is 51.8 m by 11.3 m by 4.3 m tall (170 ft by 37 ft by 14 ft). The weather structure is constructed using a hot-dipped galvanized steel frame that meets ASTM 123. The fabric is a flame-resistant and self-extinguishing vinyl-coated polyester. The structure will support a snow load of 30 lbs/ft^2 and withstand a design wind velocity of 100 mph. The floor surface of LSA-1 consists of leveled, compacted, fine river gravel, and has been modified to include concrete floor.

7.6.6.3 Lag Storage Area-3

LSA-3 is a clear span structure with a pre-engineered frame and steel sheathing and covers an area of 26.8 m by 88.7 m (88 ft by 291 ft). The usable area is 24.4 m by 86.3 m by 6.7 m tall (80 ft by 283 ft by 22 ft). The structure will support a snow load of 40 lbs/ft^2 and withstand a design wind velocity of 80 mph.

A 15-cm (6-in) high concrete curb encloses the inner perimeter. The thickness of the slab is 18 cm (7 in). LSA-3 may be heated by indirect-fired natural gas furnaces as necessary to reduce the effect of the natural freeze-thaw cycle on waste, thus minimizing the deterioration of containers stored at this location.

7.6.6.4 Lag Storage Area-4

LSA-4 is a clear span structure with a pre-engineered frame and steel sheathing and covers an area of 26.8 m by 88.7 m (88 ft by 291 ft). The usable area is 24.4 m by 86.3 m by 6.7 m tall (80 ft by 283 ft by 22 ft). The structure will support a snow load of 40 lbs/ft^2 and withstand a design wind velocity of 80 mph.

A 15-cm (6-in) high concrete curb encloses the inner perimeter. The thickness of the slab is 18 cm (7 in). LSA-4 may be heated by indirect-fired natural gas furnaces as necessary to reduce the effect of the natural freeze-thaw cycle on waste, thus minimizing the deterioration of containers stored at this location. LSA-4 provides housing for the CSPF described in Section 7.6.2.3.

An enclosed passageway connecting LSA-4 with LSA-3 is approximately 6.1 m (20 ft) wide and 9.1 m (30 ft) long and allows passage of fork trucks between the two buildings without going outside. There is a roll-up door between LSA-4 and the connector.

7.6.6.5 LSA-4 Shipping Depot

The LSA-4 Shipping Depot is attached to the south side of LSA-4 and is designed for loading LLW containers on flat bed trailers for shipment off-site

for disposal. The containment structure is used to sort, repackage, size-reduce, and perform other activities to prepare waste for shipment. The foot print of this facility is approximately 722 m^2 (7,770 ft^2). An office space is provided adjacent to the waste handling area within the depot.

7.6.6.6 Hardstands

The WVDP utilizes several outdoor lay-down areas for the storage of contaminated and uncontaminated bulk equipment; for the temporary storage of high activity wastes removed from process facilities; and for the temporary staging of materials awaiting characterization prior to transfer to a Lag Storage Facility building. These areas typically are provided with a compacted gravel or asphalt base and are generically referred to as hardstands. Hardstand areas at the WVDP are illustrated in Figure 7.5-2.

The site maintains several hardstand areas for the storage or temporary staging of uncontaminated or marginally contaminated materials. These hardstand areas are primarily located south of site processing areas in the general vicinity of the Drum Cell or NRC-Licensed Disposal Area. Equipment stored on these hardstands include expended test equipment, vessels, excess equipment, and similar materials.

Contaminated bulk equipment that is transferred to hardstand areas may contain either fixed external contamination or internal contamination that does not present the potential for release. Contaminated equipment is protected to ensure that residual radioactivity associated with the component will not be released to the environment. These contamination levels have been reduced to meet the requirements of WVDP-010, *WVDP Radiological Controls Manual*, to ensure that the potential for contamination of an area is minimized.

The site also maintains three hardstands that are relied on for the storage or temporary staging of high-activity or fissile-bearing materials. The first of these areas is located north of the FRS building, the second area is in proximity to the CPC-WSA, while the third area lies to the north and west of the Lag Storage Facility buildings.

The hardstand that is identified as the North FRS yard is constrained to the east and north by an access roadway. The CSRF and FRS buildings define the eastern and southern boundaries of the area, which is used primarily for the storage of shielded vaults that contain high-integrity containers filled with spent resin and diatomaceous earth from the FRS water treatment system.

The second identified hardstand is an asphalt paved area surrounding the CPC-WSA. Wastes stored on this hardstand include drums of cement produced during the preoperational testing of the Cement Solidification System. Drums stored on this hardstand are used primarily as shielding to reduce personnel exposure from the radiation associated with equipment stored in the CPC-WSA. In addition, boxes containing vessels and other TRU wastes removed during the decontamination of Extraction Cell 2 are also stored on this hardstand.

The third hardstand area lies north of the Lag Storage Facility buildings and encompasses three relatively discrete hardstand units, which include the LSA-2 hardstand, the Vitrification (Vit) Storage Area, and the Lag hardstand. The Lag Storage hardstand area extends from the north of the Lag Storage Building to the CPC-WSA hardstand and is constrained to the west by a roadway that passes between the Lag Storage Building and the Waste Tank Farm. The eastern boundary of the hardstand is generally defined by a line from the northwest corner of the Lag Storage Annex 3 building to the southeast corner of the CPC-

WSA. Hardstands within this area provide storage for high-activity and fissile-bearing wastes.

Bulk high-activity wastes that are stored on hardstand areas include mobilization and transfer pumps removed from the high-level waste tanks in the Waste Tank Farm. High-activity wastes also include wastes removed from the Vitrification Facility and HEC. External contamination on materials transferred to these shielded vaults are reduced to the greatest extent practicable prior to transfer to the vault.

Fissile-bearing wastes that are temporarily staged in the Lag Storage hardstand area include wastes packaged to meet the criteria of PSR-6, "Fissile Material Packaging and Storage Requirements," although wastes that have been packaged to meet the criteria of PSR-18, "Collection, Processing, and Storage Requirements for Fissile-Bearing Debris," or other criticality safety controls may also be stored in this area. These wastes are staged in the hardstand area pending the results of radiological characterization analyses that will permit transfer to a Lag Storage Facility building. Temporary weather structures are often used to provide protection of these waste containers while the containers are on the hardstand.

The criticality safety of stored or staged fissile-bearing materials on any hardstand is ensured through storage of these waste containers in designated Criticality Control Zones (CCZs) that may be established on a hardstand. Administrative controls associated with CCZs are discussed in Section 8.7.4.2. As stated in Section 8.7.3.4, wastes containing fissile-bearing materials that are packaged under different administrative control criteria are stored in a manner that ensures that interaction between units is critically safe.

The three hardstands discussed above (i.e., the hardstands associated with the North FRS Yard, CPC-WSA, and Lag Storage), which are shown on Figure 7.5-2, may be used to store radioactive wastes that have been characterized as LLW, TRU, HLW-contaminated, or mixed. Storage of non-radioactive hazardous wastes is provided by the Hazardous Waste Storage Facility, which is discussed in Section 7.7.2.1.

7.6.6.7 Pump Storage Vaults

The pump storage vaults are located behind the Lag Storage facility. They are constructed of prefabricated, interlocking modular concrete slabs. The dimensions of each vault are approximately 19 m (63 ft) long, 2.5 m (8 ft) high, and 4.5 m (15 ft) wide, with a wall thickness of 0.6 m (2 ft). The vaults store contaminated mobilization and/or transfer pumps that have been removed from the HLW tanks. In the future, the vaults may be used to store other contaminated equipment, such as vitrification equipment.

7.6.6.8 Rail Packaging and Staging Area

The RPSA is located west of the NDA and east of the rail spur. It is a 61-m by 37-m (200-ft by 120-ft) gravel area on which are placed two concrete pads. One pad (the loading area) is 27 m by 7.3 m (90 ft by 24 ft). The other concrete pad (the Staging Area) is 20 m by 7.3 m (64 ft by 24 ft). Electrical power is provided to the RPSA to support rail shipping activities.

The RPSA is used for preparing gondola cars and bulk containers for LLW packaging. This area also accommodates heavy-capacity fork lifts, cranes, and excavators that are used to place waste into gondola rail cars, sealands, or other bulk containers, and to load containers onto flat rail cars.

This area is also used to stage the massive and heavily shielded overpacks that contain the highly contaminated and extremely radioactive major process components removed during Vitrification Cell dismantlement. The design of the shield container used for storage of the vessel as well as the grout used to fill both the process component and the void space inside the shield container surrounding the component stabilize the contamination and reduce the external package exposure rates to acceptable levels.

7.6.6.9 Interim Waste Storage Facility

The IWSF is a pre-engineered metal structure supported by a clear span frame and anchored to a 10.7 m by 10.7 m (35.25 ft by 35.25 ft) concrete slab foundation. A concrete curb encloses the inner perimeter of the IWSF. The area inside the curb is 10.4 m by 10.4 m (34 ft by 34 ft) on a 20-cm (8-in) thick concrete slab. The siding and roof are constructed of 26-gauge steel. The interior walls and ceiling are equipped with 10-cm (4-in) thick fiberglass insulation with reinforced vinyl facing. The IWSF is heated by two 15-kWh (51,000 BTU) electric heaters to minimize the effects of the natural freeze-thaw cycle. On the northeast corner of the IWSF is a 5-m by 3-m (16-ft by 10-ft), 26-gauge metal lean-to addition that houses the fire suppression equipment, which consists of a high expansion foam system with one 3,300-L/s (7,000-cfm) foam generator. Foam is generated at a rate sufficient to produce a 1.4-m (5.60-ft) deep layer of fire-suppressing foam across the floor of the IWSF in one minute. This system is currently scheduled to be taken out of service.

7.6.6.10 NRC-Licensed Disposal Area

The NDA covers a rectangular area of approximately 20,000 m^2 (5 acres) and is located south of the former reprocessing plant. Reprocessing wastes generated by NFS were disposed of within a U-shaped area along the eastern, northern, and western boundaries of the NDA. There are 239 disposal holes in this area. Two types of holes were used for waste burial: deep holes and special holes. Deep holes are generally 0.8 m by 2 m (32 in by 78 in) in cross section and 15 m to 21 m (50 ft to 70 ft) deep, while the shallower special holes have an average depth of approximately 6 m (20 ft) and were excavated with a variety of surface dimensions.

Disposal of decontamination and decommissioning wastes generated by the WVDP occurred in the unused area within the U-shaped NFS burials. Wastes were placed in trenches, except for disposals in four steel-lined caissons 2 m (7 ft) in diameter and 18 m (60 ft) deep outside the NFS disposals. Each of the holes and trenches were backfilled and capped with soil excavated on-site.

Historically, materials disposed in the NDA were categorized according to the radioactivity of the waste. (Radioactivity information was available in the facility operating logs.) Chemical data, not being required by the operating license, was never generated for the wastes. Consequently, chemical characterization of the waste streams is based upon historical knowledge and other records of site operations. Documentation does indicate, however, that RCRA hazardous constituents (6 NYCRR Part 371, Appendix 23) are associated with some of the materials discarded in the unit.

Liquid waste materials came from the acid fractionator condensate, floor drains in various cells and chemical makeup areas, the analytical laboratory, and from wash solutions from decontamination operations. Immiscible liquids such as the tributyl phosphate (TBP)/n-dodecane used in the extraction process were absorbed in vermiculite and disposed in the NDA.

As a result of all disposal operations, an estimated 417,000 Ci of radioactive material is in the NDA. Approximately 397,000 Ci, or 95% of the total radioactive inventory buried in the NDA, is attributed to fuel hulls and hardware from NFS fuel reprocessing activities.

During WVDP operations, waste was generated from aggressive decontamination of the Main Plant so it could be used to house IRTS component facilities and provide a safe work environment for employees. This phase of operations again generated a large amount of radioactive waste consisting of fuel reprocessing equipment, scrap, and related materials that contain trace levels of decontamination chemicals and chemical residues from past fuel reprocessing operations. Minor volumes of Class A waste from these activities were disposed of in the NDA.

An estimated 10,400 m^3 (367,000 ft^3) of radioactive waste is buried in the NDA. Approximately 4,600 m^3 (162,000 ft^3) of the total quantity was disposed of during NFS operations, and 5,800 m^3 (205,000 ft^3) was disposed of during WVDP operations. In order to characterize the NDA, a summary profile of the waste streams and the percentage by volume that they represent was prepared for inclusion in WVDP-RFI-018, *RCRA Facility Investigation Report*. This profile is included as Table 7.6-3. The quantity of each waste stream is an approximation that is based on the two NDA waste database systems and the operation logs.

The most predominant waste streams by volume in the NDA according to the profile are contaminated soils at 36%, general Main Plant wastes at 20%, and FRS and LLWTF wastes at 14% and 13%, respectively. The combination of these four waste streams constitute almost 83% of the total waste volume disposed in the NDA. The remainder of the wastes consist of decontamination-generated debris, scrap material, and equipment; analytical laboratory wastes; TBP/n-dodecane absorbed onto vermiculite; fuel hulls; fuel canisters; ruptured fuel rods; and lead shielding. Depending upon their source, some of these wastes were isolated in particular areas of the NDA. For instance, the hulls are documented as being buried exclusively in the eastern quadrant of the disposal area in the deep holes.

7.6.6.11 NDA Interceptor Trench Liquid Pretreatment System

An interceptor trench (270 m long) was constructed in order to intercept the subsurface migration of solvent from the NDA towards Erdman Brook and thereby prevent its entry into the surface water system which drains the site. The LPS is designed to reduce solvent and radionuclide content (I-129 in particular) in the trench water for efficient treatment by the LLWTS. Operation of the LPS is determined by the results of the sample analyses taken from Manhole 4 near the north NDA. If solvent is detected in the sample, the effluent will be processed through the LPS. If no solvent is detected, the effluent is processed through the lagoon system. Since construction of the NDA interceptor trench was completed, no solvent has been detected and all effluent collected in the trench has been processed through the lagoon system.

The LPS structure houses a particulate removal filter unit connected in series with two granular activated carbon (GAC) units. The LPS is housed inside a rigid metal weather structure located approximately 100 m (330 ft) north of the Drum Cell (Figure 5.1-1). All vessels and associated piping inside this structure are bermed to contain any leaks or spills.

When approximately 380 L (100 gal) of solvent have accumulated in Tanks D-01 and D-02, this solvent will be pumped from the top of the tanks and transferred to 208-L (55-gal) drums. These drums will be stored in the LPS weather structure or in the IWSF. Secondary containment in the form of two 7.3-m x 7.3-m (24-ft by 24-ft) fixed berms with 60-mil liners are provided for all tanks, GAC units, and associated pumps and pipes. In the event of a leak, each berm is of sufficient capacity to contain 23,019 L (6,100 gal), equal to 120% of the maximum capacity of the largest vessel inside each bermed area.

The pipe from Manhole 4 to the LPS is placed inside a PVC conduit buried below the frost line. The slope is such that any leaks in the primary pipe will flow back to the manhole. Tanks are vented to the atmosphere after HEPA filtration.

Each tank is equipped with liquid-level sensors. The pumps that fill and empty the tanks will shut down automatically upon receiving a high- or low-level signal from the floats inside the tanks. If the level in any of the tanks deviates from normal operating range, indicating a possible pump or sensor malfunction or system leak, local alarms will be activated at preset alarm-high and alarm-low levels, and power to the pumps will be shut off automatically. A loss of power to any of the level controllers will activate the alarm. In addition to automatic controls, power to the pumps can also be shut off manually by the operator.

The weather structure has two space heaters that prevent freezing in winter months.

7.6.6.12 Remote Handled Waste System

As part of current and future work at the WVDP, waste with high dose rates will need to be handled, sorted, size reduced and packaged remotely. The Remote Handled Waste Facility (RHWF) was designed and built to meet this need. This facility has the capability to remotely handle and package wastes with high dose rates. There is also some decontamination capability built into the facility. This decontamination activity required that the RHWF be tied into the Liquid Waste Treatment System for processing liquids generated by the decontamination. The RHWF is located in the northwest corner of the WVDP site, northwest of the Supernatant Treatment System (STS) Building and southwest of the Chemical Process Cell Waste Storage Area (CPC WSA). This facility described in detail in WVNS-SAR-023, *Safety Analysis Report for the Remote Handled Waste Facility.*

7.7 Hazardous and Mixed Wastes

Hazardous wastes generated at the WVDP include nonradioactive solid and liquid hazardous wastes and solid and liquid LLMW. Programs and facilities at the WVDP provide for the safe interim storage of these wastes prior to shipment for off-site treatment and disposal. Some mixed wastes are neutralized on-site and sent to the interceptors. Radioactive mixed wastes (RMW) which cannot be treated either onsite or offsite is identified in the WVDP site treatment plan under the Federal Facility Compliance Act (FFCA).

7.7.1 Characteristics and Volumes of Hazardous and Mixed Wastes

7.7.1.1 Hazardous Wastes

As required, hazardous wastes generated on-site from defined waste streams are accumulated in Satellite Accumulation Areas before transfer to Hazardous Waste

Storage Facilities for storage before off-site shipment. A summary of the quantity of hazardous wastes stored at the WVDP is given in Table 7.2-1.

7.7.1.2 Low-Level Mixed Wastes

Low-level mixed wastes are radioactive wastes that include hazardous components, as described in 40 CFR 261 and 6 NYCRR 371. These wastes, which may be stored RCRA interim status facilities, comprise low-level and TRU wastes of solid or liquid form that contain heavy metals, combustibles, flammables, PCB-contaminated oils, and PCB-contaminated equipment.

A summary of the quantity of LLMW stored at the WVDP is given in Table 7.2-1.

7.7.2 Storage Facilities

Storage for solid or liquid mixed wastes at the WVDP is provided as noted in Table 7.6-2. Hazardous wastes generated throughout the site are temporarily stored at the HWSF before shipment off-site for treatment and disposal. Hazardous waste storage facilities are described below.

7.7.2.1 Hazardous Waste Storage Facility

Four identical free-standing structures (lockers) located northwest of the Lag Storage Building are used for temporary storage of hazardous wastes generated at the WVDP. The hazardous waste lockers are pre-engineered structures containing segregated 1-L bottles through 322-L (85-gal) drums (included bagged waste) of hazardous and nonhazardous wastes. Each locker is 2.4 m by 4.6 m by 2.4 m high (7.9 ft by 15 ft by 7.9 ft) and contains a spill basin beneath a steel grate floor with a capacity of 474 L (125 gal). The lockers have been designed to contain flammable materials and are equipped with fire-suppression devices, remote and local fire alarm systems, explosion-proof electrical components, and explosion-proof vents. Figure 7.5-2 shows location of these lockers.

7.7.2.2 Chemical Process Cell-Waste Storage Area

The CPC-WSA facility consists of a 61 m (200 ft) long by 21 m (70 ft) wide by 9.1 m (30 ft) high arched, 12-gauge, galvanized steel-panel enclosure. The floor of the CPC-WSA is a gravel pad.

The CPC-WSA primarily contains wastes that were generated during the decontamination of the Chemical Processing Cell (CPC), located in the Main Plant. The area contains thirty-five waste storage boxes and forty-five concrete shield module overpacks (i.e., Surepaks). Twenty-two waste storage boxes resulting from the CPC decontamination effort consist of twelve jumper boxes, nine vessel boxes, and one general waste storage box. Several of the jumper boxes stored within shielded modules are expected to contain RCRA characteristic metal wastes. One hundred-fifty jumpers (pipes with special connectors) were loaded into seven inner boxes within the CPC and transferred to the Equipment Decontamination Room (EDR) adjoining the CPC. In the EDR, each inner box was lowered into an outer box (designated as storage boxes J1 through J7 [see Table 7.7-1]) with a prepared liner, then sealed and decontaminated before being moved to the CPC-WSA. General waste from the CPC also was loaded into boxes designated J8 through J12 (see Table 7.7-1). Contact exposure rates were typically 2 R/hr, with one hot spot up to 78 R/hr.

The exterior surfaces of thirteen vessels that had been part of the fuel reprocessing chemical stream in the CPC were steam-cleaned and coated with a clear fixative coating. The vessel internals were inspected with a video

camera and all were found to be clean except for the recycle evaporator, 7C-4 (subsequently loaded into a box designated 7C-4) and the LLW accountability tank, 7D-10 (subsequently loaded into a box designated 7D-10). Both pieces of equipment had a layer of sludge about 0.3-m (1-ft) thick on the bottom. Ten of the vessels were transferred to the EDR and loaded into nine boxes (fabricated of carbon steel) with resultant contact exposure rates ranging from 0.1 R/hr to 110 R/hr. The three condensers, 7E-5, 7E-8, and 3E-1, which were originally planned to go into a vessel box with this designation, were loaded into jumper box J5 instead. Final cleanup resulted in six boxes of general waste being loaded into the carbon steel vessel box designated as 7E-5/7E-8/3E-1.

Following transfer of the twenty-two waste boxes with CPC jumpers, vessels, and debris to the CPC-WSA, the waste boxes with the highest dose rates were covered with shielding to reduce general area exposure rates outside the shield modules to below 15 mR/hr. The CPC-WSA was planned as a temporary storage area for the twenty-two waste boxes. It is north of the waste tank farm and remote from routine traffic, and is within the site's protected and controlled area.

The twenty-two waste storage boxes are surrounded by forty-five concrete hexagonal shield module overpacks (Surepaks) arranged in an oblong circle. These measure 2.06 m (7 ft) across the flats and 3.2 m (10.5 ft) high. To supplement the shielding ability of these overpacks, vertical steel plates were added at select locations, as determined by radiation monitoring, to inhibit streaming. Each shield module contains twenty-one 208-L (55-gal) drums. These drums were filled with either contaminated debris or clean soil, sand, and/or gravel to enhance the shielding capabilities of the overpack. Of the total of 945 drums in the shield modules, 813 drums contain LLW, which has been classified as Class A, B, or C LLW. Of the remaining 132 drums, 128 have been classified as nonradioactive, and 4 are presently unclassified but are assumed to be Class A. Several shield module overpacks contain RMW drums.

In addition to the twenty-two waste storage boxes surrounded by shield modules, nine large waste storage boxes are on the west end of the storage pad and four large waste storage boxes are on the east end. These boxes have external exposure rates ranging from 1 mR/hr to 30 mR/hr.

The entire storage array is covered with a steel weather structure that shields the storage boxes and shield modules from rain and snow. When a remotely controlled size-reduction facility is available, the CPC equipment in the waste boxes will be volume-reduced and packaged for disposal.

Preliminary estimates by Meigs (1987), updated to include activity estimates for waste box J12, indicated 263 Ci of Sr-90, 274 Ci of Cs-137, 6 Ci of Am-241, and 234 Ci total Pu are present in the twenty-two waste boxes. These activity estimates are based on actual container dose rates as measured during the 1985-1987 period. Isotopic distribution is based on a site-specific, reference spent fuel isotope distribution. Table 7.7-1 provides estimates of Cs-137 activity for 1987 as well as estimates of Cs-137 activity decay corrected to the year 1996. Using the following isotopic breakdown for total plutonium, 6.4% Pu-238, 2.1% Pu-239, 1.3% Pu-240, and 90.2% Pu-241, the isotopic activity can be estimated as 15 Ci of Pu-238, 5 Ci of Pu-239, 3 Ci of Pu-240, and 211 Ci of Pu-241.

Based on inventory alone, and in accordance with the methodology presented in DOE-STD-1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23*, the CPC-WSA is a Category 3 nuclear facility. It is postulated that a natural phenomenon-induced accident

involving CPC-WSA radiological materials could lead to "significant localized consequences"; therefore, the final hazard categorization for the CPC-WSA is Category 3.

As indicated previously, a large volume of Class A, Class B, and Class C LLW is in 208-L (55-gal) drums within the shield modules, as well as in the thirteen steel boxes located at the east and west ends of the oblong circle of shield modules. Only a small percentage of these have readings above 25 mR/hr, indicating that the total nuclide activity would not increase the overall facility hazard category (since the twenty-two waste storage boxes are estimated to contain well below Category 2 inventory thresholds).

Before final size-reduction and packaging, some of the containers may need to be moved, in which case the following problems could arise:

- Moving the shield modules may require the removal of the 55-gal drums from the modules. Some drums may have corroded during the storage period to date.
- Radiological hazards must be considered when moving the jumper and vessel storage boxes.
- The size-reduction boxes and special storage boxes outside the shield modules contain radioactive waste that has not been well-characterized.

Before any waste container is moved, a radiation work permit (RWP) and an industrial work permit (IWP) will be prepared to ensure that work will be conducted safely and in accordance with WVDP-010, WVDP-087, *WVDP Hoisting and Rigging Manual*, and ISMS principles.

7.7.3 Operating Procedures

Operating procedures for the handling and storage of hazardous and mixed wastes at the WVDP have been developed per the guidance given in WV-996, *Hazardous Waste Management Program*, WVDP-080, *PCB and PCB Contaminated Materials Management Plan*, WVDP-019, *Annual Waste Management Plan*, and WVDP-370, *WVDP Radioactive Waste Acceptance Program*. These waste management plans have been developed to ensure compliance with the local and federal codes and regulations outlined in Table 7.1-1. Development of facility operating procedures is consistent with the development of other procedures at the WVDP, as discussed in Section 10.4.1.

REFERENCES FOR CHAPTER 7.0

New York State Codes, Rules and Regulations, Title 6. Section 360-1.2(b)(80): *Industrial Waste.*

_____. Section 370: *Hazardous Waste Management System: General.*

_____. Section 371: *Identification and Listing of Hazardous Waste.*

_____. Section 372: *Hazardous Waste Manifest System and Related Standards for Generators, Transporters and Facilities.*

_____. Section 373-1: *Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements.*

_____. Section 373-2: *Final Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage and Disposal Facilities.*

_____. Section 373-3: *Interim Status Standards for Owners and Operators of Hazardous Waste Facilities.*

_____. Section 374: *Standards for the Management of Specific Hazardous Wastes and Specific Types of Hazardous Waste Management Facilities.*

_____. Section 376: *Land Disposal Restrictions.*

U.S. Department of Energy. June, 1982. DOE/EIS-0081: *Final Environmental Impact Statement, Long-Term Management of Liquid High-Level Radioactive Wastes Stored at the Western New York Nuclear Service Center, West Valley.* Table B.16.

_____. February 8, 1990. Change 2 (January 7, 1993). DOE Order 5400.5: *Radiation Protection of the Public and the Environment.* Washington, D.C.

_____. December 1992. Change 1 (September 1997). DOE-STD-1027-92: *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports.* Washington, D.C.

_____. January 15, 1993. DOE Order 450.1: *Environmental Protection Program.* Washington, D.C.

_____. July 1993. Change 1 (January 1996). DOE-STD-1021-93: *Natural Phenomena Hazards Performance Categorization Guidelines for Structures, Systems, and Components.* Washington, D.C.

_____. August 19, 2003. Change 1 (June 3, 2004). DOE Order 231.1A: *Environmental, Safety, and Health Reporting.* Washington, D.C.

_____. October 26, 2000. Change 1 (September 28, 2001). DOE Order 451.1b: *National Environmental Policy Act Compliance Program.* Washington, D.C.

_____. January, 1991. DOE/EH-0173T: *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance.* Washington, D.C.

REFERENCES FOR CHAPTER 7.0
(Continued)

_____. April 1994. Change 1 (January 1996). DOE STD-1020-94: *Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities*. Washington, D.C.

_____. October 13, 1995. Change 3 (November 22, 2000). DOE Order 420.1: *Facility Safety*. Washington, D.C.

_____. January, 1996. DOE/EIS-0226-D: *Draft Environmental Impact Statement for Completion of the West Valley Demonstration Project and Closure or Long-Term Management of Facilities at the Western New York Nuclear Services Center*.

_____. July 9, 1999. DOE Order 435.1: *Radioactive Waste Management*. Washington, D.C.

U.S. Department of Transportation. October 1, 2000. *Other Regulations Relating to Transportation*. 49 CFR Pts. 100 to 178.

U.S. Environmental Protection Agency. July 2001. Code of Federal Regulations. Title 40, Section 61, Subpart H: *National Emission Standards for Hazardous Air Pollutants*. Washington, D.C.

_____. January 1, 2001. Code of Federal Regulations. Title 10, Section 830. *Nuclear Safety Management*.

_____. *Identification and Listing of Hazardous Waste*, 40 CFR 261, as amended.

_____. Code of Federal Regulations. Title 40, Section 260: *Hazardous Waste Management System: General*.

_____. Code of Federal Regulations. Title 40, Section 261.3: *Definition of Hazardous Waste*.

_____. Code of Federal Regulations. Title 40, Section 262: *Standards Applicable to Generators of Hazardous Waste*.

_____. Code of Federal Regulations. Title 40, Section 268: *Land Disposal Restrictions*.

_____. Code of Federal Regulations. Title 40, Section 270: *EPA Administered Permit Programs: The Hazardous Waste Permit Program*.

_____. Code of Federal Regulations. Title 40, Section 761: *Polychlorinated Bi-Phenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions*.

U.S. Nuclear Regulatory Commission. Code of Federal Regulations. Title 10, Section 61: *Licensing Requirements for Land Disposal of Radioactive Waste*.

West Valley Nuclear Services Co. WVDP-010: *WVDP Radiological Controls Manual*. (Latest Revision).

_____. WVDP-011: *WVDP Industrial Hygiene and Safety Manual*. (Latest Revision.) West Valley Nuclear Services Co., Inc.

REFERENCES FOR CHAPTER 7.0
(Concluded)

_____. WVDP-019: *WVDP Long-Term Radioactive Waste Management Plan.* Table 2-3. (Latest Revision).

_____. WVDP-043: *West Valley Demonstration Project Spill Prevention Control and Countermeasure Plan.* (Latest Revision.) West Valley Nuclear Services Co., Inc.

_____. WVDP-080: *PCB and PCB Contaminated Materials Management Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-087: *Waste Minimization/Pollution Prevention Awareness Plan.* (Latest Revision).

_____. WVDP-098: *Environmental Monitoring Program Plan.* (Latest Revision.

_____. WVDP-164: *Used Oil Management Plan.* (Latest Revision.)

_____. WVDP-370: *WVDP Radioactive Waste Acceptance Program.* (Latest Revision.)

_____. *WVDP Radioactive Waste Disposal Records.* WVDP No. 1 to WVDP No. 7, WVDP Caisson No. 1, March 27, 1982 to November 3, 1983.

_____. WV-996: *Hazardous Waste Management Program* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. FFA-9: *Lag Storage Area - Facility Fire Assessment* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-FAM-001: *Keltron System Alarm Code Listing and Guidelines* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. September 1995. *RCRA Facility Investigation Report*, Volume 2: Nuclear Regulatory Commission-Licensed Disposal Area (Rev. 0). WVDP-RFI-018. West Valley, NY: West Valley Nuclear Services Co.

_____. WV-980: *WVDP Environmental Management System* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-072: *Asbestos Management Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-417: *TRU Waste Management Program Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. March 29, 1993. Federal and State Facility Compliance Agreement (FSFCA). *The West Valley Demonstration Project and the Western New York Nuclear Service Center.* Docket No. II, RCRA-93-0207.

_____. August 27, 1996. West Valley Demonstration Project (WVDP). *Federal Facility Compliance Agreement (FFCA).*

TABLE 7.1-1

WASTE MANAGEMENT PLANS, CODES, AND REGULATIONS EMPLOYED AT THE WVDP

WASTE MANAGEMENT PLAN	LOCAL AND FEDERAL CODES AND REGULATIONS
ENVIRONMENTAL MANAGEMENT AND MINIMIZATION OF WASTES	
WV-980 - WVDP Environmental Management System WVDP-087 - Waste Minimization/ Pollution Prevention Awareness Plan	DOE Order 231.1 DOE Order 451.1B DOE Order 450.1 DOE Order 5400.5DOE/EH-0173T 40 CFR, Various sections 6 NYCRR, Various sections
RADIOACTIVE AND MIXED WASTES	
WVDP-019 - Low-Level Waste Management Program Plan WVDP-417 - TRU Waste Management Program Plan	DOE Order 435.1 10 CFR 61 40 CFR 264 40 CFR 265 6 NYCRR 373 Federal and State Facility Compliance Agreement Federal Facility Compliance Act
HAZARDOUS WASTE	
WV-996 - Hazardous Waste Management Program WVDP-080 - PCB and PCB Contaminated Materials Management Plan	40 CFR 261-268 40 CFR 270 6 NYCRR 370-374 6 NYCRR 376
INDUSTRIAL WASTE	
WVDP-072 - WVDP Asbestos Management Plan WVDP-164 - Used Oil Management Plan	

TABLE 7.2-1

TYPICAL INVENTORY OF WASTE STORED AT THE WVDP

Waste Class	Volume or Mass
Low-Level Waste	
Class A	3,762 m^3
Class B	439 m^3
Class C	105 m^3
TRU Waste*	815 m^3
CPC Waste	180 m^3
Contaminated Soil	2,906 m^3
Mixed Waste	300 m^3
Hazardous Waste	1 m^3

TABLE 7.2-2

RADIOLOGICAL CHARACTERISTICS OF HIC CONTENTS

Parameter	HIC "A"(1) (µCi/g)	HIC "B"(2) (µCi/g)	HIC "C"(3) (µCi/g)	HIC "D"(4) (µCi/g)	HIC "E"(5) (µCi/g)	Total Activity(6) (Ci)
Gross α	6.65E-02	3.03E-01	3.49E-02	4.10E-02	6.20E-02	1.62E+00
Gross β	3.37E+01	8.10E+01	3.03E+01	4.24E+01	2.67E+01	6.85E+02
Co-60	-----	1.63E+00	8.37E-02	1.26E-02	3.58E-03	6.04E+00
Sr-90	1.43E+00	6.80E-01	3.36E-01	4.32E-01	7.16E-02	9.43E+00
Cs-137	2.24E+01	6.52E+01	2.97E+01	2.92E+01	2.57E+01	5.51E+02
Pu-238	-----	-----	3.13E-03	3.95E-04	8.74E-05	9.27E-02
Pu-239/240	-----	-----	1.74E-02	2.88E-03	5.90E-04	5.77E-01
Am-241	2.95E-02	5.63E-02	1.56E-02	3.63E-03	1.05E-02	3.70E-01
Total Pu	8.70E-02	9.69E-02	2.05E-02	3.26E-03	6.76E-04	6.67E-01

Notes:

Concentrations based on average of top, middle, bottom samples.

(1) - Ref: Analytical Request Form No. 87-3131. (West Valley Nuclear Services Co. 1987)
(2) - Based on average of top, middle, bottom samples, and analysis from separate sample. Ref: Analytical Request Form Nos. 86-1730 & 87-1113.
(3) - Ref: Analytical Request Form Nos. 9101655, 9101656 & 9101657. (West Valley Nuclear Services Co. 1991)
(4) - Ref: Analytical Request Form Nos. 9203040,9203041 & 9203042 (as amended by memo# IH:93:0044, Adjusted Plutonium Results [West Valley Nuclear Services Co., April 1, 1993]).
(5) - Ref: Analytical Request Form Nos. 96-0485, 96-0486 & 96-0487. (West Valley Nuclear Services Co. 1996)
(6) - Based on the sum of activity from all HICs and an assumed mass of sludge of 3.2E+6 g per HIC. Total Co-60 activity based on an estimated concentration of Co-60 in HIC "A." Estimate determined from Cs-137 concentration in HIC "A" and average of Co-60:Cs-137 ratios in HICs "B" through "E." Total Pu-238 and Pu-239/240 activities based on estimated concentrations of Pu-238 and Pu-239/240 in HICs "A" and "B." Estimates determined from total Pu concentration in respective HIC (A or B) and average of Pu isotopic: Total Pu ratios in HICs "C" through "E."

TABLE 7.4-1

VESSELS VENTILATED BY THE VESSEL OFF-GAS SYSTEM

Vessel	Description	Cell[1]	Reference Drawing
3D-2	Condensate Catch Tank	LWC	3R-A-1
7D-2	LL Waste Evap Feed Tank	LWC	7R-A-1
7D-8	Tank 6D-3 Overflow Receiver	LWC	7R-A-1
7D-14	Hot Anal Cell Drain Catch Tank	LWC	7R-A-1
13D-7	Solvent Waste Catch Tank	LWC	15R-A-6
13D-8	Solvent Waste Hold Tank	LWC	15R-A-6
4D-8	Empty/OOS - still negative	LWC	15R-A-6
4D-10	Empty/OOS - still negative	LWC	15R-A-6
4D-13	Empty/OOS - still negative	LWC	15R-A-6
6D-3	Catch Tank	OGC	6R-A-1
6D-6	Catch Tank	OGC	6R-A-1
7D-13	CSS Sump Receiver	Yard	901D-021S2
5D-12A	Empty/OOS - still negative	PPC	5R-A-1
5D-12B	Empty/OOS - still negative	PPC	5R-A-1
5D-13A	Empty/OOS - still negative	PPC	5R-A-1
5D-13B	Empty/OOS - still negative	PPC	5R-A-1
5D-13C	Empty/OOS - still negative	PPC	5R-A-1
5V-1	Empty/OOS - still negative	ULO	5R-A-1
7D-3	Empty/OOS - still negative	ARC	7R-A-2
7E-10	Empty/OOS - still negative	AR-OG roof	7R-A-2
7D-11	Empty/OOS - still negative	HAC	7R-A-2
7D-12	Empty/OOS - still negative	HAC	7R-A-2
7E-13	Empty/OOS - still negative	ARC	7R-A-2

TABLE 7.4-1
(Concluded)
VESSELS VENTILATED BY THE VESSEL OFF-GAS SYSTEM

Vessel	Description	Cell[1]	Reference Drawing
LWTS System Vessels			
71C-004	Evaporator/Condenser	XC-3	901D-022
71D-005	Distillate Surge Tank	XC-3	901D-022
71D-006	Spent Resin Tank	XC-3	901D-026
71D-007	Spent Zeolite Tank	XC-3	901D-026
71D-008	Filter Backwash Filter Tank	XC-3	901D-026
71D-009	Feed Sample Tank	XC-3	901D-022
71D-011	Low TDS Feed Tank	XC-3	901D-023S2
71V-010	Filter	XC-3	901D-023S1
5D-15A1	Evap Concentrates	UPC	5R-A-1
5D-15A2	Evap Concentrates	UPC	5R-A-1
5D-15B	LWTS Evap Feed Tank	UPC	5R-A-1
14D-7	Acid Add Tank	LXA	901D-059
14D-18	Caustic Add Tank	LXA	901D-059

NOTE:

[1] Tanks in XC-1 are out-of-service (OOS) and have been flushed with decontamination solutions (Riethmiller 1981); however, the VOG still provides negative pressure on the vent lines to these tanks. A summary of equipment in XC-1 is presented in Table 5.2-9.

TABLE 7.5-1

LLWTS EFFLUENT ISOTOPIC CONCENTRATIONS
TEN-YEAR AVERAGE

ISOTOPE	10-Year Average Lagoon 3 Conc.[1] (µCi/mL)
Alpha	2.07E-8
Beta	5.98E-7
H-3	1.21E-5
C-14	1.52E-8
Sr-90+[2]	1.34E-7
I-129	3.45E-9
Cs-137+[2]	6.93E-8
U-233/234	6.84E-9
U-235/236	2.29E-10
U-238	3.89E-9
Pu-238	3.38E-10
Pu-239/240	1.60E-10
Am-241	1.72E-10

Notes:

1 Based on ten-year average of Lagoon 3 concentrations compiled from WVNSCO Annual Site Environmental Reports, Calendar Years 1993-2003, Table C-2.
2 '+' indicates tabulated activity is the sum of the parent activity and the daughter activity.

TABLE 7.6-1

ESTIMATED AVERAGE RADIOLOGICAL INVENTORY OF LAG STORAGE WASTE CONTAINERS[1]

Nuclide	Drum Contents (Ci)	Box Contents (Ci)
Am-241	6.12E-05	1.10E-03
Am-242	4.70E-07	8.45E-06
Am-242m	4.72E-07	8.48E-06
Am-243	2.80E-06	5.04E-05
Ba-137m	9.07E-08	1.63E-06
C-14	7.69E-08	1.38E-06
Ce-144	3.79E-11	6.81E-10
Cm-242	3.85E-07	6.91E-06
Cm-243	1.52E-08	2.72E-07
Cm-244	8.92E-06	1.60E-04
Cm-245	1.36E-09	2.44E-08
Cm-246	2.14E-10	3.84E-09
Co-60	1.37E-05	2.45E-04
Cs-134	1.47E-06	2.65E-05
Cs-135	9.07E-08	1.63E-06
Cs-137	3.86E-03	6.94E-02
Eu-152	1.93E-07	3.47E-06
Eu-154	4.55E-05	8.18E-04
Eu-155	5.55E-06	9.97E-05
Fe-55	1.88E-07	3.37E-06
Nb-93m	1.08E-07	1.94E-06
Ni-59	5.57E-08	1.00E-06
Ni-63	4.73E-06	8.51E-05
Np-237	1.47E-08	2.65E-07
Np-239	2.80E-06	5.04E-05
Pd-107	7.44E-10	1.34E-08
Pm-147	3.67E-05	6.60E-04
Pr-144	3.79E-11	6.81E-10
Pu-238	2.06E-02	3.70E-01

TABLE 7.6-1
(Concluded)
ESTIMATED AVERAGE RADIOLOGICAL INVENTORY OF LAG STORAGE WASTE CONTAINERS[1]

Nuclide	Drum Contents (Ci)	Box Contents (Ci)
Pu-239	4.96E-03	4.58E-02
Pu-240	4.02E-03	7.21E-02
Pu-241	1.87E-01	1.72E+00
Pu-242	5.26E-06	9.46E-05
Rh-106	1.27E-09	2.28E-08
Ru-106	1.27E-09	2.28E-08
Sb-125	6.07E-07	1.09E-05
Sb-126m	2.44E-08	4.39E-07
Se-79	2.26E-08	4.07E-07
Sm-151	1.15E-04	2.07E-03
Sn-126	2.44E-08	4.39E-07
Sr-90	3.58E-03	6.42E-02
Tc-99	9.52E-07	1.71E-05
Te-125m	1.40E-07	2.52E-06
U-232	8.78E-05	8.12E-04
U-233	1.23E-04	1.14E-03
U-234	6.25E-05	1.12E-03
U-235	1.31E-06	1.21E-05
U-236	3.90E-06	3.61E-05
U-238	1.11E-05	1.02E-04
Y-90	3.58E-03	6.42E-02
Zr-93	1.38E-07	2.49E-06

Note:

(1) Average inventory was estimated based upon WVNSCO' LAG Storage database using the dose-to-curie method and an assumed radionuclide distribution from "Estimation of Activity in the Former Nuclear Fuel Services Reprocessing Plant" J.C. Wolniewicz, March 1993.

TABLE 7.6-2

WASTE TYPE AND AVAILABLE STORAGE LOCATIONS IN WVDP STORAGE FACILITIES

Waste Type	Lag	LSA-1	LSA-3	LSA-4	IWSF	HWSF	SAA	Hardstands	NDA	CPC-WSA
Low-level	X	X	X	X	X			X	X	X
Transuranic	X	X	X	X				X	X	X*
Suspect Transuranic	X	X	X	X				X		X
Mixed	X	X	X	X	X			X	X	X
Liquids	X	X	X	X	X			X	X	
Hazardous						X	X		X	
Poly overpacks, Poly wrapped equipment, Oversized containers	X	X	X	X				X	X	
Equipment contaminated with HLW residue	X	X	X	X				X	X	X

* Includes suspect TRU Waste

TABLE 7.6-3

NDA WASTE DISPOSAL SUMMARY PROFILE

CATEGORY	NFS-162,000 ft^3		WVNS-205,000 ft^3	MAXIMUM POTENTIAL TOTAL *	APPROXIMATE % OF TOTAL DISPOSAL BY VOLUME	GENERAL LOCATION OF BURIAL
	1966-1975	1976-1981	1982-1986			
Hulls	7,403	0	0	7,403	2%	Southeast Quadrant
Culligans, FRS, Filters	18,002	35,718	1,220	54,940	14%	Throughout NDA, but more predominant in Southeast Quadrant
Solvent-contaminated Materials	4,302	711	367***	5,830	1%	North Boundary Section
LLWTF Sludge	1,384	39,299	12,852	53,535	13%	
HLW and General Process Building Waste	9,093	11,319	56,696	77,108	20%	
Fuel	39	0	0	39	<.01%	Holes 48 & 102-Northeast Quadrant
Contaminated Soils	40,830	1,172	103,305	145,307	36%	North Boundary Section
Scrap, Junk, Debris	4,080	11,588	11,597	27,265	6%	
Analytical	722	321	390	1,433	<1%	
Fuel Canisters	28	7,506	3,780	11,314	3%	Holes 88, 89, 90, and WVDP-11
Lead	4	7,601**	9	7,614	2%	SH-105 and WVDP-8
Miscellaneous	N/A	N/A	10,523	10,523	3%	

(WVDP-RFI-018, Rev. 0)

* Maximum potential disposal of targeted waste streams (will not equal the total amount disposed).
** This quantity is based on the total amount disposed of in SH-105 as the specific quantity for lead was not given. Thought to be very high
*** There was a discrepancy between two different tracking databases; therefore this quantity represents the worst case scenario.
FRS - Fuel receiving and storage
HLW - High-level waste

TABLE 7.7-1

CPC-WSA[1] INVENTORY

Storage Box Designation	Contents	Contents of Box WT lbs/(kg)	Average Exposure Rate mR/hr	Activity: Cs-137 Ci (Ci)[6]	Fissile Mass (U-235 equivalent) Grams (Estimated)
Twelve Jumper Storage Boxes (double boxed)					
J1[2]	Jumpers and metallic debris		157	1.96 (1.59)	3.507
J2	Jumpers and metallic debris		1,378	17.23 (14.01)	30.831
J3	Jumpers and metallic debris		1,680	21.00[3] (17.08)	37.577
J4[2]	Jumpers and metallic debris		196	2.45 (1.9)	4.384
J5[2]	Jumpers, metallic debris, three condensers (7E-5, 7E-8, and 3E-1)		326	4.08 (3.32)	7.301
J6[2]	Jumpers and metallic debris		226	2.82 (2.29)	5.046
J7[2]	Jumpers and metallic debris		266	3.33 (2.71)	5.959
J8[2]	Metallic debris		329	4.11 (3.34)	7.354
J9[2]	Metallic debris		1,057	13.20 (10.73)	23.619
J10[2]	Metallic debris		1,550	19.36 (15.74)	34.641
J11	Metallic debris		2,034	25.39 (20.65)	45.431
J12	Debris		2,360	29.50 (23.99)	52.785
Nine Vessel Storage Boxes					
3C-1	Fuel dissolver	26,015 (11,800)	2,634	32.93[4] (26.78)	58.925
3C-2	Fuel dissolver	26,015 (11,800)	2,854	35.67[4] (29.01)	63.828
7C-2[2]	LLW Evaporator	14,110 (6,400)	120	1.50 (1.22)	2.684
3E-2/ 3E-3	Dissolver Condensers	14,991 (6,800)	42	0.53 (0.43)	0.948
7C-4[2]	LLW Evaporator	9,921 (4,500)	98	1.23 (1.00)	2.201
7D-10[2]	LLW Accountability and Neutralizer Tank	9,921 (4,500)	47	0.59 (0.48)	1.056
7C-1[2]	HLW Evaporator	5,512 (2,500)	1,239	15.49 (12.60)	27.718
3D-1	Fuel Accountability and Feed Adjustment Tank	10,582 (4,800)	250	3.13 (2.55)	5.601
7D-4[2]	HLW Accountability and Neutralizer Tank	5,952 (2,700)	743	9.29 (7.55)	16.624
One General Waste Storage Box					
7E-5/ 7E-8/ 3E-1	Six 44" x 44" (1.12 m x 1.12 m^2 x 1.12 m) boxes full of general waste	2,800 (1,273)	2,360	29.50 (23.99)	52.785
TOTALS				**274.29 (222.96)**	**490.81**

1 *Based on information in memo HB:86:0161, R. Keel and R. Meigs to P. Valenti, November 5, 1986*

2 *These containers contained no equipment that was used to process fissile materials. Cs-137 inventory is due to HLW, so a spent fuel distribution conservatively overestimates fissile content.*

3 *78 R/hr hot spot was assumed to be a short line source.*

4 *7 Ci of Co-60 is assumed as a contributor to the dose rate. It was not included since it is not from the fission product inventory.*

5 *Estimated activity 1987.*

6 *Activity decay corrected to 1996.*

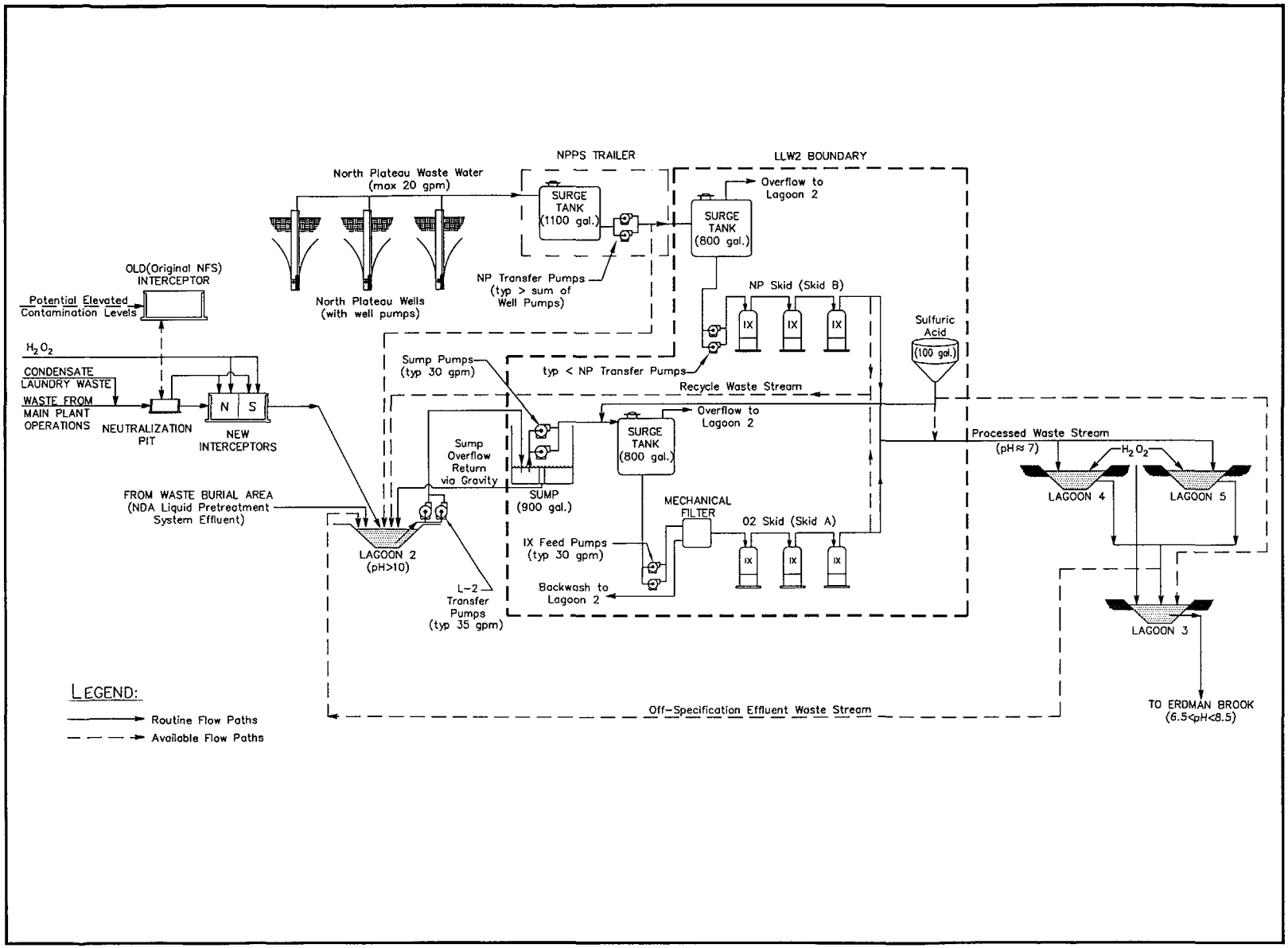


Figure 7.5-1 Flow Diagram of Low-Level Waste Treatment System.

N:\39399976.06354\CAD\SarRev10\Chapter_07\04Sr1- 7-5-1

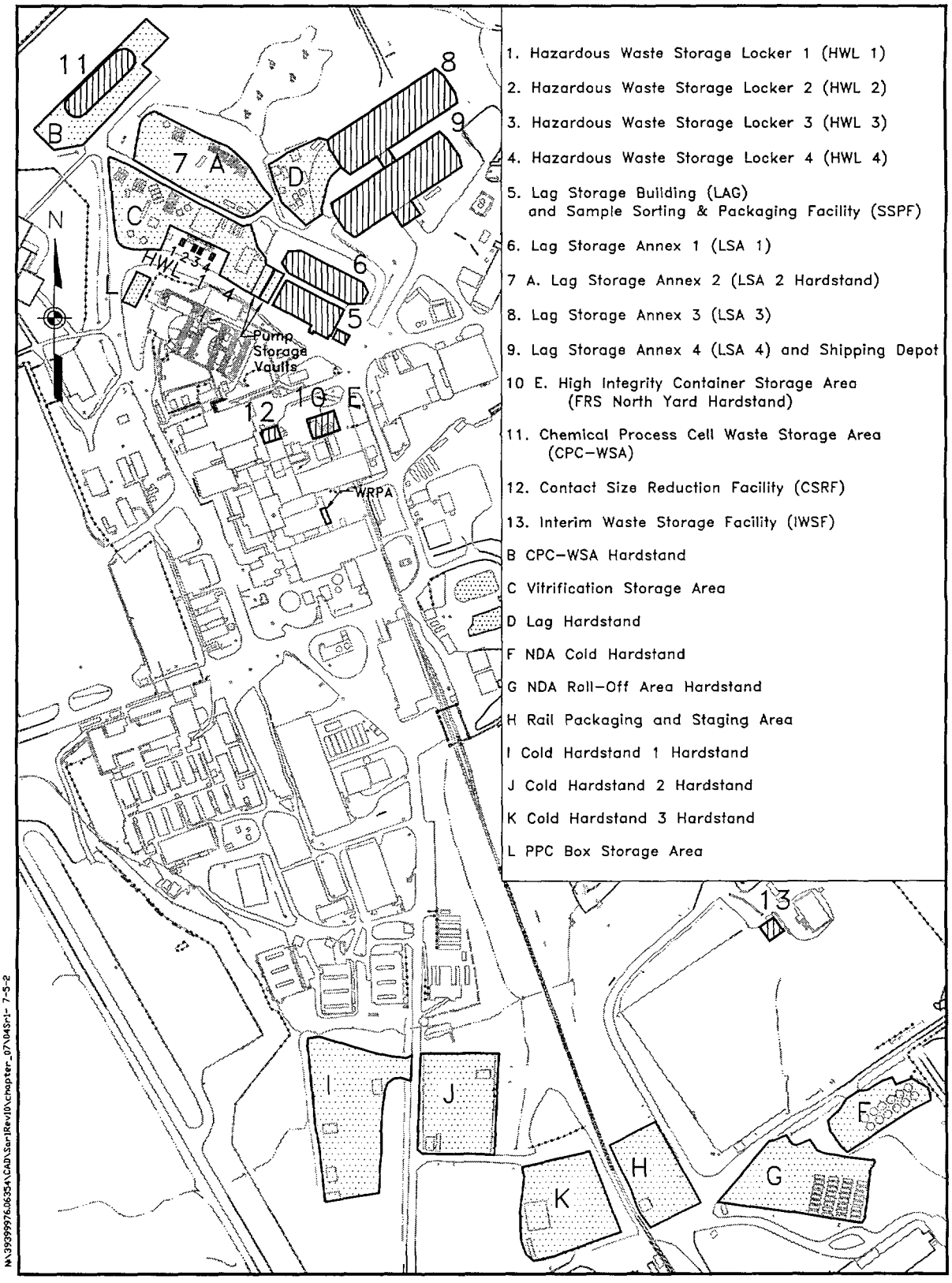


Figure 7.5-2 Location of Waste Storage and Processing Facilities

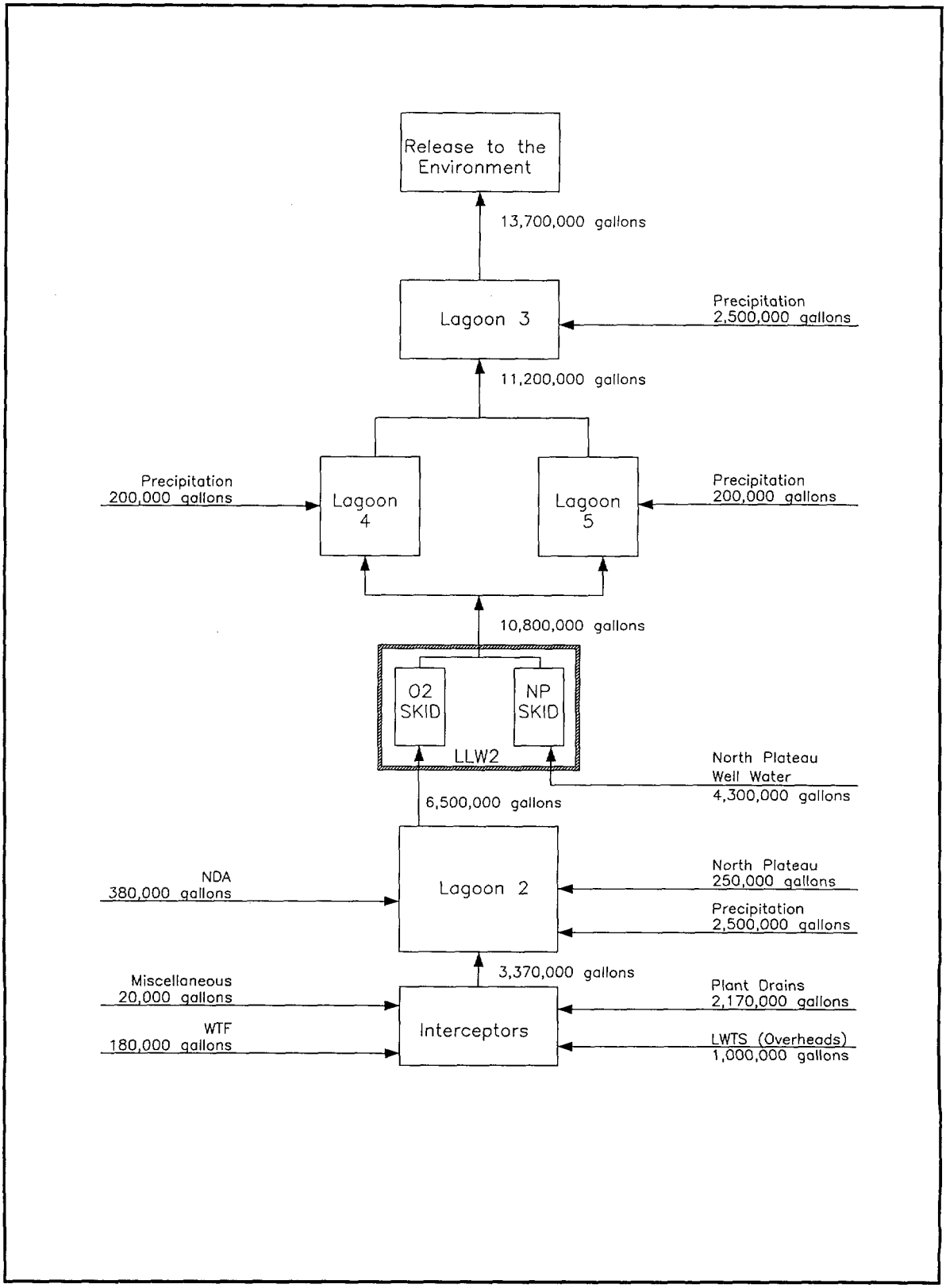


Figure 7.5-3 Estimated Annual Water Balance for LLWTS for CY–2002.

8.0 HAZARDS PROTECTION

This chapter identifies hazards associated with the operation of the West Valley Demonstration Project (WVDP); design features and programs that are in place to ensure that workers and the public are adequately protected from those hazards; an occupational and off-site receptor dose assessment; and a discussion on ensuring that exposures to radiological and hazardous materials are kept as-low-as-reasonably-achievable (ALARA).

8.1 Assuring that Occupational Hazards Exposures Are ALARA

8.1.1 Policy Considerations

A formal documented program directed toward maintaining personnel radiation doses ALARA has been established in West Valley Nuclear Services Company (WVNSCO) Policy and Procedure WV-984, *ALARA Program*. The ALARA program is based on radiation protection requirements set forth in DOE Order 5400.5, *Radiation Protection of the Public and the Environment*, 10 CFR 835, *Occupational Radiation Protection*, and DOE-STD-1098-99, *DOE Radiological Control Standard*. Guidance provided in DOE G 441.1-2, *Occupational ALARA Program Guide*, and DOE Publication PNL-6577, *Health Physics Manual of Good Practices for Reducing Radiation Exposure Levels that are As Low As Reasonably Achievable*, has also been implemented in the ALARA program. The radiation protection program and the ALARA program site-specific requirements are outlined in WVDP-010, *WVDP Radiological Controls Manual*; WVDP-076, *Environmental Protection Implementation Plan*; and WVDP-163, *WVDP ALARA Program Manual*. WVDP-163 is the implementing document for both the occupational and environmental ALARA programs. Standard operating procedures, work instructions, radiation work permits (RWPs), and departmental procedures are used to provide more detailed instructions for workers and technical personnel.

The WVDP ALARA program includes formal plans and measures for applying the ALARA process to occupational and environmental exposures from radiation and radioactive materials, and establishes annual radiological performance goals, work conduct and design requirements, and ALARA training requirements. The annual radiological performance goals include dose, contamination, and waste reduction objectives. Progress toward meeting the goals is reported to management quarterly, with annual summary reports presenting the accomplishments from the previous year and establishing goals and corresponding activities for the following year. The formal ALARA program and its implementation is the subject of quarterly Radiation and Safety Committee reviews, per WV-906, *Radiation and Safety Committee*.

In addition to radiation protection programs, the WVDP has established a comprehensive Industrial Hygiene and Safety (IH&S) program for the identification, assessment, and monitoring of nonradiological hazards. Administration of the IH&S program is through WVDP-011, *WVDP Industrial Hygiene and Safety Manual*, which incorporates the requirements of DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*, as well as the DOE-adopted Occupational Safety and Health Administration (OSHA) standards 29 CFR 1910, *Occupational Safety and Health Standards*, and 29 CFR 1926, *Safety and Health Regulations for Construction*. As required by DOE P 450.4, *Safety Management System Policy*, WVNSCO systematically integrates safety into management and work practices at all levels via an Integrated Safety Management System (ISMS). The ISMS is discussed in detail in Chapter 10.

8.1.2 Design Considerations

Design requirements contained in 10 CFR 835 and DOE-STD-1098-99 have been implemented at the WVDP. Design reviews are conducted with ALARA principles incorporated into design documents (i.e., design bases and drawings), where

applicable. Requirements for ALARA design reviews are provided in WVDP-010, *WVDP Radiological Controls Manual*, WV-984, *ALARA Program*, and WVDP-163, *WVDP ALARA Program Manual*.

The primary consideration in maintaining radiation and hazardous material exposures ALARA is ensuring that positive control of these materials is maintained. Design features that ensure the confinement of radioactivity and radioactive materials to achieve exposure level objectives include the following:

- pressure differentials are maintained between confinement zones, and between confinement zones and the outside atmosphere, to ensure that air flow is from areas of lesser potential for contamination to areas of greater potential for contamination.
- remote valving and instrumentation are used for vessels and components containing radioactive sources.
- ventilation filtration systems ensure that effluent air streams are decontaminated before being discharged through a stack to the atmosphere.
- highly radioactive materials are shielded to reduce exposure rates to acceptable levels.
- remote-indicating radiological instrumentation is used to provide verification that operations are occurring within design limits.
- liquid spills drain to a sump, from which they are routed for further processing.
- high activity radioactive liquids are transported outside of confinements via double-walled piping that contains instruments to detect any leakage from the primary piping to the encasement piping.
- radioactive liquids are processed in vessels that are vented in a controlled manner.
- shield walls, shield windows, and administrative controls are used to reduce the radiological dose to operators.

Additional mitigative measures provided by design include:

- use of redundancy in primary ventilation components.
- providing central control panels to permit remote operation of all essential instrumentation and controls from the lowest radiation zone practicable;
- airlocks that assist ventilation systems in maintaining contamination under negative pressure.
- use of solid-state electronic instrumentation and control equipment to provide high reliability.
- use of redundant equipment, sensors and controls in critical aspects of operations.
- equipment designed to enable remote replacement of failed components, if necessary.
- use of Closed Circuit Television (CCTV) to provide a clear and unobstructed view of critical areas.

Design features that ensure that exposures to nonradiological hazardous materials are maintained ALARA include:

- specially designed facilities in the New Warehouse (Main 2) that provide storage and isolation of bulk quantities of reactive chemicals.
- laboratory fume hoods that prevent occupational exposure to analytical reagents.

- paint spray booths that prevent exposure of maintenance personnel to berms, sumps, and other spill containment mechanisms.

8.1.2.1 General Design Considerations for Maintaining Exposures ALARA

General design considerations and methods employed to maintain radiation doses ALARA, as required by WVDP-010, WV-984, and WVDP-163, are as follows:

- Measures are taken to maintain radiation exposure in controlled areas ALARA through physical design features and administrative controls. The primary methods used are physical design features (e.g., confinement, ventilation, remote handling, and shielding). Administrative controls are employed only as supplemental methods to control radiation exposure;
- For specific activities where use of physical design features are demonstrated to be impractical, administrative controls are used to maintain radiation exposures ALARA;
- Radiation and airborne radioactivity levels are minimized in routinely occupied areas and in the vicinity of equipment expected to require the attention of individuals;
- Whole body radiation doses of personnel are maintained below either 500 mrem per year and ALARA for most general employees or 1,500 mrem and ALARA for select operations personnel based on planned radiological activities; and
- Exposure rates to radiological workers are maintained less than 0.25 mrem per hour in full-time occupied areas (2000 hours per year) and ALARA and, where occupancy differs from the above, exposure rates to workers are maintained less than 500 mrem per year per individual and ALARA.

8.1.2.2 Equipment Design Considerations for ALARA

Equipment design considerations to minimize personnel time in radiation areas include:

- Incorporating design features and constructing equipment, components, and materials to reduce the need for repair or preventive maintenance;
- Providing maintenance and repair convenience (including easy disassembly and the use of modular components) so that repairs can be made in areas with lower radiation levels;
- Remotely or mechanically operating, repairing, servicing, monitoring, and inspecting equipment where practicable;
- Selecting materials that facilitate operations, maintenance, decontamination, and decommissioning.

8.1.2.3 Facility Layout Design Considerations for ALARA

Optimization methods are used to ensure that occupational exposure is maintained ALARA in developing and justifying facility design and physical controls in accordance with 10 CFR 835, *Occupational Radiation Protection*. Facility design considerations to minimize the amount of time personnel spend in radiation areas, as required by WVDP-010, WVDP-984, and WVDP-163, include:

- Locating equipment and instruments that require routine maintenance, calibration, operation, or inspection in easily accessible areas in order to minimize the amount of time needed to perform those operations;
- Separating radioactive or potentially radioactive equipment from nonradioactive equipment;

- Providing for the transportation of equipment components requiring service to areas with lower radiation levels;
- Separating radiation sources from occupied areas (e.g., designing facilities so that pipes and ducts containing potentially radioactive materials do not pass through normally occupied areas);
- Providing adequate shielding between radiation sources and access and service areas;
- Providing means for controlling contamination and airborne radioactivity by proper design of the ventilation system (i.e., designing air flow rate, velocity, and flow patterns for maximum confinement efficiency); and
- Designing surfaces subject to possible contamination so that they are free of crevices and sharp edges, and coating them to facilitate decontamination.

8.1.3 Operational Considerations

In accordance with the policy contained in WV-984 and consistent with 10 CFR 835, DOE Guide 441.1-2, and DOE/PNL-6577, radiation exposure to plant personnel is kept ALARA by the facility design, continued review of operations and training, and the functioning of the Radiation Protection organization. Administrative and procedural control is maintained in accordance with WVDP-011, WVDP-010, and specific standard operating procedures and work instructions. In addition to planning, training, and monitoring all activities related to radiation exposure of personnel, some of the ALARA techniques used to reduce exposures are listed below.

- Work is performed outside radiation areas to the extent practicable.
- Entry and exit points are located in areas where dose rates are as low as practicable.
- Shielding is used whenever possible. Temporary shielding is also used for operations near radiation sources.
- Work is preplanned when it involves whole-body exposure to high levels of radiation or contamination. This ensures expeditious performance in a safe manner and with minimum personnel exposure.
- When required, protective clothing and respiratory equipment are worn for radiological protection and selected to minimize the discomfort of workers, so that efficiency is maintained and less time is spent in radiation areas.
- Workers entering radiation areas where significant doses could be received wear self-reading or electronic dosimeters so that they can determine their accumulated exposure at any time while on the job.
- Areas with potential for significant loose contamination or airborne radioactivity are isolated by air locks and/or airflow control to prevent inhalation of contamination and the potential for the spread of contamination.

8.1.4 Defense-In-Depth

The design of facilities provides defense-in-depth for public and worker safety during normal, off-normal, and accident conditions. Defense-in-depth, as an approach to facility safety, has extensive precedent in nuclear safety philosophy. Defense-in-depth entails the concept that layers of defense are provided against the release of radiological and hazardous materials such that no one layer by itself, no matter how good, is completely relied upon. This philosophy is a fundamental approach to hazard control for nonreactor nuclear facilities, even though nonreactor nuclear facilities generally do not possess the same magnitude of accident potential associated with nuclear power plants.

In keeping with the graded approach concept, no requirement to demonstrate a generic, minimum number of layers of defense-in-depth exists. However, defining defense-in-depth is important for determining a safety basis. As defined in DOE-STD-3009-94, a safety basis is "the combination of information relating to the control of hazards at a facility (including design, engineering analyses, and administrative controls) upon which DOE depends for its conclusion that activities at the facility can be conducted safely."

Typical layers of defense for a facility are given below in order of relative importance:

- Passive confinement barriers;
- Wasteform and limited inventory;
- Active confinement barriers; and
- Alarms and monitors.

These features are discussed in Chapters 4, 5, 6, 10, and 11 of this SAR. Aspects of these defense-in-depth features are summarized in the following subsections as they relate to the Vitrification Facility (VF). Though the VF no longer vitrifies liquid high-level waste (HLW) (or receives HLW from Tank 8D-2), there exists a substantial amount of contamination in the Vitrification Cell.

8.1.4.1 Passive Confinement Barriers

Passive confinement barriers include the Vitrification Cell, Crane Maintenance Room (CMR), and Transfer Tunnel walls, floors, doors, roofs, and shield windows.

Releases to the environment can reasonably be expected to be very small, if not negligible, during all accident conditions and especially during natural phenomena induced accident conditions due to the fact that the Secondary Filter Room, Heating, Ventilation Operating Station (HVOS), Diesel Generator Room (DGR), and the associated controls and equipment of these rooms are designed to withstand extreme natural phenomena events.

The stainless steel lined process pit and sumps provide corrosion resistance capability to provide long-term confinement of process liquids within the Vitrification Cell.

8.1.4.2 Wasteform and Limited Inventory

The 275 canisters of vitrified HLW that were produced by the vitrification campaign are designed to limit release to the environment for tens of thousands of years in a repository environment. Hence, solidified borosilicate glass represents only a small potential hazard to the environment while in interim storage in the high-level waste interim storage (HLWIS) area.

8.1.4.3 Active Confinement Barriers

The HVAC system that services the Vitrification Cell (described in Chapter 5) creates negative internal pressure (relative to atmospheric pressure) within the Vitrification Cell. Continued operation of the Vitrification Cell HVAC system during and after a DBE event is expected because the HVOS, controls, blowers, filter units, Uninterruptible Power Supply (UPS), and associated stand-by diesel generator are DBE qualified.

The Vitrification Building HVAC has parallel (fully redundant) high efficiency particulate air (HEPA) filter trains (including suction blowers), so more than one train must be damaged before HEPA filtration capability is no longer available.

Even though unlikely to occur, damaged or breached HEPA filters offer some particulate removal capability since air passing through the un-breached portion of the filter is filtered. The 01-14 Building off-gas suction blowers are not DBE qualified, but are backed up with stand-by diesel power. Thus, if the system survives the accident conditions, site power is not essential to resume the Process Off-Gas system.

There are three UPSs located in the Vitrification Building that provide power to several important components, instruments, and control systems in the event of loss of off-site power and stand-by power. These components, instruments, and control systems are discussed in Chapter 5.

The Vitrification Cell, Equipment Decontamination Room (EDR), and HLWIS area do not have automatic Fire Protection systems installed due to the lack of flammable materials present in them. All other work areas are protected by automatic Fire Protection systems as discussed in Section 5.3. This helps to ensure that fires are detected and controlled before they do significant damage.

A DBE-qualified High Pressure Air system is provided to position critical HVAC dampers and valves if loss of the Instrument Air system occurs. The ability to cross-tie utility and instrument air manifolds is also provided to give maximum recovery capability during off-normal plant conditions.

8.1.4.4 Alarms and Monitors

The monitoring and alarm systems for the VF are backed up by UPS until stand-by power or off-site power can be recovered. Area Radiation Monitors (ARMs) and Continuous Air Monitors (CAMs) are placed at strategic locations throughout the VF to warn operators of elevated radiation and airborne contamination levels. Outputs from these monitors are continually recorded by a dedicated database computer. Leakage is monitored by level monitoring sensors, conductivity probes, radiation monitors, and visual inspection (through cell shielded windows and utilizing CCTV cameras).

8.2 Sources of Hazards

Spent nuclear fuel (SNF) reprocessing operations at the former Nuclear Fuel Services (NFS) facility generated reprocessing wastes and contamination, including High-level, Transuranic, and Low-level wastes in various operating systems, buildings, nearby land, and structural storage areas. While many of the shorter-lived radionuclides from the SNF have decayed, radiation sources are currently present in various operating systems and facilities at the WVDP that stem from the longer-lived radionuclides from reprocessed SNF.

Radiological hazards at the WVDP are either contained (i.e., within process vessels and piping) or airborne. Shielding is the major protective means for contained hazards, while ventilation is used to control exposures from airborne materials.

8.2.1 Contained Sources

8.2.1.1 Radioactive Material Sources

The Main Plant currently provides facilities to house components of the IRTS and VF, and also provides confinement for contamination remaining from fuel reprocessing operations. The High-Level Waste Interim Storage (HLWIS) area, which provides vitrification canister storage, is located in the former Chemical Process Cell (CPC) and is described in Section 6.2.10.3. Radiation sources in the plant include radioactive process solutions in vessels, high activity decontamination wastes

stored in drums in rack locations in the HLWIS, and radioactive particulate contamination associated with ventilation system filters.

Contamination in Vitrification Facility and Main Plant cells presents an additional source of radiation. Radioactive debris and residual process solution sludges comprise the major sources of radioactivity in these areas. Decontamination of highly contaminated plant cells and process equipment, which has been initiated, will reduce the sources in these areas. The Process Mechanical Cell (PMC) and General Purpose Cell (GPC) contained a significant amount of high activity wastes and have been largely decontaminated. Nuclides in these wastes include fission products, activation products, transuranics (TRU), and other long-lived alpha emitters.

Sources of radiation associated with ventilation and off-gas operations are located in the Head End Ventilation (HEV) building, Ventilation Exhaust Cell (VEC), Ventilation Wash Room (VWR), and Off-Gas Cell (OGC). These areas were designed to support operations with concentrations of radioactivity much greater than those associated with current operations. Shielding is therefore significantly greater than that necessary to attenuate current exposure rates to acceptable levels.

Radiation sources in Integrated Radwaste Treatment System (IRTS) facilities derive from radioactivity present in waste that was contained in Tank 8D-2 and from the radioactively contaminated zeolite in Tank 8D-1. Due to the extended storage period, all gamma-emitting isotopes have decayed to levels insignificant with respect to Cs-137. Design basis Cs-137 concentrations for IRTS facilities are given in Table 8.2-3.

Radiation sources in the Supernatant Treatment System (STS) are located within process vessels located in Tank 8D-1 and in transfer piping between Tanks 8D-1 and 8D-2. Radiation sources in the LWTS include radioactive solutions in process vessels and piping located in Extraction Cell 3 (XC-3), Uranium Product Cell (UPC), and Liquid Waste Cell (LWC). Pumps and piping associated with the LWTS are located in niches in the Lower Warm Aisle (LWA), Upper Warm Aisle (UWA), and Uranium Load Out (ULO) facilities. These facilities are all located in the Main Plant building in areas originally designed to accommodate process solutions with activity levels much greater than those currently processed in the LWTS. Shielding is therefore much greater than that necessary to attenuate exposure rates to acceptable levels. The CSS was shut down following the cessation of IRTS low-level waste processing activities and radiation sources have been removed from the facility.

Design basis gamma curies for Main Plant cells are given in Table 8.2-4. Tables 8.2-5 through 8.2-9 provide conservative estimates of material-at-risk concentrations in HEPA filters, high-level waste, lagoon liquid, liquid low-level waste, and solid low-level waste, respectively.

8.2.1.2 Hazardous Material Sources

Bulk chemicals that are required are primarily those used for pH control. These chemicals, which include sulfuric acid for neutralization of Low-Level Waste Treatment System (LLWTS) effluent, and nitric acid for Utility Room operations, are stored at the location of use. Temporary storage of chemicals to be used throughout the site is provided in a specially constructed area of the New Warehouse (Main 2) facility. Separate areas of this facility provide storage for various quantities of caustics, acids, and oxidizers, as indicated in Table 9.1-1.

Maintenance activities require the use of solvents, oils, and other lubricants. These materials are stored in secure storage lockers at the maintenance building. Storage for gasoline and diesel fuel is provided in aboveground tanks located east of the New Warehouse. Fuel oil for steam boilers and back-up equipment is located

in storage tanks in the Utility Room, fire pump house, the yard east of the Utility Room, STS generator room, and 01-14 Building.

The analytical laboratory maintains inventories of a great number of reagents; however, only very small quantities of these reagents are stored at the laboratory site and storage is provided in a manner that precludes reaction.

In addition to these hazardous materials, hazardous wastes are stored in several facilities throughout the site. These include the Lag Storage Facilities, Interim Waste Storage Facility (IWSF), Hazardous Waste Storage Lockers (HWSL) and Satellite Accumulation Areas (SAA).

8.2.2 Airborne Hazards Sources

Contamination on cell surfaces represents the primary source of airborne radioactive material in both the Vitrification Facility and Main Plant.

Sources of airborne radioactive material in the Main Plant are being reduced through decontamination of highly contaminated areas. A small increase in the amount of airborne radioactive particulate activity results from decontamination and decommissioning (D&D) operations, deterioration of cell penetrations and access ports from former plant operations, operations within the analytical cells, and maintenance operations. Airborne contamination is removed by high efficiency filters in the various ventilation and off-gas systems. Airborne radioactivity levels in routinely accessed areas (e.g., operating aisles and laboratories) are maintained at less than 0.02 times the DAC values specified in 10 CFR 835.

Areas of the Main Plant such as the Head End Cells (HECs), extraction cells, and support cells contain a significant amount of loose particulate contamination generated during original NFS operations. Decontamination activities in these areas mobilize this contamination; however, the cell ventilation system, which is described in Chapter 5, is expected to maintain control of any mobilized contamination.

Appropriate levels of respiratory protection are provided (e.g., air-purifying respirators, air-line respirators, and self-contained breathing apparatuses) whenever manned entries are made into airborne radioactivity areas. When dust generating equipment is used, local HEPA-filtered airborne contamination control devices are used.

8.2.2.2 Airborne Hazardous Material Sources

Asbestos is present in the Main Plant Building, Waste Tank Farm (WTF), Cold Chemical Building (CCB), 01-14 Building, and some gasket material throughout the VF. Asbestos fibers may be released during removal or maintenance activities. Lead can be released into the air during the handling of lead shielding or from the disturbance of lead-based paint. Fumes may also be generated throughout the facility during painting and welding activities.

8.3 Hazard Protection Design Features

8.3.1 Radiation Protection Design Features

Because the WVDP has made the maximum feasible use of the former SNF reprocessing facilities, many radiation protection design features are based on original facility structural and process designs. Additions, modifications, and enhancements to design features of these buildings and systems were used when necessary. The radiation protection design features that will be addressed in this section stem

from either original, modified, or added design features. Additional information on design considerations is presented in Section 8.1.2.

8.3.1.1 Vitrification Facility

To maintain radiation exposures ALARA, the VF design utilized process isolation and confinement, structural barriers, ventilation, and continuously operating instrumentation to verify radioactivity confinement. The design included technology developed over the past forty years at commercial and federal installations. Major design features that provided assurance that radiation exposures were kept ALARA were the following:

- The highly radioactive wastes were isolated within a heavily shielded confinement structure that was ventilated in a controlled manner.
- All in-cell maintenance activities were performed remotely.
- The occupied areas were continuously monitored for radiation levels and airborne radioactivity levels, and appropriately alarmed to warn workers of abnormal conditions.
- The amount of radioactive materials released to the environment was minimized through the use of HEPA filters.

8.3.1.2 IRTS and Legacy Facilities

All radioactive material handling and processing operations in IRTS components occur within shielded confinement structures. Valves are designed for remote operation. Highly instrumented control rooms include visual display and visual/audible alarm systems, enabling IRTS operators to control processes from a remote location. Equipment and components in radioactive service have been designed for remote removal and replacement should failure occur. High maintenance equipment such as pumps are located in lower exposure rate areas. Ventilation systems provide assurance that materials contained within the cells are not released into operating aisles and areas. Airborne radioactive particulates are removed from the exhausted air and a lower air pressure is maintained in the more highly contaminated areas from adjoining areas. All IRTS and Main Plant areas are maintained with an air pressure differential that directs air into more highly contaminated areas.

The HLW storage tanks provide multiple confinement barriers, including the tank, pan and vault, and the natural silty till surrounding the vault.

8.3.2 Shielding

Shielding for Vitrification and Main Plant facilities has been designed and constructed to reduce radiation dose rates to acceptable levels under normal operating conditions. Areas in these facilities where shielding is not sufficient to reduce radiation levels below the level for uncontrolled access, as required by 10 CFR 835, are posted as Radiation Areas, High Radiation Areas, or Very High Radiation Areas. At the WVDP, areas where a worker can receive greater than 100 mrem in one year, under full-time occupancy, are posted as Radiological Buffer Areas since personnel dosimetry and monitoring is required by 10 CFR 835 at these levels.

Currently, exposure rates in operating areas of the Main Plant range from 0.1 to 5.0 mR/hour, with most areas having an exposure rate of less than 1 mR/hr. Modifications to the HECs required to support cell decontamination (such as shield window replacement) are designed such that the exposure rate in occupied areas of the Main Plant will not be increased.

When maintenance is required on contaminated equipment or when decontamination activities require personnel to work in elevated exposure rate areas, supplemental shielding may be used to shield workers from the radiation source and reduce exposure rate levels. Before work is initiated, the area is surveyed with an exposure rate meter to assure the effectiveness of the additional shielding, with stay times established on the RWP.

Details of shielding design criteria for the Vitrification Facility and Main Plant are given below.

Vitrification and IRTS Shielding

Shielding for the Vitrification Facility and IRTS component facilities has been designed such that the radiation dose rate in full-time occupancy areas does not exceed 0.25 mrem/hour. This criterion applies to control room areas. Furthermore, shielding for full-time access areas such as operating aisles has been designed such that the dose rate does not exceed 2.5/t mrem/hr (in which "t" is the maximum average time in hours per day that the area is expected to be occupied by one individual). Shielding is sufficient to ensure that the dose to maintenance personnel is less than 0.5 rem/yr for each planned maintenance task. Routine operational area radiation measurements ensure that the design exposure rates are not exceeded. A summary of IRTS shielding evaluations is given in Tables 8.3-1 and 8.3-2.

Main Plant Shielding

The Main Plant building was designed to protect operating personnel from the intense radiation fields associated with SNF. Shielding for the plant was designed based on a fuel with the following irradiation history:

Burnup	30,000 MWD/MTU
Specific Power	35 MW/MTU
Cooling Time	150 Days

The activity of gamma-emitting nuclides of design fuel is given in Table 8.2-4. Due to shutdown of reprocessing activities in the plant and decontamination of plant areas, a great reduction in facility radiation levels has been achieved. Summary shielding descriptions for areas of the plant in which routine operations occur or in which high contamination levels exist are given in Tables 8.3-3 through 8.3-7 (Nuclear Fuel Services 1970). Certain specific sources listed in these tables have been removed from the plant as a result of decontamination and dismantlement activities by WVNSCO. However, these sources have been included in the respective table as representing the basis for the original shielding calculations.

In areas of the plant where it was necessary to penetrate shielding walls with pipes, ducts, or cables, provisions in the original design features were made to ensure the specified shielding requirements of the area. This was done by keeping the size and quantity of penetrations to a minimum and by avoiding straight streaming paths by using multiple offsets, slopes and shadow shields as the individual situation required. Future shield penetrations will be evaluated to ensure continued radiological protection.

8.3.3 Ventilation

Facility ventilation systems are described in Chapter 5. These systems have been designed to ensure confinement of contamination during normal operations and to minimize the spread of contamination during abnormal operations. Several features have been included in system designs to ensure that personnel safety is maintained. Continuous air samples are collected in routinely accessed areas such as stairwells

and operating aisles and are analyzed to ensure that internal exposures are maintained as low as practicable. Access to areas having elevated airborne contamination levels is restricted through administrative controls set forth in WVDP-010, *Radiological Controls Manual.*

All air flow is directed from areas of low contamination potential toward areas of greater potential for contamination. Normal airflow is from stairwells and operating aisles, to cell service areas and airlocks, to process cells. Manned entry to contaminated cells and areas is via airlocks. Airlocks ensure that sufficient negative pressure is maintained between contaminated and uncontaminated areas. Back-up capability has been provided for facility ventilation systems in the event of a power outage. Redundancy is provided for both blowers and filter trains. Discussions of these systems have been provided in Chapter 5.

Facility ventilation systems process air through a series of filters before discharge. The final filter in each system is a HEPA filter capable of removing 99.95% of aerosol particles greater than 0.3 microns in diameter. To ensure that facility ventilation systems are performing adequately, ventilation effluent is monitored in system stacks. Pressure differential instruments are calibrated annually, alarms and switchover capabilities are operationally tested quarterly, and HEPA filters are leak-tested in place annually.

The PVS and the VOG system provide ventilation for process vessels located in the WTF, Main Plant, and LWTS. Configuration of these systems is discussed in Sections 5.4 and 7.4.

Additional protection from releases of activity into uncontaminated areas during cell or waste tank riser access is ensured through the use of temporary confinement tents and portable or temporary ventilation equipment. These temporary confinement systems are erected and operated per approved work procedures that ensure that radiological and industrial safety controls specified in WVDP-010 and WVDP-011, *WVNSCO Industrial Hygiene and Safety Manual,* are adequately implemented.

8.3.4 Radiation and Airborne Radioactivity Monitoring Instrumentation

Requirements for air monitoring programs are specified in 10 CFR 835. Additional guidance is contained in DOE Guide 441.1-8, *Air Monitoring Guide*, and American National Standards and NUREG documents referenced therein. DOE Order 5480.4, *Environmental Protection, Safety, & Health Protection Standards* requires that monitoring instrumentation comply with the requirements set forth in the applicable American National Standard. The WVDP has implemented these requirements in site service manuals and operating procedures. Audits, appraisals, and surveillances are conducted by external and internal groups at the WVDP to ensure compliance with DOE Orders and DOE-prescribed standards.

Area radiation monitors (ARMs) provide an audible alarm when a preset exposure rate is reached. These instruments operate in the range of 0.1 mR/h to 1.0 R/h. Continuous airborne monitors (CAMs) sample air through a fixed particulate filter at flow rates of 28.3 lpm and will alarm when a pre-set count rate is reached. Separate CAMs are used for the detection of beta-gamma and alpha-emitting radioisotopes. The beta CAM instruments use open window Geiger-Mueller detectors which are sensitive to both beta and gamma activity. The alpha CAMs are solid-state detectors. The type of CAM placed in the work area is determined by, but not limited to, the ratio between alpha and beta radioisotopes, the history of the work area, and the work to be performed. Table 8.3-8 provides a summary of information on the back-up and/or standby power supply, range, sensitivity, accuracy, calibration frequency, alarm set points, recording devices, location of detectors, readouts, and alarms for CAMs. Stack exhaust monitors and their calibration are discussed in Section 8.6.1.1.

At the WVDP, air monitoring samples are taken in locations throughout the Vitrification Facility and Main Plant to detect and evaluate airborne radioactive material at work locations and routinely accessed operating aisles. Data obtained by air monitoring is used for assessing the control of airborne radioactive material in the workplace. The WVDP has incorporated the general guidance for placement of air monitors provided in DOE Guide 441.1-8 and NUREG-1400 into the air monitoring program.

Continuous radiation monitoring capabilities are provided to warn of undesirable trends and/or abnormal conditions. ARMs and CAMs are located in the fresh zeolite dispensing area and in the Manipulator Operating Aisle (MOA) (minimum of two ARMs and two CAMs for each area). CAMs are provided in the FRS facility to detect airborne contamination. Radiation monitoring is connected to backup power. A summary of radiation monitors in the IRTS and Main Plant is provided in Table 8.3-9.

There are approximately five (5) alpha, eleven (11) beta-gamma, and seven (7) alpha & beta-gamma CAMs employed at fixed locations in the Main Plant, as indicated in Table 8.3-10. Additional units (usually between five and ten) of both monitoring types are frequently in service in support of work activities performed in the facility. Filters are routinely removed from the stack monitor CAM, and the other CAMs and counted for both gross alpha and gross beta-gamma activity after short-lived radionuclides have decayed to insignificant levels (i.e., approximately one week).

Gamma radiation fields in areas supporting current D&D activities within the VF are continuously monitored by ARMs that have been strategically located. The output from these monitors is continuously transmitted to a dedicated database computer system where it is audited, compared to preestablished radiation background and alarm level values, and stored. Alarm points for detectors located in D&D support areas are set by the RP Department. These alarms trigger visual or audiovisual indications in the PSO Office to alert operators to higher than normal radiation level conditions. The data from these monitors is periodically reviewed to indicate potential trends.

The Closed Loop Cooling Water (CLCW) system and Steam Condensate Return system have gamma radiation monitors on return water and steam condensate that are returned from in-cell process vessels. If radiation is detected in these water streams, an alarm sounds both locally and in the VF Control Room.

CAMs are provided in areas supporting current D&D activities within areas of the VF. CAMs located in the VF have preset alarm levels that provide personnel with local audiovisual alarms of elevated airborne concentrations of radioactive material. These alarms also signal in the PSO Office. All data collected by these monitors is collected and stored on a computer-based data processing system for future reference. Airborne activity trends are analyzed to identify potential problems. Beta CAMs in the 01-14 Building also provide local alarms and trending information. Table 8.3-11 provides a listing of typical types and locations of various radiation monitoring systems in the Vitrification Building and 01-14 Building.

There are also personnel friskers at various locations throughout the VF to allow checks of workers for personal contamination. Automated personnel contamination monitors (PCMs) are available to provide a whole body frisk of workers before they exit the building.

All airborne effluents to the atmosphere are sampled isokinetically and continuously monitored for gross alpha and beta activity. Samples are collected and analyzed for specific radionuclides that are being released to the atmosphere. If preset alarm

points are exceeded, audiovisual alarms are activated (as required by NESHAP permits) to inform operators of off-normal operating conditions.

8.3.5 Hazardous Material Protection Design Features

Facility design features have been provided to protect against exposure to hazardous materials. The New Warehouse (Main 2) contains five engineered segregated storage areas for corrosives, acids, oxidizers, flammables, and health hazards (poisons). Each storage area is equipped with a 15-cm (6-in) deep basin below a steel grate floor to contain spills. Each area also has a separate ventilation system and an automatic fire suppression system and alarm. Access to these rooms is controlled by the Warehouse Manager.

The Hazardous Waste Storage Lockers are pre-engineered lockers containing segregated containers. Lockers have a spill basin with a capacity sufficient to contain a spill equivalent to 10% of the volume of material stored in the locker. The lockers are designed to contain flammable materials and are equipped with fire-suppression devices and alarms.

The Interim Waste Storage Facility (IWSF) is a heated, metal, Butler-type building used for the collection, sorting, handling, sampling, and interim storage of uncharacterized wastes and suspect radiological mixed wastes. Waste oils and process chemicals are held until classified. The IWSF is equipped with a fire alarm and detection system and a sump for spill handling.

Exposure to hazardous chemical fumes produced during analytical or painting activities is minimized by conducting analytical procedures in ventilated laboratory hoods and painting activities in ventilated paint booths.

Tanks containing hazardous chemicals are sealed so they will not release gases. In addition, vessel vent systems are used to provide a negative pressure in each tank. During transfers, when vapors are primarily displaced, the system can draw up to 0.06 m^3/s (133 cfm). Tank vapors can be drawn through a venturi scrubber to remove noxious gases, particulates, odors, fumes, and dusts before release to the atmosphere.

For nonradiological hazards, the above cited design features and adherence to WVDP-011 provide effective nonradiological hazards protection. WVDP-011 addresses the measures required to ensure the safe handling of chemicals and the selection of personal protective equipment required for the handling of hazardous materials and caustic and acid solutions. Additionally, Appendix B of WVDP-011 provides a substantial listing of incompatible chemicals.

8.4 Estimated Collective On-site Dose Assessment

The radiological performance goal of collective occupational dose is predetermined for annual exposures resulting from routine operations at the WVDP. The collective occupational dose performance goal is based upon WVNSCO administrative control levels and is monitored quarterly to ensure that excessive exposures are not being accrued. In the event that the collective occupational dose performance goal is being exceeded for a given operation, the operation is flagged for additional management attention and/or evaluation.

8.4.1 Vitrification Facility

As described in Section 8.1.3, shielding requirements for the VF limit occupational doses to less than 500 mrem/yr by limiting dose rates based on projected occupancy times. Since the vitrification campaign is complete, occupational doses at the VF

are generally related to D&D efforts, which may vary substantially from year to year.

Internal radiation dose hazards are not expected to be significant, or result in appreciable doses, due to the confinement philosophy and use of airborne activity monitoring equipment.

8.4.2 IRTS and Legacy Facilities

Support activities in the Main Plant include analytical and process chemistry, radiological control monitoring, routine maintenance activities and facility surveillance by security and safety personnel.

Decontamination activities in the Main Plant will necessitate manned entry to contaminated cells and support areas such as crane maintenance rooms. Work in high radiation areas will be conducted remotely due to significant in-cell radiation levels. These levels, though, are typically significantly below the facility's original shielding design basis. Based on engineering judgment, the average annual exposure per worker will increase slightly for some work groups because of the performance of decontamination activities, but will remain below the administrative control level at the WVDP of 1,000 mrem per year for a given worker.

Whole body exposure estimates for personnel providing support for plant activities are calculated as part of the WVDP ALARA program. Cumulative occupational exposures from the WVDP ALARA program for these work groups are given in Table 8.4-1. Calculations for the ALARA budget provide total exposure estimates for each work group or project, which are then compared to the actual exposures received. Based on data from this table and the number of workers in each ALARA group, doses for workers are well within the limits set forth in 10 CFR 835. Table 8.4-2 shows the 2004 Budgeted Cumulative ALARA dose.

A program of air particulate monitoring is in place for the Main Plant and waste processing facilities to ensure that airborne radioactivity levels in routinely occupied areas are well within acceptable limits. This is accomplished by drawing plant air at a constant rate through glass fiber filters placed in holders. These filter assemblies are placed at breathing levels in various locations inside the Main Plant and waste processing facilities.

The estimated inhalation dose added to the annual whole body exposure yields the total annual occupational dose. Dividing the total annual occupational dose by the numbers of workers produces the annual average occupational dose per person. In 2003, the total annual occupational dose was 41.671 rem and the number of workers was 568. The annual average occupational dose per worker was 0.07336 rem or 73.36 mrem per worker.

8.5 WVDP Hazards Protection Programs

8.5.1 Integrated Safety Management System

WVNSCO systematically integrates safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment. This integration is accomplished by implementing an ISMS as required by DOE P 450.4, *Safety Management System Policy*. The DOE has developed seven guiding principles to provide the focus for implementing an ISMS. While these principles guide the implementation of an ISMS, five core functions define its make-up. These functions comprise a cycle of activities which, although different in detail, are the same for activities on a program or site level and a facility and work task level. WVDP implementation of ISMS is described in WVDP-310, *Safety Management System Description*.

8.5.2 WVDP Health Physics Program

A formally documented health physics program for the WVDP has been established in WVNSCO Policy and Procedure WV-905, *Radiological Protection*. The health physics program is based on requirements set forth in DOE Order 5400.5 and 10 CFR 835. At the WVDP, the health physics program's site-specific requirements are promulgated in WVDP-010.

8.5.2.1 Organization

Development of the health physics program is the responsibility of the Radiation Protection organization. The Radiation and Safety Committee is responsible for the development of policies and procedures relative to the independent safety review program. This independent review program, established by WV-906, *Radiation and Safety Committee*, requires the formation of ad hoc committees to conduct objective reviews of significant modifications to programs or facilities. The organizational structure and duties of the staff that provides health physics program management are described below.

8.5.2.1.1 Radiological Protection Operations

WVDP management has provided a staff of radiological protection professionals to administer those health physics policies which are related to specific organizational duties. In general terms, the health physics-related responsibilities of the Radiation Protection organization are to:

- Establish, interpret, and implement the health physics program and policy requirements;
- Adopt and interpret applicable codes, standards, and guides;
- Provide health physics services for employees;
- Provide training support and support an emergency response capability;
- Support line organizations with regard to health physics matters;
- Collect, evaluate, and disseminate health physics-related information; and
- Support hazard and risk assessment and systems safety programs.

The Radiation Protection organization is responsible for all activities concerning radiological protection of employees and on-site visitors in accordance with WV-905. Department responsibilities, charters, goals, and qualifications are maintained in WVDP-423, WVDP *Radiation Protection Program Plan*.

The Radiation Protection organization is responsible for maintaining radiological safety of the plant by regularly evaluating and assessing surface contamination, radiation levels, and airborne radioactivity concentrations in work areas with respect to approved limits in accordance with WV-905. A major responsibility of the organization is to assist management in developing programs and plans to maintain radiation exposures ALARA. Cost effectiveness or optimization of these programs is considered in the development and justification of design and physical controls. The Radiation Protection organization is responsible for:

- Ensuring that a personnel dosimetry program is in place to determine radiation exposures of employees and visitors who are authorized to receive occupational radiation exposure and that records of such exposures are properly maintained and reported;
- Ensuring proper calibration and maintenance of the radiological control instrumentation used in normal or emergency operations;

- Analyzing and radioassay of samples collected by the Radiation Protection Operations staff;
- Ensuring that radiological surveys and monitoring are performed in the workplace and that internal and external exposure controls are adequate in protecting individuals within exposure limits and ALARA;
- Oversee the conduct of radiological training courses and briefings that ensure that site personnel and visitors have the necessary skills and training to conduct radiological work activities;
- Removing from the list of employees authorized to receive occupational radiation exposure those who have exceeded the established facility administrative control levels, or have not demonstrated their continuing understanding of the Project's radiological safety-related operating procedures or the need for compliance with them; and
- Reviewing facility and process design, operating procedures, design and process changes, and providing engineering support to operational groups which prepare those procedures.

Radiation Protection staff have the authority and responsibility to cease operations in the event that they are not proceeding in accordance with established operating procedures and safety controls or involve an unreviewed operation which presents a safety risk. The Radiation Protection organization maintains WVDP-010, *WVDP Radiological Controls Manual*, which implements the policies contained in WV-905. Radiological control procedures are contained in WVDP-131, *Radiological Control Procedures*, and provide details to the Radiation Protection organization in implementing radiation protection program requirements. Program manuals and technical basis documents are developed by the Radiation Protection staff to describe a specific program's requirements and also to provide a rationale or background for calculations, measurement frequencies, etc., for such programs.

The Nuclear Safety & Emergency Management Manager is responsible for reviewing facility operations that involve fissile material storage, processing, handling and shipping, and for developing and implementing a control and monitoring program to prevent accumulating unsafe quantities of fissile materials. The Nuclear Safety & Emergency Management Manager is responsible for ensuring that nuclear criticality alarm instrumentation, nuclear accident dosimeters, and an effective and well-documented analysis program and review system are in place if and when conditions require such monitoring. In compliance with WVNSCO policy, these systems will meet or exceed the DOE requirements for nuclear criticality safety of nonreactor nuclear facilities described in DOE O 420.1A, *Facility Safety*, and DOE-mandated American National Standards. The program is implemented at the WVDP through WV-923 and WVDP-162. The Nuclear Safety & Emergency Management Manager reports to the Environmental, Safety, Health & Quality Manager, who reports directly to the WVNSCO President/Project Director.

8.5.2.1.2 Facility Operations

The Radiation Protection organization provides support to Project teams, Operations, Maintenance, and other technical support groups in the area of radiological monitoring and radiological emergencies (i.e., the radiological control team). The Training and Development staff develops and conducts radiation safety training programs, qualification standards and questionnaires for use in general employee and radiological worker training, use of containment devices, nuclear criticality safety training, and radiation safety orientation for on-site visitors and general employees. Training records are maintained in a central file by the Records and Configuration/Document Control Department. Specific training policies and requirements are discussed under Section 10.3.

The Radiation Protection organization is responsible for providing radiological control support to the Emergency Management staff in implementing the requirements of DOE O 151.1A. The Radiation Protection staff also performs duties for the DOE Radiological Assistance Program (RAP), which is coordinated by Brookhaven National Laboratory for Region I and includes the eleven Northeastern states. This program is described and implemented in WVDP-246, *Radiological Assistance Program Plan*.

8.5.2.1.3 Radiation and Safety Committee

WV-906, *Radiation and Safety Committee*, establishes the Radiation and Safety Committee (R&SC), a group of individuals appointed by the President/Project Director to provide objective and independent review of safety-related operations, systems, and activities. The R&SC, which functions in an advisory capacity to the line organization and the President/Project Director, provides an independent review of significant modifications to programs and facilities to ensure that:

- Health physics matters are comprehensively addressed in formal documents and reports submitted for review;
- Risks have been identified and are acceptably low with respect to the benefits gained; and
- Management authorization of operations is documented.

The Radiation and Safety Committee is staffed by standing members who are independent of the organization being reviewed. The R&SC Chairman and standing committee members are appointed by the President. The Radiation and Safety Committee reports directly to the WVNSCO President/Project Director.

8.5.2.2 Radiation Detection Equipment, Instrumentation, and Support Facilities

The instrumentation used by radiological control personnel can be divided into four categories:

- Fixed radiation counting instruments;
- Portable radiation detection instruments;
- Area radiation monitoring instruments; and
- Airborne radioactivity sampling and monitoring instruments.

Instruments are consistent throughout the WVDP facilities. Requirements for radiation protection instrumentation found in 10 CFR 835 and DOE-STD-1098-99 are implemented in WVDP-010, *WVDP Radiological Controls Manual*. ANSI N323A-1997 calibration requirements are implemented in WVDP-318, *WVDP Radiological Instrumentation Calibration and Maintenance Program Manual*, and in individual radiological control procedures contained in WVDP-131, *WVDP Radiological Control Procedures*. Instruments are repaired and calibrated by instrument maintenance and calibration personnel in the Radiation Protection Labs within Radiation Protection Operations. In some cases, specialized instruments may be returned to the manufacturers for repair and calibration.

8.5.2.3 Radiological Control Procedures

8.5.2.3.1 Radiation and Contamination Surveys

Radiological Control technicians perform routine radiation and contamination surveys of all accessible areas of the facility. Survey areas and frequencies are determined in accordance with DOE-STD-1098-99 as well as site-specific requirements contained in WVDP-131, *Radiological Control Procedures*, and manuals and are based upon the probability of contamination, changes in radiation level, and personnel

occupancy. These surveys consist of radiation measurements and/or total and removable contamination measurements as appropriate for the specific area. The records of the survey results are retained by Radiation Protection and are reviewed periodically so that trends indicating problem areas are identified as early as possible.

Direct radiation surveys are performed using portable instruments in accordance with the following criteria:

- Appropriate radiation surveys are performed periodically to control radiation doses during vitrification and decontamination and decommissioning activities.
- Routine gamma surveys are performed at frequencies specified by DOE-STD-1098-99 and WVDP-010.
- Gamma surveys are performed in spaces surrounding radiation areas subsequent to movement of radioactive equipment or material. The boundaries are adjusted as necessary.
- Boundaries of radiation areas established for a specific short-term purpose are surveyed each work day that activities are performed during which radiological conditions might change.

The Radiation Protection staff establishes and maintains a routine schedule for surface contamination surveys and direct radiation surveys. Requirements and guidelines for the conduct of contamination and radiation surveys are provided in DOE-STD-1098-99 and WVDP-010. The survey schedule defines the area to be surveyed and the frequency of the survey. In general, areas with a higher potential for contamination are surveyed more frequently than areas with a lower contamination potential. In addition, sufficient surveys are taken during work involving radioactive material handling to ensure that contamination control is maintained.

Two types of contamination surveys are made: surveys performed with portable instruments (total contamination measurements) and smear surveys (removable contamination measurements) using fixed laboratory counting instruments for analyses. For any item to be removed from a radiologically controlled area, portable instruments are used to determine the amount of total (fixed) contamination deposited on the surface. The probe is placed in close proximity to the surface being surveyed, and the total amount of radioactivity detected by the instrument is averaged over the active area of the probe. These probe surveys are followed by removable contamination measurements made by wiping a 100 cm^2 area with wipes and analyzing the wipe in the counting laboratory to determine the amount of gross alpha and beta activity wiped from the potentially contaminated surface.

Results are compared with the maximum allowable surface radioactivity levels permitted outside contaminated areas. Limits for removable contamination for accessible surfaces within clean areas are specified in 10 CFR 835, DOE-STD-1098-99 and DOE Order 5400.5 as well as the WVDP Radiological Controls Manual.

The survey methods discussed above are capable of detecting activities below the applicable surface radioactivity limits. Based on the results of these surveys, areas are posted and controlled in accordance with the criteria discussed in Section 8.5.2.3.3.

8.5.2.3.2 Procedures for Ensuring that Occupational Doses are ALARA

The objective of the Radiation Protection program is to ensure that the exposure of employees to radiation and radioactive materials is within the requirements of 10 CFR 835 and DOE-STD-1098-99, as implemented in WV-984 and WVDP-163, and that such exposures are kept ALARA. These objectives are met by ensuring that:

- Personnel receive a level of radiation protection training appropriate to their assignments;
- Appropriate access control techniques and protective clothing are used to limit the spread of external contamination;
- Engineering and administrative controls are used to control contamination in the workplace, a respiratory protection program is in place, and respiratory protective equipment is used where required;
- Radiation areas are segregated and appropriately posted to limit radiation exposure;
- Instruments and equipment are properly calibrated so that accurate radiation, contamination, and airborne activity surveys can be performed;
- Appropriate personnel dosimetry devices are supplied, and a radiation exposure record system is maintained;
- An internal dose assessment program (whole body counting and/or urinalysis) is in place; and
- Work in radiation areas and surface or airborne contamination areas is preplanned and reviewed from an ALARA standpoint.

8.5.2.3.3 Access Control

Access to portions of the facility is controlled in accordance with 10 CFR 835, DOE-STD-1098-99 and the WVDP Radiological Controls Manual. Personnel entering radiologically posted areas of the plant must know the radiological control procedures, must receive documented training for the specific area or areas as specified in Section 8.5.2.3.5, or must be escorted continuously by someone who has received such training. All personnel entering a radiologically posted area will wear appropriate dosimetry. Radiologically posted areas at the WVDP are accessed through an administrative system of RWPs and, for High and Very High Radiation Areas, locks are placed on the entrances to prevent inadvertent entry.

The RWP specifies the controls necessary for the planned entry, such as protective clothing, stay times, respiratory protection, and supplemental dosimetry. The necessity for these controls may be based exclusively on radiation level, a combination of surface contamination and radiation level, the concentration of airborne contamination, or the potential for occurrence of any of these conditions.

Access and stay time are rigidly controlled for High and Very High Radiation Areas. If conditions are of a nature that manned entry is not warranted, remote techniques are used. The exposure and contamination controls to be specified depend on the nature of the work performed in the areas. A stay time or maximum allowable dose for each entry is determined by Radiation Protection and noted on the RWP. In addition to TLD badges, entering personnel may be accompanied by a member of Radiation Protection who continuously monitors the dose rate in the work area.

There are thirteen types of radiologically posted areas as defined in the following sections: Radiation Area, High Radiation Area, Very High Radiation Area, Hot Spot, Fixed Contamination Area, Contamination Area, High Contamination Area, Airborne Radioactivity Area, Soil Contamination Area, Underground Radioactive Materials Area, Restricted Access Area, Radioactive Material Area, and Radiological Buffer Area. Posting may include any combination of classifications needed to correctly

characterize the area. Personnel who do not enter the above areas are not expected to receive greater than 100 mrem/yr. Criteria for individual postings are provided in WVDP-010.

8.5.2.3.4 Sealed Source and Radioisotope Control

No sealed sources may be purchased without the approval of Radiation Protection and an approved purchase specification. A Radioactive Source Control Program is established and implemented in WVDP-291, *WVDP Radioactive Source Control Program*. The control program for the purchase of radioisotopes (e.g., gas, liquid, or solid calibration standards, etc.) is essentially the same as that for sealed sources. The sealed source program meets the requirements of 10 CFR 835 and DOE-STD-1098-99.

Facilities that use high-radiation source range equipment or radiography equipment shall meet the requirements of ANSI N43.3, *General Radiation Safety for Installations Using Nonmedical X-Ray and Sealed Gamma-Ray Sources, Energies up to 10 MeV* (ANSI) and the requirements of WVDP-292, *WVDP Radiation-Generating Device and Radiography Work Operations Program Manual*. WVDP-292 requires that as-built engineering drawings of the facility be maintained current, user training and certification be maintained current, and an operational survey program be developed for the system or facility. Records of site operations and of equipment maintenance and calibration are maintained in an auditable manner.

8.5.2.3.5 Radiation Safety Training

Radiation Safety training is conducted at the WVDP to ensure that each worker understands the following: the general and specific radiological aspects of their assignment, their responsibility to co-workers and the public for safe handling of radioactive materials, and their responsibility for minimizing their own dose. As a general statement of policy, WVNSCO provides a level of training commensurate with an individual's work assignment and responsibilities. All radiation safety training meets the requirements contained in 10 CFR 835, DOE-STD-1098-99, and DOE Handbook DOE-HDBK-1131-98 *General Employee Radiological Training*, DOE Handbook DOE-HDBK-1130-98, *Radiological Worker Training*, and DOE-STD-1122-99 *Radiological Control Technician Training* series standardized core training materials. All WVDP radiation safety training requirements are set forth in WVDP-010 and WVDP-290, *WVDP Radiation Safety Training Program Manual*.

In addition to completion of routine employee training programs, Radiological Control Technicians are required to demonstrate their proficiency in performing to a minimum standard in qualification examinations. The training standards for Radiological Control Technicians are maintained as separate qualification standards. Personnel who have not demonstrated acceptable performance to a documented standard for a given activity are not permitted to perform that activity except under the direct, continuous control of a qualified employee. Employees who have qualified but whose actions on the job may indicate a lack of knowledge in health physics are immediately disqualified and retrained.

Information on training may be found in Section 10.3.

8.5.2.3.6 Personnel Monitoring Program

Personnel at the WVDP are monitored for both internal and external dose. The external dosimetry monitoring program at the WVDP complies with requirements contained in 10 CFR 835 and DOE-STD-1098-99. The requirements are described in WVDP-010 and WVDP-071, *WVDP External Dosimetry Program Manual, and Technical Basis Document*. A routine external dose monitoring program at the WVDP measures the

radiation dose received by personnel. The basic monitoring device is the thermoluminescent dosimeter (TLD).

WVDP badges both Radiological Workers I and II, who have their dosimeter badges exchanged monthly or quarterly. Employees with a greater potential for exposure are placed on the monthly- or quarterly-direct (i.e., issued direct-reading dosimeters or electronic dosimeters) TLD processing schedule. Quarterly-direct workers are issued a direct-reading pocket ionization chamber dosimeter or an electronic dosimeter to be worn in conjunction with the TLD badge.

Radiological workers at WVDP are monitored for external dose in accordance with 10 CFR 835 and DOE-STD-1098-99. The program is accredited by the Department of Energy Laboratory Accreditation Program (DOELAP), described in DOE-STD-1095-95 and DOE-STD-1111-98. In cases where a limited portion of the body (e.g., head, arms) is exposed to the source of radiation, supplemental dosimeters are placed at the point of the highest anticipated dose rate to monitor the localized exposure.

The internal dosimetry monitoring program at the WVDP complies with requirements contained in 10 CFR 835 and DOE-STD-1098-99. The requirements are described in WVDP-010 and WVDP-070, *WVDP Internal Dosimetry Program Manual and Technical Basis Document*. Internal doses are assessed by personnel in vivo counting and in vitro radioanalysis techniques. The in vitro program is supported by a subcontract laboratory with provisions for routine, nonroutine, and emergency assessments of urine and/or fecal samples. The monitoring program is capable of detecting internal depositions of transuranic elements, fission products, and activation products. DOE-STD-1121-98, *Internal Dosimetry*, provides detailed guidance on internal dosimetry in fulfilling the requirements of 10 CFR 835 and provisions of DOE-STD-1098-99 and is used by the WVDP Internal Dosimetry Program.

In vivo counters are used to measure the gamma rays from radionuclides present inside the body. This whole body counter is sensitive to the relatively high-energy gamma rays emitted by fission products and, in general, can detect an internal deposition of gamma-emitting radionuclides at a level much less than 10 nanoCuries and less than one percent of the Annual Limit of Intake as defined in 10 CFR 835.

Bioassay analysis is used to monitor for americium-241, strontium-90, tritium, uranium isotopes, and plutonium isotopes. Urinalysis is the normal method used in the bioassay program. Urine samples are collected to obtain the equivalent of a 24-hour sample.

The routine internal exposure monitoring program is designed to detect deposition of both actinide and fission products. Employees on the monthly and quarterly-direct TLD-processing schedule and those required to wear respiratory protection in radiologically posted areas are required to submit a urine sample annually. More frequent urine samples may be collected if deemed necessary by the dosimetry staff and Radiation Protection management. All radiological workers permanently assigned to WVDP are required to undergo a whole body count annually. Most radiological workers not permanently assigned to WVNSCO are required to have whole body counts at the start and termination of the work, and may also be required to submit urine samples initially and upon termination if WVDP determines the need.

DOE-STD-1112-98, *DOE Laboratory Accreditation Program for Radiobioassay*, describes the technical requirements and processes specific to the DOELAP Radiobioassay Accreditation Program as required by 10 CFR 835.

8.5.2.3.7 Airborne Radioactivity Monitoring Program

The function of the airborne radioactivity occupational monitoring program is to comply with 10 CFR 835 and DOE-STD-1098-99 and to verify that the survey program

described in Section 8.5.2.3.1 is detecting contamination control problem areas. Requirements for the WVDP workplace airborne radioactivity monitoring program and the technical basis are presented in WVDP-216.

Fixed filters from the low-volume air samplers located throughout the Main Plant are collected and analyzed weekly for gross alpha and gross beta activity. If the amount of radioactivity on the filter paper indicates that the work area DAC has been exceeded during the sampling period, the sample may be tested to determine the isotopic content (tests may include alpha, beta, and/or gamma spectroscopy and radiochemical analysis techniques). These data are used in performing follow-up assessments of internal dose.

Fixed filters on the CAM units are changed twice per week or more frequently if required by dust loading. These filters are analyzed with the same methods used for low-volume air sample filters.

High-volume air samplers are available for rapid measurement of airborne activity. The short-term samples are taken:

- If the installed CAM in a work area is inoperative and radioactive work is being performed;
- When opening a radioactive system to the atmosphere for maintenance;
- Before entering tanks or voids containing potentially radioactive piping; or
- Where a proposed operation could potentially release airborne radioactivity.

8.5.3 WVDP Industrial Hygiene and Safety Program

The WVDP has established a comprehensive Industrial Hygiene and Safety (IH&S) program dedicated to the anticipation, recognition, evaluation, and control of occupational hazards and stresses that may cause sickness or impair health. This program is implemented through WVDP-011, *WVDP Industrial Hygiene and Safety Manual*, which incorporates the guidance of DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees* and DOE-adopted Occupational Safety and Health Administration (OSHA) standards 29 CFR 1910, *Occupational Safety and Health Standards* and 29 CFR 1926, *Safety and Health Regulations for Construction*.

Occupational hazards of concern may be grouped into four general categories: chemical, physical, biological, and ergonomics. To control and minimize exposure to these hazards, the WVDP IH&S program addresses the following: identification of health hazards, hazard evaluation, control measures, periodic monitoring, employee education, and medical monitoring. This section will primarily focus on these activities as they relate to, and provide for, hazardous material protection.

8.5.3.1 Hazardous Material Protection Program

Elements of the Hazardous Material Protection program ensure that hazardous materials are identified, stored, and handled in a manner consistent with the ALARA philosophy. Several organizations, including the IH&S Department, Project teams, WVNSCO Engineering groups, Operations Support, Training and Development, and Employee Health Services, are responsible for implementing aspects of the Hazardous Material Protection program. Responsibilities and interfaces between these and other organizations are presented in WVDP-011.

8.5.3.2 ALARA Policy and Program

It is the policy of WVNSCO to keep safety and health risks as ALARA. Hazardous materials are identified, controlled, monitored, handled, and stored in a manner consistent with the ALARA philosophy. The major components of hazardous material exposure control are Hazard Prevention and Hazard Control. Hazard Prevention is that part of the safety program dedicated to the elimination of hazards through design and planning. The review of work instruction documents and the purchase of less toxic materials are two examples. Hazard Controls, which are the means applied to existing hazards to ensure worker safety, include:

- Substitution - e.g., using non-toxic or lower hazard products or equipment;
- Engineering Controls - e.g., laboratory fume hoods;
- Administrative Controls - e.g., arranging worker schedules to reduce exposure;
- Personal Protective Equipment - e.g., respirators and gloves.

These and other aspects of hazardous material control used to ensure consistency with the ALARA philosophy are discussed in greater detail in the following sections.

8.5.3.3 Hazardous Material Training

All picture-badged employees at the WVDP receive General Employee Training (GET), which includes OSHA Hazard Communication training per 29 CFR 1910.1200. GET requalification is required on a biennial basis. OSHA Hazardous Waste Operations (HAZWOPER) training, per 29 CFR 1910.120 and 29 CFR 1926.65, is required for those individuals, including subcontractors, entering into a predetermined hazardous waste operations exclusion zone or performing hazardous waste operations activities. An annual refresher is required for maintenance of hazardous waste qualifications. Additional training is required for individuals involved in the transportation of hazardous materials.

Operators working in specific areas who are routinely involved with hazardous chemicals are required to meet qualification standards which address specific training requirements for handling chemicals in these job functions.

Additional information on training may be found in Section 10.3.

8.5.3.4 Hazardous Material Exposure Control

Measures for the control of hazardous materials are present at many levels at the WVDP. Controls begin during work planning by including IH&S review and approval whenever the potential for hazardous materials exposure is present or wherever industrial hazards may occur. Controls continue through process operation and closeout via the review process and appropriate industrial hygiene programs and procedures. IH&S reviews site-wide procedures whenever industrial hygiene or industrial safety hazards are expected to be encountered, thus ensuring that proper controls are identified.

WV-921, *Hazards Identification and Analysis*, establishes the policy and means "to conduct hazards analyses for all WVNSCO activities during the work planning process, prior to commencement of work." WV-921 provides the mechanism for the Work Originator, Work Group Supervisor, and/or Work Review Group to determine when Hazard Control Specialists are included in the work planning process at a task level. A site Health and Safety Plan (HASP) (WVDP-241) has been prepared to document the WVDP Hazardous Waste Operations and Emergency Response (HAZWOPER) Program, assign responsibilities, establish personnel protection standards, prescribe mandatory health and safety practices and procedures, and provide for

contingencies that may arise during the performance of hazardous waste operations work activities at the WVDP.

An additional managerial control is the industrial work permit (IWP) system. The IWP is a permit system which reviews and controls unique and/or high-risk jobs. Jobs subject to review include but are not limited to those involving hazardous material handling. For certain tasks, the IH&S Department reviews the IWP to evaluate the hazards, specify necessary personal protective equipment, and issue any appropriate precautionary remarks. SHIP-201, *Industrial Work Permits*, details the policy and administrative controls in place for use of the IWP.

To reduce occupational exposure to the lowest practical levels, the planning and design aspects of all work are required to include consideration of safety hazards and risks to health. This is done during the design stage by using engineering controls such as ventilation, containment, isolation, and/or substitution. Remote handling is an example of system planning intended to separate workers from process hazards. Per WVDP-011, IH&S is required to review and approve all equipment designs and purchases intended for implementing engineering control of health hazards.

Because airborne hazards pose the most immediate threat to personnel health, a major consideration in design controls includes ventilation of related process hazards. Ventilation systems, which include both dilution and removal systems, play a vital role at the WVDP in reducing or eliminating toxic substance exposure. All new systems are designed in accordance with the following:

- Industrial Ventilation - Manual of Recommended Practice (American Conference of Governmental Industrial Hygienists [ACGIH]);
- 29 CFR 1910 - Occupational Safety and Health Standards;
- DOE O 420.1A - Facility Safety;
- ASHRAE 62-1989 - Ventilation for Acceptable Indoor Air Quality (American Society of Heating, Refrigeration, and Air Conditioning Engineers).

Modifications or other changes to existing ventilation systems are also required to comply with these standards. All new or significantly modified ventilation systems used for personal protection (e.g., lab hoods, etc.) are performance tested by IH&S before being placed in, or returned to, service.

Several programs have been implemented at the WVDP with the goal of minimizing health hazards from specific hazardous materials. Formal approved site procedures provide for the controlled handling of certain hazardous materials, including asbestos, lead, carcinogens, mercury, and polychlorinated biphenyls (PCBs). Other procedures control those operations that involve hazardous materials, such as laboratory activities, painting, and hazardous waste operations.

Because it is a WVNSCO objective, per WVDP-011, to minimize the use of highly toxic or dangerous substances where technically feasible, substitution of less toxic/dangerous materials is a highly recommended health and safety practice. Formal approved procedures require that purchase requisitions for all chemical and hazardous material purchases be reviewed by IH&S for identification of potential health hazards. Depending on the nature of the hazardous material, the requisitioner may be directed to substitute a less hazardous material or initiate procurement of necessary controls or specific personal protective equipment.

Certain hazardous materials are either prohibited or under restricted usage at the WVDP. Prohibited materials, which include confirmed human carcinogens, lead-based and chromate-containing paints, asbestos-containing material, and picric acid, may not be purchased or used unless written approval is granted by the IH&S. Restricted use materials, which include suspected carcinogens, isocyanates, mercury,

particulate polycyclic organic matter, perchloric acids and their salts, peroxidizable compounds, and grinding coolants or cutting oils containing inorganic oxidants require written approval by the IH&S Department prior to purchase or use.

8.5.3.5 Hazardous Material Identification Program

Before acquiring any chemical or hazardous material at the WVDP, the user must identify any potential risk associated with that chemical and, as appropriate, plan and identify resources for:

- Safe and proper transportation;
- Adequate facility design;
- Proper facility equipment and process design;
- Required protective equipment;
- Safe storage;
- Use and process procedures;
- Review of proposals and procedures;
- Employee training; and
- Safe disposal.

Recognition of hazards associated with chemicals is aided through the use of Material Safety Data Sheets (MSDS), which are required for every chemical received on site and which must be read prior to working with any chemical. MSDSs are available for evaluation and assessment of the above items and are retained in a location accessible to the workplace, including electronic availability on the site intranet. Supervisors are responsible for knowing what chemicals are present, what hazards are associated with them, and what precautions are required. Supervisors must inform all personnel in the work area of these hazards and enforce the necessary precautions. The IH&S Department is consulted if there are any questions concerning the hazards of any material, the proper procedures, or protective equipment.

A formal approved procedure provides for the identification, evaluation, and control of health hazards at the WVDP. Elements of this procedure provide for the following aspects of health hazard control and hazardous material control:

- Identification of Health Hazards - Health hazards are identified through knowledge and assessment of existing operations, periodic walk-through surveys, review of proposed projects, facilities, engineering plans, and specifications, chemical inventories, injury/illness reports, complaints, and purchase requisitions. An inventory of health hazards is maintained by the IH&S Department.
- Health Hazard Evaluations - Potential health hazards are evaluated by qualified personnel using professional judgment, application of established standards or guidelines, and such evaluation techniques as air sampling and bioassay.
- Control Measures - Control measures are required whenever it is determined that a potential health hazard exists that is capable of causing injury or illness. Engineering controls, process changes, or material substitution are among the primary options in controlling hazardous materials. Administrative controls are implemented when engineering controls cannot be used; personal protective equipment is used when engineering and administrative controls are not feasible.

- Periodic Reviews - Periodic reviews are conducted to ensure safe use and disposal of hazardous materials. Walk-through surveys of facilities are conducted and reports are provided to the appropriate supervisor. Periodic area monitoring and personal sampling are conducted as appropriate to ensure that existing control measures are adequate.

Hazardous material identification and assessment is also implemented as part of the site Emergency Management program. WVDP-193, *WVDP Hazards Assessment*, identifies and evaluates on-site hazardous materials and characterizes their associated hazards. Additional information on emergency planning is given in Section 10.5.

8.5.3.6 Administrative Limits

The exposure limits used in hazard evaluation and mitigation may not exceed those in the mandatory industrial hygiene standards of OSHA or the DOE. OSHA Permissible Exposure Limits (PELs) and American Conference of Governmental Industrial Hygienists Threshold Limit Values (ACGIH TLVs) are used by the IH&S Department. The more stringent OSHA PEL or ACGIH TLV is used for any hazardous material. If a potential health hazard is identified that has no assigned PEL or TLV, a guideline on evaluation and control is developed based on the best available toxicological information.

An administrative control limit of ten percent of the PEL or TLV for a chemical hazard is used as the WVDP standard for determining the necessity of further sampling, monitoring, evaluation, or control, per WVDP-215.

8.5.3.7 Occupational Medical Programs

The policies, objectives, and functions of the WVNSCO Employee Health Services (EHS) program are presented in WVDP-026, *WVNSCO Occupational Health Manual*. WVDP-026 serves as a tool for implementation of DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees* and other OSHA and DOE regulations. The primary objective of the EHS Occupational Health Program is the prevention, early detection, and mitigation of occupationally-related injury or disease.

Employee health assessments are given to provide initial and continuing assessment of the employee. Guidelines for the frequency, content, and documentation of these examinations are provided in WVDP-026. Medical records are maintained, updated, and stored in accordance with WVDP-026.

8.5.3.8 Respiratory Protection

At the WVDP, respiratory protection is required for both radiological and toxicological hazards. A comprehensive program, built around ANSI Z88.2, *American National Standard for Respiratory Protection* (ANSI), OSHA standards, and in full compliance with applicable DOE requirements, is detailed in WVDP-179, *Respiratory Protection Program Plan*. Further program requirements for radiological and toxicological hazard applications are set forth in WVDP-010, *WVDP Radiological Controls Manual*, and WVDP-011, *WVDP Industrial Hygiene and Safety Manual*, respectively. The WVDP Respiratory Protection program comprises NIOSH-approved equipment, extensive employee training, quantitative fit testing, worker medical and bioassay monitoring, independent examination and maintenance of all reusable respirator components, and maintenance of records of all such activities. To ensure worker protection, all use of respiratory protection is strictly controlled by specification in either an RWP or IWP as prepared by the Radiation Protection organization or IH&S Department, respectively, and issuance in accordance with

standard operating procedures. Air-line respirators and full- and half-face air-purifying respirators are routinely used for worker protection while self-contained breathing apparatuses are dedicated for emergency and unknown conditions.

8.5.3.9 Hazardous Material Monitoring

As discussed in WVDP-215, *Industrial Hygiene and Safety Exposure Assessment and Monitoring Plan*, monitoring at the WVDP is grouped into the following three categories:

- Baseline Monitoring - This type of monitoring is performed to evaluate the range or distribution of exposures among specified homogenous exposure groups. The baseline is the primary database used by the IH&S Department and EHS for determining the acceptability of exposures and the need for diagnostic sampling and additional controls.
- Diagnostic Monitoring - This type of monitoring is performed on special case evaluations to identify the predominant source(s) and tasks that are causing exposures. Results of these activities are used to devise control strategies for the identified high exposures. If the source is stationary, area monitoring may be used. If the source moves with the employee or is dependent on individual work practices (e.g., asbestos removal), personal monitoring is used.
- Compliance Monitoring - This type of monitoring is performed to make formal comparisons with organizational guidelines and governmental standards for acceptable exposures. Examples include monitoring to ensure compliance with OSHA regulations for asbestos, lead, and cadmium.

WVDP-215 contains guidance for selecting the type of sampling, duration of sampling, number of samples to be taken, reporting of results, and data interpretation. Other formal procedures provide guidance for sampling plant breathing air, performing personal sampling, and routine sampling for various air contaminants.

Periodic monitoring ensures compliance with applicable code limits. The industrial hygiene staff determines the type and frequency of periodic monitoring and reports to line management regarding the continuing adequacy of controls, the need for additional controls, or recommendations for maintenance or re-emphasis of administrative controls.

A discussion of nonradiological monitoring of site emissions, effluents, and discharges is provided in Section 8.6.1.2. A discussion of the WVDP on-site meteorological program may be found in Chapter 3.

8.5.3.10 Hazardous Materials Protection Instrumentation

Formal approved procedures contained in WVDP-121, *Fire, Health, and Safety Procedures Manual*, provide guidance for the operation and regular calibration of industrial hygiene field sampling instruments. WVDP-121 also contains information on selection, sensitivity, range, and types of hazardous material protection instrumentation. All personal and area sampling equipment used by the IH&S Department which requires regular calibration per manufacturer specifications is tracked by the instrument calibration tracking system. The design review process described in Section 8.5.3.4 ensures that appropriate detection and monitoring instrumentation is incorporated into the design requirements for facilities involved with hazardous materials.

8.5.3.11 Hazardous Material Protection Record Keeping

Records pertaining to hazardous material protection are prepared, maintained, and transferred to Records Management for storage in accordance with WVDP-262, *WVNSCO Manual for Records Management and Storage*. Industrial hygiene hazard inventories, reports, and monitoring data are made available to Employee Health Services in support of the Occupational Health Program. Records access is provided to employees or designated representatives of employees in accordance with OSHA regulations. All records relating to occupational health are retained in accordance with current OSHA and DOE Orders.

8.5.3.12 Hazard Communication Program

The WVDP Hazard Communication Program is implemented through WV-988, *Employee 'Right-to-Know' Program - Hazard Communication*. WV-988 implements an integrated program to provide site personnel, including subcontractors, maximum protection and awareness of job hazards in compliance with the New York State "Right-To-Know" Law, the Federal OSHA Standard on "Hazard Communication", and applicable DOE Orders. WV-988 provides guidance on hazard evaluation, material safety data sheets (MSDS), chemical inventories, labeling, directions for non-routine tasks and subcontractors, and training on these subjects.

8.5.3.13 Occupational Chemical Exposures

WVDP-215, *Industrial Hygiene and Safety Exposure Assessment and Monitoring Plan*, provides the specifications for developing and implementing a risk-based approach to characterize employee exposures to hazardous materials. The plan includes criteria for exposure assessment and defines the interface between the IH&S Department and Employee Health Services. WVDP-215 is based on criteria set forth in DOE O 440.1A, DOE Guide 440.1-3, *Occupational Exposure Assessment*, and the American Industrial Hygiene Association publication, *Strategy and Occupational Exposure Assessment* (AIHA).

8.6 Off-Site Dose Assessment

In order to assess effects of site activities on the public and the environment, air emissions are monitored and/or sampled, liquid effluents are sampled, ambient air, surface water, groundwater, soils, sediments, and biological media are sampled, and direct radiation is measured. Data from environmental monitoring samples, together with data from the site meteorological system, are used to estimate dose to the public and the environment.

8.6.1 Environmental Monitoring Program

Prior to the DOE assuming responsibility for the WVDP, NFS had monitored the environment in conformance with NRC requirements. When WVNSCO assumed operational control of the site, an evaluation of the existing environmental monitoring program determined that a more intensive program would be necessary to support HLW processing.

The expanded program was designed to consider the following: potential effluent streams from HLW processing; routes that contaminants could follow into the environment; site geological, hydrological, and meteorological conditions; quality assurance standards for sampling and analysis; and contaminant limits and standards as set by federal and state agencies.

The major pathways for potential movement of radionuclides away from the site are by airborne transport and surface water drainage. In addition to the major pathways, a potentially significant pathway to man is through consumption of farm animals and produce from the WVDP area and ingestion of game animals and fish. Thus, samples of beef, milk, hay, fruits and vegetables, venison, and fish from off-site locations are collected and analyzed. Direct environmental radiation is also monitored through the placement of TLDs at on-site and off-site locations.

The environmental monitoring program for the WVDP began in February 1982 and has been updated as facilities were added or taken out of service and as processes were changed. The program has also been modified as necessary to address updates to regulatory requirements, DOE Orders, and guidance standards. The current program, as summarized in WVDP-098, *Environmental Monitoring Program Plan,* has been designed to comply with the requirements of DOE Orders 450.1, 5400.5, and 435.1. A separate plan, WVDP-239, *Groundwater Monitoring Plan,* focuses specifically on groundwater sampling and analysis.

WVDP-098 and WVDP-239 describe the rationale and requirements for sampling, the location of on-site and off-site sampling points, types of samples (or direct environmental measurements), sampling matrices and frequencies, analytical parameters, quality assurance requirements, records maintenance, and reporting requirements. Methods for conducting dose assessments are described in WVDP-098, Section 9.0.

Data from the monitoring program are subjected to multiple levels of review, including bench top supervisory review, automated screening for anomalous data upon entry to the database, a formal data validation process, and a final formal peer review of data reports. Environmental data are evaluated monthly and reported in Monthly Trend Analysis Reports. Groundwater data are evaluated and reported quarterly in Groundwater Trend Analysis Reports. Data and evaluations from both environmental and groundwater sampling programs are presented in annual Site Environmental Reports (SERs), as are annual estimates of doses from WVDP activities to the public and the environment. Separate reporting of doses from airborne releases is also made on an annual basis to the Environmental Protection Agency (EPA) in conformance with Clean Air Act regulations.

8.6.1.1 Radiological Monitoring

Air and water sampling are the primary emphases of the monitoring program for radiological parameters because the two major pathways for potential movement of radionuclides from the site are by airborne transport and by surface water drainage. Samples are collected on-site at locations from which radioactivity is normally released or might be released, from perimeter locations to determine if contaminants might be migrating off-site, from off-site locations to assess dispersion and off-site dose pathways, and from background locations to serve as a baseline for comparison with on-site and near-site results.

8.6.1.1.1 Radioactivity in Air

Sources of treated airborne emissions having the potential to result in a dose to the maximally-exposed off-site individual (MEOSI) exceeding 0.1 mrem effective dose equivalent (EDE) in a year are required by the DOE and the EPA to be permitted as specified under National Emissions Standards for Hazardous Air Pollutants (NESHAP), 40 CFR 61 Subpart H. Currently, all point sources that could exceed the 0.1 mrem threshold for radioactive emissions on-site are continuously monitored and/or sampled. The site also continuously monitors all emission sources with the potential to release <0.1 mrem but >0.01 mrem EDE to the MEOSI. Per agreement with the EPA, sources that could release radioactivity resulting in <0.01 mrem EDE will be periodically monitored or the release will be estimated using process knowledge.

Diffuse sources are evaluated to meet the requirements of DOE/EH-0173T. On-site air monitoring locations are shown on Figure 8.6-1. Off-site air is monitored at ten locations in all, including six perimeter locations (Figure 8.6-2), two communities near the site, and two background locations. On-site ambient air is monitored at three waste storage areas with the potential to be diffuse sources of air emissions: the lag storage area; the NRC-licensed disposal area (NDA); and the state-licensed disposal area (SDA). At all ambient air locations the sampler head is set at 1.7 meters above the ground, the height of the average human breathing zone.

WVDP-098, Section 3.0 (Effluent Monitoring - Airborne Emissions), describes the rationale for monitoring air emissions at each site location, the regulatory requirements for monitoring, the locations within each facility where air is monitored, the activities contributing to emissions at each point, the type of monitoring at each point, and the analytical parameters measured at each location.

Currently there are six fixed ventilation stacks that are permitted through the EPA at the WVDP. The Main Plant ventilation stack monitoring and sampling equipment is housed in an insulated building located south of the Main Plant stack base on the Ventilation Exhaust Cell (VEC) roof. Ventilation air exhausted from the STS is released from the STS Permanent Ventilation System (PVS) stack located at the WTF. Monitoring equipment for the PVS is located in a dedicated structure that is next to the PVS building. The CSS ventilation stack is located on top of the 01-14 Building with sampling and monitoring equipment is located inside the 01-14 Building. The CSRF ventilation stack is located on top of the Main Plant about 25 m (82 ft) north of the Main Plant stack. Ventilation air from the CSPF is exhausted through the ventilation stack located along the south wall of LSA-4. The Vitrification Facility (VF) heating, ventilation, and air conditioning system (HVAC) directs the flow of air through the VF. Gaseous effluent from the VF is released through the existing Main Plant ventilation stack and the VF HVAC system stack. The VF HVAC system stack is located on the west side of the Vitrification Building. The VF HVAC stack sampling and monitoring equipment is located in the West Aisle (El. 33.5 m [110 ft]). These units are operated at various locations around the WVDP and provide ventilation to support temporary activities in areas that are not routinely ventilated and where the potential for airborne contamination exists.

Isokinetic air samples from these stacks are continuously drawn and transported to the sampling and monitoring instruments. The sample streams pass through glass fiber particulate filters and charcoal cartridges before returning back to the stack for discharge to the environment. (For the Main Plant stack, a fraction of the air from the downstream side of the fiber filter and charcoal cartridge is passed through desiccant columns designed to collect tritiated water vapor.) Filters are changed and screened weekly for gross radioactivity. Quarterly composites from both the glass fiber and charcoal filters are analyzed for gamma isotopes, Sr-90, I-129, and actinide isotopes. Currently there are no requirements to monitor for nonradiological parameters.

The monitoring system at the Main Plant stack is comprised of a set of nozzles and an air monitoring transport line, independent of the sampler system, that isokinetically and continuously transports air samples to continuous air monitors (CAMs). The monitoring stream is wyed into both a beta CAM and an alpha CAM, which each have alarm set points that are set and maintained in accordance with environmental monitoring procedures. The alarm set points for alpha and beta/gamma activity are set to allow for corrective actions to be taken to limit public and/or environmental exposures. CAMs are also present at other stack exhaust points to provide alarm indications should radioactive particulate levels in the exhaust air exceed pre-set levels. Flow and count-rate sensors will activate a backup vacuum pump and various alarms if equipment failures occur. The systems are provided with auxiliary backup power. Monitoring capabilities are given in Table 8.3-9.

8.6.1.1.2 Radioactivity in Surface Water and Groundwater

Surface Water

Surface water samples are collected on-site from ponds, streams, swamps, seeps, and from drainage channels that flow through the Western New York Nuclear Service Center (WNYNSC) and off-site into Cattaraugus Creek.

On-site and off-site surface water monitoring locations are shown in Figures 8.6-3 and 8.6-4, respectively. The most recent monitoring program information and results on these locations are provided in the SER for CY2000. Historical surface water monitoring program information and sample analysis results are provided in previous SERs.

Surface water samples are collected manually by grab sampling or automatically by using fixed sampling equipment. Automatic samplers are used to collect surface water at select points along drainage channels within the WNYNSC that are most likely to show radioactivity released from the site and at one background station upstream of the site.

The two largest sources of radioactivity released to surface waters from the project are: 1) the discharge from the LLWTS through the Lagoon 3 weir into Erdman Brook, a tributary of Frank's Creek and 2) the drainage from the north plateau via monitoring location WNSWAMP which also reaches Frank's Creek.

WVDP-098, Section 2.0, provides a detailed discussion of the liquid effluent monitoring program. Nonradiological releases to surface waters by the site are regulated by the New York State Department of Environmental Conservation (NYSDEC) under the site's State Pollutant Discharge Elimination System (SPDES) permit. (See Section 8.6.1.2, *Nonradiological Monitoring.*) Radiological releases in liquid effluents are compared to derived concentration guides (DCGs) as specified in DOE 5400.5. Estimates of dose to individuals and populations are calculated using unit dose factors from WVDP-065, *Manual for Radiological Assessment of Environmental Releases at the WVDP,* and the procedures in EM-201, *Radiological Dose Assessment Procedures.*

Off-site surface waters are collected from Buttermilk and Cattaraugus Creeks both upstream and downstream of the site in order to assess effects of site drainage into the creeks. Standing surface waters are also sampled at points near the site (see Figure 8.6-4 for off-site surface water locations). WVDP-098, Section 5.1, provides a description of the program for monitoring off-site surface water.

Groundwater

The WVDP groundwater monitoring program is designed to support DOE Order 450.1 requirements and those of the RCRA 3008(h) Administrative Order on Consent that involves NYSDEC, EPA, NYSERDA, and DOE. On-site and near-site groundwater monitoring well locations are shown in Figures 8.6-5 and 8.6-6, respectively. The groundwater monitoring program is described in WVDP-239.

8.6.1.1.3 Radioactivity in the Food Chain

The biological monitoring program consists of sampling and analysis of milk and beef from cattle at near-site and remote locations, forage and produce such as hay, corn, apples, and beans from near-site and background locations, and fish and deer from near-site and background locations during periods when they would normally be taken by sportsmen for consumption. Near-site biological sampling locations are shown on Figure 8.6-6. Information on the biological monitoring program and detailed sample analyses results are presented in the SER for CY2002. Biological sample results and

program information for previous years are provided in past SERs. The monitoring program for foodstuffs is described in WVDP-098, section 5.4.

8.6.1.1.4 Direct Environmental Radiation

To further assist in determining total radiation exposures to on-site and off-site populations from site and background radiation, an array of thermoluminescent dosimeters (TLDs) is placed on-site near waste-management units, at locations along the site security fence, around the site perimeter, in communities near the site, and at off-site background locations. On-site TLD locations are shown in Figure 8.6-7 and site boundary and off-site TLD locations are shown in Figure 8.6-8. The perimeter TLDs (1 through 16, 20, 24, and 26-34) are located around the WNYNSC boundary in the sixteen compass sectors and at locations along the security fence; while TLDs 17, 21 to 23, 37, and 41 monitor community and background locations.

Information on the TLD monitoring program and exposure results are provided in the SER for CY2002. Historical results from these monitoring locations are provided in previous SERs. See WVDP-098, section 5.3 for the description of methods for monitoring environmental radiation.

8.6.1.2 Nonradiological Monitoring

Surface Water Monitoring

Nonradiological parameters in liquid effluents are regulated by NYSDEC and are monitored as a requirement of the site SPDES permit. The WVDP SPDES permit identifies the outfalls where liquid effluents are released to Erdman Brook, specifies the sampling and analytical requirements for each outfall (or combination of outfalls), and sets limits on concentrations of constituents being released from each outfall. Nonradiological constituents for which liquid effluents are monitored are listed in WVDP-098, Appendix A. The site SPDES permit was renewed effective February 1, 2004, and expires on February 1, 2009.

Four outfalls are identified in the permit: outfall 001, discharge from the LLWTS; outfall 007, discharge of sanitary and utility water from the waste water treatment plant; outfall 008, groundwater effluent from the perimeter of the LLW2 storage lagoons; and pseudo-outfall 116 used as a compliance point for TDS monitoring.

Drinking Water Monitoring

The site's drinking water is monitored for various nonradiological parameters to verify compliance with EPA and New York State Department of Health regulations. Special monitoring is conducted under the direction of the Cattaraugus County Health Department. Analytical parameters are listed in WVDP-098, Appendix A. Near-site drinking water is monitored at locations shown in Figure 8.6-6.

Groundwater Monitoring

Nonradiological parameters routinely monitored in site groundwater are listed, by monitoring point, in WVDP-239. Modifications that affect compliance monitoring for the RCRA 3008(h) consent order must be approved by NYSDEC.

8.6.2 Analysis of Multiple Contributions

This section is not applicable to the WVDP because there are no nearby nuclear facilities either operating or planned during the duration of the Project. (The adjacent SDA is maintained in a shut-down status by NYSERDA. Per the cooperative agreement between DOE and NYSERDA, effluents from this facility had been treated and discharged by the Project.) Following closure of the SDA lagoon in 1991, NYSERDA

has maintained sole responsibility for all effluents and waste generated as a result of management and maintenance of the closed LLW disposal facility. Data from monitoring of points on or near the SDA are reported in the SER.

The WVDP will continue to measure the concentrations of radioactivity in all permitted air and liquid effluents from the site and to report the total calculated off-site doses in the Annual Site Environmental Reports.

8.6.3 Estimated Exposures

8.6.3.1 Source Term Estimation

Source terms for each system or facility are developed through the application of analytical methods, extrapolation of relevant measurement data, and to the extent necessary, from engineering judgment. Characterization information for several WVDP facilities is contained in Radioisotope Inventory Reports (RIRs). For dose assessment calculations, only radionuclides that contribute greater than 0.1% of the total effective dose equivalent are reported.

Several important parameters are considered when estimating radiological source terms (activity released) from source inventories (total activity available). These calculations require quantification of parameters including Material-at-Risk (MAR), Damage Ratio (DR), Airborne Release Fraction (ARF) or Airborne Release Rate (ARR), Leak Path Factor (LPF), and Respirable Fraction (RF). Estimated source terms used in accident calculations are derived using these parameters and guidance provided in DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Non-Reactor Nuclear Facilities*.

8.6.3.2 Environmental Pathways

The pathways by which radioactive effluents may be dispersed into the off-site environment and eventually expose members of the general public to radiation are broadly categorized as airborne or waterborne. Both of these major pathways may lead to direct external exposure since gamma and energetic beta emitters will usually be among those radionuclides released. External exposure can result from immersion in an airborne cloud of radioactive particulates or from immersion in contaminated waters, or from proximity to radioactivity deposited on land, vegetation, sediments, and stream banks.

The more significant exposures from both the air and water pathways are likely to result from internally deposited radionuclides. Inhalation of airborne radioactive particulates is an important cause of lung irradiation and irradiation of other tissues and organs when particles move from the lung. Ingestion of radionuclides also results in internal radiation exposure. Some ingestion pathways are direct, such as drinking contaminated water. Others are more complex, such as the transfer of radioiodine deposited from air or irrigation water on forage to cows, to milk, and to humans. The pathways to be analyzed for routine releases from the WVDP (by the CAP88-PC and GENII codes [PNL, 1982], discussed in Section 8.6.3.4) are illustrated in Figure 8.6-9.

For short-term accidental releases to the atmosphere, only inhalation and direct radiation from cloud immersion are of significance and need be considered when estimating the dose to the maximally exposed individual. This is done by using the models and codes described in Section 8.6.3.4. Accidental releases to the hydrosphere of short duration will result in dispersion over an extended time and are modeled in most cases as a chronic release, using the GENII code. If an accident scenario is identified which leads to a credible release of short duration directly to surface water, an analysis of the pathways is done using the GENII computer code or by hand calculations.

8.6.3.3 Radiological Parameters

Calculations of dose to the public from exposures resulting from both routine and unplanned activities or accidents are performed using standard EPA, DOE, or NRC analytical models and dose conversion factors prescribed in regulations applicable to WVDP operations. Analytical models and radiological parameters used for dose evaluations are appropriate for characteristics of emissions (e.g., gas, liquid, or particle; depositing or non-depositing); mode of release (e.g., stack or vent; surface or subsurface water; continuous or intermittent); environmental transport medium (e.g., air or water); and exposure pathway (e.g., inhalation; ingestion of food, water, or milk; direct radiation). Information on dispersion in the environment, demography, land use, food supplies, and exposure pathways used in the dose calculations is provided in Chapter 3. Dose evaluation models that are coded, approved, or accepted by regulatory or other authorities will be used where appropriate, such as the CAP88-PC code for demonstrating compliance with 40 CFR 61 Subpart H, *National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities* (USEPA).

The dose conversion factors used to make dose evaluations under normal operations and during accidents are those provided in three EPA and DOE documents: EPA-520/1-88-020; DOE/EH-0070; and DOE/EH-0071. The internal dose conversion factors presented in EPA-520/1-88-020 and in DOE/EH-0071 are based upon the ICRP reference man model (ICRP 1974). Because radionuclides taken into the body by ingestion or inhalation will continue to irradiate the body as long as they exist and are retained by the body, these internal dose conversion factors represent the committed dose, which is the dose integrated over an interval of 50 years. The doses from exposure to external radiation from radionuclide concentration in air and in water that result from submersion or from exposure to contaminated plane surfaces are estimated using the external dose conversion factors presented in DOE/EH-0070.

Dose to the maximally exposed on-site and off-site individual and dose to a population are calculated. In the context of Project safety analysis, "dose" is understood to mean the sum of the external dose and the 50-year committed dose equivalent expressed in units of rem or millirem (mrem). Effective dose equivalent commitments are calculated using standard EPA and DOE dose conversion factors. No attempt is made to estimate dose as a function of the age or sex of the maximally exposed individual.

For short-term airborne releases, the maximally exposed on-site individual is assumed to be at the On-Site Evaluation Point (OEP) and off-site individuals are assumed to be located at the nearest site boundary, or at the distance that produces the maximum exposure using site-specific meteorology or prescribed stability class and wind speed conditions. Radionuclide-specific unit dose factors are calculated using dose conversion factors and χ/Q values calculated for various meteorological conditions as presented in WVDP-065.

8.6.3.4 Analytical Tools

The principal environmental pathways considered in the assessment of doses to off-site individuals include:

- atmospheric dispersion,
- surface water transport, and
- subsurface or groundwater transport.

Codes used for evaluation of doses through each of these pathways are briefly discussed below:

Atmospheric Dispersion

The CAP88-PC computer code (USEPA, 1992) is used to predict individual doses from continuous releases of radioactivity for the maximally exposed off-site individual (MEOSI), doses at site boundaries, and the collective dose within 80 km of the WVDP. This code uses a modified version of the straight-line Gaussian plume dispersion equation and site-specific meteorological conditions to compute radionuclide concentrations in air, rates of deposition on ground surfaces, concentrations in foods, and human intake rates resulting from inhalation and ingestion of contaminated air and food products.

Waterborne Pathway

The radiological impact of liquid effluents released to surface water is estimated using the GENII code (PNL, 1982), which implements the radiological exposure models of NRC Regulatory Guide 1.109. Radiological impacts from potable water, aquatic foods, shoreline deposits, swimming, boating, and irrigation are calculated in terms of dose to the maximally exposed individual and to the general population living within 80 km of the WVDP. Dose conversion factors, based on ICRP Publication 30, are generated by the GENII code.

Soil Pathway

To analyze radiological impact from surface or subsurface contamination, the methodology employed in the RESRAD (Gilbert et al. 1989) and PRESTO-II codes is used. RESRAD is a computer code for implementing DOE guidelines for residual radioactive material. The RESRAD code establishes soil cleanup criteria on the basis of prediction of radiation doses received by an individual from radionuclides contained in the soil and transported in the environment. The code considers six long-term environmental transport pathways: external radiation from contaminated soil materials; internal radiation from ingestion of contaminated dust particles; internal radiation from ingestion of plant foods grown on contaminated areas and irrigated with water drawn from a nearby well or pond; internal radiation from ingestion of milk from livestock fed with fodder grown on a contaminated area and water drawn from a nearby well or pond; internal radiation from drinking water from a nearby well or pond; and internal radiation from ingestion of aquatic food from a nearby pond.

PRESTO-II is a computer code developed to evaluate possible health effects from shallow land burial of LLW. The model is intended to assess radionuclide transport and health impact to a local population for up to 1,000 years following the end of burial operations. Pathways and processes of transport from the disposal trench to an individual or population include: vertical subsurface flow, groundwater transport, chemical exchange, overland flow, erosion, surface water dilution, resuspension, inhalation, and ingestion of contaminated beef, milk, crops, and water. Off-site population and individual doses may be calculated as well as doses to the on-site individual.

8.6.3.5 Estimated Exposures from Airborne Releases

Airborne emissions result from ventilation of contaminated areas of the VF, Main Plant building and other contaminated areas and vessels. Ventilation air is filtered before discharge to the stacks. The Main Plant stack serves as the discharge point for the VF Process Off-Gas System, the Main Plant ventilation system, the Head End Cell ventilation system, the VOG system, and the FRS facility ventilation exhaust. Emissions from other smaller stacks identified in WVDP-098 are also used to calculate the exposure from airborne releases.

Dose assessments for discharges from the stacks identified in WVDP-098 in addition to the contribution from PVUs were performed. The total airborne activity released per year from the VF, Main Plant, STS, 01-14 Building, CSPF, and CSRF stacks is listed in Table 8.6-1.

The total effective dose equivalent (TEDE) to the MEOSI in 2003 was calculated to be 1.7E-3 mrem/yr for airborne discharges from all stacks.

8.6.3.6 Estimated Exposures from Liquid Releases

Radioactive liquid wastes are processed through existing systems at the WVDP such as the LWTS and LLWTS. Discharges from the LLWTS are monitored, and annual individual and collective doses to the public are calculated.

An estimate of the dose to the MEOSI has been calculated using analytical data obtained from lagoon discharge sampling. Table 8.6-2 lists the curie contributions from isotopes contributing greater than 0.1% to the total activity. The dose to the MEOSI for Main Plant liquid discharges in 2003 was 1.8E-2 mrem (West Valley Nuclear Services Co. and URS Corp., August 2004).

8.7 Prevention of Inadvertent Criticality

8.7.1 Introduction

The criticality safety program at the WVDP has been developed to control fissionable materials and potential nuclear criticality hazards in a way that assures that workers, members of the general public, government and personal property, and essential operations are protected from the effects of an inadvertent criticality accident. Fissionable materials at the WVDP are processed, stored, transported, transferred, and handled in a manner that assures that the potential for an inadvertent criticality is acceptably low.

The criticality safety program assures that environmental protection, safety, and health protection matters associated with all fissile and fissionable materials operations at the WVDP are comprehensively addressed and receive an objective review with all identifiable risks reduced to acceptably low levels, and that management authorization of all operations is documented. Consideration is given to all potential criticality hazards associated with fissionable material operations.

Criticality safety at the WVDP is achieved through the application of administrative controls. Evaluations have shown that there is no credible potential for an inadvertent criticality associated with VF activities, IRTS activities, or Main Plant activities when fissile materials are packaged in conformance with site administrative controls.

8.7.2 Requirements

Criticality safety at the WVDP is maintained through the management policy established in WV-923, *Nuclear Criticality Safety,* and adherence to the requirements set forth in WVDP-162, *WVDP Nuclear Criticality Safety Program Manual*. This manual implements the requirements of DOE O 420.1A, *Facility Safety,* and incorporates the elements of the following mandatory American National Standards of the American Nuclear Society (ANSI/ANS) pertaining to nuclear criticality safety:

- ANSI/ANS-8.1-1983, R88, *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors,* (with paragraphs 4.2.2 and 4.2.3, and paragraph 3.3 modified as directed in Section 4.3.3.d of DOE O 420.1A)

- ANSI/ANS-8.3-1986, *Criticality Accident Alarm System*, (with paragraphs 4.1.2, 4.2.1 and 4.2.2 modified as directed in Sections 4.3.3.c and 4.3.3.e of DOE O 420.1A)
- ANSI/ANS-8.5-1986, *Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material*
- ANSI/ANS-8.6-1983, R88, *Safety in Conducting Subcritical Neutron-Multiplication Measurements In-Situ* (with paragraph 5.3 modified as directed in Section 4.3.3.f of DOE O 420.1A)
- ANSI/ANS-8.7-1975, R87, *Guide for Nuclear Criticality Safety in the Storage of Fissile Materials* (with paragraph 5.2 modified as directed in Section 4.3.3.c of DOE O 420.1A)
- ANSI/ANS-8.9-1987, *Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials*
- ANSI/ANS-8.10-1983, R88, *Criteria for Nuclear Criticality Safety Controls in Operations with Shield and Confinement*
- ANSI/ANS-8.12-1987, R93, *Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors*
- ANSI/ANS-8.15-1981, R87, *Nuclear Criticality Control of Special Actinide Elements*
- ANSI/ANS-8.17-1984, R89, *Criteria for the Handling, Storage, and Transportation of LWR Fuel Outside Reactors*, (with paragraph 4.3 modified as directed in Section 4.3.3.g of DOE O 420.1A)
- ANSI/ANS-8.19-1984, R89, *Administrative Practices for Nuclear Criticality Safety*
- ANSI/ANS-8.20-1991, *Nuclear Criticality Safety Training*
- ANSI/ANS-8.21-1995, *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors.*

Notification, investigation, and reporting requirements are in accordance with DOE Orders 232.1A, *Occurrence Reporting and Processing of Operations Information.*

8.7.3 Criticality Concerns

Many areas of the WVDP are contaminated with materials containing concentrations of fissile material that represent a criticality concern. These materials are in the form of solids, such as fuel fines, and in the form of liquids and sludges. The primary fissile nuclides in these materials are U-235 and Pu-239, although U-233 and Pu-241 are also present in quantities that also contribute to the reactivity of a system. The concentration of fissile material in most of this debris is well below a level that represents a criticality safety concern. However, wastes containing greater than 1 gram of fissile material are evaluated and, if necessary, are managed to ensure that criticality safety is maintained during the packaging and storage of these materials.

Many of the processes associated with both the NFS and WVDP technologies generated product and waste streams containing fissile material. Primary known sources of fissile material wastes at the WVDP include the high level waste tanks, Main Plant head end, extraction, product, and analytical cells and the wastes contained in the Lag Storage Building. Analyses have been performed for a broad range of conditions of waste moderation, reflection, composition, fissile material form, and package geometry to provide the most generally applicable limits possible for the safe packaging and storage of these fissile materials.

8.7.3.1 General Criticality Concerns

Analyses referenced in Appendix A of WVNS-NCSE-001, *Nuclear Criticality Safety Evaluation for the Packaging and Storage of Fissile-Bearing Wastes at the WVDP*, establish limits for 55-gallon drums and B-25 boxes as well as limits for boxes having dimensions less than those of a B-25 box. The analysis provides a set of generally applicable limits that assure the criticality safety of packaged fissile materials regardless of the waste matrix composition, internal package moderation, external package moderation and reflection, fissile material composition, or homogeneity of fissile material within the waste matrix. To accomplish this objective, a number of parametric analyses were performed to determine the most reactive condition for several parameters including fissile material composition, waste matrix material composition, waste container moderator content, fissile material homogeneity, and external waste package reflection.

Given the highly variable nature of waste streams at the WVDP, several simplifying, conservative assumptions were made to assure that the analysis contained in NCSE-001 would be generally applicable to all WVDP waste streams. The analysis assumes that:

- all fissile material in waste containers is Pu-239, which is the most reactive fissile nuclide at the WVDP;
- waste is stored in an infinite two-dimensional array four tiers (12 feet) high;
- fissile material in adjacent drums in the storage array is heterogenously distributed and is configured in a way that produces a maximum array reactivity; and
- the waste is optimally moderated and reflected.

The determination of the fissile mass limits for waste drums and boxes required the identification of the fissile material composition to be used in models. Fuel received by NFS for reprocessing typically contained uranium enriched to 3 weight percent U-235 or less. Historical records indicate that only one special campaign of mixed oxide thorium-based fuel contained an initial enrichment of U-235 greater than 5 weight percent. Fuel in this campaign was manufactured by down-blending high enriched uranium (93 w/o U-235) with thorium oxide. The resulting U-235 enrichment in the blended fuel was approximately 5.8 weight percent.

NFS received little mixed oxide fuel for reprocessing and therefore most fuel did not contain an initial inventory of plutonium or other fissile nuclides. However, reactor irradiation of U-238 generated plutonium and other fissile isotopes in proportion to the degree of fuel burnup. Based on a review of WVDP waste and product streams, it was concluded that the only fissile nuclides of concern at the WVDP are U-233, U-235, Pu-239, and Pu-241. While the relative proportion of these nuclides in a particular waste stream may have a significant effect on the reactivity of a system, Pu-239 was selected as the sole nuclide in all calculations for the analysis due to its high reactivity relative to other nuclides.

The waste matrix for the analysis was determined through an evaluation of materials known to be good moderators and that were known to exist in WVDP waste streams. These materials were water, concrete, and cellulose. A series of models were prepared to assess the reactivity of a two-dimensional infinite array of 90 ft^3 boxes (i.e., B-25 boxes) and 55-gallon drums containing Pu-239 homogeneously distributed throughout the waste matrix. In the case of cellulose and concrete, the waste matrix was blended with varying amounts of water ranging from 100% water (no waste material) to 0% water (all waste material) to assess the effect of included moderator in the matrix. These analyses concluded that the matrix material corresponding to the most reactive system was cellulose.

Following identification of the matrix material, models were prepared to assess the potential for increased reactivity in arrays of WVDP waste drums and boxes. The models involved a series of parametric analyses in which it was assumed that all the fissile material in the waste package was contained either in a metal sphere or a sphere in which the fissile material is blended with cellulose. Through these analyses it was determined that a maximum array reactivity exists for the condition in which the fissile material in each of eight adjacent waste packages is concentrated at the point of intersection of the containers. Applying this methodology, safe fissile mass limits for boxes and drums of waste were identified. Due to the nature of the analysis, the limits are expected to be generally applicable and bounding for all potential waste streams that may be encountered at the WVDP.

8.7.3.2 Criticality Concerns During Facility Decontamination

The assumptions and conservative nature of the analysis contained in WVNS-NCSE-001 ensures that the limits derived in the analysis can be safely applied to all fissile-bearing wastes generated at the WVDP. Occasionally, though, these limits are too restrictive and it is necessary to develop controls that are not based on such highly conservative assumptions. Analyses for other WVDP waste streams that may potentially contain fissile material masses in excess of the limits permitted by WVNS-NCSE-001 have been developed for wastes removed from the Head End Cells and the Product Purification Cell (PPC).

8.7.3.2.1 Criticality Concerns Related to Head End Cell Decontamination

Fuel processing operations in the Main Plant involved the handling and processing of significant quantities of fissile material. Much of this material has been removed from the Main Plant through decontamination of plant areas, either by NFS or WVNSCO; however, some areas remain contaminated with fissile materials. While some of this material is present as sludges in plant vessels, a concern for criticality safety exists in the PMC and GPC due to the presence of solid fissile materials throughout these cells.

The PMC contains fines and hull sections that contain or may potentially contain fuel. This material is located on the cell floor and other surfaces throughout the cell. The GPC contains similar material in an accumulation in the sump area directly below the PMC/GPC hatch. Decontamination activities have removed much of this debris.

An analysis, based on the guidelines given in NRC Regulatory Guide 3.33, *Assumptions used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Fuel Reprocessing Plant*, was performed to determine the occupational and environmental impacts of a criticality in the cell (Wolniewicz October 28, 1993). The analysis indicated that an individual in the adjacent operating aisle would receive an approximate whole-body exposure of 98 mrem due to a 2E+19 fission event, which is considered to be significantly greater than an event involving a non-solution system. An additional analysis found that there would be little environmental impact due to the fission gas release (approximately 1 mrem to the MEOSI).

Decontamination of the GPC and PMC presents criticality concerns during the collection, processing, and storage of fissile-bearing materials. In the GPC, potentially moderated fissile-bearing wastes are collected and packaged. This activity alters the configuration of the material and potentially results in a more reactive configuration than currently exists in the slab configuration in which the material now lies. Packaged waste is dried if necessary prior to transfer to a storage array.

Collection, packaging, processing, and storage activities associated with HEC decontamination require that containers of fissile-bearing material be brought in proximity to each other. These activities present the potential for inadvertent criticality under certain conditions of moderation and spacing when the containers are filled with fuel-bearing materials having an enrichment of 5 w/o U-235. Little validated characterization data for the debris in the HEC exists; consequently, conservative assumptions were made in the analyses to evaluate the reactivity of decontamination operations. These assumptions are:

- the fuel in the debris is unirradiated
- the fuel has a U-235 enrichment of 5 w/o (97.5% of the fuel reprocessed by NFS had effective enrichments of less than 3.3 w/o)
- fuel hulls and fine particulate debris are assumed to be unreprocessed fuel
- arrays of fissile-bearing debris storage containers are assumed to be in an infinite two-dimensional hexagonal array
- fissile-bearing debris inside collection and storage containers is assumed to be arranged in an optimum configuration (i.e., hexagonal-pitch array).

Analyses to determine the reactivity of various normal and accident conditions are documented in WVNS-NCSE-002, *Nuclear Criticality Safety Evaluation for the Handling and Storage of Fissile-Bearing Debris in the Head End Cells*. The NCSE provides the basis for the controls (i.e., limiting conditions for operation) that are stipulated in PSR-18, *Collection, Processing, and Storage Requirements for Fissile Material from the Head End Cells*. Through analyses contained in NCSE-002, limits and controls are provided for the safe collection, packaging, and storage of fuel-bearing wastes from the HECs under both normal and accident conditions. NCSE-002 explicitly evaluates the criticality safety of collection/packaging and storage under normal conditions and collection/packaging and storage under abnormal and accident conditions.

A summary of the calculated keff for normal and accident conditions is provided in Table 8.7-1.

8.7.3.2.2 Criticality Concerns Related to PPC Decontamination

The PPC was used for the processing, handling and storage of high concentration plutonium and uranium product streams. Although vessels from the PPC were flushed and drained prior to removal from the cell, the potential that vessels removed from the PPC could exceed existing fissile material mass limits still exists. Consequently, analyses that specifically evaluated wastes removed from this cell were performed to develop less conservative but more appropriate limits for these wastes.

WVNS-NCSE-003 and WVNS-NCSE-006 together consider the removal and co-located storage of PPC vessels 5D-5A, 5D-5B, 5C-2, 5E-7, 5C-6A, 5C-6B and 5D-6. The following assumptions are made in WVNS-NCSE-006:

- Fissile material in tanks 5D-6, 5C-2, 5E-7, 5D-5A and 5D-5B is an homogeneous solution of $Pu(NO_3)_4$ containing 200g Pu/l.
- $Pu(NO_3)_4$ solution in tank 5D-6 is assumed to be uniformly distributed throughout the tank and is assumed to be half-density solution (0.66675 g/cm^3).
- Uranium silica gel beds 5C-6A and 5C-6B are full of an homogeneous uranyl nitrate solution containing 5 w/o U-235
- Vessels containing $Pu(NO_3)_4$ are half full
- $Pu(NO_3)_4$ solution systems contain no Pu-240

- Under normal operation conditions, reflection of all boxes is provided only by the ground. Under accident and abnormal conditions reflection is also provided by variable density water on the top.

These analyses assume that each vessel is stored in its own container and that the storage container is sealed to prevent the accumulation of water and release of contamination. The analysis determined that an array of PPC vessel storage containers is critically safe under all normal and credible abnormal conditions.

8.7.3.2.3 Criticality Concerns Related to Vit Facility Decontamination

Criticality calculations have been performed to determine the reactivity of HLW glass canisters (Yuan, January 1994). The model was very conservative and did not consider the neutron-absorbing boron present in the vitrified waste. Other differences between the calculational model and the actual material composition were treated conservatively (i.e., they were made to overestimate k_{eff}). The conclusion of this analysis was that the concentration of fissile material in the WVDP HLW glass canisters is so low that, even for an infinite array of canisters, the k_{eff} is well below 0.1 with optimum geometry and water moderation. This analysis applies equally well to waste materials removed from the Vitrification Facility during facility decontamination. Although these wastes may contain fissile materials in excess of that typically evaluated through the criticality safety program, the referenced analysis provides sufficient evidence to demonstrate that none of the wastes associated with decontamination of the Vitrification Facility need to be controlled for criticality safety purposes.

8.7.3.3 Criticality Concerns During Liquid Transfers of Fissile Materials

Normal plant process activities as well as cell and equipment decontamination activities generate liquid wastes that contain suspended or dissolved fissile materials. Due to the nature of activities at the WVDP, many waste streams contain some quantity of fissile material. For those waste streams containing greater than 1 gram of fissile uranium or plutonium, administrative controls have been developed to manage fissile material concentrations.

An analysis by WVNSCO (O'Ahoofe, 1985) calculated the safe concentration of Pu-239 corresponding to a given concentration of U-235. The analysis assumed a moderated, unreflected system containing only U-235 and Pu-239. Other fissile nuclides at the WVDP include U-233 and Pu-241. Although the analysis considered these nuclides, it concluded that they would not contribute significantly to the reactivity of the system in which they are present due to the relatively small fraction (less than 5%) of the total fissile mass that these nuclides represent.

8.7.3.4 Criticality Concerns Associated with Waste Storage

Fissile wastes at the WVDP may be packaged to one of several criteria. Individual criticality evaluations discussed in Sections 8.7.3.1 through 8.7.3.3 above establish the criticality safety of wastes that are handled, packaged and stored in a manner consistent with the assumptions of the respective evaluations. It is possible, however, that wastes packaged to various criteria may not be safe due to interaction between arrays of stored containers. To preclude the possibility of unsafe interaction between arrays of stored containers, wastes packaged to a specific criteria are stored in individual administrative control areas (see section 8.7.4.2 for a discussion of Criticality Control Zones). These areas are surrounded by a buffer region of at least 2.4 m (8 feet) in which no other fissile materials may be stored in order to ensure that neutronic interaction is minimized to a negligible degree. This applies to all accessible staging and storage areas in which waste containers containing more than 1 g of fissile material are located and for which interaction hasn't been demonstrated to be critically safe.

To improve the efficiency of waste container storage for wastes generated during facility decontamination, an analysis has been performed that evaluates the juxtaposed storage of wastes that conform to one of the following criticality safety base assumptions or were derived from one of the following generation areas:

- wastes packaged to meet the criteria of WVNS-NCSE-001;
- wastes packaged to meet the criteria of WVNS-NCSE-002;
- bulk, high activity HEC wastes containing <9,800 g of fissile material; and
- Vitrification Facility wastes.

The analysis that demonstrates the safety of storing these wastes in a common area is documented in WVNS-NCSE-007, *Nuclear Criticality Safety Evaluation for the Co-Located Storage of HEC and Non-HEC Wastes Containing Fissile Material*. NCSE-007 does not stipulate requirements beyond those given in WVNS-NCSE-001 and WVNS-NCSE-002. Rather it evaluates the safety of co-locating containers previously evaluated in WVNS-NCSE-001 and WVNS-NCSE-002.

The model evaluated in WVNS-NCSE-007 considers wastes described in WVNS-NCSE-001 as either 55-gallon drums with 125 g of Pu-239 or as a B-25 box with 200 g of Pu-239. These containers were subjected to varying amounts of internal and external moderation to maximize system reactivity. In both cases the sources were taken to be spheres located within their containers so as to maximize neutron generation. Wastes described by WVNS-NCSE-002 were modeled as 30-gallon drums holding 1920 fuel rods. One third of all rods in a drum were taken to be filled with UO_2 enriched to 5 w/o and 5 v/o water. A worst case scenario incorporating two 30-gallon drums as described, with the difference being that the remaining two thirds of the fuel rods are completely filled with water. The other two thirds of the rods contained 5 v/o water only. Various horizontal co-locations of containers of differing array heights were analyzed and found to be critically safe under all conditions of external moderation.

Storage arrays modeled in WVNS-NCSE-007 assumed that wastes packaged to the criteria of WVNS-NCSE-001 are stacked to the height limit specified in WVNS-NCSE-001 while wastes packaged to the criteria of WVNS-NCSE-002 are stacked to the height of an array specified in WVNS-NCSE-002. Arrays of containers packaged to these different requirements placed next to each other were modeled in the WVNS-NCSE-007 analysis; however, no attempt was made to determine the safety of arrays in which materials that are packaged to the criteria of the individual analyses are stacked in a mixed array in the same vertical column.

The WVNS-NCSE-007 evaluation considered bulk HEC wastes as solids with fissile material particles imbedded in the surface. It was determined that, given the nature of the materials and the distribution and geometry of the fissile material, a criticality accident was not credible. The analysis argues that the bulk HEC waste will have no greater fissile mass than other HEC wastes, but the dimensions of the containers are in all cases greater than that of a 30-gallon drum. This serves to decrease the density of fissile material making the containers subcritical.

8.7.4 Criticality Controls

Criticality controls at the WVDP are developed through the guidelines given in WVDP-162 and the references contained therein. Engineering and administrative controls are provided to ensure that the occurrence of an inadvertent criticality is prevented throughout the course of normal activities and accident conditions. Administrative controls are the primary means of criticality control at the WVDP.

8.7.4.1 Engineering Controls

There are currently no engineered features in WVDP facilities that are relied on to prevent an inadvertent criticality.

8.7.4.2 Administrative Controls

Administrative controls developed through the guidelines and requirements given in WVDP-162 are the primary means for criticality control at the WVDP. These controls ensure that activities that require the storage, processing, or handling of fissile or fissionable materials are performed in a manner that provides an acceptable margin of safety for the prevention of an inadvertent criticality.

WVNS-NCSE-001 was written to provide a set of site wide criticality controls for handling fissile bearing wastes. The analysis considered various compositions and arrangements of fissile bearing waste matrices parametrically to establish upper bounds for container fissile mass limits and arrangements. The following general requirements are established by NCSE-001 and implemented in PRS-6:

- No more than 125 grams of fissile material may be stored in a 55-gallon drum, and no more than 200 grams of fissile material in any container whose smallest dimension is 30 inches. Containers whose smallest dimension is smaller than 30 inches are addressed in NCSE-001, and they have smaller mass limits.
- Containers may be stacked no more than 4 tiers high or 12 feet high, whichever is greater.

Equipment requirements specified in WVNS-NCSE-002 for HEC decontamination activities are summarized below.

- Only 114-L (30-gal) carbon steel drums, 72.4 cm + 1 cm (28.5 in + 0.4 in) high (outside) with an inside diameter of 46.0 cm + 1 cm (18.1 in + 0.4 in), shall be used for the storage of HEC fissile-bearing debris. (The selected tolerance of 1 cm (0.4 in) corresponds to a variation in geometry having an insignificant effect on reactivity for a waste package or array of packages.)
- The volume of an HEC fissile material debris-collection or processing container shall not exceed the dimensions of an HEC storage container specified above.
- Each 114-L (30-gal) HEC fissile-bearing debris storage drum shall be vented with a HEPA filter that can withstand at least 122-cm (48-in) water column without allowing water entry into a container (Nuclear Filter Technology Incorporated NucFil 013 filter with Gore-Tex, or equivalent).

Criticality analyses documented in WVNS-NCSE-002 have only evaluated the criticality safety of fissile-bearing debris that is contained in 114-L (30-gal) carbon steel drums. No parametric analyses have been performed for container size; therefore, storage is only permitted in containers having the dimensions prescribed above. Storage in containers having these dimensions ensures a limit on maximum fissile content per drum (based on process knowledge of fissile-bearing materials in the cell) and ensures a routine geometry in the storage array. Collection and processing of fissile-bearing materials can be performed using containers with smaller dimensions than those indicated; however, these containers must be over-packed in 114-L (30-gal) carbon steel drums for storage.

The safety of the fissile material array is enhanced when the presence of moderator in the storage containers is minimized. This is accomplished initially through the drying of collection containers to remove liquid to the greatest extent practicable,

and is assured subsequently through the use of water-resistant HEPA filters that prevent the infiltration of water into a sealed drum even in the event that the drum is subjected to a significant head of water.

Accessible areas of WVDP facilities for which administrative controls must be maintained to preclude an inadvertent criticality as a result of the form, quantity, or concentration of stored fissile or fissionable material are designated as Criticality Control Zones. Criticality Control Zones are posted to indicate a definite boundary and provide a means of controlling fissionable material inventory in the designated location. Administrative controls placed on activities conducted in these areas ensure that amounts of moderating material are minimized, that procedures for work involving fissionable material are reviewed by a criticality safety engineer (CSE), and that fissionable material in an unmoderated criticality zone is maintained as such.

WVNS-NCSE-003, WVNS-NCSE-004 and WVNS-NCSE-006 were written to evaluate the storage of vessels removed from the PPC during D&D operations in that cell. These analyses evaluated various conditions of external moderation and fissile mass within the vessels. It was assumed that each vessel was packaged in its own waste storage box, and it was found that under all conditions of external moderation, these vessels were critically safe by a wide margin.

WVNS-NCSE-005 was written to address criticality issues related to the RHWF, and further information can be found in WVNS-SAR-023.

WVNS-NCSE-001 and WVNS-NCSE-002 did not consider the possibility that the different wastes examined in each evaluation would be stored in close proximity. This is the origin of the requirement for the 8 feet of separation between criticality control zones. WVNS-NCSE-007 was an analysis performed to examine the co-location of wastes governed by NCSE-001 and NCSE-002, as well as evaluating the use of containers larger than 114-L (30-gallon) for large equipment being removed from the HEC.

Certain pieces of equipment in the HEC were too large to be feasibly size reduced to fit in 114-L (30-gallon) containers, such as the PMC fuel shear. NCSE-007 determined that it was critically safe to use larger containers to accommodate these items.

NCSE-007 also evaluated the practice of co-locating wastes governed by PSR-6 and PSR-18. No assessment of criticality safety was made with regard to stacking differently controlled wastes in the same vertical column, and this NCSE does not relax any of the Limiting Conditions for Operation (LCO) established in the preceding NCSE.

Administrative control limits have been established to ensure that activities conducted within WVDP facilities maintain a wide margin to criticality. Specific process control limits have been developed for the concentration of fissionable materials in liquids transferred between tanks; for the mass of fissionable materials in waste containers; for the amount of moderator that may be present in a Head End Cell storage container; and for the stacking height of containers of fissile bearing wastes in a storage array. These controls establish limits, dictate surveillance requirements to ensure compliance with the limits, and provide contingent actions for circumstances when it is discovered that the limits are not met.

In addition to these controls, criticality safety has been incorporated into the WVDP Integrated Safety Management (ISM) program. ISM hazard screening requirements ensure that activities that involve the handling, storage, transfer, disposal, or

processing of fissionable materials, or activities conducted in or potentially affecting areas of the WVDP known to contain fissionable materials, are reviewed by a CSE.

8.7.4.3 Application of Double Contingency

WVDP-162 has been written to ensure that the double-contingency principle requirements set forth in DOE O 420.1A, are incorporated into all criticality control elements for activities conducted at the WVDP.

The following contingencies exist for the storage of 114-L (30-gal) carbon steel drums containing fissile-bearing debris from the HECs.

Fissile Mass - There would have to be much more fissile mass than that estimated to be present in the HECs (i.e., estimates of the fissile mass in the HECs would have to be in extreme error).

Moderation - At any one time, no more than two drums of HEC fissile-bearing debris shall contain a significant quantity (greater than 5 v/o) of water.

Spacing - HEC fissile-debris waste shall be stored only in 114-L (30-gal) carbon steel drums and shall be collected in containers having dimensions not exceeding those of a storage container.

The double-contingency analysis contained in Table 1 of WVNS-NCSE-002 evaluates these contingencies and assesses their integrity under abnormal operation and accident conditions. This evaluation concluded that all contingencies are sufficiently protected such that failure of any one would be an extremely unlikely event.

The Lag Storage Facility complies with criteria associated with the Double Contingency Principle by maintaining administrative control on two independent process parameters: the concentration of fissile material in the waste containers, and the height of the array of waste containers. (Memo FD:99:0049, WVNSCO, June 29, 1999, and Memo FD:99:0055, WVNSCO, August 4, 1999.)

8.7.5 Criticality Protection Program

Criticality safety at the WVDP is implemented through the requirements of WVDP-162, *WVDP Nuclear Criticality Safety Program Manual*. Subsections of this section provide general information regarding the WVDP criticality safety program.

8.7.5.1 Criticality Safety Organization

Administration of the criticality safety program at the WVDP is through WVNSCO Nuclear Safety & Emergency Management (NS&EM). The NS&EM Manager is responsible for monitoring and implementing nuclear criticality safety requirements and for assisting operating management in developing programs and plans for maintaining nuclear criticality safety by regular evaluations and assessments in work areas. The NS&EM Manager is responsible for developing and maintaining the criticality safety program manual, for concurring with the establishment and abolishment of Criticality Control Zones, and for Criticality Control Zone management. Additional responsibilities of the NS&EM Manager are listed in WVDP-162.

The Criticality Safety Engineer (CSE) is responsible for establishing and abolishing Criticality Control Zones and their operating limits, and for performing nuclear criticality safety evaluations for activities conducted at the WVDP. In addition, the CSE provides programmatic evaluation to ensure that fissionable materials are packaged in a manner that protects worker health and safety and the environment, and

that nuclear criticality safety evaluations are performed to identify potential accumulations of fissionable material during production, storage, transport, and handling. The CSE is responsible for developing controls for fissionable material accumulations to reduce the risk of accidental criticality.

8.7.5.2 Criticality Safety Plans and Procedures

Activities at the WVDP where nuclear criticality safety is a consideration are governed by written plans and procedures for initial planned activities and for subsequent modifications that may affect reactivity. Documented plans and procedures are provided for storing, processing, and handling of fissionable materials. Modifications to these plans and procedures are subject to an Unreviewed Safety Question Determination (USQD) evaluation to assess any potential impact on the approved Safety Basis.

8.7.5.3 Criticality Safety Training

A criticality safety training program has been developed at the WVDP in accordance with the requirements of DOE Order 5480.20A. As indicated in Section 10.3, criticality safety training is given to individuals who operate, maintain, and/or supervise activities in areas where significant quantities of fissionable materials are stored or handled. Elements of the training program require that each individual receive instruction in nuclear criticality safety, including a summary of criticality accident history and nuclear criticality theory, normal procedures, radiation control practices, configuration control, Criticality Control Zones, procedural compliance, and individual responsibility.

8.7.5.4 Determination of Operational Nuclear Criticality Limits

Operational nuclear criticality limits at the WVDP are developed based upon consideration of approved nuclear criticality safety evaluations. At the WVDP these evaluations are based on industry standards, such as LA-10860-MS, or are performed using industry-accepted Monte Carlo codes such as KENO-V.a or MCNP-4A and various cross section data provided by the Radiation Shielding Information and Computation Center (RSICC) at Oak Ridge National Laboratory. Before use at the WVDP, these codes are verified on each computing platform on which it will be used following standard site computer code verification procedures. Bias and bias uncertainty for each analysis are determined through comparison to benchmark criticals for systems of similar composition and documented in a nuclear criticality safety evaluation.

Safety margins for all calculations performed for WVDP activities and systems are established such that the calculated effective neutron multiplication factors, including all computational uncertainties for a unit, array of units, or systems containing fissionable material, are no greater than 0.95 within a 95% probability and 95% confidence level (i.e., $k_{eff} + 2\sigma \leq 0.95$, where σ is the uncertainty associated with the method of calculation and the value of k_{eff} incorporates any bias and bias uncertainty).

Analyses used to develop operational limits are reviewed by the WVDP Radiation and Safety Committee in accordance with WV-906 and WV-923. In addition, these analyses are independently reviewed by individuals whose education and experience meet the criteria for qualification as a CSE.

8.7.5.5 Criticality Safety Inspection/Audits

The WVDP Quality Assurance Manager is responsible for ensuring that independent appraisals are performed in accordance with WV-121, *Integrated Assessment Program.* Appraisals review and evaluate nuclear criticality safety against DOE Orders, federal and management requirements, Technical Safety Appraisal criteria listed in

DOE STD 1158-2002, *Self Assessment Standard for DOE Contractor Criticality Safety Programs*, or latest DOE requirements, as well as best management practices.

8.7.5.6 Criticality Infraction Reporting and Follow-Up

Occurrence reporting requirements dictated by DOE M 231.1-2, *Occurrence Reporting and Processing of Operations Information*, are implemented at the WVDP through WVDP-242, *Event Investigation and Reporting Manual*. This procedure establishes a system for determining, evaluating, reporting, and correcting occurrences.

As prescribed in the procedure, the facility manager is responsible for evaluating and categorizing occurrences, including criticality infractions, and completing oral notification per DOE requirements when determined to be applicable. Furthermore, the facility manager is responsible for ensuring that the corrective actions proposed and implemented as a result of an occurrence are adequate, and for approving the closeout of identified corrective action items resulting from occurrences in areas for which he/she is responsible.

8.7.6 Criticality Instrumentation

DOE O 420.1A requires that, for facilities in which the mass of fissionable material exceeds the limits established in paragraph 4.2.1 of ANSI/ANS-8.3-1986 and the probability of a criticality accident is greater than 10^{-6} per year, a criticality alarm system (CAS) be provided to cover occupied areas in which the expected dose exceeds 12 rads in free air. For those occupied areas in which the expected dose is not anticipated to exceed 12 rads in free air, a criticality detection system (CDS) shall be provided. For DOE purposes, a CAS is defined to be a criticality accident detection device and a personnel evacuation alarm, while a CDS is defined to be an appropriate criticality accident detection device but without an immediate evacuation alarm.

Analyses cited in Section 8.7.3 have demonstrated that, although the mass of fissionable material exceeding the limits established in paragraph 4.2.1 of ANSI/ANS-8.3-1986 does exist in certain facility areas, the credible potential for an inadvertent criticality in the Main Plant does not currently exist. DOE O 420.1A states that under those circumstances in which an inadvertent criticality accident is determined to be incredible due to the physical form of the fissionable material, or the probability of occurrence is determined to be less than 10^{-6} per year, neither a CAS nor a CDS is required. Nevertheless, analyses of Main Plant stack effluents for Sr-89 and Cs-137 are performed to detect the occurrence of a criticality, should one occur. (Calculations have shown that elevated levels of Cs-137 *and* the presence of Sr-89 in stack effluent samples would serve as indicators of an inadvertent criticality [Crotzer February 28, 1994].) Although these analyses are not required, they are performed as a best management practice.

8.8 Fire Protection

Fire Hazard Analyses (FHAs) are conducted to comprehensively and qualitatively assess the fire risk within individual areas comprising the facilities on-site. A complete discussion of the FHA process and its requirements are given in WVDP-177, *Fire Protection Manual*. DOE O 420.1A states that FHAs shall be developed for "all nuclear facilities, significant new facilities, and facilities that represent unique or significant fire safety risks." This Order also states that FHAs shall be developed using a graded approach. WVNSCO's proposed approach to performing FHAs for WVDP facilities in accordance with DOE O 420.1A requirements (Jablonski 1998) was accepted by DOE-OH/WVDP (Provencher 1998). FHAs that have been developed for nuclear facilities within the scope of this SAR are as follows:

- WVNS-FHA-001, *Fire Hazard Analysis - Vitrification Facility.*
- WVNS-FHA-010, *Fire Hazard Analysis - Chemical Process Cell - Waste Storage Area.*
- WVNS-FHA-011, *Fire Hazard Analysis Main Process Plant*, which also covers the Waste Reduction and Packaging Area, CSRF, and LWTS. Two addenda to WVNS-FHA-011 have been issued to cover the FRS facility and the HECs.
- WVNS-FHA-013, *Fire Hazard Analysis Cross-Reference STS/PVS Facilities.*

The FHAs listed above document that there are no open findings/audit items or requirements (i.e., actions required to correct fire protection deficiencies to comply with mandatory fire protection requirements). The FHAs conclude that the facilities evaluated either meet or exceed both the DOE property loss requirements and the Life Safety requirements for special-purpose industrial occupancies or industrial occupancies, as applicable.

The fire service main, which includes site-wide fire-fighting water supply, storage, and distribution, is discussed in WVNS-FHA-004, *Fire Hazard Analysis Fire Service Main/Hydrant System.* WVDP-319, *Facility Fire Assessments*, provides fire assessments for a number of other WVDP facilities.

The WVDP Fire and Explosion Protection Program is discussed in Section 4.3.6.

REFERENCES FOR CHAPTER 8.0

American Conference of Governmental Industrial Hygienists. *Industrial Ventilation - Manual of Recommended Practices.* (Latest Revision).

American Industrial Hygiene Association. 1991. *Strategy for Occupational Exposure Assessment.*

American National Standards Institute. 1966 (revised 1972). ANSI 1316-1966. *Practice for Occupational Radiation Exposure Records Systems.* New York, NY: American National Standards Institute.

_____. 1969. ANSI 13.1-1969. *Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities.* New York, NY: American National Standards Institute.

_____. 1975 (revised 1987). ANSI/ANS 8.7-1975. *Guide for Nuclear Criticality Safety in the Storage of Fissile Materials.* LaGrange Park, Illinois: American Nuclear Society.

_____. 1978. ANSI N323-1978. *Radiation Protection Instrumentation Test and Calibration.* New York, NY: Institute of Electrical and Electronic Engineers, Inc.

_____. 1981 (revised 1987). ANSI/ANS 8.15-1981. *Nuclear Criticality Control of Special Actinide Elements.* New York, NY: American National Standards Institute.

_____. 1983a (revised 1988). ANSI/ANS-8.1-1983. *Nuclear Criticality Safety in Operations with Fissionable Materials Outside Reactors.* LaGrange Park, Illinois: American Nuclear Society.

_____. 1983b (revised 1988). ANSI/ANS 8.10-1983. *Criteria for Nuclear Criticality Safety Controls in Operations with Shielding and Confinement.* New York, NY: American National Standards Institute.

_____. 1983c (revised 1988). ANSI/ANS 8.6-1983. *Safety in Conducting Subcritical Neutron-Multiplication Measurements in Situ.* LaGrange Park, Illinois: American Nuclear Society.

_____. 1984a (revised 1989). ANSI/ANS 8.17-1984. *Criteria for Handling, Storage, and Transportation of LWR Fuel Outside Reactors.* LaGrange, Illinois: American Nuclear Society.

_____. 1984b (revised 1989). ANSI/ANS 8.19-1984. *Administrative Practices for Nuclear Criticality Safety.* New York, NY: American National Standards Institute.

_____. 1986a. ANSI/ANS 8.3-1986. *Criticality Accident Alarm System.* LaGrange Park, Illinois: American Nuclear Society.

_____. 1986b. ANSI/ANS 8.5-1986. *Use of Borosilicate-Glass Raschig Rings as a Neutron Absorber in Solutions of Fissile Material.* LaGrange Park, Illinois: American Nuclear Society.

REFERENCES FOR CHAPTER 8.0
(Continued)

_____. 1987a. ANSI/ANS 8.9-1987. *Nuclear Criticality Safety Criteria for Steel-Pipe Intersections Containing Aqueous Solutions of Fissile Materials.*

_____. 1987. (revised 1993). ANSI/ANS 8.12-1987. *Nuclear Criticality Control and Safety of Plutonium-Uranium Fuel Mixtures Outside Reactors.* New York, NY: American National Standards Institute.

_____. 1995. ANSI/ANS 8.21-1995. *Use of Fixed Neutron Absorbers in Nuclear Facilities Outside Reactors.* LaGrange Park, Illinois: American Nuclear Society.

_____. 1997. ANSI-N323A-1997. *Radiation Protection Instrumentation Test and Calibration, Portable Survey Instruments.* New York, NY: Institute of Electrical and Electronic Engineers, Inc.

_____. 1993. ANSI N43.3-1993. *General Radiation Safety - Installations Using Nonmedical X-Ray and Sealed Gamma-Ray Sources, Energies up to 10 MeV.*

_____. 1992. ANSI Z88.2-1992. *American National Standard for Respiratory Protection.*

American Society of Heating, Refrigeration, and Air Conditioning Engineers. 1989. ASHRAE 62-1989. *Ventilation for Acceptable Indoor Air Quality.*

Bixby, W.W. April 11, 1990. *West Valley Demonstration Project Vitrification Off-Gas System (DW:90:0291).* Letter to J.M. Pope.

Caldwell, J.T. March 11, 1991. *K_{eff} Calculations for WVNS.* Letter ZW:91:0031. West Valley, NY: West Valley Nuclear Services Co.

Carl, D.E., et al. September 30, 1990. *West Valley Demonstration Project Vitrification Process Equipment Functional and Checkout Testing of Systems (FACTS).* Topical Report DOE/NE/44139-64. West Valley Nuclear Services Co. (See also Bonenberger, D.L. May 30, 1991. WD:91:0579.)

Crocker, R.L. October 10, 1989. *Vitrification Mass Balance Revision Number 7 (EK:89:0232).* Letter to V.S. Arakali, et al. West Valley Nuclear Services Co.

Crotzer, M. E. February 28, 1994. *General Purpose Cell (GPC) Criticality Detection.* Memo to T.J. Rowland. (IO:94:0044). West Valley, NY: West Valley Nuclear Services Co.

DiBiase, R. February 20, 1986. *Shielding Analysis: CTS Conversion (HG:86:0035).* Letter to K.A. O'Ahoofe. West Valley Nuclear Services Co.

_____. March 4, 1986. *Shielding Analysis: CTS Conversion with Attachment (HG:86:0047).* Letter to K.A. O'Ahoofe. West Valley Nuclear Services Co.

Ebasco Services, Inc. July 1, 1985. LWTS Shielding Analysis Report. EBAR 560.

REFERENCES FOR CHAPTER 8.0
(Continued)

Eggert, J.A. February 26, 1987. *Transmittal of Approved CSE and OSRs for Consolidation of TRU Waste Drums Containing Process Solutes.* Memo to S. Marchetti (FB:87:0067). West Valley, NY: West Valley Nuclear Services Co.

Elder, J.C. et al. January 1986. *A Guide to Radiological Accident Considerations for Siting and Design of DOE Nonreactor Nuclear Facilities, LA-10294-MS.* Los Alamos, NM: Los Alamos National Laboratory.

Gilbert, T.L., et. al. June, 1989. *A Manual for Implementing Residual Radioactive Material Guidelines.* Argonne National Laboratory, DOE/CH/8901, ANL/ES-160.

International Commission on Radiological Protection (ICRP). October, 1974. *Report of the Task Group on Reference Manual.* ICRP Report 23.

_____. July, 1979. Limits for Intake of Radionuclides by Workers. ICRP Publication 30, Part 1.

_____. 1979. *Limits for Intake of Radionuclide by Workers.* ICRP Publication 30, Part 2, 1980.

Jablonski, J.F. April 3, 1998. *Facilities Selected for Fire Hazard Analyses.* Letter to Mr. T.J. Rowland (WD:98:0262). West Valley, NY: West Valley Nuclear Services Co.

Johnson, P.G. November 12, 1993. *Shielding Analysis for the Vitrification Facility (BJ:93:0027).* Memorandum to J.J. Prowse with attachment.

_____. November 22, 1993. *Shielding Analysis for Storage of the High-Level Radioactive Waste Canisters in the Chemical Process Cell (BJ:93:0028).* Memorandum to J.J. Prowse with attachment.

National Fire Protection Association. February 11, 1994. NFPA 101®: *Code for Safety to Life from Fire in Buildings and Structures.* (See also Life Safety Code® Handbook.)

New York State Department of Environmental Conservation. January 8, 1992. *Permits to Construct Permanent Cold Chemical Building Air Emissions Sources 42200-0114-CTS02, 42200-0114-CTS03, and 42200-0114-CTS04.*

Nixon, Justina. May 1, 1995. *Vitrification Mass Balance*, Rev. 8. Memo No. CC:95:0031. Letter to V.S. Arakali, et al. West Valley Nuclear Services Co.

Nuclear Fuel Services, Inc. 1964. *Final Safety Analysis Report: Spent Fuel Reprocessing Plant.* Nuclear Regulatory Commission Docket 50-201.

_____. 1970. *Safety Analysis, Spent Fuel Reprocessing Plant, AEC Docket No. 50-201. Revision 5.*

_____. 1973. *Final Safety Analysis Report: Nuclear Fuel Services, Inc.* Reprocessing Plant, West Valley, New York. Nuclear Regulatory Commission Docket 50-201.

O'Ahoofe, K.A. July 2, 1985. *Allowable Fissile Material Solution Concentration for Liquid Transfers (FB:85:0150).* Letter to C.J. Roberts. West Valley Nuclear Services Co.

REFERENCES FOR CHAPTER 8.0
(Continued)

_____. March 24, 1986. *Vitrification Shielding Review/Analysis: CIEF Phase II Shielding Requirements (FB:86:0083)*. Letter to C.C. Chapman. West Valley Nuclear Services Co.

_____. April 11, 1986. *Vitrification Facility Shielding Review/Analysis: CIEF Phase II Shielding Requirements: Apron/Crane Maintenance Room (CMR)(FB:86:0089)*. Letter to C.C. Chapman. West Valley Nuclear Services Co.

_____. May 13, 1986. *Radiation Exposure Dose Map Outside the Vitrification Facility (FB:85:0112)*. West Valley Nuclear Services Co.

Oak Ridge National Laboratory. 1973. *ORIGEN - The ORNL Isotope Generation and Depletion Code*. ORNL-4628. M.J. Bell.

_____. November, 1990. *Publication CCC-542. CAP-88, Clean Air Act Assessment Package*. RSIC Computer Code Collection.

_____. June 1987. *PRESTO-II: Code System for Low-Level Waste Environmental Transport and Risk Assessment*. CCC-504 Radiation Shielding Information Center.

_____. May 1980. *User's Manual for LADTAP-II - A Computer Program for Calculating Radiation Exposure to Man from Routine Release of Nuclear Reactor Liquid Effluents*. NUREG/CR-1276.

Occupational Safety and Health Administration. *Occupational Safety and Health Standards*, 29 CFR 1910, as amended.

_____. *Safety and Health Regulations for Construction*, 29 CFR 1926, as amended.

Parks, C.V., and H.R. Dyer. March 19, 1991. Visit to WVDP to Discuss Criticality Safety Concerns Associated with Fissile Material Accumulation in the Integrated Radwaste Treatment System Evaporator, February 13-14, 1991. Letter Report to P.J. Valenti. West Valley, NY: West Valley Nuclear Services Co.

Provencher, R.B. April 22, 1998. *Selecting Facilities for Fire Hazard Analysis (FHA), DOE Order 420.1*. Letter to Mr. J.F. Jablonski (DW:98:0283). West Valley, NY: West Valley Nuclear Services Co.

Prowse, J.J. June 26, 1991. *Criticality Safety Analysis for WVNS Sludge Tanks and Related Processing Equipment*. Memo to Records Management. (FB:91:0129). West Valley, NY: West Valley Nuclear Services Co.

_____. March 1992. *Fault Tree for TR-IRTS-12*. (FB:92:0061). West Valley, NY: West Valley Nuclear Services Co.

_____. March 1, 1994. *Evaluation of Criticality Detection Capabilities of the Main Plant Effluent Sampling Equipment*, Rev. 1. Dames & Moore Memo: D&M:94:OP:JJP:05:0013 to M.E. Crotzer.

Rykken, L.E. June 2, 1986. *High-Level Waste Characterization at West Valley*. DOE/NE/44139-14.

REFERENCES FOR CHAPTER 8.0
(Continued)

Schiffhauer, M. and R.E. Inzana. 1987. *Scale Model Equipment Testing Final Report for the Period FY1985 to FY1987.* West Valley, NY: West Valley Nuclear Services Co.

U.S. Department of Energy. May 15, 1984. Change 4 (January 7, 1993). DOE Order 5480.4. *Environmental Protection, Safety, & Health Protection Standards.* Washington, D.C.

_____. February 8, 1990. Change 2 (January 7, 1993). DOE Order 5400.5. *Radiation Protection of the Public and the Environment.* Washington, D.C.

_____. June 1990. DOE/EH-0135. Performance Objectives and Criteria for Technical Safety Appraisals at Department of Energy Facilities and Sites. Office of Environmental, Safety, and Health (DOE-EH). Washington, D.C.

_____. July 1988a. DOE/EH-0070: *External Dose-Rate Conversion Factors for Calculation of Dose to the Public.*

_____. July 1988b. DOE/EH-0071: *Internal Dose Conversion Factors for Calculation of Dose to the Public.*

_____. January 15, 1993. DOE Order 450.1, *Environmental Protection Program.* Washington, D.C.

_____. December 1994. DOE-HDBK-3010-94: *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities.* Washington, D.C.: U.S. Department of Energy.

_____. July 1997. DOE Guide 440.1-3, *Occupational Exposure Assessment.* Washington, D.C.: U.S. Department of Energy.

_____. March 1999. DOE Guide 441.1-2: *Occupational ALARA Program.* Washington, D.C.: U.S. Department of Energy.

_____. March 17, 1999. DOE Guide 441.1-8. *Air Monitoring Guide.* Washington, D.C.

_____. November 15, 1994. DOE Order 5480.20A. *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities.* Washington, D.C.

_____. November 1, 2000. DOE Order 151.1A: *Comprehensive Emergency Management System.* Washington, D.C.: U.S. Department of Energy.

_____. September 30, 1995. Change 2 (November 7, 1996). DOE Order 231-1A. *Environment, Safety, and Health Reporting.* Washington, D.C.

_____. October 15, 1996. DOE P 450.4. *Safety Management System Policy.* Washington, D.C.

_____. August 19, 2003. DOE Manual 231.1-2. *Occurrence Reporting and Processing of Operations Information.* Washington, D.C.

_____. March 27, 1998. DOE Order 440.1A. *Worker Protection Management for DOE Federal and Contractor Employees.* Washington, D.C.

REFERENCES FOR CHAPTER 8.0
(Continued)

_____. June 2004. DOE-STD-1098-99: *DOE Radiological Control Standard*. Change 1. Washington, D.C.: U.S. Department of Energy.

_____. December 1995. DOE-STD-1095-95: *DOE Laboratory Accreditation Program for Personnel Dosimetry Systems*. Washington, D.C.: U.S. Department of Energy.

_____. December 1998. DOE-STD-1111-98: *The Department of Energy Laboratory Accreditation Program Administration*. Washington, D.C.: U.S. Department of Energy.

_____. December 1998. DOE-STD-1112-98: *DOE Laboratory Accreditation Program for Radiobioassay*. Washington, D.C.: U.S. Department of Energy.

_____. December 1999. DOE-STD-1121-98: *Internal Dosimetry*. Washington, D.C.: U.S. Department of Energy.

_____. December 1998. DOE-STD-1131-98: *General Employee Radiological Training*. Washington, D.C.: U.S. Department of Energy.

_____. December 1998. DOE-STD-1130-98: *Radiological Worker Training Program Management Manual*. Washington, D.C.: U.S. Department of Energy.

_____. June 1999. DOE-STD-1122-99: *Radiological Control Technician Training*. Washington, D.C.: U.S. Department of Energy.

_____. June 1988. PNL-6577. *Health Physics Manual of Good Practices for Reducing Exposure Levels that are As Low As Reasonably Achievable*.

_____. January 1, 2001. *Occupational Radiation Protection*. Code of Federal Regulations Title 10, Pt. 835. Washington, D.C.

_____. May 20, 2002. Change 3 (November 22, 2000). DOE Order 420.1A. *Facility Safety*. Washington, D.C.

U.S. Department of Labor. July 1, 2001a. *Occupational Safety and Health Standards*. Code of Federal Regulations Title 29, Pt. 1910. Washington, D.C.

_____. July 1, 2001b. *Safety and Health Regulations for Construction*. Code of Federal Regulations Title 29, Pt. 1926. Washington, D.C.

_____. *Respiratory Protective Devices*, 42 CFR 84.

U.S. Environmental Protection Agency. 1988. *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*. EPA-520/1-88-020, Federal Guidance Report No. 11.

_____. 1988. EPA-520/1-88-020: Federal Guidance Report No. 11, *Limiting Values of Radionuclide Intake and Air Concentration and Dose Conversion Factors for Inhalation, Submersion, and Ingestion*.

_____. *National Emission Standards for Emissions of Radionuclides Other than Radon from Department of Energy Facilities*, 40 CFR 61, Subpart H.

REFERENCES FOR CHAPTER 8.0
(Continued)

U.S. Nuclear Regulatory Commission. April 1977. *Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in a Fuel Reprocessing Plant.* Guide 3.33.

_____. October, 1977. Regulatory Guide 1.109: *Calculation of Annual Doses to Man from Routine Releases of Reactor Effluents for the Purpose of Evaluating Compliance with 10 CFR Part 60, Appendix I.*

_____. April 1977. Regulatory Guide 3.33: *Assumptions Used for Evaluating the Potential Radiological Consequences of Accidental Nuclear Criticality in Fuel Reprocessing Plant.*

_____. February 1993. NUREG-1400. *Air Sampling in the Workplace.*

_____. December 1996. NUREG/CR-6483. *Guide to Verification and Validation of the SCALE-4 Criticality Safety Software.*

Vance, R.F. November 1986. *Characterization of the Head End Cells at the West Valley Nuclear Fuel Reprocessing Plant.* Topical Report DOE/NE/44139-31. West Valley, NY: West Valley Nuclear Services Co.

_____. October 12, 1994. *Estimates Of Radioactivity Of The SCR Catalyst Bed.* (CC:94:0106). Letter to F. W. Damerow. West Valley Nuclear Services Co.

Weiss, T.G. January 28, 1999. *Plutonium Distribution in Three Big Rock Point EP Type Assemblies in the FRS Fuel Pool.* Letter to File (EN:99:0002). West Valley, NY: West Valley Nuclear Services Co.

West Valley Nuclear Services Co. WV-121: *Integrated Assessment Program* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WV-730: *Records Management and Storage* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WV-905: *Radiological Protection* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WV-906: *Radiation and Safety Committee*(latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. SHIP-201: *Industrial Work Permits* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WV-921: *Hazards Identification and Analysis* (latest revision). West Valley Nuclear Services Co.

_____. WV-923: *Nuclear Criticality Safety* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WV-984: *ALARA Program* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WV-988: *Employee "Right-to-Know" Program - Hazard Communication* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

REFERENCES FOR CHAPTER 8.0
(Continued)

_____. WVDP-010: *WVDP Radiological Controls Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-011: *WVNSCO Industrial Hygiene and Safety Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-026: *WVNSCO Occupational Health Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-065: *Radiological Parameters for Assessment of West Valley Demonstration Project Activities* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-070: *WVDP Internal Dosimetry Program Manual and Technical Basis Document* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-071: *WVDP External Dosimetry Program Manual, and Technical Basis Document* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-076: *Environmental Protection Implementation Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-098: *Environmental Monitoring Program Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-121: *Fire, Health, and Safety Procedures Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-131: *WVDP Radiological Control Procedures Manual, Volumes 1 through 8* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-162: *WVDP Nuclear Criticality Safety Program Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-163: *WVDP ALARA Program Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-177: *WVDP Fire Protection Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-179: *Respiratory Protection Program Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-193: *Emergency Action Derivation and Guidance Manual* for the West Valley Demonstration Project (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-215: *WVDP Hazards Assessment* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-216: *WVDP Workplace Radiological Air Sampling and Monitoring Program and Technical Basis Document* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

REFERENCES FOR CHAPTER 8.0
(Continued)

_____. WVDP-234: *WVDP Workplace Radiological Surface Measurements Program and Technical Basis Document* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-239: *Groundwater Monitoring Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-241: *Site Health and Safety Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-242: *Event Investigation and Reporting Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-246: *Radiological Assistance Program Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-262: *WVNSCO Manual for Records Management and Storage* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-290: *WVDP Radiation Safety Training Program Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-291: *WVDP Radioactive Source Control Program* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-292: *WVDP Radiation - Generating Device and Radiography Work Operations Program Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-293: *Radiological Protection Record Keeping and Reporting Program Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-310: *WVDP Safety Management System (SMS) Description* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-317: *WVNSCO Radiation Protection Laboratory Quality Assurance Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-318: *WVDP Radiological Instrumentation Calibration and Maintenance Program Manual* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-319: *Facility Fire Assessments* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVDP-423: *Radiation Protection Program Plan* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-FHA-001, *Fire Hazard Analysis - Vitrification Facility* (latest Revision.) West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-FHA-010, *Fire Hazard Analysis - Chemical Process Cell - Waste Storage Area* (latest Revision.) West Valley, NY: West Valley Nuclear Services Co.

REFERENCES FOR CHAPTER 8.0
(Continued)

_____. WVNS-FHA-011: *Fire Hazard Analysis Main Process Plant* (latest revision.) West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-FHA-011 Addendum 2: *Fire Hazard Analysis Addendum, Main Process Plant* (Fuel Receiving and Storage)(latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-FHA-013: *Fire Hazard Analysis Cross-Reference STS/PVS Facilities* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-DC-046: *Design Criteria, Sludge Mobilization Waste Removal System* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-NCSE-001: *Nuclear Criticality Safety Evaluation for the Packaging and Storage of Fissile-Bearing Wastes at the WVDP* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. WVNS-NCSE-002: *Criticality Safety Evaluation for the Handling and Storage of Fissile Bearing Debris in the Head End Cells* (latest revision). West Valley, NY: West Valley Nuclear Services Co.

_____. September 23, 1983. *Safety Assessment Document for the West Valley Demonstration Project Fuel Receiving and Storage Area*, West Valley, New York. Rev. 1.

_____. March 1987. *Spent Nuclear Fuel Removal Program at the West Valley Demonstration Project*. Topical Report DOE/NE/44139-37.

_____. June 29, 1999. *Closure of an Action Item Resulting from a Self-Assessment of WVDP-162 "Nuclear Criticality Safety Program Manual."* J.A. Lazzaro to L.J. Chilson, Memo FD:99:0049. West Valley, NY: West Valley Nuclear Services Co.

_____. August 4, 1999. *Safety Documentation Requirements for the Storage of TRU Waste Containers in Lag Storage Facilities*. J.A. Lazzaro to F.A. Tarantello, Memo FD:99:0055. West Valley, NY: West Valley Nuclear Services Co.

West Valley Nuclear Services Co. and URS Group, Inc. August 2001. *West Valley Demonstration Project Site Environmental Report Calendar Year 2000*. West Valley, NY: West Valley Nuclear Services Co.

Westinghouse Hanford Corporation. November 16, 1993. *West Valley, General Purpose Cell Criticality Evaluation*. WHC Radiation Physics and Shielding to M. Haas and M. Crotzer. Memo LW:93:0226.

_____. October 16, 1996. *Revised Criticality Assessment of the General Purpose Cell*. J.Greenborg to M. Crotzer. Memo LW:96:0025.

REFERENCES FOR CHAPTER 8.0
(Concluded)

Wolniewicz, J.C. April 23, 1993. *Transmittal of Estimate of Activity in the Former NFS Reprocessing Plant*. Letter to File (CN:93:0015).

_____. October 28, 1993. *Evaluation of a Criticality in a Main Plant Cell*. Memo to M. E. Crotzer and M. N. Haas (BJ:93:0026).

White, J.E and Eckerman, K.F. November, 1982. User's Manual for LPGS: *A Computer Program for Calculating Radiation Exposure Resulting from Accidental Radioactive Releases to the Hydrosphere*. Oak Ridge National Laboratory, Oak Ridge, TN.

Yuan, Y.Y. January 16, 1991. *Criticality Evaluation: Sludge Wash and Mobilization System - Zeolite Column*. Memo to C. J. Roberts (FB:91:0012). West Valley, NY: West Valley Nuclear Services Co.

_____. January 1994. WVDP High-Level Waste Nuclear Characteristics: An Independent Study. (See also Yuan, Y.C. January 31, 1994. D&M:OP:YCY:99:0001.)

_____. February 1994. *Criticality Evaluation of the WVDP Vitrification Process*. D&M:OP:YCY:05:0007 with attachment.

_____. April 11, 1991. *Criticality Evaluation IRTS Evaporator Draft, Final Report*. Memo to C. J. Roberts (FB:91:0081). West Valley, NY: West Valley Nuclear Services Co.

_____. April 22, 1996. *Nuclear Criticality Safety Evaluation: Spent Fuel Handling and Storage at the WVDP*. Orchard Park, NY: Square Y Consultants.

TABLE 8.2-1

DESIGN BASIS Cs-137 CONCENTRATIONS FOR IRTS FACILITIES

Facility	Design Basis Cs-137 Concentration (µCi/mL)
Supernatant Treatment System	
High-level waste	1,530 [1]
Liquid Waste Treatment System	
Decontaminated HLW	50.0
Cement Solidification System	
Waste Stream	6.0
Cement Drum	3.7 [2]
Drum Cell	
Cement Drum	3.7 [2]

Notes:

(1) Evaluation basis concentration based on first sludge wash Cs-137 concentration
(2) Concentration is 1 Ci Cs-137/drum

TABLE 8.2-2

GAMMA CURIES OF DESIGN FUEL FOR THE MAIN PLANT BUILDING*
Basis 1000 kg Uranium 150 Day Cooling

Isotope	Total Curies	Energy of Gamma Photons MeV	Gamma Photons per Second
Cs-137	9.2E4	0.66	3.1E15
Pm-147	3.2E5	0.12	1.2E15
Eu-155	4.7E3	0.15	1.4E14
Ru-106	6.8E4	2.42	5.0E12
		1.54	1.2E13
		1.05	5.0E13
		0.88	7.5E12
		0.62	2.5E14
		0.50	5.0E14
Ce-144	1.1E6	2.20	4.0E14
		0.70	4.0E14
		0.13	1.0E16
Zr-95	3.8E5	0.75	2.8E16
		0.23	2.8E14
Y-91	2.9E5	1.20	3.2E13
Sr-89	2.1E5	0.92	7.7E11
Ru-103	6.7E4	0.61	1.7E14
		0.50	2.2E15
Ce-141	6.9E4	0.14	1.8E15
La-140	5.2E2	3.00	1.9E11
		2.50	1.0E12
		1.50	1.8E13
		0.80	5.6E12
Gases			
Kr-85	1.3E4	0.52	4.7E12
I-131	2.2	0.72	2.2E9
		0.64	7.4E9
		0.36	6.9E10
		0.16	5.6E8

- Ref: Table 6.60a NFS, 1970. Gamma photons of Ru-106 are actually those of the daughter isotope, Rh-106.

TABLE 8.2-3

MATERIAL AT RISK CONCENTRATIONS IN HEPA FILTERS

Isotope	Source Term (Ci/Kg)*	Isotope	Source Term (Ci/Kg)
C-14	1.19E-06	Sm-151	1.68E-03
Fe-55	3.75E-07	Eu-152	2.00E-06
Ni-59	8.66E-07	Eu-154	3.78E-04
Co-60	7.43E-05	Eu-155	2.82E-05
Ni-63	6.97E-05	U-232	1.34E-05
Se-79	3.51E-07	U-233	2.04E-05
Sr-90	4.58E-02	U-234	9.84E-06
Y-90	4.58E-02	U-235	2.17E-07
Zr-93	2.15E-06	U-236	6.46E-07
Nb-93m	1.37E-06	U-238	1.82E-06
Tc-99	9.33E-06	Np-237	2.31E-07
Ru-106	8.05E-11	Np-239	4.37E-05
Rh-106	8.05E-11	Pu-238	3.00E-03
Pd-107	1.16E-08	Pu-239	8.20E-04
Sb-125	1.27E-06	Pu-240	6.25E-04
Te-125m	3.12E-07	Pu-241	2.10E-02
Sn-126	3.79E-07	Pu-242	8.19E-07
Sb-126m	3.79E-07	Am-241	9.17E-04
Sb-126	5.31E-08	Am-242	7.05E-06
Cs-134	1.55E-06	Am-242m	7.09E-06
Cs-135	1.40E-06	Am-243	4.37E-05
Cs-137	5.00E-02	Cm-242	5.85E-06
Ba-137m	4.73E-02	Cm-243	1.94E-07
Ce-144	4.74E-13	Cm-244	1.02E-04
Pr-144	4.74E-13	Cm-245	2.11E-08
Pm-147	6.89E-05	Cm-246	3.33E-09

* Curies per kilogram of material loaded onto filter (e.g., dust)

TABLE 8.2-4

MATERIAL AT RISK CONCENTRATIONS IN HIGH LEVEL WASTE

Isotope	Source Term (Ci/L)	Isotope	Source Term (Ci/L)
C-14	6.30E-06	Ba-137m	2.50E-01
Fe-55	1.98E-06	Ce-144	2.50E-12
Ni-59	4.57E-06	Pr-144	2.50E-12
Co-60	8.36E-06	Pm-147	3.64E-04
Ni-63	3.68E-04	U-236	1.38E-08
Se-79	1.86E-06	U-238	3.90E-08
Sr-90	2.42E-01	Np-237	1.22E-06
Y-90	2.42E-01	Np-239	2.31E-04
Zr-93	1.13E-05	Pu-238	2.95E-04
Nb-93m	7.23E-06	Pu-239	8.02E-05
Tc-99	7.83E-05	Pu-240	6.17E-05
Ru-106	4.25E-10	Pu-241	2.05E-03
Rh-106	4.25E-10	Pu-242	8.02E-08
Pd-107	6.12E-08	Am-241	3.15E-03
Sb-125	6.72E-06	Am-242	3.72E-05
Te-125m	1.65E-06	Am-242m	3.74E-05
Sn-126	2.00E-06	Am-243	2.31E-04
Sb-126m	2.00E-06	Cm-242	3.09E-05
Sb-126	2.80E-07	Cm-243	1.02E-06
Cs-134	8.20E-06	Cm-244	5.39E-04
Cs-135	7.41E-06	Cm-245	1.11E-07
Cs-137	2.64E-01	Cm-246	1.76E-08

TABLE 8.2-5

MATERIAL AT RISK CONCENTRATIONS IN LAGOON LIQUID

Isotope	Source Term (Ci/L)
H-3	1.54E-08
C-14	6.12E-11
Sr-90	2.93E-10
I-129	1.08E-11
Cs-137	7.19E-11
U-233	1.43E-11
U-234	7.04E-12
U-235	1.96E-13
U-236	5.82E-13
U-238	1.18E-11
Pu-238	3.94E-13
Pu-239	1.28E-13
Pu-240	9.89E-14
Am-241	1.59E-13

TABLE 8.2-6

MATERIAL AT RISK CONCENTRATIONS IN LIQUID LLW

Isotope	Source Term (Ci/L)	Isotope	Source Term (Ci/L)
C-14	1.15E-07	Sm-151	1.62E-04
Fe-55	3.60E-08	Eu-152	1.93E-07
Ni-59	8.33E-08	Eu-154	3.63E-05
Co-60	1.52E-07	Eu-155	2.72E-06
Ni-63	6.71E-06	U-232	5.24E-09
Se-79	3.38E-08	U-233	7.96E-09
Sr-90	4.40E-03	U-234	3.92E-09
Y-90	4.40E-03	U-235	8.47E-11
Zr-93	2.06E-07	U-236	2.52E-10
Nb-93m	1.32E-07	U-238	7.11E-10
Tc-99	1.43E-06	Np-237	2.22E-08
Ru-106	7.74E-12	Np-239	4.20E-06
Rh-106	7.74E-12	Pu-238	5.37E-06
Pd-107	1.12E-09	Pu-239	1.46E-06
Sb-125	1.22E-07	Pu-240	1.12E-06
Te-125m	3.00E-08	Pu-241	3.74E-05
Sn-126	3.65E-08	Pu-242	1.46E-09
Sb-126m	3.65E-08	Am-241	5.74E-05
Sb-126	5.11E-09	Am-242	6.79E-07
Cs-134	1.49E-07	Am-242m	6.82E-07
Cs-135	1.35E-07	Am-243	4.20E-06
Cs-137	4.81E-03	Cm-242	5.63E-07
Ba-137m	4.55E-03	Cm-243	1.86E-08
Ce-144	4.56E-14	Cm-244	9.82E-06
Pr-144	4.56E-14	Cm-245	2.03E-09
Pm-147	6.63E-06	Cm-246	3.20E-10

TABLE 8.2-7

MATERIAL AT RISK CONCENTRATIONS IN SOLID LLW

Isotope	Source Term (Ci/Kg)
Sr-90	1.83E-04
Y-90	1.83E-04
Cs-137	2.50E-04
Ba-137m	2.37E-04
Pu-238	8.17E-06
Pu-239	1.32E-06
Pu-240	2.17E-06
Pu-241	1.57E-04
Am-241	1.17E-05
Am-243	6.00E-08
Cm-244	2.50E-06

TABLE 8.2-8

VITRIFICATION IN-CELL OFF-GAS SYSTEM SOURCE TERM
June 1993

Nuclide	Total Curies[a]	Curies/Yr	DF per NRC[b]	Discharge Ci/Year
C-14	5.49E-01	1.83E-01	1.00E+00	1.83E-01
Sr-90	5.81E+06	1.94E+06	4.95E+09	3.91E-04
Tc-99	1.09E+02	3.63E+01	1.00E+04	3.63E-03
I-129	1.81E-01	6.02E-02	2.00E+00	3.01E-02
Cs-137	6.28E+06	2.09E+06	1.09E+08	1.92E-02
Ac-227	9.43E+00	3.14E+00	1.00E+09	3.14E-09
Pu-238	7.92E+03	2.64E+03	4.95E+09	5.33E-07
Pu-239	1.63E+03	5.42E+02	4.95E+09	1.09E-07
Pu-240	1.19E+03	3.98E+02	4.95E+09	8.04E-08
Pu-241	6.04E+04	2.01E+04	4.95E+09	4.07E-06
Am-241	5.36E+04	1.79E+04	4.95E+09	3.61E-06
Am-242m	2.89E+02	9.63E+01	4.95E+09	1.94E-08
Am-243	3.47E+02	1.16E+02	4.95E+09	2.33E-08
Cm-243	1.16E+02	3.86E+01	1.00E+09	3.86E-08
Cm-244	6.07E+03	2.02E+03	1.00E+09	2.02E-06

a) Note: Radionuclides content of Tank 8D-2.
b) Bixby April 11, 1990.

TABLE 8.2-9

VITRIFICATION IN-CELL PRIMARY FILTER SOURCE TERM
June 1993

Assumption: 0.001% of the radioactivity of materials that are vitrified becomes airborne within the Vitrification Cell.

Nuclides	Total Curies	Curies/Yr	DF per NRC	Discharge Ci/Year
Sr-90	5.81E+06	1.94E+01	1.00E+05	1.94E-04
Y-90	5.81E+06	1.94E+01	1.00E+05	1.94E-04
Cs-137	6.28E+06	2.09E+01	1.00E+05	2.09E-04
Ac-227	9.43E+00	3.14E-05	1.00E+05	3.14E-10
Pu-238	7.92E+03	2.64E-02	1.00E+05	2.64E-07
Pu-239	1.63E+03	5.42E-03	1.00E+05	5.42E-08
Pu-240	1.19E+03	3.98E-03	1.00E+05	3.98E-08
Pu-241	6.04E+04	2.01E-01	1.00E+05	2.01E-06
Am-241	5.36E+04	1.79E-01	1.00E+05	1.79E-06
Am-242m	2.89E+02	9.62E-04	1.00E+05	9.62E-09
Am-243	3.47E+02	1.16E-03	1.00E+05	1.16E-08
Cm-244	6.07E+03	2.02E-02	1.00E+05	2.02E-07

TABLE 8.3-1

SUMMARY OF STS SHIELDING CALCULATIONS

STS PIPEWAY WALLS - SHIELDING ANALYSIS

(91 cm Thickness of Concrete)

SUPERNATANT STREAM - 6210 µCi/mL Cs-137 Source

Concrete Density g/cc	Exposure Rate mR/hr
2.24	0.477
2.35	0.243
2.50	0.097
2.85	0.011
3.00	0.004
3.20	0.001

STS PIPEWAY ROOF - SHIELDING ANALYSIS

(91 cm Thicknesses of Concrete)

SUPERNATANT STREAM - 6210 µCi/mL Cs-137 SOURCE

Concrete Density g/cc	Exposure Rate mR/hr
2.24	0.450
2.35	0.227
2.50	0.090
2.85	0.010
3.00	0.004
3.20	0.001

TABLE 8.3-1
(Concluded)
SUMMARY OF STS SHIELDING CALCULATIONS

STS VALVE AISLE - FRONT WALL - SHIELDING ANALYSIS

(30 cm [12 in] Thicknesses of Steel)

76, 189, 379 L (20, 50, 100 gals) @ 230 MBq/mL (6210 µCi/mL) ^{137}Cs
SUPERNATANT SOURCE

Front Wall cm (in)	µSv/h 76 L	µSv/h 189 L	µSv/h* 379 L
30 (12)	5.900E-01	1.480E-00	2.950E-00

SOURCE GEOMETRY: (1.5 m [5 ft] X 1.8 m [6 ft] X 1.5 m [5 ft])

STS VALVE AISLE - SIDE WALL - SHIELDING ANALYSIS

(30 cm [12 in] Thicknesses of steel)

76, 189, 379 L (20, 50, 100 gals) @ 230 MBq/mL (6210 µCi/mL) ^{137}Cs
SUPERNATANT SOURCE

Side Wall cm (in)	µSv/h 76 L	µSv/h 189 L	µSv/h* 379 L
30 (12)	5.600E-01	1.420E-00	2.830E-00

SOURCE GEOMETRY: (1.5 m [5 ft] X 1.8 m [6 ft] X 1.5 m [5 ft])

STS VALVE AISLE ROOF - SHIELDING ANALYSIS

(30 cm [12 in] Thicknesses of Steel)

76, 189, 379 L (20, 50, 100 gals) @ 230 MBq/mL (6210 µCi/mL) ^{137}Cs
SUPERNATANT SOURCE

Roof cm (in)	µSv/h 76 L	µSv/h 189 L	µSv/h* 379 L
30 (12)	2.400E-02	52.980E-02	1.180E-01

SOURCE GEOMETRY: (1.5 m [5 ft] X 1.8 m [6 ft] X 1.5 m [5 ft])

* 1 µSv/h = 0.1 mrem/h

TABLE 8.3-2

RESULTS OF LWTS SHIELDING ANALYSES [1]

Location	Elevation (ft)	Calculated [2] Exposure Rate (mR/hr)	Maximum [3] Exposure Rate (mR/hr)
ULO Pump Room - North Wall	100	2.48	2.5
ULO Pump Room - South Wall	100	2.24	2.5
UPC - N & S Walls	100	2.30	2.5
UPC - West Wall	100	1.00	2.5
UPC - East Wall	100	N/A	2.5
Pipe Chase	131	2.00	2.5

(1) - Performed by Ebasco (1985)
(2) - Calculated exposure rate with additional shielding in place
(3) - Per LWTS Design Criteria
N/A - Not Available

TABLE 8.3-3

SHIELDING SUMMARY
FOR SOURCE AREA - PROCESS MECHANICAL CELL*

Specific Source - Three fuel assemblies in the following locations in cell:
1 at Disassembly Table 2V-11
1 at Disassembly Saw 2V-2
1 in Feed Mechanism of Shear 2V-4

Shielded Area	Elev. (feet)	Design Exposure Rate mR/hr	Shielding			Remarks
			Thick (m)	Material[1]	C.F.[2]	
Lab Area	131	0.2	1.8	OC	A	
Vent Supply Room	114	1	1.7	OC	A	
Mech. Oper. Aisle	100	1	1.7	OC	A	
Chem. Oper. Aisle	114	1	1.7	OC	A	
Miniature Cell	76	10	1.7	OC	C	
Mech. Crane Room	114	100	0.9	OC	A	
General Purpose Cell	76	100	1.7	OC	C	
Vent Wash Room	114	1	1.5	OC	A	
Ram Equip Room	100	1	1.7	OC	A	

1) OC = Ordinary Concrete
2) C.F. = Controlling Factor

A. Thickness required to attenuate normal operating activity levels in source area to design dose specified.
B. Thickness required to attenuate 1/10 normal operating activity levels in source area to design dose specified, for maintenance operations.
C. Thickness provided is dictated by structural reasons and is greater than thickness required for shielding purposes.
D. Thickness arbitrarily set for shielding of a criticality incident.

* Ref: NFS, 1970

TABLE 8.3-4

SHIELDING SUMMARY
FOR SOURCE AREA - GENERAL PURPOSE CELL*

Specific Source - 6 full scrap drums
6 full fuel baskets in rack 2V-35
1 full fuel basket in transport

Shielded Area	Elev. (feet)	Design Exposure Rate mR/hr	Shielding			Remarks
			Thick (m)	Material[1]	C.F.[2]	
Miniature Cell	76	5	1.3	HDC	C	
Miniature Cell	76	5	1.1	HDC	A	
GPC Oper. Aisle	76	1	1.2	HDC	A	3
GPC Oper. Aisle	76	10	0.9	HDC	A	4
GPC Oper. Aisle	76	10	0.9	OC	A	5
GPC Crane Room	73	100	1.1	OC	A	6
GPC Crane Room	73	100	0.8	HDC	A	6 & 8
Mech Oper. Aisle	100	1	1.7	OC	A	
Scrap Removal	100	10	1.7	OC	C	
Scrap Removal	100	200	0.3	Steel	B	7

1) HDC=High Density Concrete, OC=Ordinary Concrete
2) See Table B.8.3-3
3) Below El 87 feet
4) Near transfer hatches and above El 87 feet
5) Above El 87 feet
6) 10 mR/hr in shutdown status (i.e. no fuel in transport)
7) Hatch 2V-28
8) Door 2M-7

* Ref: NFS, 1970

TABLE 8.3-5

SHIELDING SUMMARY
FOR SOURCE AREA - CHEMICAL PROCESS CELL*

Sp. Source - Vessels 3C-1, 3C-2, 3C-3, 3D-1, 7C-4, 7D-10, 7C-4, 7C-1, 7C-2 Plus one fuel basket being loaded, or three dissolvers fully loaded and 1000 R/hr of background.

Shielded Area	Elev. (feet)	Design Exposure Rate mR/hr	Shielding			Remarks
			Thick (m)	Material[1]	C.F.[2]	
Scrap Removal	100	10	0.5	Steel	A	
Mech Oper. Aisle	100	10	1.8	OC	A	
Liquid Waste Cell	100	100	1.8	OC	C	
Off-Gas Cell	100	100	1.5	OC	C	
Office Building	100	1	1.8	OC	A	
Equip. Decon. Room	100	10	1.2	OC	A	
Chem. Oper. Aisle	114.5	1	1.8	OC	A	
Off-Gas Cell	114.5	100	1.5	OC	A	
Chem Viewing Aisle	114.5	1	1.5	OC	C	
Equip. Decon. Room	114.5	10	1.2	OC	A	
Chem Viewing Aisle	117	1	0.6	HDC	A	3
Chem. Crane Room	131	300	0.9	OC	A	
Chem. Crane Room	131	100	0.9	OC	C	
Analytical Decon.	131	1	1.0	OC	A	
Laboratories	131	1	1.0	HDC	A	
ARC-OGC Aisle	131	1	0.9	HDC	A	
Office	131	1	1.0	HDC	A	4
Office	131	1	1.0	OC	A	5
Process Chem. Room	148	1	1.5	OC	A	
Hot Acid Cell	148	100	1.5	OC	C	
Vent Exhaust Cell	148	10	1.5	OC	C	
Roof	148	10	1.5	OC	C	
General Purpose Cell	100	100	1.7	OC	C	
GPC Crane Room	100	10	1.1	OC	A	6

1) , 2) See Table B.8.3-3
2) Reflected radiation only
3) At north end of CPC
4) At south end of CPC
5) Liquid sources only
* Ref: NFS, 1970

TABLE 8.3-6

SHIELDING SUMMARY
FOR SOURCE AREA - EXTRACTION CELL NO. 3*

Specific Source - Vessels 4C-10, 4C-11, 4C-12, 4D-12, 13C-3, 13C-6, 5D-1, 5D-2, 13D-3, 13D-6

Shielded Area	Elev. (feet)	Design Exposure[1] Rate mR/hr	Shielding			Remarks
			Thick (m)	Material	C.F.[1]	
Cell Access Aisle	100'-0"	1	3'-0"	OC	D	
Cell Access Aisle	110'-0"	1	4"	Steel	A	(2)
Prod. Pur Cell	All	100(M)	1'-6"	OC	C	
X Cell No. 2	All	100(M)	1'-6"	OC	C	
Lower Warm Aisle	100'-0"	1	3'-0"	OC	D	
Lower Ext Aisle	114'-6"	1	3'-0"	OC	D	
Upper Warm Aisle	114'-6"	1	3'-0"	OC	D	
Ext Sample Aisle	131'-0"	1	3'-0"	OC	D	
Solvent Storage Tanks	131'-0"	1	3'-0"	OC	D	
Upper Ext Aisle	144'-0"	1	3'-0"	OC	D	
Ext Chem Room	160'-0"	1	3'-0"	OC	D	

1) See Table B.8.3-3
2) Door 15 M-11

* Ref: NFS, 1970

TABLE 8.3-7

SHIELDING SUMMARY
FOR SOURCE AREA - ANALYTICAL CELLS*

ANALYTICAL HOT CELL

Specific Source - Six 5-ml samples at 8,000 Ci/L

Shielded Area	Elev. (feet)	Design Exposure Rate mR/hr	Shielding			Remarks
			Thick (m)	Material[1]	C.F.[2]	
Lower Extrac. Aisle	114	1	0.6	HDC	A	
Chemical Oper. Aisle	114	1	0.6	HDC	A	
Anal. Oper. Aisle	131	1	0.9	OC	A	3
Anal. Oper. Aisle	131	1	0.6	HDC	A	4
ANC Decon. Aisle	131	1	0.3	Steel	A	5
Sample Storage Cell	134	-	0.9	HDC	-	6
Adjacent ANC	131	-	0.5	HDC	-	6
Control Room	144	1	0.9	OC	A	

ANALYTICAL SAMPLE CELL*

Specific Source - 5 L of HAF 660 Ci/L

Shielded Area	Elev. (feet)	Design Exposure Rate mR/hr	Shielding			Remarks
			Thick (m)	Material[1]	C.F.[2]	
Chem. Operating Aisle	114	1	1.4	OC	A	
Anal. Operating Aisle	131	1	0.9	HDC	A	
ANC, Decon Area	132	1	0.9	HDC	A	

1) , 2) See Table B.8.3-3
2) Above El 138 feet
3) Below El 138 feet
4) Door 15M-6
5) Arbitrary thickness by NFS

* Ref: NFS, 1970

TABLE 8.3-8

SPECIFICATIONS OF MONITORING INSTRUMENTS

Specifications	Beta/Gamma Continuous Air Monitor	Alpha Continuous Air Monitor
Standby and/or Backup Power Supply	Portable - None Stack - Plant standby power	Portable - None Stack - Plant standby power
Range	10^1 to 10^5 cpm	10^0 to 10^4 cpm
Sensitivity	Counting efficiency - 30 percent (2π) (Sr-90/Y-90 Disc Source)	Counting efficiency - 10 percent (2π) (Pu-239 Disc Source)
Accuracy	±10 percent	±10 percent
Calibration Method and Frequency	Electronic/Source - Semiannual	Electronic/Source - Semiannual
Alarm Set Point	Portable - 20 cpm above bkg Stack - 4,500 cpm above bkg	Portable - 3,000 cpm above bkg Stack - 200 cpm above bkg
Recording Device	Chart Recorder	Chart Recorder
Readout	Portable - Analog-log scale on unit Stack - Readout in main control room	Portable - Analog-log scale on unit Stack - Readout in main control room
Alarm	Portable - Red beacon visual with bell audible on unit Stack - Alarm in control room	Portable - Red beacon visual with bell audible on unit Stack - Alarm occurs in control room

TABLE 8.3-9

PROCESS AND EFFLUENT RADIATION MONITORS

Monitor	Type	Range of Measurements
Supernatant Treatment System		
Permanent Ventilation System	alpha beta/gamma	1-10k cpm 10-100k cpm
Decontaminated Supernatant Post Filter Discharge (STS-RE034)	gamma	$0-10^7$ cpm
Pump 50G-007 (STS-RE037)	gamma	$0-10^7$ cpm
Main Plant/Liquid Waste Treatment System		
Main Plant Ventilation Exhaust Monitors	alpha beta/gamma	1-10k cpm 10-100k cpm
Utility Room Plant Cooling Water Return	gamma	$0-10^6$ cpm
Steam Condensate Return	gamma	$0-10^6$ cpm
LWTS 037/070	gamma	$0-10^6$ cpm
LWTS 082/089	gamma	$0-10^6$ cpm
Cement Solidification System		
01-14 Building Ventilation System	alpha beta/gamma	1-10k cpm 10-100k cpm

TABLE 8.3-10

CONTINUOUS AIRBORNE RADIOACTIVITY MONITORS*

Location	Alpha	Beta/ Gamma	Alpha & Beta/Gamma	Pump Location**	Location Monitored	Sampling Line Length (m)	Sample Type
General Operating Aisle	---	X	---	Separate	General Area	---	---
Upper Extraction Aisle	---	X	---	Separate	General Area	---	---
Analytical Aisle	---	---	X	Separate	General Area	---	---
Vitrification Lab - north	---	---	X	Separate	General Area	---	---
Vitrification Lab - south	---	---	X	Separate	General Area	---	---
Radiochemical Lab - east - west	---	---	X X	Separate	General Area	---	---
Mass Spectroscopy Lab	---	---	X	Separate	General Area	---	---
Laundry	---	---	X	Separate	General Area	---	---
WTF - Con Ed Building	X	---	---	Separate	General Area	---	---
WTF - Main Shelter	---	X	---	Separate	General Area	---	---
WRPA	—	X	---	Plant Vacuum	Compactor	3	Remote
CSRF	—	X	---	Separate	General Area	2	---
Stack Monitor	X(2)	X(2)	---	Separate	Stack Effluent	21.3	Remote
Uranium Load Out	---	X	---	Separate	General Area	5	---
Lower Warm Aisle	X	---	---	Separate	General Area	---	---

TABLE 8.3-10
(Concluded)
CONTINUOUS AIRBORNE RADIOACTIVITY MONITORS*

Location	Alpha	Beta/ Gamma	Alpha & Beta/Gamma	Pump Location**	Location Monitored	Sampling Line Length (m)	Sample Type
Lower Extraction Aisle	X	---	---	Separate	General Area	---	---
STS Upper Level	---	X	---	Separate	General Area	---	---
STS Operating Aisle	---	X	---	Separate	General Area	---	---
PVS	---	X	---	Separate	General Area	---	---
WTF 8D-1, M-7 Riser	---	X	---	Separate	General Area	---	---
CSS	---	X	---	Separate	General Area	---	---
EDR	---	X	---	Separate	General Area	---	---
CSPF Sorting Room	X	X	---	Separate	General Area	---	---
LLW2 Resin Loadout	---	X	---	Separate	General Area	---	---

* Quantities and locations of CAMS will vary based on specific Project activities.
** Separate = vacuum pump at CAM location; Plant Vacuum = connected to plant vacuum system.

TABLE 8.3-11

RADIATION MONITORING EQUIPMENT TYPICAL LOCATIONS

Type*	Elevation	Location
Vitrification Building		
PF-1	100 ft	Southwest Corner (SFR)
PCM-1	100 ft	Northwest Stairwell
PCM-2	100 ft	Northeast Stairwell
PCM-3	110.25 ft	North Operating Aisle
PF-5	110.25 ft	North Operating Aisle
PF-8	110.25 ft	East Operating Aisle
PF-7	110.25 ft	Southwest Corner (HVOS)
PF-9	124 ft	West Operating Aisle
PF-11	131 ft	South Wall (CMR)
01-14 Building		
CAMß-1	130 ft	Process Filter Removal Room
CAMß-2	124 ft	Off-Gas Treatment Room (Roof)
CAMß-3	116.5 ft	Process Area
CAMß-4	144 ft	Process Area

* Type: CAM - Continuous Air Monitor - α, ß
PCM - Personnel Contamination Monitor
ARM - Area Radiation Monitor
PF - Personnel Frisker

TABLE 8.4-1

Cumulative Dose CEDE

ALARA Group	2003 Dose (R) (Jan - Dec)	2004 Dose (R) (Jan - Nov)
Analytical & Process Chemistry	1.405	0.829
Decontamination & Decommissioning	28.887	21.433
Maintenance	2.335	2.260
Radiation Control Operations	7.064	6.531
Site Operations	0.863	0.324
Others	1.117	0.900
TOTAL	**41.671**	**32.277**

TABLE 8.4-2

2004 ALARA Budget (CY)

Task	Dose (R)
Analytical Laboratory	1.3378
Head End Cells	2.131
Extraction Cell 2 Dismantlement	12.800
Waste Management	3.66135
Vitrification Dismantlement	8.9844
Routine and Miscellaneous	2.342
Planned and Support Activities	1.223
Remote Handled Waste Operation	0.175
TOTAL	**32.65455**

Table 8.6-1

TOTAL RADIOACTIVITY (CURIES) IN AIRBORNE EMISSIONS RELEASED FROM WVDP STACKS IN 2003

	Main Plant Stack (Ci) [1]	Vit Stack (Ci) [2]	CSS Stack (Ci) [3]	STS Stack (Ci) [4]	CSPF Stack (Ci) [5]
Gross Alpha	1.68E-06	-1.78E-08	-1.48E-08	1.50E-10	-1.58E-09
Gross Beta	5.46E-05	4.68E-08	1.39E-08	2.53E-08	2.71E-09
H-3	2.41E-03	----	----	5.40E-05	----
Co-60	4.62E-08	-2.28E-08	-2.10E-09	7.23E-09	-1.26E-09
Sr-90	4.31E-06	2.70E-08	6.40E-10	2.49E-09	1.73E-09
I-129	6.49E-05	2.69E-07	4.90E-08	1.61E-05	1.59E-07
Cs-137	1.22E-05	1.24E-08	2.20E-09	1.36E-08	1.85E-09
U-232	3.32E-08	5.20E-10	1.35E-09	-3.40E-11	5.80E-11
U-233/234	5.75E-08	3.84E-08	1.06E-08	6.89E-09	9.98E-10
U-235/236	6.14E-09	5.36E-09	1.80E-09	1.28E-09	1.52E-10
U-238	5.03E-08	2.77E-08	1.10E-08	7.21E-09	1.08E-09
Pu-238	1.69E-07	-1.10E-10	-3.70E-11	1.65E-10	2.00E-11
Pu-239/240	2.19E-07	1.70E-09	8.00E-11	6.31E-10	1.00E-12
Am-241	5.16E-07	4.71E-09	1.55E-09	4.28E-10	-2.90E-11

1 WVNS, August. ASER for CY2003. Table D-1, p. D-3.
2 - _____. ASER for CY2003. Table D-2, p. D-4.
3 - _____. ASER for CY2003. Table D-4, p. D-5.
4 - _____. ASER for CY2003. Table D-6, p. D-6.
5 - _____. ASER for CY2003: Table D-7, p. D-7.

Note: Negative numbers in the table are an artifact of the calculational process used. Negative numbers communicate that the activity for the given nuclide is not distinguishable from background activity levels.

Table 8.6-2

TOTAL RADIOACTIVITY (CURIES) IN LIQUID EFFLUENTS RELEASED FROM LAGOON 3 IN 2003

	Total Activity Released from **Lagoon 3** **(Ci)** [1]
Gross Alpha	1.56E-03
Gross Beta	1.30E-02
H-3	2.30E-01
C-14	1.08E-03
K-40	1.27E-03
Co-60	7.53E-05
Sr-90	4.66E-03
Tc-99	2.13E-03
I-129	1.19E-04
Cs-137	3.28E-03
U-232	6.41E-04
U-233/234	3.88E-04
U-235/236	1.71E-05
U-238	2.32E-04
Pu-238	3.47E-05
Pu-239/240	3.70E-05
Am-241	2.32E-05

1 - WVNS, August. ASER for CY2003. Table C-2A, p. C-11.

TABLE 8.7-1

SUMMARY OF CRITICALITY ANALYSIS RESULTS FOR NORMAL AND ACCIDENT CONDITIONS

ARRAY	MODERATION		U-235 w/o ENRICHMENT	K_{eff} (K_∞) +2σ	REFERENCE CALCULATION
	INTERNAL	EXTERNAL			
NORMAL OPERATIONS					
COLLECTION & HANDLING					
2 x 1	10 v/o water	Dry	5	0.5627	BUF-2000-067
STORAGE					
∞ x ∞ x 1 (GPC)	Dry	Dry	5	0.6630	BUF-2000-052
∞ x ∞ x 3	Dry	Dry	5	0.7107	BUF-2000-052
∞ x ∞ x 3	5 v/o water	Dry	5	0.8700	BUF-2000-059
ABNORMAL OPERATIONS & ACCIDENT CONDITIONS					
COLLECTION & HANDLING					
Hemispherical Pile	33 v/o water in lower 9"	Dry	5	0.93	BUF-2001-021
2 x 1 next to 7 x 7 x 3	33 v/o water in 1 x 1	Dry	5	0.9187	BUF-2001-019
2 x 1	~40 v/o water (w/p=0.7)	Dry	5	<0.93	BUF-2000-067
2 x 1	50 water v/o (w/p=1)	Dry	3.327	0.9063	BUF-2000-067
STORAGE					
∞ x ∞ x 1 (GPC)	Dry	Full	5	0.9149	BUF-2000-052
2 x 1 next to 7 x 7 x 3	33 v/o water in 1 x 1	Dry	5	0.9187	BUF-2001-019

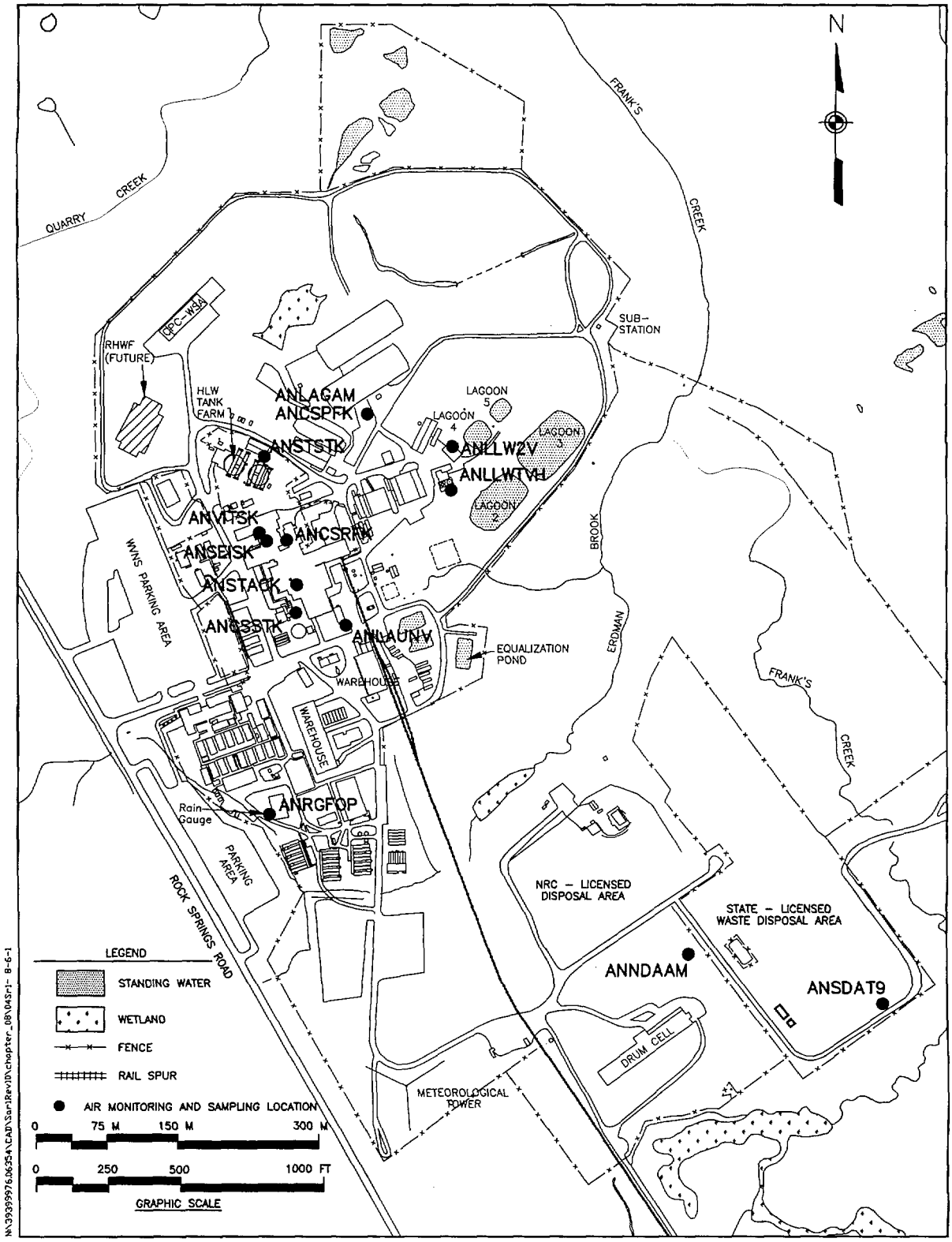


Figure 8.6-1 On-Site Air Monitoring and Sampling Points

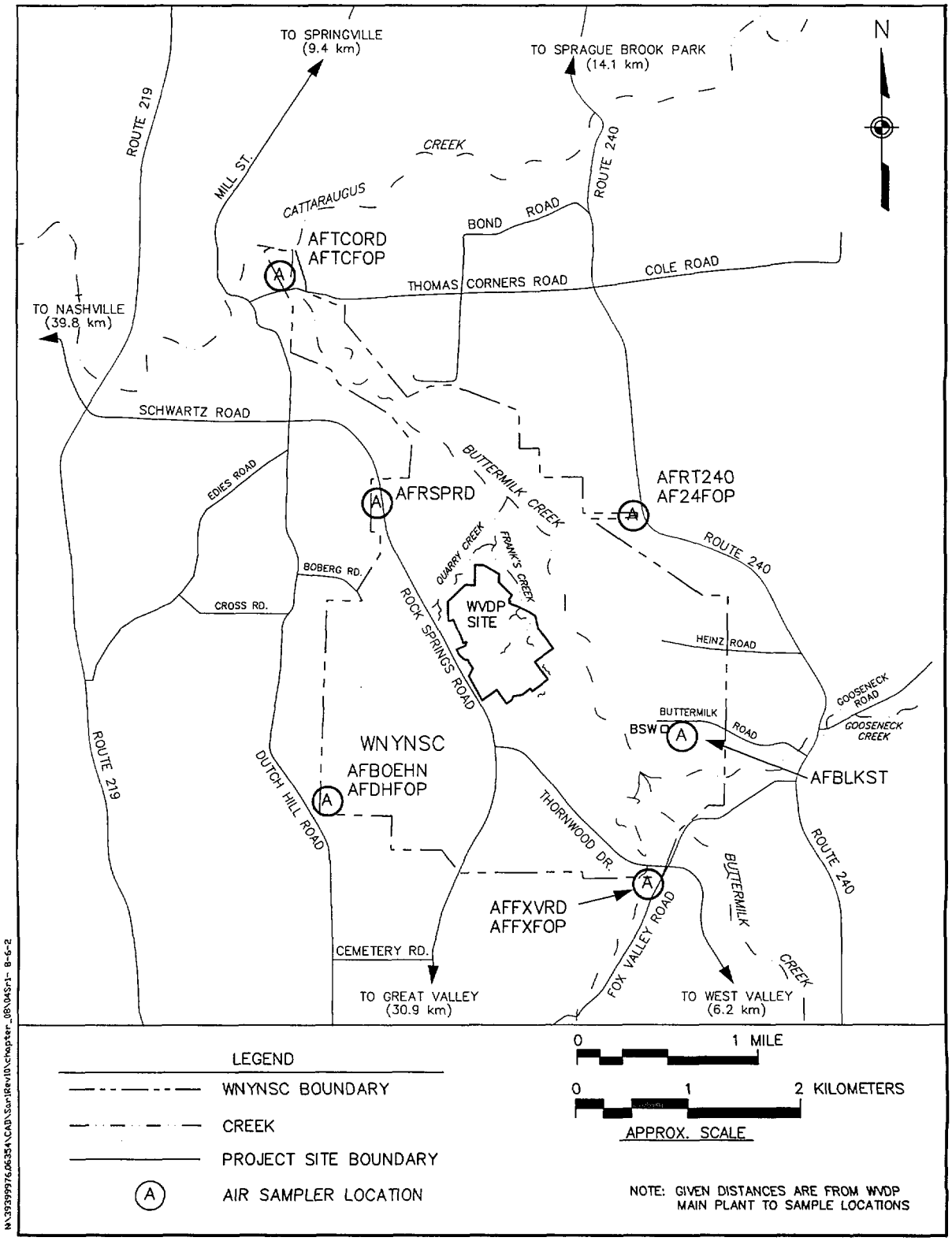


Figure 8.6-2 Off–Site Air and Fallout Sampling Points

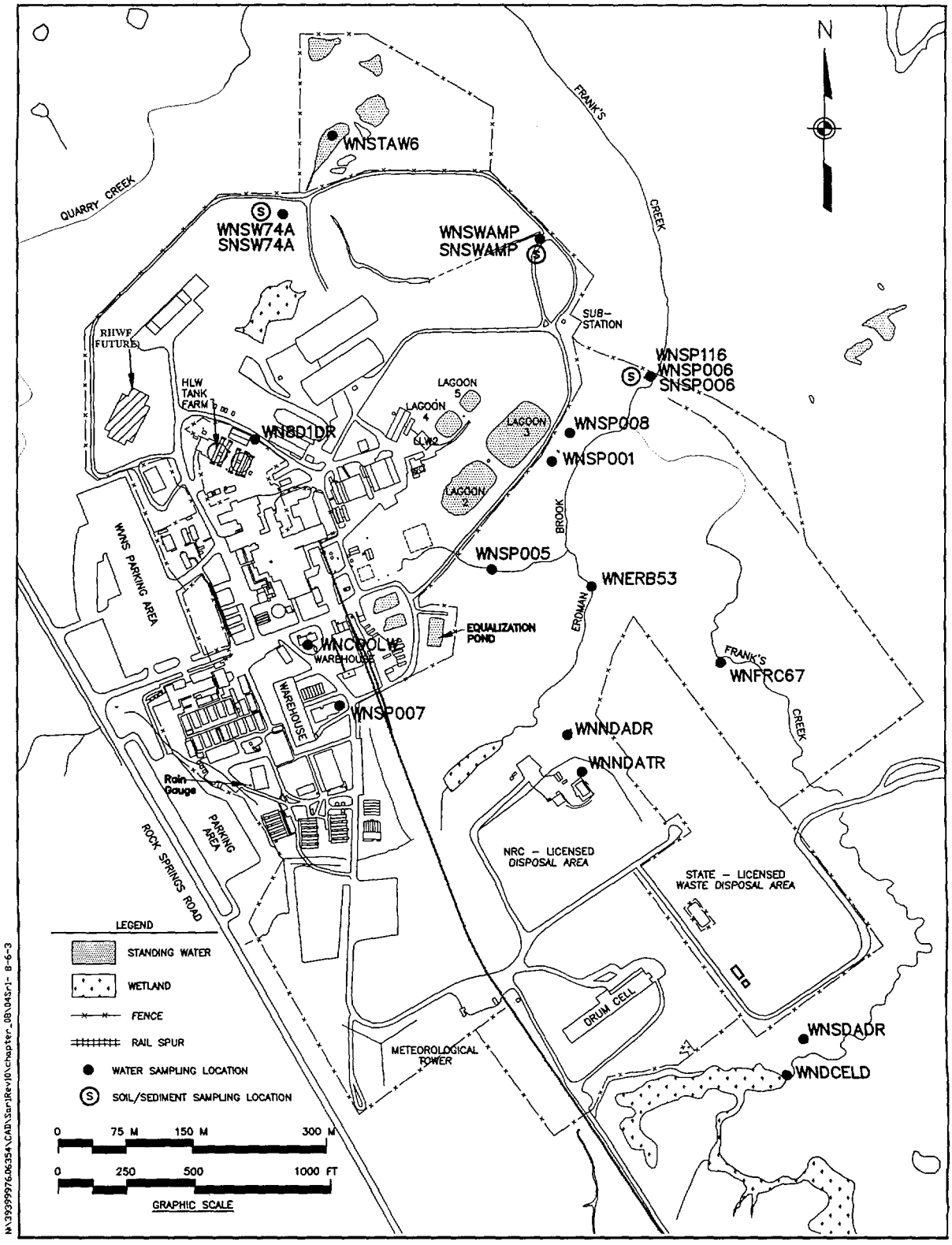


Figure 8.6-3 On–Site Surface Water and Soil/Sediment Sampling Locations

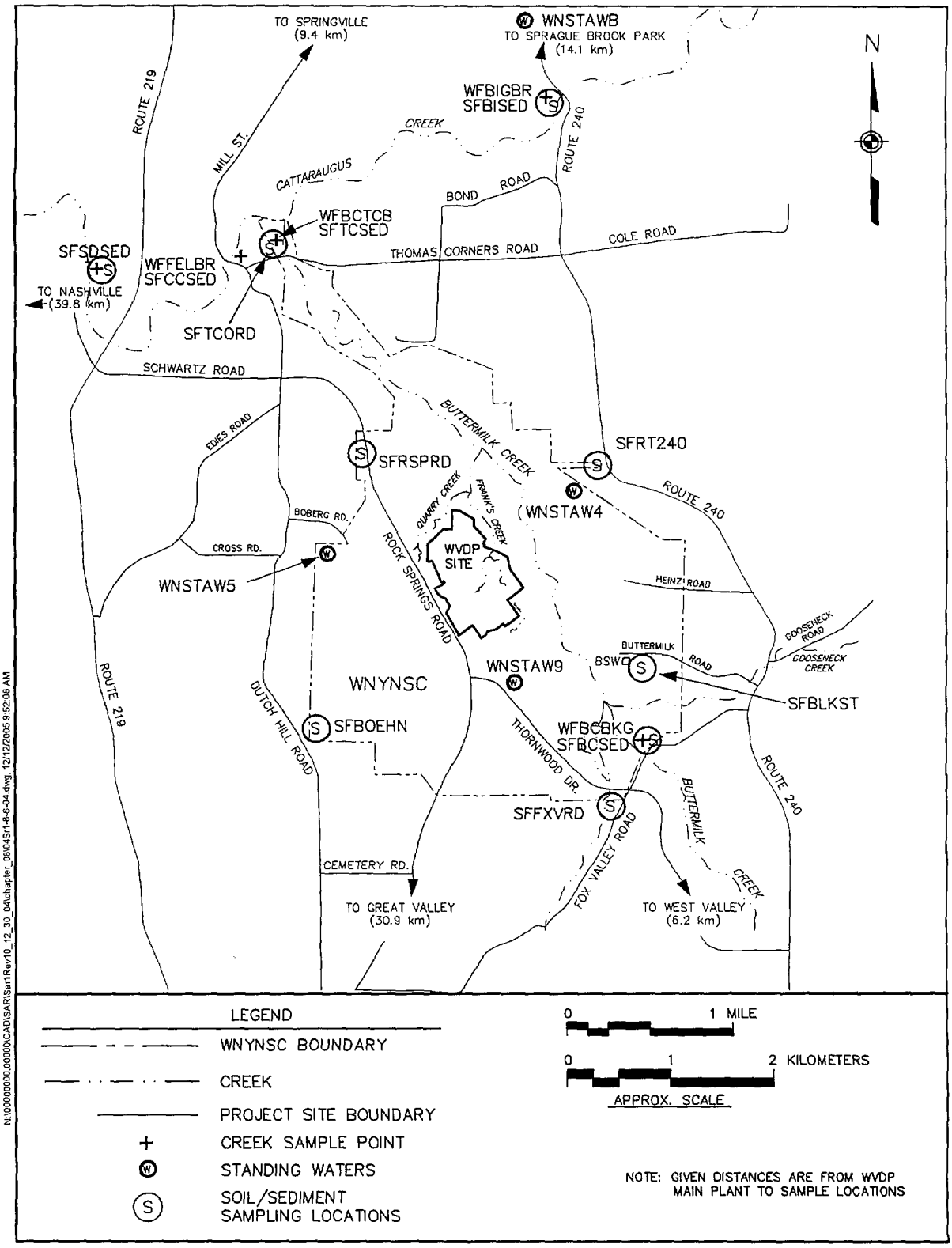


Figure 8.6-4 Off–Site Surface Water and Soil/Sediment Sampling Locations

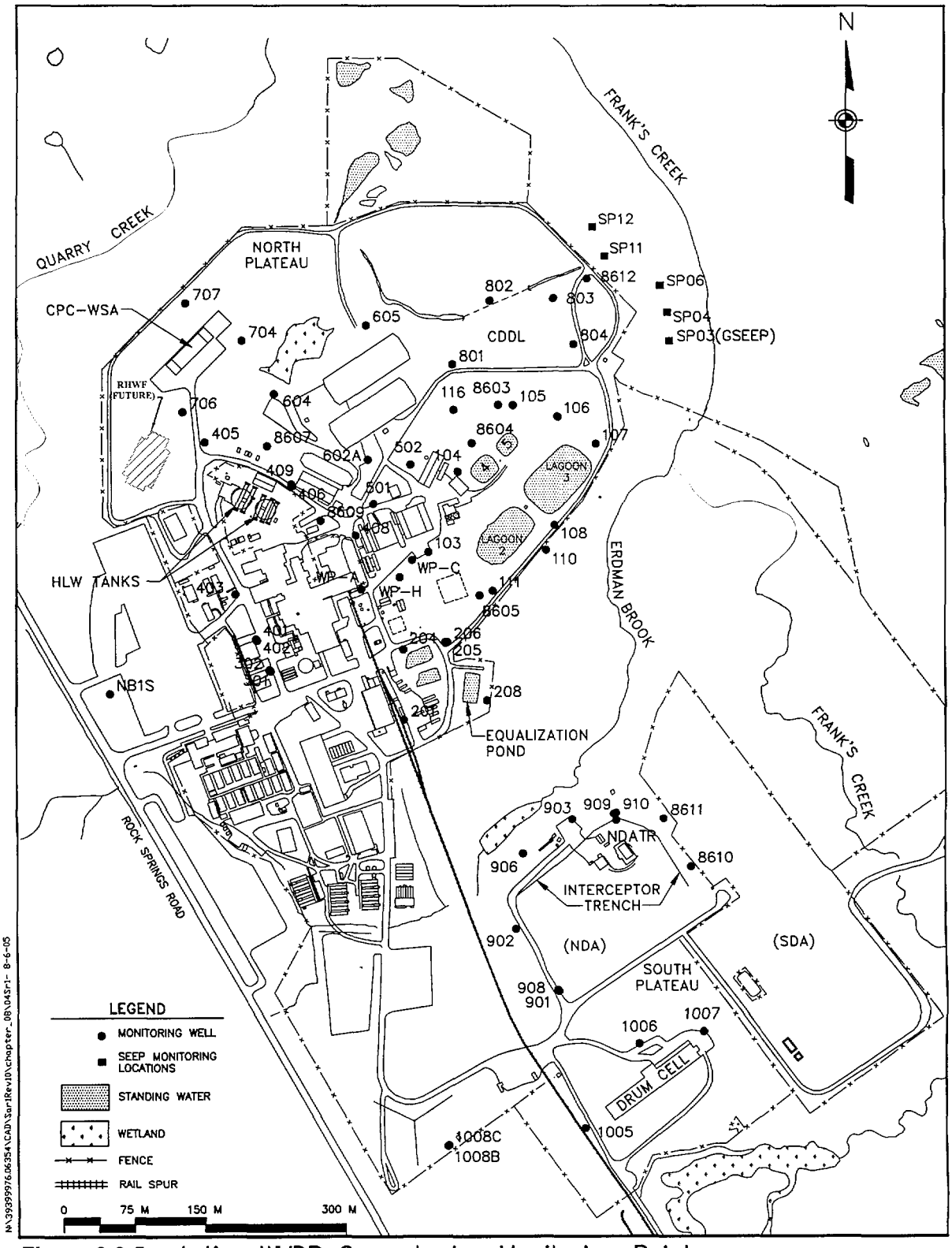


Figure 8.6-5 Active WVDP Groundwater Monitoring Points

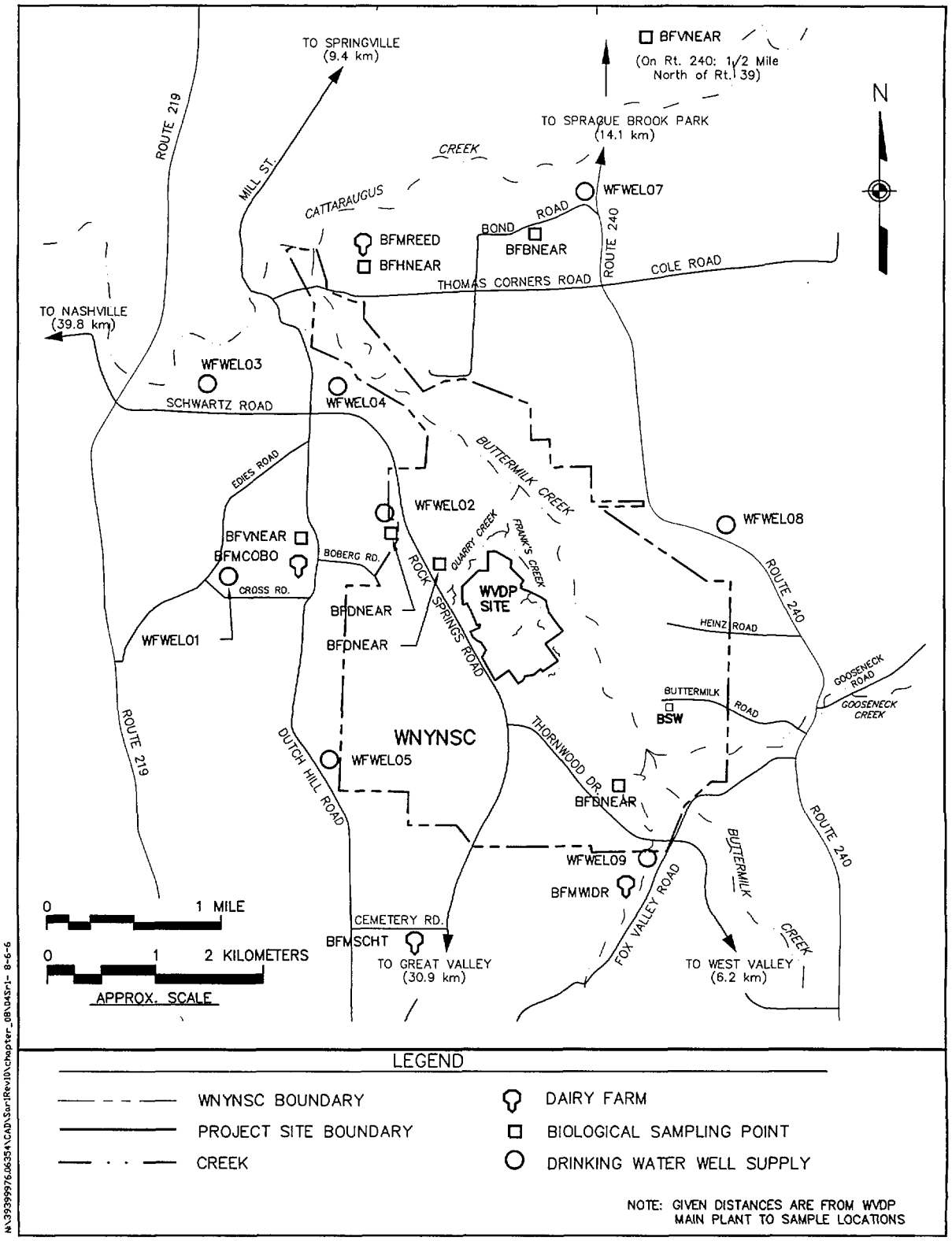


Figure 8.6-6 Near–Site Drinking Water and Biological Sampling Points

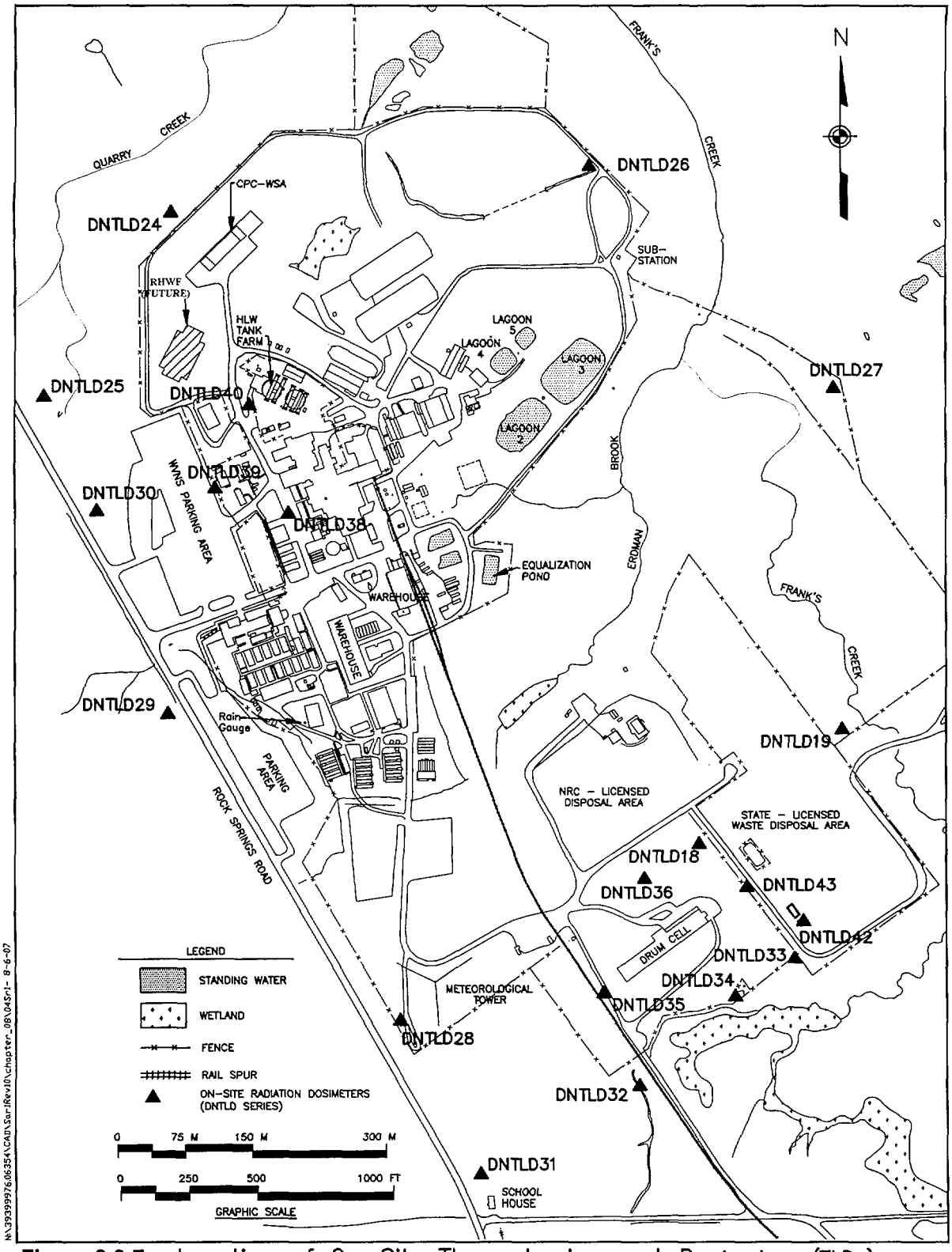


Figure 8.6-7 Location of On-Site Thermoluminescent Dosimeters (TLDs)

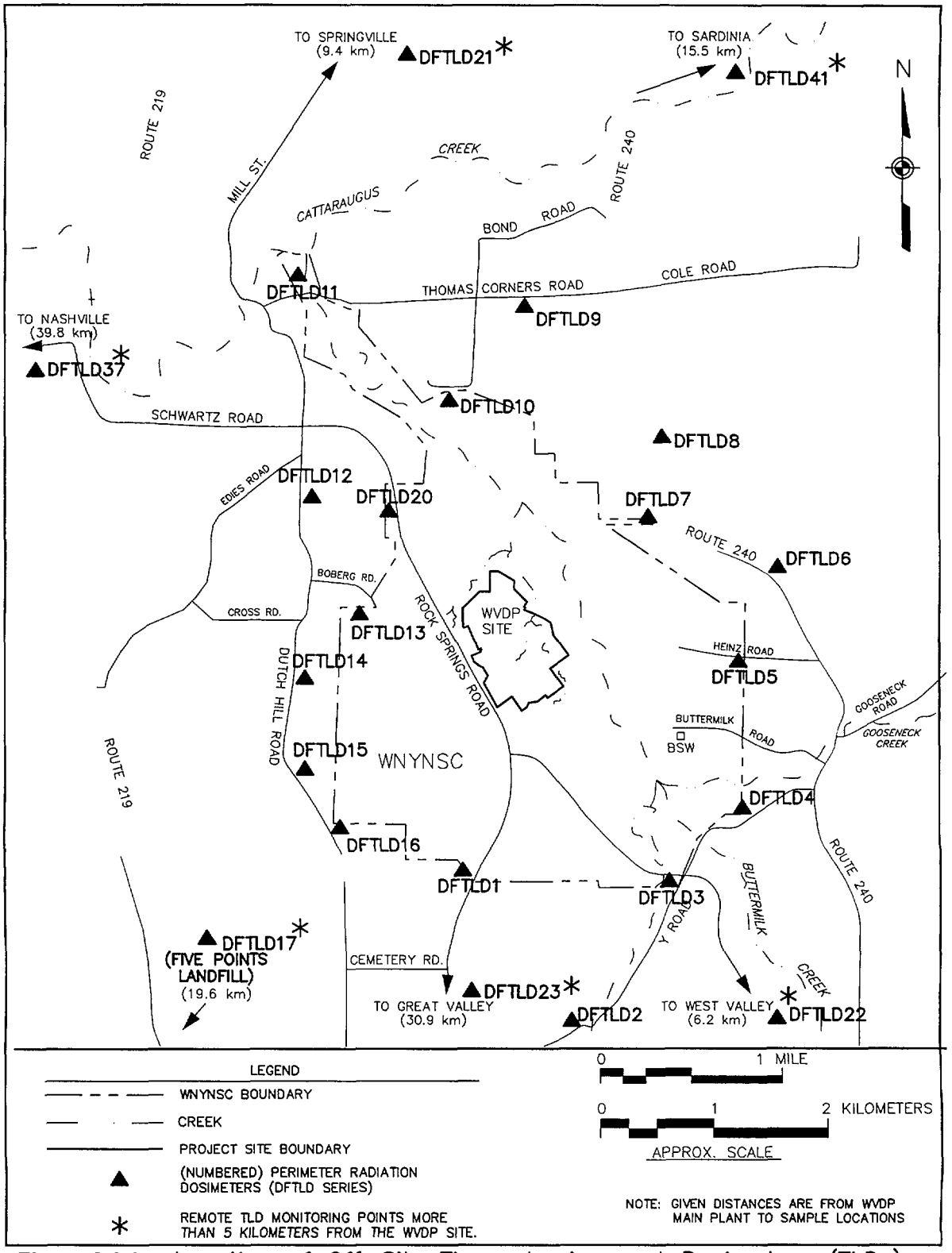


Figure 8.6-8 Location of Off-Site Thermoluminescent Dosimeters (TLDs)

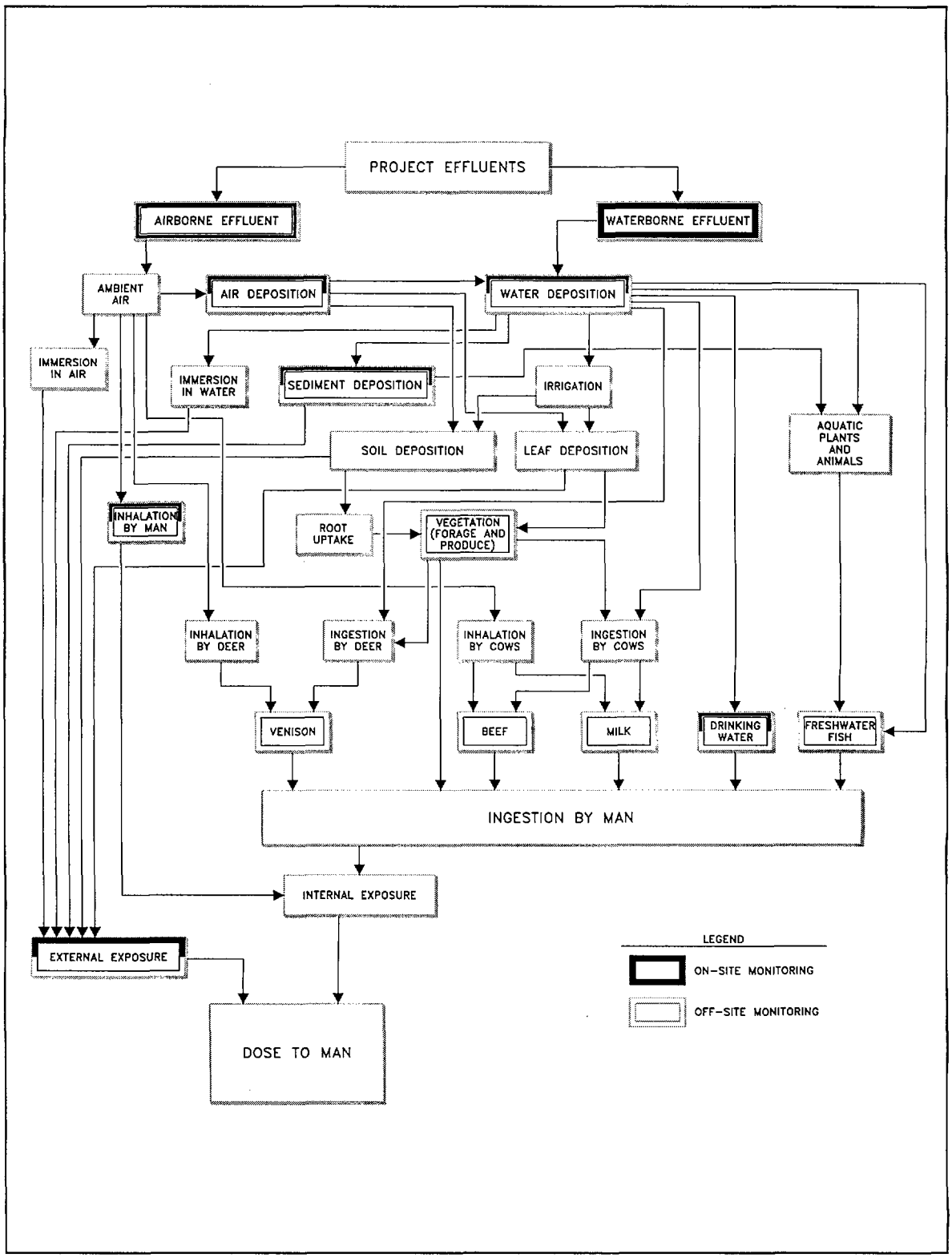


Figure 8.6-9 Schematic of Pathways Considered for Dose Assessments.

9.0 HAZARD AND ACCIDENT ANALYSES

9.1 Hazard Analysis

The systematic analysis of hazards associated with the facilities and activities at the West Valley Demonstration Project (WVDP), with the exception of the Remote Handled Waste Facility (RHWF), has been accomplished in this Safety Analysis Report (SAR) through the completion of a Process Hazards Analysis (PHA), which is presented in Table 9.1-1. (WVNS-SAR-023, *Safety Analysis Report for the Remote Handled Waste Facility*, provides safety analyses for the RHWF.) The PHA is intended to provide a qualitative analysis of the hazards and the preventive and mitigative features associated with facilities and activities discussed in this SAR. Information gained through this analysis is then used in selecting accidents to be further analyzed in a more rigorous quantitative fashion (in Section 9.2) and in grading facility and process descriptions provided throughout the SAR.

9.1.1 Methodology

The PHA shown in Table 9.1-1 is consistent with hazard analysis guidelines provided in DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. A hazard should be understood as "a source of danger, with the potential to cause illness, injury, or death to personnel." A PHA consists of two primary steps, namely, hazard identification and hazard evaluation.

9.1.1.1 Hazard Identification

The process of accomplishing the PHA identifies the hazards in terms of quantity, form, location, potential initiating events, and other events that could result in an undesirable consequence. To ensure a comprehensive, systematic analysis was performed, information was obtained from several sources. Primary among these sources were previous versions of safety documents that identify and evaluate the risks of significant hazards in Project facilities. In demonstrating compliance with Resource Conservation and Recovery Act (RCRA) spill contingencies, the WVDP has developed WVDP-043, *WVDP Spill Prevention, Controls and Countermeasures Plan*. In support of the site emergency planning program, WVDP-193, *WVDP Hazards Assessment*, has been developed. These documents and others supported the identification and evaluation of facility hazards. Additional information for the PHA has been obtained from process flow diagrams, facility operating procedures, system descriptions, and miscellaneous site documents referenced therein.

Because many accidents contained in the PHA are of a similar nature (e.g. spills, leaks, fires, etc.), bounding accidents may easily be identified through examination of relative inventories. Certain events, however, are more unusual and require quantitative analysis to determine the event frequency or consequence. These quantitative analyses are provided in references listed at the end of Table 9.1-1.

9.1.1.2 Hazard Evaluation

Evaluation of hazards for the PHA required the qualitative assessment of event consequences and frequencies. Qualitative consequence and frequency classifications used in Table 9.1-1 are as follows.

Qualitative Consequence Classification:

Negligible	Negligible on-site and off-site impact on people or the environs.
Low	Minor on-site and negligible off-site impact on people or the environs.
Moderate	Considerable on-site impact on people or the environs; only minor off-site impact.
High	Considerable on-site and off-site impacts on people or the environs.

Qualitative Frequency Classification:

Anticipated	($10^{-1} \geq f > 10^{-2}$) Incidents that may occur several times during the lifetime of the facility.
Unlikely	($10^{-2} \geq f > 10^{-4}$) Accidents that are not anticipated to occur during the lifetime of the facility.
Extremely Unlikely	($10^{-4} \geq f > 10^{-6}$) Accidents that will probably not occur during the life cycle of the facility.
Incredible	($10^{-6} \geq f$) Accidents that are not credible.

(f is the frequency of a given event per year).

For each event in Table 9.1-1A-E, a Risk Factor has been developed that is based on the consequence and frequency for the event. The value of the risk factor is determined from a three-by-three frequency and consequence-ranking matrix, shown in Figure 9.1-1. Events with negligible consequences or a frequency of occurrence of less than or equal to 1E-06 per year were assigned a risk factor of zero (0).

9.1.2 Hazard Analysis Results

9.1.2.1 Hazard Identification

Hazards at the WVDP are of two broad types: radiological and nonradiological (toxicological). These hazards exist as confined and unconfined sources. Table 9.1-1 presents the PHA on a facility by facility (i.e., location) basis.

Accidents with significant off-site consequences result when upsets in systems or operations involve both significant quantities of radioactive or nonradioactive hazardous materials and large sources of energy.

In developing potential initiating events, energy sources were identified. Site waste management activities and decontamination and decommissioning efforts are primarily physical in nature, presenting low inherent operational energy sources as could be present in chemical process facilities.

9.1.2.2 Hazard Categorization

The hazard categorization for WVDP facilities and activities is addressed in Section 1.5.

9.1.2.3 Hazard Evaluation

9.1.2.3.1 Summary of Significant Worker-Safety Features

Section 8.1.4 discusses features that provide reasonable assurance of public, worker, and environmental protection in normal, off-normal, and accident conditions. Concrete structures and walls, and thick shield windows, are examples of the most important elements of the worker-safety features because they are passive in nature. These passive features are integral to the radiological protection of workers and to accomplishing the objectives of the Radiological Protection Program at the WVDP. These objectives are achieved through effective implementation of the requirements provided in WVDP-010, *WVDP Radiological Controls Manual*.

During the development of the PHA presented in Table 9.1-1, certain programs at the WVDP were identified as making a significant contribution to the safety of workers. These programs are as follows:

- Safety Document Preparation Program
- Worker Safety Program
- Radiological Protection Program
- Nuclear Criticality Safety Program
- Emergency Response Program
- Quality Assurance Program
- Fire Protection Program
- Performance Based Training Program
- Maintenance Program
- Conduct of Operations Program
- Waste Management Program

9.1.2.3.2 Accident Selection

Appendix A of DOE-STD-3009-94 states the following regarding Design Basis Accidents (DBAs):

> "The concept of a DBA has historically been applied in the nuclear industry for deterministic evaluation of potentially high consequence accidents (primarily for nuclear power plants). The DBA analyses encompass evaluations of the need for and the adequacy of those important SSCs whose failure could have an adverse impact on the public (i.e., SC SSCs). For many DOE facilities, due largely to their age and the absence of safety documentation, the original design bases for their SSCs, including safety-related features, are severely lacking or nonexistent. In recognition of this deficiency, the standard requires the development and analysis of derivative DBAs (which for simplicity were also referred to as DBAs in the body of the standard) for the existing facilities in lieu of actual DBAs."

DOE-STD-3009-94 also states that it provides guidance "for evaluating the safety of a facility for which documentable, deterministic design basis accidents do not exist in order to establish bounding accidents (derivative design basis accidents) that envelope the safety of existing facilities." Because of their age, the facilities at the WVDP that are addressed in this SAR have derivative DBAs (DDBAs) associated with them.

The identification of accidents presenting the greatest risk to on-site individuals and the off-site public is one of the primary goals of the PHA. Accidents selected for more rigorous quantitative evaluation are presented in Section 9.2. These accidents result from operations and support activities that were determined to present the greatest risks based on accident consequence and frequency.

Accidents that were selected for further evaluation are:

1) Main ventilation system HEPA bank failure
2) Hydrogen peroxide spill
3) Energetic event involving TRU Waste
4) Drop of a Loaded High Integrity Container
5) Failure of Uranium Product Cell (UPC) Vessels
6) HLW canister drop
7) Process off-gas or HVAC system HEPA filter failure

These accidents were identified in the PHA as having a risk factor greater than or equal to 3. While other accidents of a similar nature were identified in the hazards analysis, these accidents were selected due to their bounding risk for exposure, both radiological and nonradiological. As a result, the accidents listed above also represent the DDBAs for activities analyzed in this SAR.

Beyond DDBAs have been hypothesized using engineering judgment. A Beyond Design Basis Earthquake (BDBE) that results in failure of the High-Level Waste Interim Storage (HLWIS) area roof and/or falling of the HLWIS area crane is evaluated.

No major accidents or hazardous situations have occurred throughout the operational history of the site.

9.1.3 Evaluation Guideline

The Evaluation Guideline (EG) provided in Appendix A of DOE-STD-3009-94 is 25 rem Total Effective Dose Equivalent (TEDE), regardless of accident sequence frequency. The value of 25 rem is not to be used as a "hard" pass/fail level. Radiological consequences should be compared against this EG to determine whether they challenge the EG, rather than exceed it. This is because consequence calculations are highly assumption driven and uncertain. Manmade DDBAs with estimated frequencies ≤1E-06 per year are not considered credible.

The DOE-provided EG and WVNSCO best management practice toxicological EG are given in Section 9.1.3. Regarding non-radiological hazardous materials, the American Industrial Hygiene Association prepares the Emergency Response Planning Guideline (ERPG) values to provide estimates of concentration ranges above which one could reasonably anticipate observing adverse effects. ERPG-1 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing any effects other than mild transient adverse effects or perceiving a clearly defined objectionable odor. ERPG-2 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing irreversible or other serious health effects or symptoms that could impair their ability to take protective action. ERPG-3 is the maximum airborne concentration below which it is believed nearly all individuals could be exposed for up to one hour without experiencing or developing life-threatening health effects.

DOE-STD-3009-94 does not provide a toxicological EG for members of the public. Appendix A to DOE-STD-3009-94 states "There is no industrial or regulatory precedent for safety class designation of SSCs in facilities or processes with only toxicological hazards." Nevertheless, as a best management practice, a toxicological EG for members of the public is used at the WVDP. For credible accidents, the (off-site) results of quantified analyses of non-radiological hazardous substance releases are compared to the Emergency Response Planning Guidelines (ERPG)-2 concentration or Temporary Emergency Exposure Limits (TEEL)-2 concentration for a given substance.

Regarding on-site guidance to facilitate the selection of safety-significant SSCs, relevant guidance is contained in DOE Guide 420.1-1, *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide for Use with DOE O 420.1, Facility Safety*, and DOE-STD-3009-94. The discussion in DOE Guide 420.1-1 regarding safety-significant SSCs is taken nearly entirely from DOE-STD-3009-94. Select text from DOE Guide 420.1-1 regarding safety-significant SSCs is provided below:

> Safety-significant structures, systems, and components (safety-significant SSCs) are structures, systems, and components not designated as safety-class SSCs, but whose preventive or mitigative function is a major contributor to defense in depth (i.e., prevention of uncontrolled material releases) and/or worker safety as determined from hazard analysis. As a rule of thumb, safety-significant SSC designations based on worker safety are limited to those systems, structures, or components whose failure is estimated to result in a prompt worker fatality or serious injuries (e.g., loss of eye, loss of limb) or significant radiological or chemical exposures to workers. This rule of thumb is neither an evaluation guideline nor a quantitative criterion. It represents a threshold of concern for which safety-significant SSC designation may be warranted. Estimates of worker consequences for the purpose of a safety-significant SSC designation are not intended to require detailed analytical modeling, due to the uncertainties in analyses, especially for facility workers. Considerations should be based on engineering judgment of possible effects and the potential added value of safety-significant SSC designation.

Engineering judgment of possible effects and the potential added value of safety-significant SSC designation, coupled with the "rule of thumb" noted above, provide the primary basis for identifying safety-significant SSCs. Based on relevant technical information, a dose (prompt or committed effective dose equivalent) on the order of a few tens of rem is not comparable to fatality or loss of a member of the body. To further facilitate identification of safety-significant SSCs, consideration is given to SSCs "whose preventive or mitigative function is a major contributor to defense in depth." The need to designate a given SSC that is serving a defense in depth function as a safety-significant SSC is assessed within the context of the discussion provided in Section 2.3 of DOE Guide 420.1-1.

9.2 Accident Analyses

9.2.1 Methodology

Accident analyses are performed through the use of established and accepted references and computer codes. Computer codes used in accident analyses are verified per approved procedures prior to use. Accidents analyzed in this SAR

represent the bounding accident for a particular event type (i.e., spills, filter failure, liquid release, fire, etc.). Events presenting the greatest risk have been identified through process hazards analysis.

Analyses to evaluate the consequences of airborne radiological releases utilize source terms developed from guidance given in DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Non-Reactor Nuclear Facilities;* site-specific dispersion factors calculated using the PAVAN computer codes (Pacific Northwest Laboratory November, 1982); and radiological dose conversion factors given in DOE/EH-0070, *External Dose-Rate Conversion Factors for Calculation of Dose to the Public,* and DOE/EH-0071, *Internal Dose Conversion Factors for Calculation of Dose to the Public.* Unit dose factors assume a two-hour exposure time for affected individuals (consistent with guidance provided in NRC Regulatory Guide 1.145) and an individual breathing rate of 0.333 L/s (ICRP 23, 1975).

Site-specific dispersion factors (χ/Q values) are calculated using the PAVAN computer code, which implements the guidance provided in Regulatory Guide 1.145, *Atmospheric Dispersion Models for Potential Accident Consequences Assessments at Nuclear Power Plants.* The χ/Q calculations are based on the theory that material released to the atmosphere will be normally distributed (Gaussian dispersion) about the plume center-line. A straight-line trajectory is assumed between the point of release and all distances for which the χ/Q values are calculated.

The PAVAN program uses meteorological data in the form of joint frequency distributions of hourly averages of wind direction and wind speed by atmospheric stability class. Wind direction is distributed into 16 sectors (N, NNE, NE,...) and atmospheric stability is distributed into 7 classes (A-G). For each of 16 downwind sectors, the program calculates χ/Q values for each combination of wind speed and atmospheric stability at the site boundary for the respective sector. The χ/Q values calculated for each sector are then ordered from greatest to smallest and an associated cumulative frequency distribution is derived based on the frequency distribution of wind speed and stabilities for that sector. The program then determines for each sector an upper envelope curve based on these data such that no plotted point is above the curve. From this upper envelope, the χ/Q value which is equaled or exceeded 0.5% of the total time is obtained. The maximum 0.5% χ/Q value from the 16 sectors becomes the maximum sector χ/Q value, which has been used in consequence analyses in this SAR. See WVDP-065, *Manual for Radiological Assessment of Environmental Releases at the West Valley Demonstration Project,* for additional information.

Another technique that can be employed to develop conservative χ/Q values is directionally independent (i.e., determined on an "overall site basis"), as opposed to the 0.5% directionally dependent technique discussed in the previous paragraph. Regarding the directionally independent technique, Regulatory Guide 1.145 states the following: "An overall cumulative probability distribution for all directions combined should be constructed. A plot of χ/Q versus probability of being exceeded should be made, and an upper bound curve should be drawn. The 2-hour χ/Q value that is exceeded 5 percent of the time should be selected from this curve as representing the dispersion condition indicative of the type of release being considered." Based on guidance presented in Regulatory Guide 1.145, Section 4, the higher value of the maximum sector χ/Q (0.5% value) or the 5 percent overall site χ/Q should be used in evaluations.

WVDP-065 used the guidance presented above to determine that the maximum sector 0.5% χ/Q value would be used for the maximally exposed individual dose calculations. A maximum sector 0.5% χ/Q value was calculated for elevated (stack) and ground level releases. This SAR applies these χ/Q values for dose calculations performed at a distance producing maximum exposure for site-specific 95% meteorology. The expression "site-specific 95% meteorology" is often used to communicate the 5% directionally independent technique, although maximum sector 0.5% χ/Q values are used for dose calculations. The rationale for this is established in Regulatory Guide 1.145, which states that "selection of the 0.5 percent level is based on an equality, without consideration of plume meander, between the 5 percent directionally independent evaluation of χ/Q and the 0.5 percent directionally dependent evaluation of χ/Q averaged over a reasonably representative number of existing nuclear power plant sites." Given the established equality between the two techniques, and given the fact that the expression "site-specific 95% meteorology" is often used to communicate the 5% directionally independent technique, the terminology "site-specific 95% meteorology" is used in this SAR to communicate conservatively developed site-specific χ/Q values.

Analyses to evaluate the consequences of liquid radiological releases use source terms developed based on the guidance given in DOE-HDBK-3010-94 and radiological dose conversion factors given in DOE/EH-0070 and DOE/EH-0071.

The consequences of nonradiological releases are calculated using a standard computer code. The Emergency Prediction Information Code (EPIcode), version 6.0, was used to model the atmospheric dispersion of nonradiological source terms from the postulated accident scenarios described in Section 9.2.2. EPIcode is endorsed by the DOE as a useful tool for helping emergency planners estimate potential impacts from atmospheric releases of toxic substances. EPIcode uses a straight-line Gaussian Plume Model to calculate peak ground-level concentrations downwind of a release. It allows the user to choose the meteorological and environmental conditions of the release, including the Pasquill-Gifford Stability Class (A-F), ground wind speed, type of terrain, effective release height, ambient temperature, and sampling time. EPIcode does not account for terrain effects, plume buoyancy, or wake effects due to nearby structures.

9.2.1.1 Initiating Event Summary

Initiating event summaries have not been provided for accident evaluations in this SAR as all assessments deterministically assume the occurrence of a particular accident event, with no regard for the mechanisms or chains of events necessary to arrive at the analyzed event. Exceptions to this general rule are made only to the extent necessary to adequately "define" a given accident for calculational purposes.

9.2.1.2 Scenario Development

Accident scenarios have been provided in sufficient detail to support the evaluation of source terms used in the calculations. Scenario developments deterministically assume the occurrence of a particular accident event, with no regard for the mechanisms or chains of events necessary to arrive at the analyzed event. Exceptions to this rule are made only to the extent necessary to adequately "define" a given accident for calculational purposes.

9.2.1.3 Source Term Analysis

For radiological accident scenarios, source terms are calculated based on the method described in DOE-HDBK-3010-94. This calculation requires quantification of Material-at-Risk (MAR), Damage Ratio (DR), Airborne Release Fraction (ARF) or Airborne Release Rate (ARR), Respirable Fraction (RF), and Leakpath Factor (LPF) and is given as: Source Term = MAR x DR x ARF x RF x LPF.

In order to bound the consequences of accidents analyzed, source terms used in this SAR are often based on the entire inventory of material at risk; that is, damage ratios and leakpath factors, as described in DOE-HDBK-3010-94, are assumed to be equal to 1. Source terms for nonradiological releases are calculated by EPIcode based on the quantity of material at risk.

9.2.1.4 Consequence Analysis

Consequences of radiological accidents in this SAR are calculated for both on-site and off-site individuals. Consequences for non-VF-related accidents are calculated for several meteorological conditions: stability class "D", wind speed 4.5 m/s; stability class "F", wind speed 1 m/s; and site-specific 95% meteorology. For ground-level releases, on-site doses are calculated at the On-Site Evaluation Point (OEP), located 100 m (328 ft) from the center of the accident release. For elevated releases, the dose at the OEP is not provided since the plume essentially passes over a receptor located at the OEP.

Dose to off-site individuals is calculated at the nearest site boundary, 1,050 m (3,445 ft), as shown in WVDP-065, and at the distance producing maximum dose for site-specific 95% meteorology. Consequences for VF-related ground-level release accidents are calculated for only stability class "F", wind speed 1 m/s conditions, while VF-related elevated release accidents are calculated for only site-specific 95% meteorological conditions. The reasons for this difference with non-VF-related accident consequence results are rooted in the historical development of these safety basis calculations and the fact that for ground-level releases, stability class "F", wind speed 1 m/s conditions will always yield a more conservative analysis than stability class "D", wind speed 4.5 m/s conditions. Additionally, for ground-level releases, stability class "F", wind speed 1 m/s conditions result in larger doses to receptors of interest than site-specific 95% meteorology, as shown in WVDP-065. WVDP-065 also shows that, for elevated (i.e., Main Plant stack) releases, site-specific 95% meteorological conditions result in larger doses to receptors of interest than either stability class "F", wind speed 1 m/s or stability class "D", 4.5 m/s conditions.

For all accident analyses, an exposure duration of two hours is used since it is assumed that it would be possible to control (shut-off) the source and/or remove any potentially exposed individuals within a two-hour period. The actual site boundary is easily accessible for surveillance or passes through rough, relatively inaccessible terrain where a person would be extremely unlikely to be loitering. In most cases, the duration of the release is less than two hours, so truncating the exposure is not an issue.

Consequences of nonradiological airborne releases are calculated for individuals at the OEP (100 m) and site boundary (1,050 m) using the straight-line Gaussian plume model EPIcode to calculate peak ground-level concentrations downwind of a release.

9.2.1.5 Comparison to Guidelines

The results of accident analyses are evaluated in the context of the EG presented in Section 9.1.3 to assess the need for identifying safety SSCs. For the purposes of evaluation of Unreviewed Safety Questions, the accidents analyzed in Chapter 9 of this SAR present the bounding safety basis risk for activities conducted at the WVDP, with the exception of the RHWF.

9.2.2 Accident Evaluations

DDBAs are accidents such as fires, explosions, spills, and drops that occur due to operational mishaps (i.e., human error and/or equipment failure) or natural phenomena. No credible external events (i.e., man-made initiators external to the WVDP) have been identified.

9.2.2.1 Ventilation System Filter Failure

9.2.2.1.1 Scenario Development

The Main Plant ventilation system provides contamination control for several areas in the Main Plant building, including those areas associated with Liquid Waste Treatment System (LWTS) and Analytical Laboratory operations. Currently, site ventilation systems do not provide instruments for real-time filter activity measurements. An indication of filter activity is obtained from routine radiation surveys of adjacent operating areas. Very conservative assumptions have been made regarding the accident source term.

The ventilation exhaust filtration system is comprised of a bank of 30 roughing filters in series with a bank of 30 High Efficiency Particulate Air (HEPA) filters. The deterministic assumption has been made that a pressure excursion in the ventilation system results in the release of some radioactivity from each of the filters in the bank of 30 HEPA filters.

9.2.2.1.2 Source Term Analysis

Contamination remaining from original Nuclear Fuel Services (NFS) reprocessing activities is the primary source of contamination deposited on Main Plant ventilation filters. Years of operational experience has shown that ventilation system filter changeout is initiated as a result of high filter differential pressure, rather than exposure rate. Nevertheless, the assumption is made that activity loading on Main Plant HEPA filters results in an exposure rate of 10 R/hr at a distance of 0.3 m (1 ft) from the face of a filter. Calculations show that an exposure rate of 1 R/hr at 0.3 m (1 ft) from the face of a HEPA filter corresponds to a Cs-137 loading of 0.75 Ci (Peterson February 8, 1985). Assuming an exposure rate of 10 R/hr per filter, 0.75 Ci of Cs-137 per R/hr measured exposure rate and 30 filters results in a filter bank Cs-137 activity loading of 225 Ci.

The total radiological inventory on the Main Plant HEPA filter bank may be found by scaling a radionuclide distribution to the 225 Ci of Cs-137 assumed to be on the filter bank. An evaluation of previous HEPA filter dust samples and review of historical stack effluent monitoring data reveal that airborne effluents from the Main Plant have a radionuclide distribution similar to high-level waste. However, due to the nature of the NFS process, this waste stream is depleted in the actinide materials that present the greatest risk following an accidental release. To ensure a conservative analysis, a spent fuel distribution as given in the column entitled "Total Activity in Spent Fuel" of WVNS memo CN:93:0013 (Wolniewicz, 1993) is used as the basis for accident evaluations since this distribution does not assume a reduction in

actinide activity due to fuel reprocessing. Nuclides in this list are scaled to the 225 Ci of Cs-137 assumed to be on the Main Plant HEPA filter bank. This inventory is the material-at-risk as shown in Table 9.2-1.

The accident source term was calculated from this MAR using airborne release fractions and respirable fractions given in DOE-HDBK-3010-94. The handbook provides fractions for several release scenarios, including releases due to shock effects, blast effects and fire. For several reasons, it is not expected that filters in the Main Plant ventilation system will be exposed to the energy associated with the blast evaluated in the handbook: 1) there are no sources of explosives, including natural gas, in the Main Plant building, 2) the ductwork and other equipment in the ventilation path (washers, scrubbers) would present resistance to any blast force, and 3) the shear volume of the cells in which any possible blast could occur would take up much of the blast force. Thus, the possible events, which could credibly impact the HEPA filters are a shock or fire. While neither of these events have a likely initiator, it is noted that the values of ARF and RF of 5E-4 and 1.0 associated with a fire are conservative relative to those associated with a shock event. Therefore, these values, which are also consistent with the values for impaction stresses involving enclosed filter media (Section 5.4.4.1 of DOE-HDBK-3010-94), were selected for use in the analysis for conservatism.

9.2.2.1.3 Analysis of Results

Table 9.2-1 presents the potential dose to an off-site individual from the failure of the Main Plant ventilation system filter bank for various meteorological conditions. The maximum TEDE received by an off-site individual has been calculated to be 0.268 rem. It should be noted that these doses have been calculated based on the conservative assumptions of very high filter activity loading and total filter bank failure. It is not expected that either of these analysis basis parameters would be approached.

9.2.2.1.4 Comparison with the EG

The dose to the MEOSI of 0.268 rem TEDE due to the failure of the bank of ventilation system filters is well below the EG of 25 rem TEDE specified in Section 9.1.3. No safety SSCs need to be identified in association with this accident.

9.2.2.2 Hydrogen Peroxide Spill

9.2.2.2.1 Scenario Development

Technical grade 35% hydrogen peroxide is stored in 1,249-L (330-gal) polyethylene totes in the Oxidizer Room of the New Warehouse (Main 2). Due to installed safety features in the Oxidizer Room (collective berm, automatic sprinkler system, controlled ventilation) and administrative controls that limit access to the room, a spill and/or a fire within the Oxidizer Room would be of limited severity, with no consequence to the off-site public.

A maximum of one tote can be placed on a forklift for transport at any time. With only the tote as a barrier to release to the environment, a significant spill outside of the Oxidizer Room presents a risk requiring further evaluation.

9.2.2.2.2 Source Term Analysis

The release rate of the hydrogen peroxide from the tote is not significant since evaporation is the dominant release mechanism. It was assumed that one

tote spills its entire contents (1,249-L) outside the warehouse. It was also assumed that the temperature of the hydrogen peroxide was 30°C (86°F) and that the total quantity spilled from the tote formed a uniform 6-mm (0.236-in) deep pool (i.e., a pool area of 208 m^2 (2,239 ft^2)). A pool depth of 1-mm (0.039-in) was not assumed in the analysis because the corresponding area (1,249 m^2 (13,444 ft^2)) of the spill is unrealistic.

9.2.2.2.3 Analysis of Results

For stability class "F" and 1 m/s wind speed conditions, EPIcode calculated ground-level concentrations of 54 ppm at the 100 m (328 ft) OEP and 1.6 ppm at the 1,050-m (3,445-ft) site boundary.

9.2.2.2.4 Comparison with the EG

The dosage to the MEOSI of 1.6 ppm due to a hydrogen peroxide spill is below the WVNSCO toxicological EG specified in Section 9.1.3. (The ERPG-2 value for hydrogen peroxide is 50 ppm.) No safety SSCs need to be identified in association with this accident. It is noted that the dosage at the OEP is only slightly larger than the ERPG-2 value for hydrogen peroxide, and well below the ERPG-3 value for hydrogen peroxide (i.e., 100 ppm).

9.2.2.3 Energetic Event Involving TRU Waste

Facility decontamination and waste shipping activities at the WVDP require the staging, storage, handling, sampling, compositing, repackaging, consolidation, analysis, and physical stabilization of drums and boxes containing radioactive and/or hazardous wastes. These wastes range in nature from low specific activity soils to high activity transuranic (TRU) wastes in potentially combustible waste matrices.

TRU wastes at the WVDP contain plutonium, which presents a concern for inadvertent criticality as well as for elevated off-site doses following an accidental release. General site criticality safety administrative controls place an upper administrative limit on the amount of fissile material in a waste drum. This plutonium, in addition to the other associated actinide nuclides, are a concern for off-site release since these nuclides present a significantly greater health risk than nuclides associated with low-level wastes. Consequently, an analysis has been performed to assess the consequences of an accident involving a TRU waste container since the consequences of accidents involving these wastes bound the consequences of accidents involving low-level waste containers, including containers having significantly greater external exposure rates than TRU waste containers.

9.2.2.3.1 Scenario Development

The Lag Storage Building (LSB) provides storage for a significant amount of TRU waste generated at the WVDP, including a majority of the TRU waste in a potentially combustible waste matrix. Although other areas of the WVDP are also used for storage of TRU wastes, some of which contain greater inventories of actinide materials than those in storage in the LSB, it is believed that the wastes stored in the LSB present the greatest risk for offsite release due to the concentration of TRU waste in the facility and the form of the waste in containers in the facility.

A bounding analysis for a fire involving TRU waste in storage in the LSB was developed using information from analysis performed at DOE sites; results of experiments of fire propagation in drum/box storage arrays; historical data

from DOE's Occurrence Reporting and Processing System (ORPS); and from review of facility-specific design features and operational activities.

The Radioactive Waste Management Complex (RWMC) located at the Idaho National Engineering and Environmental Laboratory (INEEL) contains the single largest inventory of contact-handled TRU waste in interim storage within the DOE complex. Over 100,000 drums and over 10,000 boxes and bins of contact-handled TRU waste are located at the RWMC. Within the RWMC is the Waste Storage Facility (WSF), which consists of one Type I building and seven Type II buildings. The Type II buildings provide an interim storage area for TRU and mixed TRU waste containers.

The INEEL FSAR addresses the probability that fire can propagate from a burning drum to surrounding drums and eventually involve a substantial quantity of waste within the building. Engineering analysis, existing test data, and historical fire accident data are used in the analysis. The FSAR analysis determined that a burning waste drum may cause some of the contents of drums adjacent to the burning drum to smolder, with some pressure relief past the gasket, but that the fire would not be of sufficient intensity to induce ignition and complete burning of the contents of the adjacent containers. The analysis, which takes no credit for fire suppression equipment in limiting the propagation of the fire, concludes that a single drum fire is the design basis fire for the facility.

An analysis performed for Hanford's Waste Receiving and Processing Facility (WRAP) assumes that a handling accident involving a fire in the shipping and receiving area would involve no more than four drums. The Hanford analysis determined that a forklift could possibly puncture two drums, but operating speeds would be insufficient to penetrate adjacent drums. It was assumed that the resulting fire could affect two more drums by lid seal failure. The consequence analysis, however, does not assume that each of the drums is loaded with activity to some administrative control limit but rather assumes different source terms for each drum involved in the fire.

Experiments involving several drum and box fire/explosion were also reviewed to assess the risk of accidents involving TRU waste in storage at the WVDP. The results of several experiments involving burning waste containers are discussed in WHC-SD-SQA-ANAL-501, *Fire Protection Guide for Waste Drum Storage Arrays*. The Hanford analysis documents that fire propagation in a storage array can potentially occur (1) via drum to drum, (2) via spilled contents, and (3) via the storage structure. The viability of all three means of fire propagation are analyzed.

The analysis states that whereas an initiating event such as a pool fire will cause exposed drums to fail and burn, the spread of fire through the drum array is limited by the ability of the burning drums to heat neighboring drums via radiation to allow fire propagation. However, it was found through a combination of experimental and analytical methods that horizontal drum to drum fire propagation based on the burning of drum contents within a drum is not expected. A similar analysis for a rack configuration showed that drum burning cannot support upward fire propagation in a rack. A conservative analytical study along with experimental test data demonstrated that lid failure of solid waste drums will not occur from drums exposed to trash fires. Therefore, fire propagation through the array can not occur from the burning of expelled drum contents.

Full-scale testing by Hughes Associates, Inc. (HAI), which is documented in the Hanford analysis, showed that fire propagation can occur from pallet to pallet if wood pallets are used. However, propagation via this method was

slow and of minimal fire size and therefore could be easily controlled. Nevertheless, this means of fire propagation was sufficient to cause additional seal failures and venting of drums along the array.

WHC-SD-SQA-ANAL-501 also documents the results of several fire tests involving 55-gal drums. The tests show that drums engulfed in a diesel fuel pool fire are very likely to experience lid loss in a relatively short time frame. As found in the HAI experiments, the time to lid loss ranged from 70 to 145 seconds. In the rack storage array test, extensive drum and rack damage occurred within the confines of the pool fire, and lid failures were experienced on all tiers of the rack within the pool area. The study also found that typical ventilation devices, such as vent clips or carbon filters (e.g., Nucfil), are ineffective at relieving fire induced internal drum pressures.

Finally, occurrence reports (ORs) contained in DOE's Occurrence Reporting and Processing System database were reviewed to identify relevant events. Several ORs were found that report drum overpressurization/explosion events due to the accumulation of gases in unventilated containers. The gas typically involved in these events is hydrogen; however, some ORs conclude that the evolution of methane or carbon dioxide was responsible for the event. The ORs reveal that some of the events were very energetic.

Based on the ORs that were reviewed, it is concluded that the potential for a fire to ensue after a drum overpressurization/explosion event is unlikely. Only one box-related event was found (OH-FN-FFI-FEMP-1997-0034). The box-related event was a significant event that entailed a broad emergency response. Highly incompatible materials had been placed into the subject box. It is noted that at least one drum pressurization event has occurred at the WVDP, as documented in OH-WV-WVNS-WMSA-1997-0001. In this event, "the drum lid popped up approximately 8-12 inches." The conclusions of the ORs found that the events were often caused by human error (e.g., inadvertently placing incompatible materials together), or lack of analysis (e.g., the mixing of certain materials had never been evaluated/considered for potentially hazardous reactions).

TRU waste containers in the LSB are stored on steel pallets, and are segregated from other waste containers in the LSB. The Lag Storage Building has manual pull stations at each exit and heat detection throughout. The activation of fire detection devices or manual pull stations leads to an alarm in the Main Security Gate House.

Diesel-powered forklifts are used in the LSB. A diesel fuel fire resulting in a release of radioactive material from TRU waste containers is highly improbable, and could be considered not credible (i.e., to occur with a frequency of 1E-06 per year or less) based on the following analysis: For the event to occur, (1) a substantial amount (gallons) of fuel would need to leak undetected from a diesel-powered forklift (0.01 per year); (2) the fuel would need to encounter an ignition source (0.01); and (3) the fire would need to burn with sufficient intensity and duration, and in sufficient proximity to the TRU containers as to cause combustion of the drum contents(0.01).

This analysis does not reflect actions by workers or fire fighters to extinguish the fire. Such actions are likely to occur promptly since workers are likely to be present when the postulated accident occurs. The analysis also relies on a leak resulting from a catastrophic failure such as a fuel tank rupture, since leaks of a lesser rate would very likely be detected by workers before a significant fuel spill occurred. Thus, the estimate of 0.01 per year is considered to conservatively bound the frequency of the initiating

event. For fires under these conditions, WHC-SD-SQA-ANAL-501 found that in no cases did lid loss occur when drum wall temperatures were below 600 deg C (1100 deg F).

Based on information contained in the referenced analyses and a review of Lag Storage Building inventories and operations, it is concluded that an energetic event (i.e., overpressurization, explosion, and/or fire) involving a TRU waste drum is credible. An energetic event could occur due to the mixing of incompatible materials, resulting in an exothermic reaction and/or buildup of gases such as hydrogen, methane, or carbon dioxide. An energetic event could also occur due to a drum handling accident that provides the ignition source for flammable gases and/or combustible materials contained in the affected container. Evidence indicates that an energetic event in one drum will not lead to an energetic event in adjacent waste containers. In evaluating the event, credit is taken for the protection provided by the sealed drum. The analysis performed for waste drums is believed to bound the risk associated with accidents involving TRU waste boxes.

An external fire scenario resulting in the release of radioactive materials from TRU/suspect TRU waste containers in the LSB is judged to be incredible. This judgment is based primarily on the quantified analysis of the likelihood of various external fire scenarios provided in the WSF FSAR, and LSB-specific features (e.g., the use of steel pallets and absence of combustible materials in general, the lack of requisite energy sources, and the existence of fire detection and alarm features).

9.2.2.3.2 Source Term Analysis

The fissile material inventory within a drum involved in an energetic accident scenario is bounded by the applicable Process Safety Requirement (PSR). PSR-6, *Fissile Material Packaging and Storage Requirements*, provides a limit of 125 grams of fissile material per drum. The controls of PSR-6 are general in nature and therefore wastes packaged to the requirements of PSR-6 are the most likely to be in a combustible matrix.

The criticality safety analysis for PSR-6, WVNS-NCSE-001 (see Section 8.7.3.1), assumed that the entire fissile inventory of the waste container was comprised of Pu-239. This assumption leads to a conservative criticality analysis; however, for the purposes of evaluating off-site dose consequences the assumption excludes from consideration important dose contributors such as Pu-238 and Am-241. In addition, there are no waste streams at the WVDP having a fissile inventory comprised exclusively of Pu-239.

A conservative yet realistic distribution of fissile nuclides for WVDP waste streams is found in WVNS memo CN:93:0013 (Wolniewicz, 1993) in the column entitled "Total Activity in Spent Fuel." The estimate of nuclides provided in the memo compensates for the depleted inventory of uranium and plutonium in high level wastes by adjusting the high level waste inventory of these nuclides by the processing efficiency cited by NFS. The resulting distribution was then scaled by the maximum amount of fissile material allowable in a PSR-6 waste container (125g U-233 + U-235 + Pu-239 + Pu-241) to arrive at a material-at-risk for the TRU waste drum.

The release of radioactivity to the environment during a fire involving a TRU waste drum is assumed to occur via airborne transport. DOE-HDBK-3010-94 provides a bounding ARF and RF of 5E-4 and 1.0 for the thermal stress of packaged mixed waste, which is appropriate for non-combustible drums containing combustible wastes. These ARF and RF values are also consistent with the median values recommended for burning cellulosic waste. A review of

WVDP TRU waste containers reveals that the contents of a majority of TRU waste containers, particularly those containers containing elevated quantities of fissile material, are non-combustible metal wastes. Therefore, the use of release factors corresponding to combustible wastes is conservative.

9.2.2.3.3 Analysis of Results

Table 9.2-2 presents the dose to a receptor at the OEP and to an off-site individual from an energetic event involving a TRU waste drum for various meteorological conditions. All major radionuclides (i.e., those contributing at least 0.1% to the total dose received by a given receptor) are presented in Table 9.2-2. The maximum TEDE at the OEP is 18.8 rem, while the maximum TEDE received by an off-site individual is 0.349 rem.

It is noted for comparison that a drum containing 125 grams of Pu-239 produces an dose of 20.1 rem to a receptor at 100m and a dose of 0.373 rem to a receptor at 1050m when the prescribed meteorological conditions of stability class "F" and wind speed of 1 m/s are used.

9.2.2.3.4 Comparison with the EG

The dose to the MEOSI of 0.349 rem TEDE due to an energetic event involving a TRU waste drum is well below the EG presented in Section 9.1.3. No safety SSCs need to be identified in association with this accident.

9.2.2.4 Drop of a Loaded High Integrity Container

9.2.2.4.1 Scenario Development

A full HIC is lifted out of its process shield through an opening in the Radwaste Process Building roof to a height of approximately 4.6 m (15 ft). Prior to lifting the HIC free of its shield, it is lifted approximately 5 to 8 cm (2 to 3 in) and held for five minutes. If the load does not slump or drop during this time, the HIC is placed into a shielded storage container in the north FRS yard.

A HIC and its associated lifting ring are designed to withstand an abrupt lift force of 3g with a full payload of 4,500 kg (10,000 lb) and have been shown to successfully withstand drops onto compacted sand from 7.6 m (25 ft) on both a top corner and bottom corner without splitting open while fully loaded. However, it is possible that failure of any portion of the lifting or rigging equipment could result in the drop of a HIC and it is assumed that the HIC would rupture upon impact, releasing its entire contents to the ground.

9.2.2.4.2 Source Term Analysis

The radioactive inventory of a full HIC is based on the radiological characteristics of sludge and resin contained in HIC "B". (HIC "B" exhibits the highest concentration of activity of all the HICs currently on-site.) The inventory is calculated using HIC "B" characterization data and an assumed resin mass of 3,200 kg (7,000 lb). DOE-HDBK-3010-94 gives a bounding fraction of respirable material that would be released from the free fall spill of a slurry of 4E-5 (ARF = 5E-5, RF = 0.8). Multiplication of the HIC activity by this fraction gives the source term activity.

9.2.2.4.3 Analysis of Results

Table 9.2-3 presents the dose to a receptor at the OEP and to an off-site individual from the drop of a loaded HIC for various meteorological

conditions. The maximum TEDE at the OEP has been calculated to be 0.129 rem. The maximum TEDE received by an off-site individual has been calculated to be 2.40E-03 rem.

9.2.2.4.4 Comparison with the EG

The dose to the MEOSI of 2.40E-03 rem TEDE due to the dropping and catastrophic failure of a loaded HIC is well below the EG presented in Section 9.1.3. No safety SSCs need to be identified in association with this accident.

9.2.2.5 Failure of UPC Vessels

9.2.2.5.1 Scenario Development

Currently the largest available tankage for storing radioactively contaminated waste is located in the uranium process cell (UPC). Of primary concern are the 5D-15A and 5D-15B tanks. Externally, these tanks are identical, but the tank 5D-15A is internally divided into two distinct vessels, 5D-15A1 and 5D-15A2. Together, all three tanks represent 113,950 liters (30,102 gal) of available storage.

An earthquake that precipitates a common mode failure of all three tanks is postulated to occur, releasing the entire 113,950 liters (30,102 gal) of liquid into the cell. This earthquake is presumed to approach but not exceed the design basis of the Main Plant. Therefore, the structure of the Main Plant is assumed to remain intact. The vessels in question, however, have not been seismically qualified and are considered to fail in the postulated seismic event. Activity will become airborne via splashing and evaporation of the resulting pool.

9.2.2.5.2 Source Term Analysis

Decontamination of site facilities will result in the generation of liquid radioactive wastes. Vessels in the UPC have been released from their original mission, which involved storage of LWTS feed and product streams, to a more general mission of management of Main Plant liquid wastes, including wastes generated during cell decontamination activities. Since these tanks are the largest available for storage, a spill from these tanks constitutes a bounding spill accident, provided that the activity contained is representative of what could be placed in the tanks. Analyses of liquids from XC-2 vessels were used to produce a radionuclide profile. For each vessel in XC-2, a total nuclide inventory was developed from the profile, assuming each vessel is filled to capacity. The nuclide inventory for all vessels in XC-2 was then summed to create a composite inventory for the entire cell. The total volume of the tanks in XC-2 yields a volume of approximately 39,300 liters (10,381 gal), but the vessels actually analyzed only contain 22,359 liters (5,907 gal). To ensure that the event under consideration is bounding, the entire nuclide inventory is multiplied by a factor of 5.09 to give a volume of waste sufficient to completely fill vessels 5D-15A and 5D-15B. This corresponds to a total inventory of approximately 179 curies.

Two phenomena contribute to the airborne release of radioactive material. These are free fall splashing and evaporation from the liquid pool. The bounding ARF and RF values for a splash of aqueous solution from a height of 3 m (10 ft) are 2.0E-04 and 0.5 respectively. These values are provided in section 3.1 of DOE-HDBK-3010-94. Using these values is conservative in that the bottoms of these tanks are less than 1 m (3.3 ft) above the floor of the

cell. The ARF and RF values for a pool of water evaporating at ambient temperatures are insignificant by comparison, and are therefore disregarded.

For the purposes of this analysis, the Main Plant structure is assumed to remain intact, including the Main Plant stack. Therefore, it is assumed that the release is out of the Main Plant stack. No credit is taken for the decontamination effects of the ventilation system HEPA filters. Atmospheric dispersion parameters can be found in WVDP-065.

9.2.2.5.3 Analysis of Results

Table 9.2-4 presents the dose to an off-site individual from the spill of the contents of tanks 5D-15A1, 5D-15A2 and 5D-15B for various meteorological conditions. The maximum TEDE received by an off site individual has been calculated to be 1.4E-01 rem.

9.2.2.5.4 Comparison with the EG

The dose to the MEOSI of 1.4E-01 rem TEDE due to the simultaneous failure of tanks 5D-15A1, 5D-15A2 and 5D-15B is well below the EG presented in Section 9.1.3. No safety SSCs need to be identified in association with this accident.

9.2.2.6 HLW Canister Drop

9.2.2.6.1 Scenario Development

Canisters of vitrified high-level waste are currently stored in the storage rack located in the High-Level Waste Interim Storage. It is possible that the integrity of a canister could be breached either during the handling of the canister for transport into or out of a storage location or following an impact of the top of the canister with an object dropped onto it while in storage in the rack. Neither accident is likely to breach to the canister, which is necessary for any release of radioactivity. Canisters are constructed of 304L stainless steel and have been designed to withstand a 7m (23 ft) drop onto an unyielding surface without losing integrity. In addition, heavy objects are not routinely handled above any wastes in storage in the racks. Therefore, failure of a canister due to a handling or impact event is not probable. Nevertheless, a canister is assumed to be dropped from a height of 10m (32.8 ft), which is assumed to bound the energy associated with the drop of any heavy object onto the canister in storage.

9.2.2.6.2 Source Term Analysis

The results of an analysis that correlates the fraction of activity released to the environment as a function of the height from which a brittle material is dropped onto an unyielding surface is summarized in Section 4.3.3 of DOE-HDBK-3010-94. The drop of a high level waste canister from a height of 10m would generate an impact energy of 0.27 joules/cm^3, corresponding to an ARF x RF of 5.2E-5. The analysis of DOE-HDBK-3010-94 assumed the drop of a bare, brittle structure. As stated earlier, vitrified high level wastes are stored in durable steel containers. These canisters not only would serve to absorb some of the impact energy, but would also effectively contain much of the potentially released activity. A damage ratio of 0.1 is therefore assumed. This ARF x RF x DR of 5.2E-6 is applied to the radiological inventory of a HLW canister given in Table 4.1-2 to arrive at the accident source term.

9.2.2.6.3 Analysis of Results

Doses to on-site workers and the maximally-exposed off-site individual are given in Table 9.2-5. Since the HLWIS area is ventilated (i.e., exhausted) through the Main Plant stack, an elevated release was assumed for the modeling of this accident scenario. The calculated TEDE to the MEOSI is 3.90E-02 rem. The off-site dose is well within the EG given in Section 9.1.3. No safety SSCs need to be identified in association with this accident.

9.2.2.6.4 Comparison with EG

The dose to the MEOSI of 3.90E-02 rem TEDE due to the failure of a HLW canister due to being dropped or crushed by heavy object is well below the EG presented in Section 9.1.3. No safety SSCs need to be identified in association with this accident.

9.2.2.7 Process Off-Gas or HVAC System HEPA Failure

9.2.2.7.1 Scenario Development

The in-cell process HEPA filters received the Slurry Fed Ceramic Melter (SFCM) off-gas after it had passed through the Submerged Bed Scrubber (SBS) and the High Efficiency Mist Eliminator (HEME). The Process Off-Gas System also serviced other vessels during the vitrification campaign. In-cell process off-gas equipment has been removed, and the off-gas pipe in the Vitrification Cell (which leads to the ex-cell off-gas equipment in the O1-14 Building) has a blind flange installed on it. However, this flange could be removed to allow the use of ex-cell off-gas equipment for Vitrification Cell clean-up and decontamination activities. Consequences from the failure of ex-cell off-gas HEPA filter(s) are considered to be bounded by the following analysis.

There were two parallel sets of filters within the Cell that were used alternately, so only two filters in series were active at any time. It is assumed that all of the radioactivity removed from the off-gas stream was captured by the first of the two series filters and, therefore, the accident material at risk is from only one HEPA filter. Beyond the Vitrification Cell, i.e. ex-cell, the process gas flowed through two additional stages of HEPA filtration and then to the 60-m (197-ft) Main Plant stack for release.

The HVAC components that service the Vitrification Cell normally operate with two of the three parallel, in-cell HEPA filter assemblies on-line. The in-cell HVAC HEPA filters were replaced in 2004.

By virtue of their respective functions and a review of relevant information, it can be stated that the reasonably bounding radiological material at risk associated with an in-cell process off-gas HEPA filter assembly exceeded that of two in-cell HVAC HEPA filter assemblies. Therefore, a radiological material at risk is developed only for the (formerly installed) in-cell process off-gas HEPA filter. The analysis assumes that the in-cell process HEPAs were not changed-out and that all particulate activity from the vitrification campaign was collected on a single filter. The total curies collected on this filter were determined by the Decontamination Factor (DF) in the several process steps prior to the filter; namely, the process steps provided by the SFCM, the SBS, and the HEME. DF values have been defined for these pieces of equipment in Attachment D of Nixon (1995), and based on those factors the curie balance was calculated. Not all of the key isotopes are included in Nixon (1995), so the removal efficiencies in that document have been used to modify the isotopic distribution ratios from Crocker (1989).

These filter loadings for the total vitrification campaign are tabulated as the source term in Table 9.2-6.

9.2.2.7.2 Source Term Analysis

It is a characteristic of HEPA filters that the particles removed from the air stream become imbedded deep in the filter matrix. Therefore, should a filter fail due to a pressure excursion, crushing, or high heat exposure, only a very small fraction of the inventory would be dispersed. For reasons presented in Section 9.2.2.1.2, an ARF of 5.0E-04 and RF of 1.0 are used in the consequence analysis.

Data which summarize the analysis of this accident are presented in Table 9.2-6. If the accident occurs in the HVAC System, then the radioactive material release occurs through the "short" stack associated with the HVAC System that services the Vitrification Cell. Therefore, the ground-level release χ/Q for an off-site receptor of 5.67E-04 sec/m^3 from WVDP-065 was used as the basis for the dose estimate.

9.2.2.7.3 Analysis of Results

The calculated dose is 7.86E-02 rem to the MEOSI, and 4.24 rem to the on-site receptor at 100 meters. The dose to the MEOSI is a small fraction of the EG given in Section 9.1.3. No safety SSCs need to be identified in association with this event.

9.2.2.7.4 Comparison with EG

The dose to the MEOSI of 7.86E-02 rem TEDE and to the on site receptor at 100 meters of 4.24 rem TEDE due to the failure of the Vitrification Cell process off-gas or HVAC system HEPA filters is well below the EG presented in Section 9.1.3. No safety SSCs need to be identified in association with this accident.

9.2.2.8 Beyond Design Basis Failure of HLWIS Area Roof

In a BDBE, the roof of the HLWIS area could fail. Typically, this would be a partial failure, and much of the potential energy would be expended in cracking or bending rather than a free-fall drop. However, for a conservative analysis, the total roof slab is assumed to free-fall onto the HLW glass canisters, stacked in two layers. The energy from this free-fall drop would be equal to approximately 0.1 joules/cm^3 of glass. The 7-meter (23-ft) free-fall test drop to an unyielding surface, which the loaded HLW canisters survive intact, is equivalent to 0.18 joules/cm^3. It is concluded that there would be no radiological release.

In addition to the fact that much of the roof drop energy potential would be used in bending/cracking, the top of the canisters and the rack would absorb much of the fall in yield compression. These effects would further minimize the likelihood of canister failures. A high concentrated impact could result from a crane drop accident, considered below, in which the consequence of release from the failure of a few canisters is developed.

9.2.2.9 Beyond Design Basis Crane Falls in HLWIS Area

In a BDBE, it can be hypothesized that the bridge crane servicing this area could fall on top of the stored HLW glass canister array. Such a drop, depending upon the point(s) of impact, could result in failure of some of the canisters and a possible release of radioactivity.

Canister failure has been reviewed in Section 9.2.4.1 in which the 7-m (23-ft) test drop with no failure was equated to an energy of 0.18 joules/cm^3. If the total energy of a crane drop is associated to this 0.18 joules/cm^3, or 1.3E+05 joules/canister, the equivalent of four canisters could be assumed to fail. Further, if 10% of this energy is assumed to be transferred to the contained HLW glass, an ARF (per DOE Handbook 3010-94) can be calculated. Both of these assumptions are estimated to be conservative. The storage racks and tops of the canisters (air space) would partially collapse under a crane impact and this bending/crushing action would absorb much of the energy. Further, the indirect impact to the glass would not cause maximum fines (<10 microns [<3.9E-04 in]) to be generated. Even if the stainless steel canister is cracked, there still would be a significant confinement function.

Notwithstanding these mitigating functions, a release equivalent to 10% of bare glass with an energy input of 0.18 joules/cm^3 has been used to calculate an on- and off-site dose. It has also been assumed that the HLWIS area confinement integrity is not maintained, i.e., a direct ground level release to the environment is assumed. The resultant off-site dose is 5.2E-03 rem (based on the ground-level χ/Q of 5.67E-04 sec/m^3 at the site boundary 1,050 m [3,445 ft] away) and the on-site dose is 2.79E-01 rem (based on a χ/Q of 3.06E-02 sec/m^3 at a distance of 100 m [328 ft]). No fall-out or other removal function is assumed in this dose development.

9.2.3 Accident Analysis Summary for VF Accidents

A summary of consequences of VF-related accidents is provided in Table 9.2-8. All accidents analyzed are within the EG given in Section 9.1.3. The failure of the Vitrification Process Off-Gas System or HVAC System HEPA filters potentially results in a TEDE to the MEOSI of 7.86E-02 rem. This represents the bounding credible accident.

REFERENCES FOR CHAPTER 9.0

Crocker, R.L. October 10, 1989. *Vitrification Mass Balance Revision Number 7* (EK:89:0232). Letter to V.S. Arakali, et al. West Valley Nuclear Services Co., Inc.

Emergency Prediction Information Code. EPIcode. Version 6.0.

Hughes Associates. September 16, 1996. *Fire Protection Guide for Waste Drum Storage Arrays*. Rev. 0. WHC-SD-SQA-ANAL-501. Westinghouse Hanford Co.

International Commission on Radiological Protection. October 1974. *Report of the Task Group on Reference Man*. Report No. 23.

Jardine, L.J., W.J. Mecham, G.T. Reedy, and M.J. Steindler. 1982. *Final Report of Experimental Laboratory-Scale Brittle Fracture Study of Glass and Ceramics*. ANL-82-39. Argonne, IL: Argonne National Laboratory.

Nixon, Justina. May 1, 1995. *Vitrification Mass Balance*, Rev. 8. Memo No. CC:95:0031. Letter to V.S. Arakali, et al. West Valley Nuclear Services Co., Inc.

Pacific Northwest Laboratory. November 1982. PAVAN: *An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations*. NUREG/CR-2858, PNL-4413.

Peterson, J.M. February 8, 1985. *Correlation of Exposure Rate with Radionuclide Inventory on a Loaded HEPA Filter*. Memo to C. P. Bliss (HE:85:0016).

Rykken, L.E. June 1986. *High-Level Waste Characterization at West Valley*. Prepared for U.S. Department of Energy Assistant Secretary for Nuclear Energy, contract No. DE-AC07-81NE 44139.

U.S. Department of Energy. July 1988a. *External Dose-Rate Conversion Factors for Calculation of Dose to the Public*. DOE/EH-0070. Washington, D.C.

_____. July 1988b. *Internal Dose Conversion Factors for Calculation of Dose to the Public*. DOE/EH-0071. Washington, D.C.

_____. May 1994. *Safety Analysis Report for the Waste Storage Facility*. Rev. 2. EGG-WM-01774. Idaho: EG&G Idaho, Inc.

_____. December 1994. Change 1 (March 2000). DOE-HDBK-3010-94: *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*. Washington, D.C.

_____. July 1994. Change 2 (April 2002). DOE STD-3009-94: *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. Washington, D.C.

_____. November 1997. *Final Safety Analysis Report for the Waste Receiving and Processing (WRAP) Facility*. Rev. 0. HNF-SD-WO26-SAR-002. Waste Management Federal Services of Hanford, Inc.

REFERENCES FOR CHAPTER 9.0
(Concluded)

_____. March 28, 2000. DOE Guide 420.1-1. *Nonreactor Nuclear Safety Design Criteria and Explosives Safety Criteria Guide for Use with DOE Order 420.1, Facility Safety.*

_____. May 20, 2002. *Facility Safety.* DOE Order 420.1A. Washington, D.C.

U.S. Nuclear Regulatory Commission. November 1982. Regulatory Guide 1.145: *Atmospheric Dispersion Models for Potential Accident Consequences Assessments at Nuclear Power Plants* (Rev 1).

West Valley Nuclear Services Co. WVDP-010: *WVDP Radiological Controls Manual* (latest revision).

_____. FFA-9: *Lag Storage Area - Facility Fire Assessment* (latest revision).

_____. PSR-6: *Fissile Material Packaging and Storage Requirements* (latest revision).

_____. WVDP-043: *Spill Prevention Control and Countermeasures Plan* (latest revision).

_____. WVDP-065: *Manual for Radiological Assessment of Environmental Releases at the West Valley Demonstration Project.* (latest revision)

_____. WVDP-082: *DOE Hoisting & Rigging Manual.* (latest revision).

_____. WVDP-193: *WVDP Hazards Assessment.* (latest revision).

_____. WVNS-FAM-001: *Keltron System Alarm Code Listing and Guidelines.* (latest revision).

_____. WVNS-SAR-023: *Safety Analysis Report for the Remote Handled Waste Facility.* (latest revision).

Westinghouse Safety Management Solutions, Inc. April 2004. Rev. 20. ERPGs and TEELs for Chemicals of Concern. DKC-04-0003.

Wolniewicz, J.C. March 1993. CN:93:0015. *Estimation of Activity in the Former Nuclear Fuel Services Reprocessing Plant.* West Valley, NY: Dames & Moore.

TABLE 9.1-1A

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES

(All footnotes are located at the end of the table)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
HIGH LEVEL WASTE TRANSFER SYSTEM, SUPERNATANT TREATMENT SYSTEM, AND WASTE TANK FARM							
Supernatant Treatment System							
Airborne Contamination	1) Loss of ventilation system capability 2) Loss of confinement barrier integrity 3) Loss of ventilation system integrity 4) Fire involving LLW container	- tornado - seismic event - corrosion - fire/explosion - loss of line power - excess moisture/ particulate loading on HEPA filters	- Multiple barriers to access of contaminated areas - Areas providing confinement for high concentrations of radioactivity designed to withstand seismic event - Established procedures and training for personnel - Backup power for ventilation system equipment - High differential pressure alarms and controls - Heaters to increase ventilation air dew point - No organics or explosive material or gases such as H_2 in HLW tanks - Tornado dampers on ventilation exhaust - Minimal combustible loading in STS process areas	- Redundant vent system blowers - Seals on valve aisle penetrations - Redundant vent system filter trains - West Valley Volunteer Hose Company - Dry pipe sprinkler system in STS building	1) Neg 2) Neg 3) Neg 4) Low	1) A 2) U 3) A 4) EU	1) 0 2) 0 3) 0 4) 1
8D-1	Volume: 2,800,000 L	Name: PUREX HLW Tank	Location: Waste Tank Farm	Construction: Carbon steel			
Cs-loaded zeolite	1) Loss of tank integrity 2) Tank overflow	- seismic event - corrosion - explosion/over-pressurization - drop of mob pump or decon component (e.g., mast) - buoyant uplift of vault/tank system	- 0.5 inch carbon steel tank - Liquid level indicators in tank and pan - Tank/vault system constructed to withstand evaluation basis earthquake stresses - No organics or other explosive materials or gases (including H_2) in the tank [a] - N_2 inerting system for tank/vault - Tank/vault 10-40 feet below ground level - Tank ventilation systems - Earthen overburden - Groundwater infiltration minimized - System deactivated	- Reinforced concrete vault - Carbon steel pan - Redundant spare tank	1) Neg 2) Neg	1) U 2) EU	1) 0 2) 0
8D-2	Volume: 2,800,000 L	Name: PUREX HLW Tank	Location: Waste Tank Farm	Construction: Carbon steel			
High Activity Solids	1) Loss of tank integrity 2) Tank overflow	- seismic event - corrosion - explosion/over-pressurization - drop of mob pump or decon component (e.g., mast)	- 0.5 inch carbon steel tank - Liquid level indicators in tank and pan - Tank/vault system constructed to withstand evaluation basis earthquake stresses - No organics or other explosive materials or gases (including H_2) in the tank [a] - N_2 inerting system of tank/vault - Tank/vault 10-40 feet below ground level - Tank ventilation systems - Earthen overburden - Groundwater infiltration minimized - Tank has been almost completely emptied of high level waste	- Reinforced concrete vault - Carbon steel pan - Tank ventilation and natural convection to remove H_2 buildup [a] - Redundant spare tank - Tank contains wasted heels, and has been deactivated	1) Neg 2) Neg	1) U 2) EU	1) 0 2) 0

TABLE 9.1-1A

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
8D-3	Volume: 57,000 L	Name: STS Product Tank	Location: Waste Tank Farm	Construction: Stainless steel			
Liquid Radioactive Waste	1) Loss of tank integrity 2) Tank overflow	- seismic event - corrosion - operator error - mechanical error/malfunction - explosion/over-pressurization	- Stainless steel tank - Liquid level indicators - Established procedures and training for personnel - No organics or other explosive materials or gases (including H_2) in the tank	- Reinforced concrete vault lined with stainless steel	1) Neg 2) Neg	1) U 2) EU	1) 0 2) 0
8D-4	Volume: 57,000 L	Name: Waste Header Effluent Tank	Location: Waste Tank Farm	Construction: Stainless steel			
Liquid Radioactive Waste	1) Loss of tank integrity 2) Tank overflow	- seismic event - corrosion - operator error - mechanical error/malfunction - explosion/over-pressurization	- Stainless steel tank - Liquid level indicators - Pressure indicators - Established procedures and training for personnel - No organics or other explosive materials or gases (including H_2) in the tank	- Reinforced concrete vault lined with stainless steel	1) Neg 2) Neg	1) U 2) EU	1) 0 2) 0
50C-001 50C-002 50C-003 50C-004	Volume: 7,200 L Volume: 7,200 L Volume: 7,200 L Volume: 7,200 L	Name: IX Column Name: IX Column Name: IX Column Name: IX Column	Location: Tank 8D-1 Location: Tank 8D-1 Location: Tank 8D-1 Location: Tank 8D-1	Construction: Stainless steel Construction: Stainless steel Construction: Stainless steel Construction: Stainless steel			
Residual Radioactive Contamination	1) Loss of column integrity	- seismic event - corrosion - explosion/over-pressurization	- Stainless steel IX column - Pressure indicators - Low, high level alarms - Liquid level indicators - Established procedures and training for personnel - System Deactivated	- 8D-1 carbon steel tank - Reinforced concrete vault - Carbon steel pan - Leak detection system in 8D-1 pan	1) Neg	1) U	1) 0
50D-001	Volume: 6,535 L	Name: Supernatant Feed Tank	Location: Tank 8D-1	Construction: Stainless steel			
Residual Radioactive Contamination	1) Loss of tank integrity	- seismic event - corrosion - explosion/over-pressurization	- Stainless steel tank - Tank/vault system constructed to withstand evaluation basis earthquake stresses - System deactivated	- 8D-1 carbon steel tank - Reinforced concrete vault - Carbon steel pan - Leak detection system in 8D-1 pan	1) Neg	1) U	1) 0

TABLE 9.1-1A

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES

(All footnotes are located at the end of the table)(Concluded)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
50D-004	Volume: 8,110 L	Name: Sluice Lift Tank	Location: Tank 8D-1	Construction: Stainless steel			
Residual Radioactive Contamination	1) Loss of tank integrity	- seismic event - corrosion - fire/explosion/over-pressurization	- Stainless steel tank - Tank/vault system constructed to withstand evaluation basis earthquake stresses - System deactivated	- 8D-1 carbon steel tank - Reinforced concrete vault - Carbon steel pan - Leak detection system in 8D-1 pan	1) Neg	1) U	1) 0
50F-001		Name: Prefilter	Location: Tank 8D-1	Construction: Stainless steel			
Residual Radioactive Contamination	1) Loss of prefilter integrity	- seismic event - corrosion - fire/explosion/over-pressurization	- Stainless steel filter housing - Tank/vault system constructed to withstand evaluation basis earthquake stresses - System Deactivated	- 8D-1 carbon steel tank - Reinforced concrete vault - Carbon steel pan - Leak detection system in 8D-1 pan - Vented to 8D-2	1) Neg	1) U	1) 0
50F-002	Volume: 530 L	Name: Sand Postfilter	Location: Tank 8D-1	Construction: Stainless steel			
Residual Radioactive Contamination	1) Loss of postfilter integrity	- seismic event - corrosion	- Stainless steel filter housing - Tank/vault system constructed to withstand evaluation basis earthquake stresses - System deactivated	- 8D-1 carbon steel tank - Reinforced concrete vault - Carbon steel pan - Leak detection system in 8D-1 pan - Vented to vent header	1) Neg	1) U	1) 0

Notes:
[1] Materials-at-risk are determined using the vessel volume indicated, in conjunction with the referenced hazard concentration; or the volume of hazardous material indicated.
[2] Consequences are as discussed in Section 9.1.1.2: Neg = Negligible; Low; Mod = Moderate; High
[3] Frequencies are as discussed in Section 9.1.1.2: A = Anticipated; U = Unlikely; EU = Extremely Unlikely; I = Incredible
[4] See Section 9.1.1.2 for an explanation of Risk Factor.

Reference:
[a] - Prowse, 1991

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq [3]	Risk Factor [4]
MAIN PLANT, FUEL RECEIVING AND STORAGE FACILITY, AND LIQUID WASTE TREATMENT SYSTEM							
Main Plant							
Airborne Contamination	1) Loss of cell confinement 2) Loss of ventilation system operability 3) Loss of ventilation system integrity (e.g., duct break, stack failure) 4) HEPA filter failure 5) HEPA filter bank failure 6) Fire involving LLW container	- Seismic event - Corrosion - Operator error - Mechanical error/ malfunction - Fire/explosion - Tornado/high wind - Loss of line power - Impact of duct with equipment during hoisting operations - Excess particulate loading - Excess moisture loading	- Backflow filters on highly contaminated cells - Seals on penetrations - No explosives contained in cells - Minimal or no combustibles in cells - Cell pressure indicators - Multiple barriers to direct cell access - Established procedures and training for personnel - Backup generator - Area radiation detector(s) and continuous air monitors to alert workers to abnormal radiological conditions - Maintenance Program - Monitoring of differential pressure across HEPA filters - Limited amount of natural gas piping in confined areas - No natural gas piping in areas containing hazardous materials	- Redundant vent system blowers - Redundant vent system filter trains - Fire suppressant equipment - West Valley Volunteer Hose Company - Ventilation of highly contaminated areas of Main Plant possible through both Main Plant ventilation system and head end cell ventilation system	1) Neg 2) Neg 3) Low 4) Neg 5) Mod 6) Low	1) A 2) U 3) U 4) A 5) EU 6) U	1) 0 2) 0 3) 2 4) 0 5) 3 6) 2
Fissile Material	1) Criticality	- Accumulation/ Concentration of fissile material into critical configuration - Plate out of fissile material in vent ducting, tank(s) or LWTS evaporator - Moderation of existing accumulation - Seismic failure of tank releases tank contents into geometrically unsafe sump/ configuration	- Documented work instructions on storage and handling of fissile material - Sumps and sump alarms to indicate in-leakage of water - Routine plant radiation surveys to determine contamination accumulations - Established procedures and training for personnel - Sumps in areas with tanks containing high concentrations of fissile material designed to be critically safe	- Shielding of cells containing significant quantities of fissile material sufficient to attenuate exposure rates associated with a criticality to safe levels	1) Neg	1) I	1) 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
Contaminated Liquid	1) Loss of cell integrity 2) Loss of pipe/pump/vessel integrity 3) Vessel overflow 4) Plug of floor drain or sump jet	- Seismic event - Corrosion - Operator error - Mechanical error/ malfunction - Fire/explosion	- Cell sump alarm - LWTS pumps in sealed niches - Established procedures and training for personnel - Main Plant cells constructed to withstand an Evaluation Basis Earthquake (EBE) - Vessels constructed of corrosion resistant material - Minimal fire loading in Main Plant cells - No significant quantities of organic/volatile liquids handled in Main Plant tanks - Level indicators on tanks and sumps that are monitored routinely	- West Valley Volunteer Hose Company - LWTS pump niche drains to extraction cell - Plant vessels contained in cells provided with curbs and sumps - Several barriers to liquid release (cell sumps, curbs, floor drains)	1) Neg 2) Neg 3) Neg 4) Neg	1) U 2) A 3) A 4) A	1) 0 2) 0 3) 0 4) 0
FUEL RECEIVING AND STORAGE FACILITY							
Loaded resin	1) Leak resulting in minor resin release 2) Complete HIC failure resulting in major resin release 3) Fire involving LLW container	- HIC integrity failure (e.g., leak) - Total HIC failure due to drop - Explosion due to H_2 generation in full HIC - Over pressurization of HIC due to H_2 generation or during resin transfer - Fire in Radwaste Process Building, FRS north yard, or FRS building	- System walkdown/inspection prior to loaded resin transfers - Independent verification of valve lineup - All hose connections wrapped in plastic bags, and secured with tape - HIC level indication - HIC enclosed in shielding structure - Rugged construction of a HIC - Use of Surepaks for temporary storage - Established hoisting and rigging procedures, including load testing - Design conservatisms for lifting equipment (typically minimum safety factor of 5, based on ultimate strength of material) - Vent in HIC - No ignition sources at HIC - HIC resins dewatered - Minimal combustible loading - Stainless steel demineralizer - Established procedures and training	- Auto-termination of transfers if high-level detected in HIC or liquid detected in HIC overflow drum - Radwaste Building perimeter bermed - Emergency Response - West Valley Volunteer Hose Company	1) Neg 2) Mod 3) Low	1) A 2) EU 3) U	1) 0 2) 3 3) 2

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
			Head End Cells				
Fissile-bearing Debris (e.g. Fuel/Hull Material)	1) Inadvertent Criticality	- Seismic event - Operator error - Unsafe mass of fissile material packaged in waste collection container - High concentrations of fissile material in waste containers brought into proximity with each other - Internal moderation of waste containers in storage array - Containers of moderated fissile material brought into proximity with each other - External moderation of storage array due to flooding - External moderation of storage array due to fire fighting - Commingling of uncontained wastes - Use of storage containers having unanalyzed geometries - Crushing of waste container due to impact with equipment - Crushing of multiple waste containers in storage array due to structural failure	- Accumulation of fissile material in GPC critically safe in current configuration, even with full water moderation - Established procedures and training for personnel - Documented work instruction on drum stacking height - Documented work instruction on handling and processing equipment volumes - Moderator in package minimized through waste drying prior to packaging - Fissile-bearing debris dried prior to placement in storage drums - Potential for dried waste moderation minimized through the use of drum venting devices that can withstand at least 48 in. w.c. without allowing water entry and by providing long-term storage of filled drum in above-grad areas - Low reactivity of unmoderated fissile material in the HECs - Low areal density of fissile materials in HECS - Restricted use of liquid decontamination agents and other moderators in areas containing unpackaged fissile materials - Operator training in criticality safety requirements - Decontamination limited to non-acid, non-caustic means (e.g., high pressure water spray, CO_2 decon) prior to fuel/hull retrieval	- Sufficient shielding in the GPC to protect worker from inadvertent criticality - Floor drain and floor hatches in PMC prevent accumulation of water in PMC - Fire suppressant equipment - West Valley Volunteer Hose Company - Massive shielding of most cells and rooms to protect workers from a criticality event	1) Neg	1) I	1) 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
Airborne Contamination	1) Loss of cell confinement 2) Loss of ventilation system operability 3) Ventilation system failure resulting in a minor release 4) Ventilation system failure resulting in a major release	- Chemical reaction - Seismic event - Operator error - Mechanical error/malfunction - Fire/explosion - Release of contamination due to debris not completely dried - Over-pressurization	- Canisters of high pressure air or CO_2 that may be used for decontamination purposes are stored outside HECs (as opposed to inside) - Size reduction of debris does not entail the use of equipment potentially serving as an ignition source - Cells constructed to withstand an EBE - Minimal combustible loading in the HEC - No natural gas or reactive chemicals in the HEC - Substantial cell structure prevents a significant release - Large combined volume of HECs is capable of accommodating transient pressure inducing event - Debris is dried prior to being packaged, minimizing chance of radiation induced decomposition of water - Drums containing fissile-bearing debris are vented with NucFil 013 venting devices, minimizing the potential for accumulation of radiolytically-produced H_2 to explosive concentrations - Established procedures and training for personnel - Fuel and clad material primarily in bulk from which inhibits pyrophoric reactions - Fuel and clad material in oxidized state which inhibit pyrophoric reactions - Equipment grounded when necessary to reduce accumulation of static electricity - Contaminated area of cell lined with stainless steel which would prevent the accumulation of static electricity - Size reduction activities performed only on non-pyrophoric materials - Minimal amount of smoke and embers associated with pyrophoric reactions that could become entrained in HEV system exhaust airstream - No significant quantities of organic/volatile liquids handled in HEC - Ventilation for HECs possible through Main Plant Ventilation System (Embers or burning material from HEC less likely to reach Main Plant Ventilation filters)	- HEPA-filtered backflow dampers provided for HECs - Main Plant Ventilation system can be configured to service HECs - HEV system has backup train - No significant off-site doses due to atmospheric dispersion of fission gases - Ventilation for HECs possible through Main Plant Ventilation system - Buffer area established around thermally hot size reduction activities - Fire suppressant equipment - West Valley Volunteer Hose Company - Ventilation system prevents concentration of toxic off-gases within the cell/room or release to adjacent operating areas	1) Neg 2) Neg 3) Neg 4) Mod	1) A 2) A 3) A 4) EU	1) 0 2) 0 3) 0 4) 3

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
Hazardous (Toxic) Metals (e.g., Pb, Hg, Pu, U) and Materials	1) Loss of cell confinement resulting in minor release 2) Fire involving toxic metals	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion	- Fuel and clad material primarily in bulk form which inhibits pyrophoric reactions - Fuel and clad material in oxidized state which inhibits pyrophoric reactions - Equipment grounded to reduce accumulation of static electricity - Contaminated area of cells lined with stainless steel which would prevent the accumulation of static electricity - Established procedures and training for personnel - Decontamination limited to non-acid and non-caustic means (e.g., high pressure water spray, CO_2 decontamination) prior to fuel/hull retrieval	- Fire suppression capabilities - West Valley Volunteer Hose Company - HazMat Team response	1) Neg 2) Low	1) U 2) U	1) 0 2) 2
XC-1 and XC-2							
Residual Radioactive Material	1) Loss of cell confinement 2) Criticality	- Accumulation of water (moderator) in XC-1 or XC-2 - Fire or explosion in XC-1 or XC-2 - Seismic event - Corrosion - Column leak or malfunction	- Fissile material distributed throughout cell in immobile state - Fissile material in oxidized state which inhibits pyrophoric reactions - Cells lined with stainless steel which prevents accumulation of static electricity - Stainless steel and Carboline coated concrete	- Sufficient shielding to protect worker from inadvertent criticality - Very limited amount of smoke/embers that a fire would generate - West Valley Volunteer Hose Company	1) Neg 2) Neg	1) U 2) I	1) 0 2) 0
4D-2	Volume: 4,160 L	Name: Partition Cycle Waste C/H Tank (XC-1 sump receiver)	Location: XC-1	Construction: Stainless Steel			
Liquid LLW	1) Loss of tank integrity 2) Criticality	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level recorder - Established procedures and training for personnel - Documented work instructions prevent precipitation of significant amount of fissile material - Documented work instructions regarding fissile material concentrations - Tank ventilation prevents accumulation of gases or over-pressurization of tank - No organic/volatile liquids transferred to the tank	- Spills handled by XC-1 sump, which would then be transferred to 4D-10 - Overflow contained by Tank 6D-3 - XC-1, reinforced concrete	1) Neg 2) Neg	1) U 2) I	1) 0 2) 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
			Hot Acid Cell				
Residual Radioactive Material	1) Loss of integrity resulting in loss of radioactive material confinement	- Seismic event - Operator error - Mechanical error/malfunction - Fire/explosion	- Tanks have been extensively flushed - Established procedures and training for personnel - Stainless steel construction of storage tanks and components - No use of reactive chemicals for area D&D - No use of organics or combustible material for area D&D	- Tanks contained in sealed cell - West Valley Volunteer Hose Company	1) Neg	1) U	1) 0
			Acid Recovery Cell				
Residual Radioactive Material	1) Loss of general purpose evaporator integrity 2) Loss of cell integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction (seal failure) - Fire/explosion	- Stainless steel construction of equipment	- Sump with level indicator and high level alarm - Sump contents transferred to the general purpose evaporator (7C-5) - West Valley Volunteer Hose Company	1) Neg 2) Neg	1) U 2) U	1) 0 2) 0
			Ventilation Wash Room				
Radioactive contamination	1) Loss of duct work integrity 2) Uncontrolled spill of contaminated liquid	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction (pump/filter failure) - Fire/explosion	- Established procedures and training for personnel - Stainless steel pan - No significant combustion sources in cells - Minimal combustible loading in cells	- Floor tilting with flow toward a drain leading to the GPC sump via the PMC - West Valley Volunteer Hose Company - Fire Hose Stations	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0
			Process Sample Cell 2				
Radioactive Contamination	1) Loss of box integrity 2) Loss of piping integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion	- Shielded, stainless steel box - Established procedures and training for personnel - Routine surveys - No combustible material in cells	- Painted walls to fix contamination - Airlock - West Valley Volunteer Hose Company	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
			Process Sample Cell 3				
Radioactive Contamination	1) Loss of box integrity 2) Loss of piping integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion/over-pressurization	- Shielded, stainless steel box - Established procedures and training for personnel - Routine surveys - No combustible material in cells	- Painted walls to fix contamination - Airlock - West Valley Volunteer Hose Company	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0
			Liquid Waste Cell				
7D-2	Volume: 32,220 L	Name: LLW Collection Tank	Location: LWC	Construction: Stainless Steel			
Liquid Radioactive Material	1) Loss of tank integrity 2) Tank overflow 3) Criticality	- Chemical reaction - Seismic event - Operator error - Mechanical error/malfunction - Explosion/over-pressurization - Precipitation due to mixing of acid and base - Accumulation of concentration of material in tank sump - Halogen Corrosion	- Stainless steel tank - Level recorder - High and low level alarms - Cell designed to withstand an EBE - Established procedures and training for personnel - Documented work instructions prevent precipitation of significant amount of fissile material - Tank ventilation prevents accumulation of gases or over-pressurization of tank - Sparger on tank to ensure mixing to prevent precipitation - No organic/volatile liquids transferred to the tank	- Overflow contained by Tank 6D-3 - LWC, reinforced concrete - Spills handled by LWC sump which would be transferred to tank 4D-10 - LWC constructed within silty till (below grade)	1) Neg 2) Neg 3) Neg	1) A 2) A 3) I	1) 0 2) 0 3) 0
7D-8	Volume: 11,360 L	Name: Rework Evaporator Feed Tank	Location: LWC	Construction: Stainless Steel			
Liquid Radioactive Material	1) Loss of tank integrity 2) Tank overflow 3) Criticality	- Chemical reaction - Seismic event - Halogen Corrosion - Operator error - Mechanical error/ malfunction - Explosion/ over-pressurization - Precipitation due to mixing of acid and base	- Stainless steel tank - Level recorder - Cell designed to withstand an EBE - Established procedures and training for personnel - No organic/volatile liquids transferred to tank - Tank ventilation prevents accumulation of gases or over-pressurization of tank - Tank currently not in service	- Spills handled by LWC sump, which transfers to tank 4D-10 - Overflow contained by Tank 6D-3 - LWC, reinforced concrete	1) Neg 2) Neg 3) Neg	1) A 2) A 3) I	1) 0 2) 0 3) 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
7D-14	Volume: 1,900 L	Name: Hot Analytical Cell Drain Catch Tank	Location: LWC	Construction: B334 Hastelloy C			
Liquid LLW	1) Loss of tank integrity 2) Tank overflow 3) Criticality	- Chemical reaction - Seismic event - Operator error - Mechanical error/malfunction - Explosion/over-pressurization - Precipitation of fissile material due to mixing of acids & bases	- Corrosion resistant tank - Level recorder - Level alarm - Established procedures and training for personnel - Cell designed to withstand an EBE - Reactive chemical not combined in tank - No (or minimal) organic/volatile liquids handled in 7D-14	- Spills handled by LWC sump, which transfers to tank 4D-10 - Overflow contained by Tank 6D-3 - LWC, reinforced concrete	1) Neg 2) Neg 3) Neg	1) A 2) A 3) I	1) 0 2) 0 3) 0
3D-2	Volume: 3,785 L	Name: Sample Collection Tank	Location: LWC	Construction: Stainless Steel			
Liquid LLW	1) Loss of tank integrity 2) Tank overflow 3) Criticality	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Cell designed to withstand an EBE - Level recorder temperature indicator - Established procedures and training for personnel - Stainless steel construction - Documented work instructions regarding fissile material concentrations - Documented work instructions prevent precipitation of significant amount of fissile material - No organic/volatile liquids loading in cell - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- LWC reinforced concrete - Spills handled by LWC sump, which transfers to tank 4D-10	1) Neg 2) Neg 3) Neg	1) A 2) U 3) I	1) 0 2) 0 3) 0
4D-10	Volume: 23,250 L	Name: First U Cycle Waste Tank (GPC/LWC Sump Receiver)	Location: LWC	Construction: Stainless Steel			
Liquid LLW	1) Loss of tank integrity 2) Tank overflow 3) Criticality	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Cell designed to withstand an EBE - Level recorder - Density recorder - Stainless steel construction - Documented work instructions regarding fissile material concentrations - Documented work instructions prevent precipitation of significant amount of fissile material - No combustible loading in cells - No organic/volatile liquids loading in cell - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- LWC reinforced concrete - Spills handled by LWC sump which transfers to tank 4D-10	1) Neg 2) Neg 3) Neg	1) A 2) U 3) I	1) 0 2) 0 3) 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
13D-8	Volume: 2,570 L	Name: Solvent Waste Hold Tank (Cell Sump Receiver)	Location: LWC	Construction: Stainless Steel			
Liquid LLW	1) Loss of tank integrity 2) Tank overflow 3) Criticality	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization - Precipitation due to mixing of acids & bases	- Stainless steel tank - Level recorder - High and low level alarms - Established procedures and training for personnel - Cell designed to withstand an EBE - Documented work instructions regarding fissile material concentrations - Documented work instructions prevent precipitation of significant amount of fissile material - No organic/volatile liquids transferred to tank - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by LWC sump, which would be transferred to tank 4D-10 - Overflow contained by Tank 6D-3 - LWC, reinforced concrete	1) Neg 2) Neg 3) Neg	1) A 2) U 3) I	1) 0 2) 0 3) 0
Analytical and Process Chemistry Laboratories							
Laboratory Reagents (Acids, Oxidizers, Corrosives, Poisons, Flammables)	1) Loss of container integrity	- Chemical reaction - Seismic event - Operator error - Mechanical error/malfunction - Fire/explosion	- Small quantities used - Different categories of chemicals stored in separate locations - Isolation from environment - Restricted access/use - Chemical handling/storage per WVDP-011 - MSDS available - Established procedures and training for personnel	- Portable berms - Spill kits available at chemical holding areas - Fire suppression equipment - HazMat Team Response	1) Neg	1) A	1) 0
Liquid Waste Treatment System							
35104	Volume: 22,000 L	Name: LLW Collection Tank	Location: GCR Extension	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of tank integrity 2) Tank overflow	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level recorder - High and low level alarms - High level alarms in sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank - No organics transferred to the tank	- Spills handled by sump in GCR - Overflow contained by Tank 6D-3 - GCR extension, reinforced concrete walls	1) Neg 2) Neg	1) A 2) U	1) 0 2) 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
5D-15B	Volume: 56,950 L	Name: Evaporator Feed Tank	Location: UPC	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of tank integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level recorder and indicator - Low and high alarms - Sump high level alarm - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank - No organic/volatile liquids transferred to the tank	- Spills handled by UPC sump - Stainless steel liner in UPC - UPC, reinforced concrete - Overflow contained by Tank 6D-3	1) Mod	1) U	1) 5
5D-15A1	Volume: 38,150 L	Name: Evaporator Concentrates Tank	Location: UPC	Construction: Stainless Steel			
Evaporator Concentrates (Sodium Bearing Waste)	1) Loss of tank integrity 2) Criticality	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization - Transfer of evaporator acid wash solution	- Stainless steel tank - Level recorder - High and low alarms - Sump high level alarm - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank - No organic/volatile liquids transferred to tank - Tank ventilation prevents accumulation of gases or over-pressurization of tank - Documented work instructions prevent precipitation of fissile material	- Overflow contained by tank 6D-3 - Stainless steel liner in UPC - UPC reinforced concrete - Spills handled by the UPC sump	1) Mod 2) Low	1) U 2) I	1) 5 2) 1
5D-15A2	Volume: 18,990 L	Name: Evaporator Concentrates Tank	Location: UPC	Construction: Stainless Steel			
Evaporator Concentrates (Sodium Bearing Waste)	1) Loss of tank integrity 2) Criticality	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization - Transfer of evaporator acid wash solution	- Stainless steel tank - Level recorder - Level indicator - High and low alarms - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank - No organic/volatile liquids transferred to tank - Tank ventilation prevents accumulation of gases or over-pressurization of tank - Documented work instructions prevent precipitation of fissile material	- Overflow contained by tank 6D-3 - Stainless steel liner in UPC - UPC reinforced concrete - Spills handled by the UPC sump	1) Mod 2) Low	1) U 2) I	1) 5 2) 1

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
71D-001	Volume: 535 L	Name: Organic IX Column	Location: XC-3	Construction: Stainless Steel			
Organic IX media and low TDS process solution	1) Loss of column integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel column - Sump high level alarm - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by XC-3 sump - Stainless steel liner in XC-3 - XC-3, reinforced concrete	1) Neg	1) A	1) 0
71D-002	Volume: 1,820 L	Name: Zeolite IX Column	Location: XC-3	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of column integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel column - Sump high level alarm - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by XC-3 sump - Stainless steel liner in XC-3 -XC-3, reinforced concrete	1) Neg	1) A	1) 0
71D-003	Volume: 1,820 L	Name: Zeolite IX Column	Location: XC-3	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of column integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel column - High level alarm - High level alarm in the sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by XC-3 sump - Stainless steel liner in XC-3 - XC-3, reinforced concrete	1) Neg	1) A	1) 0
71D-004 (31017)	Volume: 5,680 L	Name: LWTS Evaporator	Location: XC-3	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of evaporator integrity resulting in a minor release 2) Loss of evaporator integrity resulting in a substantial release 3) Criticality	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level indicator - High, low alarm - Level alarm in the sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank - Minimal fissile U & Pu in solution in wastes processed in evaporator - Significant concentration of U-238 in uranium-bearing wastes which reduces waste reactivity	- Spills handled by XC-3 sump - Overflow contained by Tank 6D-3 - XC-3, reinforced concrete - Stainless steel liner in XC-3	1) Neg 2) Neg 3) Mod	1) A 2) U 3) I	1) 0 2) 0 3) 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
71D-005	Volume: 3,785 L	Name: Distillate Surge Tank	Location: XC-3	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of tank integrity 2) Tank overflow	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level indicator - High level alarm in the sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by XC-3 sump - Overflow contained by Tank 6D-3 - Stainless steel liner in XC-3 - XC-3, reinforced concrete	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0
71D-006	Volume: 4,650 L	Name: Spent Resin Tank	Location: XC-3	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of tank integrity 2) Tank overflow	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level indicator - High level alarm in the sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by XC-3 sump - Overflow contained by Tank 6D-3 - Stainless steel liner in XC-3 - XC-3, reinforced concrete	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0
71D-007	Volume: 4,650 L	Name: Spent Zeolite Tank	Location: XC-3	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of tank integrity 2) Tank overflow	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level indicator - High level alarm in the sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by XC-3 sump - Overflow contained by Tank 6D-3 - Stainless steel liner in XC-3 - XC-3, reinforced concrete	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0
71D-008	Volume: 2,950 L	Name: Filter Backwash Receiver Tank	Location: XC-3	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of tank integrity 2) Tank overflow	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level indicator - High level alarm in the sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by XC-3 sump - Overflow contained by Tank 6D-3 - Stainless steel liner in XC-3 - XC-3, reinforced concrete	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
71D-009	Volume: 380 L	Name: Feed Sample Tank	Location: XC-3	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of tank integrity 2) Tank overflow	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level indicator - High level alarm in the sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by XC-3 sump - Overflow contained by Tank 6D-3 - Stainless steel liner in XC-3 - XC-3, reinforced concrete	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0
71D-011	Volume: 380 L	Name: Low TDS Feed Tank	Location: XC-3	Construction: Stainless Steel			
Radioactive Liquid Waste	1) Loss of tank integrity 2) Tank overflow	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level indicator - High and low level alarms - High level alarm in the sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by XC-3 sump - Overflow contained by Tank 6D-3 - Stainless steel liner in XC-3 - XC-3, reinforced concrete	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0
71E-001	Volume: N/A	Name: Evaporator Reboiler	Location: XC-3	Construction: Stainless Steel			
Evaporator concentrates	1) Spill due to loss of reboiler integrity 2) Criticality	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel Reboiler - Level alarm - High level alarm in the sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank - Minimal fissile U & Pu in solution in wastes processed in evaporator - Significant concentration of U-238 in uranium-bearing wastes which reduces waste reactivity	- Spills handled by XC-3 sump - Stainless steel liner in XC-3 - XC-3, reinforced concrete	1) Neg 2) Mod	1) A 2) I	1) 0 2) 0
71E-005	Volume: N/A	Name: Concentrates Cooler	Location: XC-3	Construction: Stainless Steel			
Evaporator concentrates	1) Spill due to loss of cooler integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel cooler - Level indicator - High level alarm in the sump - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by XC-3 sump - Stainless steel liner in XC-3 - XC-3, reinforced concrete	1) Neg	1) A	1 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
14D-7	Volume: 375 L	Name: HNO_3 Tank	Location: LXA	Construction: Stainless Steel			
2 M nitric acid	1) Loss of tank integrity 2) Tank overflow	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level indicator - High level alarm - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Berm capable of containing entire tank contents - Drains to interceptor - Overflow contained by Tank 6D-3 - HazMat Response Team	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0
			Vessel Off-Gas System				
Airborne contamination	1) Loss of ventilation integrity resulting in minor release 2) Loss of ventilation integrity resulting in a substantial release	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion/over-pressurization	- Differential pressure - Monitoring instrumentation	- Backup HEPA filters - Air/vapors vent to a Main Plant ventilation plenum - West Valley Volunteer Hose Company	1) Neg 2) Neg	1) A 2) U	1) 0 2) 0
Contaminated liquid	1) Loss of OGC vessel integrity resulting in a minor release 2) Loss of OGC vessel integrity resulting in a substantial release 3) Spill due to loss of piping integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Level alarm on Tank 6D-3 - Sump alarm in OGC - Pumps contained in sealed niche - Personnel training established procedures and training for personnel - Level indicator on vessels - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Sump - Berm - Pump niche drains to OGC sump - Sump collections transferred to tank 13D-8 - Off gas cell is reinforced concrete lined with Carboline paint	1) Neg 2) Neg 3) Neg	1) A 2) U 3) A	1) 0 2) 0 3) 0
6D-3	Volume: 860 L	Name: VOG Condensate Catch Tank	Location: OGC	Construction: Stainless Steel			
Liquid LLW	1) Spill due to loss of tank integrity or overflow	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Level indicator - High level alarm - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by OGC sump - OGC, reinforced concrete	1) Neg	1) A	1) 0

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
6D-6	Volume: 240 L	Name: VOG Condensate Knockout Pot	Location: OGC	Construction: Stainless Steel			
Liquid LLW	1) Spill due to loss of tank integrity or overflow	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by OGC sump - Overflow contained by Tank 6D-3 - OGC, reinforced concrete	1) Neg	1) A	1) 0
6C-3	Volume: 1,500 L	Name: VOG Scrubber	Location: OGC	Construction: Stainless Steel			
Liquid LLW	1) Spill due to loss of scrubber integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by OGC sump - Overflow contained by Tank 6D-3 - OGC, reinforced concrete	1) Neg	1) A	1) 0
6V-1	Volume: 200 L	Name: VOG Cyclone	Location: OGC	Construction: Stainless Steel			
Liquid LLW	1) Spill due to loss of cyclone integrity	- Chemical reaction - Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Explosion/over-pressurization	- Stainless steel tank - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Spills handled by OGC sump - OGC, reinforced concrete	1) Neg	1) A	1) 0
CEMENT SOLIDIFICATION SYSTEM							
Airborne contamination	1) Loss of ventilation system operability 2) Spill of liquid LLW 3) Fire involving LLW container	- Seismic event - Fire/explosion - Line failure	- Isolation dampers on final HEPA filters - No explosives stored in cell - Barriers to direct cell access	- West Valley Volunteer Hose Company - Fire Suppressant Equipment - Redundant vent blowers	1) Neg 2) Neg 3) Low	1) A 2) U 3) U	1) 0 2) 0 3) 2

TABLE 9.1-1B

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES

(All footnotes are located at the end of the table)(Concluded)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
DRUM CELL							
Solidified cement drums located in the Drum Cell, 71 gallons							
Solid LLW	1) Loss of drum integrity 2) Fire involving LLW container	- Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion	- Documented work instructions on waste form integrity requirements - Established procedures and training for personnel	- West Valley Volunteer Hose Company - Fire Suppressant Equipment - Drum cell weather structure	1) Neg 2) Low	1) U 2) EU	1) 0 2) 1

Notes:
[1] Materials-at-risk are determined using the vessel volume indicated, in conjunction with the referenced hazard concentration; or the volume of hazardous material indicated.
[2] Consequences are as discussed in Section 9.1.1.2: Neg = Negligible; Low; Mod = Moderate; High
[3] Frequencies are as discussed in Section 9.1.1.2: A = Anticipated; U = Unlikely; EU = Extremely Unlikely; I = Incredible
[4] See Section 9.1.1.2 for an explanation of Risk Factor.

TABLE 9.1-1C

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES

(All footnotes are located at the end of the table)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
			WASTE TREATMENT AND STORAGE				
No ID #	Volume: 1,900 L	Name: Neutralization Pit	Location: Yard, east of Plant	Construction: Stainless Steel lined concrete			
Liquid Low-Level Waste	1) Failure of pit containment 2) Overflow	- Seismic event - Operator error - Flooding - Line plugging/valve isolation	- High level alarm - Routine surveillance by qualified operators - Stainless steel lined concrete - Established procedures and training for personnel - Weather cover provided to prevent rain infiltration	- Located in silty till - Stainless steel lined concrete	1) Neg 2) Neg	1) U 2) A	1) 0 2) 0
No ID #	Volume: 87,000 L	Name: N/S Interceptors	Location: Yard, east of Plant	Construction: Stainless Steel lined concrete			
Liquid LLW	1) Loss of pit integrity 2) Overflow	- Seismic event - Operator error - Flooding - Line plugging/valve isolation	- Concrete construction, stainless steel lined - Routine area surveillance by qualified operators - Established procedures and training for personnel - Overflow to off-line interceptor - Weather cover provided to prevent rain infiltration	- Interceptors located in silty till	1) Neg 2) Neg	1) U 2) A	1) 0 2) 0
No ID #	Volume: 57,000 L	Name: Old Interceptor	Location: Yard, east of Plant	Construction: Concrete			
Liquid LLW	1) Loss of pit integrity 2) Overflow	- Seismic event - Operator error - Flooding - Line plugging/valve isolation	- Concrete construction - Established procedures and training for personnel - Routine area surveillance by qualified operators - Weather cover provided to prevent rain infiltration	- Basin constructed in silty till	1) Neg 2) Neg	1) U 2) A	1) 0 2) 0
No ID # No ID #	Volume: 9,500,000 L Volume: 12,000,000 L	Name: Lagoon 2 Name: Lagoon 3	Location: Yard, east of Plant Location: Yard, east of Plant	Construction: Clay-lined basin Construction: Clay-lined basin			
Liquid LLW	1) Loss of Lagoon confinement integrity 2) Overflow	- Seismic event - Corrosion of drain line - Operator error - Flooding - Slumping	- Level in basins maintained with sufficient margin to accommodate precipitation - Lagoon 3 sampled prior to discharge; off-spec solutions to Lagoon 2 - Established procedures and training for personnel - Lagoon 2 overflow to Lagoon 3	- Basins constructed in silty till	1) Neg 2) Low	1) U 2) U	1) 0 2) 2
No ID # No ID #	Volume: 770,000 L Volume: 630,000 L	Name: Lagoon 4 Name: Lagoon 5	Location: Yard, east of Plant Location: Yard, east of Plant	Construction: Synthetic-lined basin Construction: Synthetic-lined basin			
Decontaminated LLW	1) Loss of Lagoon confinement integrity 2) Overflow	- Seismic event - Corrosion of drain line - Operator error - Flooding	- Level of basins maintained to accommodate precipitation - Lagoon sampled prior to discharge to Lagoon 3 - Routine area surveillance by qualified operators - Established procedures and training for personnel	- Synthetic lined basin	1) Neg 2) Neg	1) U 2) U	1) 0 2) 0

TABLE 9.1-1C

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq [3]	Risk Factor [4]
02-D-0301	Volume: 380 L	Name: Sulfuric Acid Tank	Location: LLW2	Construction: Polyethylene			
93% H_2SO_4	1) Loss of tank integrity resulting in a minor release 2) Loss of tank integrity resulting in a substantial release 3) Loss of fill line integrity resulting in a minor release 4) Loss of fill line integrity resulting in a substantial release	- Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion/over-pressurization	- Polyethylene tank - Level indicator - Handling and storage activities conducted per WVDP-011 - Established procedures and training for personnel	- Tank on floor sloped to drain into sump - West Valley Volunteer Hose Company - HazMat Team Response	1) Neg 2) Neg 3) Neg 4) Neg	1) A 2) U 3) A 4) U	1) 0 2) 0 3) 0 4) 0
02-D-0102	Volume: 3,000 L	Name: Surge Tank A	Location: LLW2	Construction: Carbon Steel			
Liquid LLW	1) Loss of tank integrity	- Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion/over-pressurization	- Vessel on floor sloped to drain into sump - Level indicator - Established procedures and training for personnel	- Drains to a skid pad which empties into a sump - Overflow to Lagoon 2	1) Neg	1) A	1) 0
02-D-0202	Volume: 3,000 L	Name: Surge Tank A	Location: LLW2	Construction: Carbon Steel			
Liquid LLW	1) Loss of tank integrity	- Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction - Fire/explosion/over-pressurization	- Level indicator - Established procedures and training for personnel	- Tank on floor sloped to drain into sump - Overflow to Lagoon 2	1) Neg	1) A	1) 0

TABLE 9.1-1C

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
02-C-0104 02-C-0105 02-C-0106 02-C-0204 02-C-0205 02-C-0206	Volume: 1.4 m^3 Volume: 1.4 m^3 Volume: 1.4 m^3 Volume: 1.4 m^3 Volume: 1.4 m^3 Volume: 1.4 m^3	Name: IX Columns Name: IX Columns Name: IX Columns Name: IX Columns Name: IX Columns Name: IX Columns	Location: LLW2 Location: LLW2 Location: LLW2 Location: LLW2 Location: LLW2 Location: LLW2	Construction: Carbon Steel Construction: Carbon Steel Construction: Carbon Steel Construction: Carbon Steel Construction: Carbon Steel Construction: Carbon Steel			
Liquid LLW Contaminated IX Resin	1) Loss of column integrity	- Seismic event - Corrosion - Operator error (collision by equipment, spill during transfer) - Mechanical error/malfunction (power loss) - Explosion/over-pressurization	- Pressure indicator - Spent resin contained in sealed, noncombustible storage containers - Established procedures & training for operations and sluicing activities - Established procedures & training for forklift and other vehicle operations	- Drains to a skid pan which empties into a sump	1) Neg	1) A	1) 0
NORTH PLATEAU PUMP SYSTEM							
Contaminated Groundwater	1) Loss of transfer line integrity	- Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction (power loss)	- Maximum combined flow from all three wells limited to 20 gpm - Equipment enclosed in shelter - Alarms and interlocks on various parameters, including well enclosure leak detection alarm, and high-high level in surge tank alarm (which auto-stops well pumps also). - All alarms transmitted to Keltron Panel in Main Security Gate House. - Established procedures and training for personnel		1) Neg	1) A	1) 0
02-T-0101	Volume: 3,400 L	Name: Sand Filter (Tank)	Location: LLW2	Construction: Carbon Steel			
Liquid Low-Level Waste	1) Spill due to loss of filter tank integrity	- Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction (power loss)	- Level instrumentation - Established procedures and training for personnel	- Overflow to LLW2 sump - Floor slopes to drain which empties into sump	1) Neg	1) A	1) 0

TABLE 9.1-1C

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
			Lag Storage Facilities				
Airborne Contamination	1) Loss of LLW or HLW container integrity (See note [5]) 2) Loss of TRU container integrity (See note [5]) 3) Fire/explosion involving LLW or HLW container 4) Fire/explosion involving TRU container	- Corrosion of container - Impact with fork truck during pick-up, or accident in-transit - Drop of container during transport or handling, including drop from a crane - Overpressurization due to gas buildup (radiolysis) or chemical reaction - Failure of storage building due to severe natural phenomena (seismic event, tornado, high straight wind, beyond design basis snow loading) - Toppling of storage array due to seismic event, or impact with fork truck, or high winds - Fire or explosion due to combustion of flammable gases in waste container - Fire due to combustion of leaked vehicle (customized forklift) fuel - Fire initiated by lightning strike	- Wastes contained in sealed, DOT-approved noncombustible containers - No significant uncontained combustion sources stored in facility - Fire detection provided in Lag Storage Building - Established procedures and training for forklift operations - Design and installation of electrical equipment to accepted electrical industry standards - Procedures that govern the types (mixtures) of waste materials that can be placed in a given container, and the amounts of radioactive materials per container - Periodic inspections of container integrity	- West Valley Volunteer Hose Company - Fire Suppressant Equipment - Berms in facility to confine releases to building interiors	1) Neg 2) Low 3) Low 4) Mod	1) A 2) A 3) U 4) U	1) 0 2) 4 3) 2 4) 5

TABLE 9.1-1C

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
Fissile Material	1) Criticality	- Quantities of fissile material beyond PSR limits packaged in multiple waste containers - High concentrations of fissile material in waste containers brought into proximity with each other - Internal moderation of waste containers in storage array - External moderation of storage array due to flooding, firefighting, snow - Commingling of uncontained wastes - Use of containers having non-analyzed geometrics - Crushing of waste container due to impact with equipment - Crushing of multiple waste containers in storage array due to structural failure of building under severe natural phenomena loads (seismic event, high straight winds, tornado, snow load) - Commingling of wastes packaged to different documented work instructions	- Documented work instructions on fissile mass and waste containers - Uncontained combustibles in facility minimized - No natural gas in LSB - Multiple containers not expected to be involved in facility fire - Wastes contained in sealed steel containers - Wastes handled and packaged by qualified operators - Periodic inspection of container integrity - Procedures that preclude packaging of incompatible materials - Amount of free liquid in waste containers minimized per procedure - Storage facilities designed to withstand severe natural phenomena loads - Significant flooding of storage areas not credible [b] - Fissile material storage drums and boxes fitted with filters that have been treated to prevent the infiltration of water - Interaction of incompatible wastes limited through implementation of criticality control zones		1) Mod	1) I	1) 0

TABLE 9.1-1C

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
Chemical Process Cell - Waste Storage Area (CPC-WSA)							
Airborne Contamination	1) Loss of container(s) integrity 2) Fire involving LLW container	- Container failure due to tornado - Container failure due to overpressurization - Failure of weather structure due to severe natural phenomena (seismic event, high straight wind, tornado, snow load) resulting in container damage - Fire/explosion due to ignition of accumulated H_2 - Container failure due to corrosion - Failure due to impact during hoisting activities	- Wastes contained in noncombustible containers - No significant combustion sources - Established procedures and training for hoisting operations - Majority of radioactive material internal to vessels in waste containers	- West Valley Volunteer Hose Company	1) Neg 2) Low	1) A 2) EU	1) 0 2) 1
Interim Waste Storage Facility							
Miscellaneous hazardous and mixed wastes	1) Loss of container(s) integrity resulting in a minor release 2) Loss of containers(s) integrity resulting in a substantial release 3) Fire involving LLW container	- Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion/over-pressurization	- Established procedures and training for system operations and handling and transfer of drums containing hazardous material	- Berm - Automatic class A fire suppression - West Valley Volunteer Hose Company - HazMat Team Response	1) Neg 2) Low 3) Low	1) A 2) U 3) EU	1) 0 2) 2 3) 1
Hazardous Waste Storage Facility							
Hazardous Wastes	1) Spill due to loss of container(s) integrity	- Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion/over-pressurization	- Audible and visible spill detection alarm - Individual locker vents - Explosion-proof electrical lights, fixtures, and switches - Exterior local visual fire alarm and light on each unit - Restricted access/use - Quantity restrictions imposed by WVDP-073 - Established procedures and training for system operations and handling and transfer of drums containing hazardous material	- Automatic dry chemical fire extinguishing system - 255-gal capacity sump - West Valley Volunteer Hose Company - HazMat Team Response	1) Neg	1) A	1) 0

TABLE 9.1-1C

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
NRC-LICENSED DISPOSAL AREA							
Radioactive waste	1) Release of contaminated material	- Flood - Seismic event - Operator error (e.g., digging in area) - Explosion	- Waste is buried many feet underground		1) Mod	1) I	1) 0
NDA Interceptor Trench Liquid Pretreatment System (LPS)							
Solvent	1) Loss of tank integrity 2) Loss of pipe integrity	- Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction (power loss) - Fire/explosion/over-pressurization	- Alarms and interlocks on various parameters including pumps - Established procedures and training for system operations and handling and transfer of drums containing hazardous material - Continuous Air Monitors in key locations - Liquid level sensors on tanks	- Berms around tanks and piping - West Valley Volunteer Hose Company - Fire Suppressant Equipment - Equipment enclosed in shelter	1) Neg 2) Neg	1) A 2) A	1) 0 2) 0
Contaminated Water in the LPS System/ Tanks	1) Loss of tank integrity resulting in a minor release 2) Loss of tank integrity resulting in a substantial release 3) Loss of pipe integrity resulting in a minor release 4) Loss of pipe integrity resulting in a substantial release	- Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction (power loss) - Fire/explosion/over-pressurization	- Alarms and interlocks on various parameters, including high level alarms on tanks - Equipment enclosed in shelter - Established procedures and training for system operations and handling and transfer of drums containing hazardous material - Continuous Air Monitors in key locations	- Berms - West Valley Volunteer Hose Company - Fire Suppressant Equipment	1) Neg 2) Neg 3) Neg 4) Neg	1) A 2) U 3) A 4) U	1) 0 2) 0 3) 0 4) 0
Spent (or Partially Used) Granular Activated Carbon	1) Loss of tank integrity resulting in a minor release 2) Loss of tank integrity resulting in a substantial release 3) Loss of pipe integrity resulting in a minor release 4) Loss of pipe integrity resulting in a substantial release	- Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction (power loss) - Fire/explosion/over-pressurization	- Alarms and interlocks on various parameters, including high level alarms on tanks - Equipment enclosed in shelter - Established procedures and training for system operations and handling and transfer of drums containing hazardous material - Continuous Air Monitors in key locations	- Berms - West Valley Volunteer Hose Company - Fire Suppressant Equipment	1) Neg 2) Neg 3) Neg 4) Neg	1) A 2) U 3) A 4) U	1) 0 2) 0 3) 0 4) 0

TABLE 9.1-1C

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES

(All footnotes are located at the end of the table)(Concluded)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
			Container Sorting and Packaging Facility				
Airborne Contamination	1) Loss of confinement in operations area 2) Fire involving LLW container	- Seismic event - Operator error during waste handling - Loss of ventilation system operability - HEPA filter failure due to fouling - Fire/explosion - HEPA filter fire	- High/low differential pressure instrumentation of HEPA filters - Established procedures and training for personnel	- West Valley Volunteer Hose Company	1) Low 2) Low	1) U 2) U	1) 2 2) 2
			Contact Size Reduction Facility				
Airborne Contamination	1) Loss of confinement in operations area 2) Fire involving LLW container	- Seismic event - Operator error during waste handling - Loss of ventilation system operability - HEPA filter failure due to fouling - Fire/explosion in cutting area - HEPA filter fire	- High/low differential pressure instrumentation of HEPA filters - Minimal combustibles in cutting area - Established procedures and training for personnel - Source capture system for cutting operation ventilation	- Backup ventilation support provided by Main Plant HEV - Fire suppressant equipment - West Valley Volunteer Hose Company	1) Low 2) Low	1) U 2) U	1) 2 2) 2
15D-6	Volume: 5,700 L	Name: HEV/CSRF Waste Catch Tank	Location: Yard east of MSM	Construction: Stainless Steel			
Liquid LLW [a]	1) Loss of tank integrity 2) Tank overflow	- Seismic event - Corrosion - Over-pressurization	- Tank constructed of stainless steel - High level alarm - Established procedures and training for personnel - Tank ventilation prevents accumulation of gases or over-pressurization of tank	- Tank located in silty till	1) Neg 2) Neg	1) U 2) A	1) 0 2) 0
			Waste Reduction and Packaging Area Compactor				
Airborne Contamination	1) Loss of confinement in operations area	- Seismic event - Operator error during handling - Mechanical error/malfunction - Fire/explosion/over-pressurization	- Documented work instructions precluding facility operation without ventilation support - HEPA filter differential pressure indicator - Established procedures and training for personnel - Small quantities of low activity waste handled in compactor and compactor area	- West Valley Volunteer Hose Company - Fire suppressant equipment	1) Neg	1) A	1) 0

Notes:
[1] Materials-at-risk are determined using the vessel volume indicated, in conjunction with the referenced hazard concentration; or the volume of hazardous material indicated.
[2] Consequences are as discussed in Section 9.1.1.2: Neg = Negligible; Low; Mod = Moderate; High
[3] Frequencies are as discussed in Section 9.1.1.2: A = Anticipated; U = Unlikely; EU = Extremely Unlikely; I = Incredible
[4] See Section 9.1.1.2 for an explanation of Risk Factor.
[5] See note [6] to Table 9.1-1E for relevant technical information for potential consequences for (crane) drop events. The actinides in TRU waste are the reason for the consequence designation relative to the consequence designation for LLW or HLW.

References:
[a] - Dames & Moore, 1995
[b] - WVNS-NCSE-001

TABLE 9.1-1D

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
NONRADIOLOGICAL FACILITIES							
New Warehouse							
New Warehouse - Acid Room							
H_2SO_4 1451.5 kg (4-800 lb drums)	1) Loss of container(s) integrity resulting in a minor release 2) Loss of containers(s) integrity resulting in a substantial release	- Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion/over-pressurization - Chemical reactions - Vehicle accident/mishap	- Each room has its own vent system - Restricted access controlled by warehouse manager - Established procedures and training for system operations and handling and transfer of drums containing hazardous material - MSDS available	- Automatic sprinkler system - Berms in each individual room (but not general warehouse) - West Valley Volunteer Hose Company - HazMat Team Response - Fire suppressant equipment	1) Neg 2) Neg	1) A 2) U	1) 0 2) 0
New Warehouse - Oxidizer Room							
35% H_2O_2 8328 L (4-330 gal totes plus 16-55 gal drums)	1) Loss of container(s) integrity resulting in a minor release 2) Loss of containers(s) integrity resulting in a substantial release	- Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion/over-pressurization - Chemical reactions - Vehicle accident/mishap	- Each room has its own vent system - Restricted access controlled by warehouse manager - Established procedures and training for system operations and handling and transfer of drums containing hazardous material - MSDS available	- Berms in each individual room (but not general warehouse) - West Valley Volunteer Hose Company - HazMat Team Response - Fire suppressant equipment	1) Low 2) Mod	1) A 2) U	1) 4 2) 5
New Warehouse - Caustic Room							
19% NaOH 832.8 L (4-55 gal drums)	1) Loss of container(s) integrity resulting in a minor release 2) Loss of containers(s) integrity resulting in a substantial release	- Seismic event - Corrosion - Operator error - Mechanical error/malfunction - Fire/explosion/over-pressurization - Chemical reactions - Vehicle accident/mishap	- Berms in each individual room (but not general warehouse) - Each room has its own vent system - Restricted access controlled by warehouse manager - Established procedures and training for system operations and handling and transfer of drums containing hazardous material	- West Valley Volunteer Hose Company - HazMat Team Response - Fire suppressant equipment	1) Neg 2) Neg	1) A 2) U	1) 0 2) 0

TABLE 9.1-1D

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
Sodium Hypochlorite 454.3 L (8-15 gal containers)	1) Loss of drum(s) integrity resulting in a minor release 2) Loss of drum(s) integrity resulting in a substantial release	- Chemical reaction - Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction (power loss) - Fire/explosion/over-pressurization - Vehicle accident/mishap	- Established procedures and training for system operations and handling and transfer of drums containing hazardous material - MSDS available	- West Valley Volunteer Hose Company - Fire suppressant equipment/sprinkler system - HazMat Team Response	1) Neg 2) Neg	1) A 2) U	1) 0 2) 0
50% NaOH 2082 L (10-55 gal drums)	1) Loss of drum(s) integrity resulting in a minor release 2) Loss of drum(s) integrity resulting in a substantial release	- Chemical reaction - Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction (power loss) - Fire/explosion/over-pressurization - Vehicle accident/mishap	- Established procedures and training for system operations and handling and transfer of drums containing hazardous material - MSDS available	- West Valley Volunteer Hose Company - Fire suppressant equipment/sprinkler system - HazMat Team Response	1) Neg 2) Neg	1) A 2) U	1) 0 2) 0
Utility Room and Yard							
PCBs in Main Plant Transformer	1) Loss of transformer integrity resulting in a minor release 2) Loss of transformer integrity resulting in a substantial release	- Chemical reaction - Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction (power loss) - Fire/explosion/over-pressurization - Lightning strike - Tornado	- 8 ft. chain link fence surrounding transformer - Built to ANSI electrical code standards	- West Valley Volunteer Hose Company - HazMat Team Response	1) Neg 2) Neg	1) A 2) EU	1) 0 2) 0

TABLE 9.1-1D

PROCESS HAZARDS ANALYSIS FOR THE MAIN PLANT AND WASTE PROCESSING FACILITIES
(All footnotes are located at the end of the table)(Concluded)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq [2]	Freq. [3]	Risk Factor [4]
31D-2	Volume: 38,000 L	Name: Fuel Oil Storage Tank	Location: Yard, east of Plant	Construction: Carbon steel			
No. 2 Fuel Oil Fire/Explosion	1) Loss of tank integrity resulting in fire 2) Loss of tank integrity resulting in a minor release 3) Loss of tank integrity resulting in a substantial release	- Chemical reaction - Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction (power loss) - Fire/explosion/over-pressurization - Tornado strike - Lighting strike	- Sight glass and level indicator - Established procedures and training for personnel	- Spill basin (87,000 L) under tank - West Valley Volunteer Hose Company - Fire suppressant equipment - HazMat Team Response	1) Neg 2) Neg 3) Neg	1) U 2) A 3) U	1) 0 2) 0 3) 0
G-01 G-02	Volume: 3,750 L Volume: 7,500 L	Name: Diesel Fuel Storage Tank Name: Gasoline Storage Tank	Location: Yard, east of New Warehouse Location: Yard, east of New Warehouse	Construction: Concrete with Double Steel Liner Construction: Concrete with Double Steel Liner			
Gasoline, Diesel Fuel Fire/Explosion	1) Loss of tank integrity resulting in fire 2) Loss of tank integrity resulting in a minor release 3) Loss of tank integrity resulting in a substantial release	- Chemical reaction - Seismic event - Corrosion - Operator error (collision by equipment) - Mechanical error/malfunction (power loss) - Fire/explosion/over-pressurization - Tornado strike - Lighting strike	- Multiple confinement barriers - Leak detection equipment installed - Anti-siphon device - Pump integral to tank - Established procedures and training for personnel	- West Valley Volunteer Hose Company - Fire suppressant equipment - HazMat Team Response	1) Low 2) Neg 3) Neg	1) U 2) A 3) U	1) 2 2) 0 3) 0

Notes:

[1] Materials-at-risk are determined using the vessel volume indicated, in conjunction with the referenced hazard concentration; or the volume of hazardous material indicated.
[2] Consequences are as discussed in Section 9.1.1.2: Neg = Negligible; Low; Mod = Moderate; High
[3] Frequencies are as discussed in Section 9.1.1.2: A = Anticipated; U = Unlikely; EU = Extremely Unlikely; I = Incredible
[4] See Section 9.1.1.2 for an explanation of Risk Factor.

TABLE 9.1-1E

PROCESS HAZARDS ANALYSIS FOR THE VITRIFICATION FACILITY AND SUPPORT SSCs
(All footnotes are located at the end of the table)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
TRANSFERS OF LIQUIDS/CONDENSATE BETWEEN TANK 8D-3 OR 8D-4 AND VITRIFICATION CELL COMPONENTS							
Contaminated Liquids	1) Loss of line/pump integrity resulting in a minor release to trench or pit 2) Loss of line/pump integrity resulting in a substantial release to trench or pit 3) Loss of line/pump integrity and trench or pit integrity resulting in a minor release 4) Loss of line/pump integrity and trench or pit integrity resulting in a substantial release 5) Loss of line/pump integrity and subsequent overflow of pit	- Seismic event - Corrosion - Erosion - Operator error (e.g., improper valve alignment) - Mechanical failure/malfunction - Pump operation with line plugging (i.e., sustained dead heading of the pump) - Fire/explosion/over-pressurization	- Double-walled transfer piping - Alarm occurs when liquid accumulates in the low point of the outer confinement piping. - Liquid sensor probes provide alarm for liquid accumulation in pits - Leaks in inner pipe but confined by outer pipe ultimately drain back to tank - Established procedures and training for personnel performing transfers - Limited pump rate significantly reduces likelihood of substantial release	- Concrete trench or pit and substantial cover surround transfer piping, valves, jumpers, and pumps - Low points provided in trench to accumulate leaks from double-walled piping - Large trench volume makes overflow of trench essentially incredible - Pits are normally kept at negative pressure (Alarm occurs for high pressure condition) - West Valley Volunteer Hose Company	1) Neg 2) Low 3) Neg 4) Low 5) Low	1) A 2) U 3) U 4) EU 5) EU	1) 0 2) 2 3) 0 4) 1 5) 1

TABLE 9.1-1E

PROCESS HAZARDS ANALYSIS FOR THE VITRIFICATION FACILITY AND SUPPORT SSCs
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
			VITRIFICATION BUILDING				
Airborne Contamination	1) Loss of offsite power (LOOP) with standby electrical power systems operating as designed 2) LOOP with failure of standby electrical power from the VF diesel generator (which supplies power to HVAC blowers servicing the Vit Building, including the Vit Cell), but standby electrical power provided to process Off-Gas and Vessel Vent System 3) LOOP with failure of standby electrical power (i.e., all diesel generators) servicing vitrification-related systems and components for at least one hour 4) Highly localized ex-cell fire (e.g., fire in operating gallery or vitrification control room) 5) Ex-cell fire affecting more than a highly localized area 6) Failure of the in-cell or ex-cell ventilation system HEPA filters, but not both 7) Failure of both the in-cell and ex-cell ventilation system HEPA filters 8) Loss of all Vit Cell coolers 9) DBT generated missile breaches Vit Cell window 10) Fire involving LLW container	- Seismic event - Operator error (e.g., during testing or maintenance of diesel generator engines) - Mechanical or electrical failure/malfunction (e.g., defective generator control circuitry, defective circuit breaker(s)) - Short circuit in operating gallery component (e.g., a motor) leads to overheating and fire - Routine or corrective maintenance activity leads to combustible material catching fire - Substantial pressure transient in ventilation exhaust system - Loss of Chilled Water system (results in loss of Vit Cell cooler function) - DBT	- Established procedures and training for personnel operating systems and components - Maintenance program and periodic (run and load) testing for diesel generators - Numerous vitrification-related SSCs designed to withstand site's DBE and DBT - Extremely limited combustible material in most ex-cell areas, especially those areas immediately outside of Vit Cell - Periodic aerosol testing of ventilation exhaust HEPA filters to ensure desired particulate removal efficiencies exist - High and low differential pressure alarms provided for ventilation exhaust system HEPA filters (High differential pressure alarm annunciates before HEPA filter design failure pressure is reached)	- Thick reinforced concrete construction of Vit Cell, thick shield windows, and formidable HVAC system that services the Vit Cell (a Zone I area) - Confinement provided by HVAC system servicing Zone II operating gallery (which includes operating aisles and stations immediately outside the Vit Cell) - Proven fire endurance of oil filled radiation shielding windows, including high flashpoint of mineral oil - Wet-pipe sprinkler system in ex-cell areas - Extensive fire detection and alarm system in ex-cell areas - West Valley Volunteer Hose Company - On-site portable generators	1) Neg 2) Neg 3) Low 4) Neg 5) Low 6) Neg 7) Mod 8) Neg 9) Neg 10) Low	1) A 2) A 3) U 4) A 5) U 6) A 7) U 8) U 9) I 10) U	1) 0 2) 0 3) 2 4) 0 5) 2 6) 0 7) 5 8) 0 9) 0 10) 2

TABLE 9.1-1E

PROCESS HAZARDS ANALYSIS FOR THE VITRIFICATION FACILITY AND SUPPORT SSCs
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
Radioactive Material Outside Vit Cell via Penetrations	1) Radioactivity enters line(s) (e.g., steam, instrument, line[s]) penetrating Vit Cell from operating gallery 2) Radioactivity enters line(s) (e.g., steam, instrument, or sampling line[s]) penetrating Vit Cell from operating gallery and leaks out of the lines 3) Confinement not maintained during maintenance/repair operations on components or lines in operating gallery that connect/interface with in-cell components or lines	- Seismic event - Operator error (e.g., improper valve alignment, failure to purge steam lines) - Mechanical failure/malfunction - Inadvertent pressurization of vessel(s) coupled with less than totally effective seals/backflow prevention devices	- Established procedures and training for personnel operating support systems such as steam, air, and water - Hardware to prevent reverse flow through lines that penetrate the Vit Cell (e.g., check valves, valves that auto-close on certain parameters, and manually-operated isolation valves) - Robust maintenance program performed by qualified personnel under oversight of radiological control personnel	- Confinement provided by HVAC system servicing Zone II operating gallery (which includes operating aisles and stations immediately outside the Vit Cell) - Radiation alarms throughout operating gallery - Ex-cell sumps	1) Neg 2) Low 3) Neg	1) A 2) U 3) A	1) 0 2) 2 3) 0
EQUIPMENT DECONTAMINATION ROOM, AND HIGH-LEVEL WASTE INTERIM STORAGE AREA							
HLW	1) Handling mishap (e.g., drop) involving contaminated equipment 2) Handling mishap (e.g., drop) resulting in a breach of a loaded canister and loss of secondary confinement 3) Localized fire potentially impacting (i.e., heating) a small amount of contaminated equipment or a few canisters 4) Fire affecting more than a localized area and resulting in a minor release to the environment 5) Fire affecting more than a localized area and resulting in a substantial release to the environment 6) Loss of secondary confinement (e.g., concrete walls of HLWIS) area due to thermal degradation (from decay heat)	- Seismic event - Operator error - Mechanical or electrical failure/malfunction - Short circuit in component (e.g., a motor) leads to overheating and fire - Routine or corrective maintenance activity leads to combustible material catching fire - Decay heat	- Established procedures and training for personnel operating systems and components - EDR and HLWIS area are capable of withstanding the site's DBE - Extremely limited combustible material in EDR and HLWIS area - Formidable structural strength of canister (designed to withstand drop from 7 meters)- Solidified HLW form does not readily become airborne (i.e., a significant energy source impacting the HLW is required) - Decay heat from canisters (a known quantity) is insufficient to degrade integrity of concrete walls in HLWIS area to point of failure/collapse	- Thick reinforced concrete construction of EDR and HLWIS area; thick shield windows, and formidable HVAC systems that service these (Zone I) areas - Proven fire endurance of oil filled radiation shielding windows, including high flashpoint of mineral oil - Confinement provided by HVAC system servicing areas immediately outside the EDR and HLWIS area	1) Neg 2) Mod 3) Neg 4) Low 5) Mod 6) Mod	1) A 2) U 3) A 4) EU 5) I 6) I	1) 0 2) 5 3) 0 4) 1 5) 0 6) 0

TABLE 9.1-1E

PROCESS HAZARDS ANALYSIS FOR THE VITRIFICATION FACILITY AND SUPPORT SSCs
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
			LOAD-IN BUILDING				
Airborne Contamination	1) Reverse airflow between EDR and Load-In Building while loading in or out item(s) 2) Mishap (other than reverse airflow) while loading in or out item(s) resulting in loss of confinement 3) Fire in Load-In Building resulting in a minor release (see note [5]) 4) Fire in Load-In Building resulting in a substantial release (see note [5])	- Seismic event - Operator error - Mechanical failure/malfunction - Short circuit in component (e.g., a power panel or electric unit heater) leads to overheating and fire - Routine or corrective maintenance activity leads to combustible material catching fire - Pressure transient in ventilation system(s)	- Established procedures and training for personnel performing load in and out operations - Load-In Building designed to withstand site's DBE - Limited combustible material in Load-In Building, especially in vicinity of opening connecting Load-In Building to EDR	- Thick reinforced concrete construction of wall between Load-In Building and EDR - Confinement provided by HVAC system servicing the EDR (designed so that air flow is from Load-In Building into EDR) - Wet-pipe sprinkler system in Load-In Building - Various fire detection mechanisms with associated alarm system - West Valley Volunteer Hose Company	1) Low 2) Neg 3) Low 4) Low	1) U 2) A 3) U 4) EU	1) 2 2) 0 3) 2 4) 1
			DIESEL FUEL OIL STORAGE TANK BUILDING				
Diesel Fuel Oil Fire/ Explosion	1) Loss of tank integrity resulting in a fire 2) Loss of tank integrity resulting in a minor release 3) Loss of tank integrity resulting in a substantial release (overflow line limits tank capacity to 7,370 gallons)	- Seismic event - Corrosion - Operator error - Mechanical failure/malfunction - Tank electric heating element or transfer pump motor shorts and initiates fire - Fire external to Building	- Established procedures and training for personnel refilling tank and maintaining fuel oil system components - Extremely limited combustible material (apart from fuel oil) in Building - Sump liquid level sensor initiates alarm condition (at 0.125 inch above bottom of sump), reducing likelihood of a substantial release	- Tank is in concrete pit which has volume to retain 110% of tank's capacity - Tank overflow line drains to sump located in pit - Building isolated from other SSCs (e.g., Building is about 100 yards from VF Diesel Generator Room) - Spring loaded fusible link equipped valves (fail closed) at strategic points in fuel line - West Valley Volunteer Hose Company - Hazmat Team response	1) Low 2) Neg 3) Neg	1) U 2) A 3) U	1) 2 2) 0 3) 0

TABLE 9.1-1E

PROCESS HAZARDS ANALYSIS FOR THE VITRIFICATION FACILITY AND SUPPORT SSCs
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
EX-CELL OFF-GAS SYSTEM (OFF-GAS TRENCH, OFF-GAS EQUIPMENT IN THE 01-14 BUILDING)							
Airborne Contamination	1) Loss of offsite power (LOOP) with standby electrical power systems operating as designed 2) LOOP with failure of standby electrical power to ex-cell Off-Gas system components, but standby electrical power provided to key Vit Building components (e.g., Vit Building HVAC components) 3) Fire affecting ex-cell Off-Gas system components resulting in a minor release 4) Fire affecting ex-cell Off-Gas system components resulting in a substantial release 5) Failure of ex-cell Off-Gas system filters6) Loss of negative pressure in ex-cell Off-Gas system not due to breach in system integrity 7) Breach in ex-cell Off-Gas system resulting in a minor release 8) Breach in ex-cell Off-Gas system resulting in a substantial release (likely due to continued operation of off-gas blower(s) after breach occurs)	- Seismic event - Corrosion - Operator error (e.g., heavy item dropped on system ducting) - Mechanical or electrical failure/malfunction - Short circuit in a component (e.g., a blower motor) leads to overheating and fire - Routine or corrective maintenance activity leads to combustible material catching fire - Substantial pressure transient in ex-cell Off-Gas system	- Established procedures and training for personnel operating ex-cell Off-Gas system components - Maintenance program and periodic (run and load) testing for diesel generators - Extremely limited combustible material in 01-14 Building, especially in the 01 and 14 cells - Periodic aerosol testing of Off-Gas system HEPA filters to ensure desired particulate removal efficiencies exist - High and low differential pressure alarms provided for ex-cell Off-Gas system HEPA filters (High differential pressure alarm annunciates before HEPA filter design failure pressure is reached) - Heated off-gas trench, entrainment separator, and reheaters upstream of HEPA filters help prevent excessive moisture loading on HEPA filters (and hence possible damage to filters) - Substantial instrumentation and interlocks associated with various ex-cell Off-Gas system parameters could serve to prevent a substantial release	- Redundant ex-cell Off-Gas system trains - Confinement provided by the two HEPA-filtered ventilation exhaust systems that service the 01-14 Building - Wet-pipe sprinkler system - Fire detection mechanisms with associated alarm system - West Valley Volunteer Hose Company - On-site portable generators	1) Neg 2) Neg 3) Low 4) Mod 5) Mod 6) Neg 7) Neg 8) Low	1) A 2) A 3) U 4) I 5) U 6) A 7) A 8) U	1) 0 2) 0 3) 2 4) 0 5) 5 6) 0 7) 0 8) 2

TABLE 9.1-1E

PROCESS HAZARDS ANALYSIS FOR THE VITRIFICATION FACILITY AND SUPPORT SSCs
(All footnotes are located at the end of the table)(Continued)

Hazard [1]	Event	Initiator	Preventive Features	Mitigative Features	Conseq. [2]	Freq. [3]	Risk Factor [4]
External Areas (i.e., Roads and Areas On-Site Located Outside of Structures)							
Radioactive Material Contaminated Components (Airborne or Otherwise Uncontrolled Release)	1) During ground transportation operations, container rupture, breach, or fluid leak resulting in a minor release 2) During ground transportation operations, container rupture, breach, or fluid leak resulting in a substantial release 3) During ground transportation operations, fire resulting in a non-trivial release of radioactive material (See note [5]) 4) Crane drops container resulting in a container breach and possibly component(s) within container breach (See note [6])	- Seismic event - Strong straight winds or tornado - Lightning strike - Corrosion - Operator error (e.g., forklift punctures, drops, or crushes container; container drops off vehicle while in transit because improperly secured; collision (traffic accident) occurs; improper crane operation) - Mechanical or electrical failure/malfunction (e.g., forklift or other vehicle brakes fail; accelerator pedal sticks; crane cable breaks)	- Forklift and other vehicle care/maintenance to ensure proper operation - Established procedures and training for forklift and other vehicle operators - Structural strength of containers and many of the components within the containers - Components usually enclosed in contamination barrier (e.g. Herculite) - Site crane inspection and load testing - Flushing of vessels and subsequent removal of liquids such that fluids should normally not be present in components transported on-site - Transportation limited to on-site (short distances and at low speeds) - Restrictions on crane lifts during adverse weather (on-site meteorological monitoring)	- The radioactive material is generally in the form of fixed contamination - West Valley Volunteer Hose Company - Hazardous material and radiological control personnel response	1) Neg 2) Low 3) Low 4) Low	1) A 2) U 3) EU 4) U	1) 0 2) 2 3) 1 4) 2
High Radiation Exposure Rate	1) Gamma dose rate substantially underestimated, or shielding reconfigured in undesired manner, resulting in dose to workers on the order of a few rem 2) Gamma dose rate substantially underestimated, or shielding reconfigured in undesired manner, resulting in dose to workers on the order of tens of rem	- Dose rate device provides erroneous output or is misread - Equipment failure or other mishap results in partial or complete loss of shielding	- Training for performing dose rate surveys - Periodic calibration of radiation instruments - Design features of shielding installation - Established procedures and training for container (and related shielding when applicable) handling operations	- Operator radiological work environment training	1) Low 2) Mod	1) U 2) I	1) 2 2) 0

Notes:

[1] Materials-at-risk are determined using the vessel volume indicated, in conjunction with the referenced hazard concentration; or the volume of hazardous material indicated.
[2] Consequences are as discussed in Section 9.1.1.2: Neg = Negligible; Low; Mod = Moderate; High
[3] Frequencies are as discussed in Section 9.1.1.2: A = Anticipated; U = Unlikely; EU = Extremely Unlikely; I = Incredible
[4] See Section 9.1.1.2 for an explanation of Risk Factor.

TABLE 9.1-1E

PROCESS HAZARDS ANALYSIS FOR THE VITRIFICATION FACILITY AND SUPPORT SSCs

(All footnotes are located at the end of the table)(Concluded)

[5] A vehicle (e.g., typical commercially available forklift or truck) accident is considered to be the dominant means for a fire or explosion. Vehicle accidents on DOE sites that involve a fire occur with a frequency of substantially less than 1.0E-06 per mile. (A smaller frequency is associated with vehicle accidents that involve an explosion.) For example, DOE/RL-2001-0036, *Hanford Site Transportation Safety Document*, provides an estimate, based on site-specific data, of 5E-09 per mile for a vehicle accident that involves fire. DOE sites have several measures in-place that reduce vehicle accident frequencies on DOE sites relative to commercial and private vehicle accident frequencies. Therefore, using commercial and private vehicle accident frequencies for analyses at DOE sites would not be proper. Regardless, it is noted that DOE/EIS-0212, *Final Environmental Impact Statement for Safe Interim Storage of Hanford Tank Wastes*, states that the frequency of truck accidents in the State of Washington is 4.2E-07 per mile. SAND84-0062, *The Transportation of Nuclear Materials*, states "Data from summaries of accident reports filed by commercial motor carriers indicate that fires occur in approximately 1.6% of all truck accidents." Hence, using commercial data, truck accidents that involve fires occur with a frequency of 6.7E-09 per mile. Typical forklifts generally present less of a fire hazard than trucks (at least in terms of fire intensity and duration, key parameters in fire hazards analyses) due to having substantially smaller fuel tanks than trucks and lower combustibles in general than trucks (e.g., truck tires are a significant fuel source). Additionally, their speeds are typically much lower than trucks, thereby reducing the likelihood that the energetics of an accident will result in a fire or explosion. The rarity of forklift fires is reflected in the Occurrence Reporting and Processing System (ORPS) database. Of the over 50,000 "occurrences" reported in ORPS as of October 7, 2003, only one has the semblance of a forklift fire. "A pinhole in a hydraulic hose leaked hydraulic fluid onto the engine bay and the insulation. Heat from the engine caused the insulation to ignite." The operator opened the engine side panel and applied agent from an ABC fire extinguisher. In consideration of the above information, and given the very short distances (i.e., small fraction of a mile) traveled per trip, vehicle accidents involving a fire (or explosion) while transporting contaminated components, and that result in the uncontrolled release of radioactive material, are considered to be not credible. A vehicle fire due to an electrical or fuel system malfunction, but not related to a traffic accident, is extremely uncommon. Such a fire could typically be expected to only affect "under the hood" equipment. Based on statistics for trucks over 8500 lbs operated on the Hanford site, the frequency of a random fire (one not associated with a collision or rollover) is 1.04E-09 per mile. (This estimate is reported in WHC-SD-WM-TA-143, *Pilot Plant Hot Test Facility Siting Study*.) In consideration of this information, and the relatively small (aggregate) amount of time per year that significantly contaminated components are on or around transport vehicles, a vehicle fire not related to a traffic accident that results in the release of radioactive material is considered to be not credible. The analyses provided above are not applicable to the customized diesel-powered forklift that has been procured for the primary purpose of supporting RHWF waste container transport-related operations, and for the secondary purpose of transporting other select waste containers on-site, including waste containers associated with Vitrification Facility D&D activities. It is not technically prudent to apply accident data for typical commercially available forklifts and trucks to the subject customized forklift. A fire event in association with the customized forklift is considered to be "extremely unlikely," and an explosion is considered to be not credible. As shown in Section 5.3.1 of DOE-HDBK-3010-94, the bounding airborne release fraction x respirable fraction (ARF x RF) for nonvolatile radionuclides is 6.0E-05 for the thermal stress of metal and other noncombustible surfaces. Additionally, multiple barriers (e.g., the materials of construction of the customized forklift, the waste container, shielding materials within the waste container, and the component(s) in the waste container) are likely to provide a substantial heat barrier/heat sink, and thereby retard the extent of thermal stress experienced by contaminated surfaces. For these reasons, the potential consequences are assessed as being "low."

[6] The airborne release fraction (ARF) from "free fall and impaction stress" of metals with fixed contamination is exceedingly small. DOE-HDBK-3010-94 states the following: "No experimentally measured values for airborne release fraction and respirable fraction are available. No significant airborne release is postulated." DOE-HDBK-3010-94 also indicates that the ARF from "free-fall and impaction stress" of nonmetallic or composite solids (such as concrete/cement) with fixed contamination is very small. Hence, the consequences from a crane dropping a container, even from a substantial height, are considered to be "low." Per year, very few containers that contain highly contaminated components are lifted by a crane (external to structures). The frequency of this event is considered to be "unlikely." Additionally, the construction of vessels lifted is such that even if they were dropped, the vessels could reasonably be expected to maintain their confinement of radioactive material (i.e., there would be deformation without breaching). The vessels are typically constructed of corrosion resistant materials.

TABLE 9.2-1

FAILURE OF MAIN PLANT HEPA FILTER BANK

Assumptions:

Airborne Release Fraction (ARF)[1]	5.0E-4	Damage Ratio (DR)	1.0
Respirable Fraction (RF)[1]	1.0	Leakpath Factor (LPF)	1.0
Number of Failed HEPA Filters	30	HEPA Filter Exposure Rate	10 R/hr
Release Height	60 m	HEPA Filter Cs-137 Activity[2]	225 Ci

Receptor Location			1050 m	1050 m	1050 m	
Stability Class, Wind Speed			D, 4.5m/s	F, 1m/s	95%	
Dispersion (χ/Q)			5.08E-06 s/m³	1.13E-07 s/m³	1.36E-04 s/m³	
Nuclide	Normalized Spent Fuel Activity[3]	Source Term (Ci)	Off-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Percent Dose Contribution
Pu-238	5.32E-02	5.99E-03	4.66E-03	1.04E-04	1.25E-01	46.5%
Am-241	1.58E-02	1.78E-03	1.57E-03	3.48E-05	4.19E-02	15.6%
Pu-239	1.36E-02	1.53E-03	1.32E-03	2.94E-05	3.53E-02	13.2%
Pu-240	1.04E-02	1.17E-03	1.01E-03	2.25E-05	2.70E-02	10.1%
Pu-241	5.14E-01	5.78E-02	9.78E-04	2.17E-05	2.62E-02	9.8%
Sr-90	9.26E-01	1.04E-01	2.29E-04	5.09E-06	6.12E-03	2.3%
Cm-244	2.31E-03	2.60E-04	1.19E-04	2.64E-06	3.18E-03	1.2%
Am-243	7.27E-04	8.18E-05	7.20E-05	1.60E-06	1.93E-03	0.7%
U-232	2.41E-04	2.71E-05	3.07E-05	6.83E-07	8.22E-04	0.3%
Am-242m	1.22E-04	1.37E-05	1.18E-05	2.63E-07	3.16E-04	0.1%
U-233	3.40E-04	3.83E-05	8.42E-06	1.87E-07	2.25E-04	0.1%
Cs-137	1.00E+00	1.13E-01	6.12E-06	1.36E-07	1.64E-04	0.1%
		TOTAL TEDE	1.00E-02	2.23E-04	2.68E-01	99.9%

Notes:
[1] - See Section 9.2.2.1.2.
[2] - HEPA activity based on 1 R/hr per 0.75 Ci Cs-137; Ref: WVNS Letter HE:85:0016.
[3] - Based on normalized spent fuel activity; Ref: CN:93:0015.

TABLE 9.2-2

ENERGETIC EVENT INVOLVING TRU WASTE DRUM AT LAG STORAGE BUILDING

Assumptions:

Airborne Release Fraction (ARF)[1]	5.0E-4	Damage Ratio (DR)	1.0
Respirable Fraction (RF)[1]	1.0	Leakpath Factor (LPF)	1.0

Receptor Location			100 m	100 m	100 m	1050 m	1050 m	1220 m	
Stability Class, Wind Speed			D, 4.5m/s	F, 1m/s	95%	D, 4.5m/s	F, 1m/s	95%	
Dispersion (χ/Q)			1.65E-03 s/m³	3.06E-02 s/m³	7.66E-03 s/m³	2.75E-05 s/m³	5.67E-04 s/m³	5.25E-04 s/m³	
Nuclide	Combustible Activity (Ci)	Source Term (Ci)	On-Site Dose (rem)	On-Site Dose (rem)	On-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Percent Dose Contribution
Pu-238	3.29E+00	0.0016	4.16E-01	7.71E+00	1.93E+00	6.93E-03	1.43E-01	1.32E-01	41.0%
Sr-90	5.24E+02	2.62E-01	1.88E-01	3.49E+00	8.74E-01	3.14E-03	6.47E-02	5.99E-02	18.6%
Pu-239	8.47E-01	4.24E-04	1.19E-01	2.20E+00	5.51E-01	1.98E-03	4.08E-02	3.78E-02	11.7%
Pu-240	6.44E-01	3.22E-04	9.02E-02	1.67E+00	4.19E-01	1.50E-03	3.10E-02	2.87E-02	8.9%
Am-241	6.17E-01	3.08E-04	8.81E-02	1.63E+00	4.09E-01	1.47E-03	3.03E-02	2.80E-02	8.7%
Pu-241	3.19E+01	1.59E-02	8.75E-02	1.62E+00	4.06E-01	1.46E-03	3.01E-02	2.79E-02	8.6%
Cm-244	1.43E-01	7.13E-05	1.06E-02	1.96E-01	4.91E-02	1.76E-04	3.63E-03	3.73E-03	1.0%
Am-243	4.49E-02	2.25E-05	6.42E-03	1.19E-01	2.98E-02	1.07E-04	2.21E-03	2.04E-03	0.6%
Cs-137	5.66E+02	2.83E-01	4.98E-03	9.23E-02	2.31E-02	8.30E-05	1.71E-03	1.58E-03	0.5%
U-232	1.50E-02	7.48E-06	2.75E-03	5.10E-02	1.28E-02	4.59E-05	9.46E-04	8.76E-04	0.3%
Am-242m	7.57E-03	3.79E-06	1.06E-03	1.97E-02	4.93E-03	1.77E-05	3.65E-04	3.88E-04	0.1%
		TOTAL TEDE	1.01E-00	1.88E+01	4.71E-00	1.69E-02	3.49E-01	3.23E-01	100.0%

Notes:

[1] - Based on Section 5.2.1.1, DOE-HDBK-3010-94.

TABLE 9.2-3

DROP OF A HIGH INTEGRITY CONTAINER

Assumptions:
ARF x RF x DR x LPF 4.00E-05 - see note [1] below
Release Height 0 m (ground level release)
Mass of sludge in HIC 3200 kg

Receptor Location				100 m	100 m	100 m	1050 m	1050 m	1220 m	
Stability Class, Wind Speed				D, 4.5 m/s	F, 1 m/s	95%	D, 4.5 m/s	F, 1 m/s	95%	
Dispersion (χ/Q)				1.65E-03 s/m^3	3.06E-02 s/m^3	7.66E-03 s/m^3	2.75E-05 s/m^3	5.67E-04 s/m^3	5.25E-04 s/m^3	
Nuclide	Conc. of Activity in HIC "B" (µCi/g)	Total Activity in HIC "B" (Ci)	Source Term (Ci)	On-Site Dose (rem)	On-Site Dose (rem)	On-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Percent of Dose
Am-241	5.63E-02	1.80E-01	7.21E-06	2.06E-03	3.82E-02	9.56E-03	3.43E-05	7.08E-04	6.55E-04	29.5%
Pu-239*	4.76E-02	1.52E-01	6.10E-06	1.71E-03	3.17E-02	7.94E-03	2.85E-05	5.87E-04	5.44E-04	24.5%
Pu-240*	3.63E-02	1.16E-01	4.65E-06	1.30E-03	2.42E-02	6.05E-03	2.17E-05	4.48E-04	4.15E-04	18.6%
Pu-241**	1.79E+00	5.74E+00	2.29E-04	1.26E-03	2.33E-02	5.84E-03	2.10E-05	4.32E-04	4.00E-04	18.0%
Pu-238	1.34E-02	4.27E-02	1.71E-06	4.32E-04	8.02E-03	2.01E-03	7.20E-06	1.49E-04	1.38E-04	6.2%
Cs-137	6.52E+01	2.09E+02	8.35E-03	1.47E-04	2.72E-03	6.82E-04	2.45E-06	5.05E-05	4.67E-05	2.1%
Sr-90	6.80E-01	2.18E+00	8.70E-05	6.25E-05	1.66E-03	2.90E-04	1.04E-06	2.15E-05	1.99E-05	0.9%
Cs-134	1.41E+00	4.51E+00	1.80E-04	4.65E-06	8.62E-05	2.16E-05	7.75E-08	1.60E-06	1.48E-06	0.1%
Co-60	1.63E+00	5.21E+00	2.08E-04	3.43E-06	6.36E-05	1.59E-05	5.71E-08	1.18E-06	1.09E-06	0.1%
			Total TEDE	6.98E-03	1.29E-01	3.24E-02	1.16E-04	2.40E-03	2.22E-03	100%

* Pu-239 and Pu-240 isotopic proportions are based on SNF distribution as reported in Wolniewicz, 1993.
** Pu-241 estimated by Pu-239: Pu-241 ratio reported in Wolniewicz, 1993.
[1] Based on values given in DOE-HDBK-3010-94.

TABLE 9.2-4

FAILURE OF UPC VESSELS

Assumptions:

ARF x RF x DR x LPF	1.0E-04
Release Height	60 meters
Volume of Liquid Waste	113,950 liters

Receptor Location				1050 m	1050 m	1050 m	
Stability Class, Wind Speed				D, 4.5 m/s	F, 1 m/s	95%	
Dispersion (x/Q)				5.08E-06	1.13E-07	1.36E-04	
Nuclide	**Inventory (µCi)**	**Source Term (µCi)**	**DCF (rem/µCi)**	**Off-Site Dose (rem)**	**Off-Site Dose (rem)**	**Off-Site Dose (rem)**	**Percent of Dose**
Am-241	3.20E+07	3.20E+03	5.20E+02	2.81E-03	6.26E-05	7.53E-02	53.7%
Pu-238	1.85E+07	1.85E+03	4.60E+02	1.44E-03	3.20E-05	3.85E-02	27.4%
Pu-239	5.13E+06	5.13E+02	5.10E+02	4.43E-04	9.85E-06	1.19E-02	8.4%
Pu-240	3.91E+06	3.91E+02	5.10E+02	3.37E-04	7.50E-06	9.03E-03	6.4%
Pu-241	1.19E+08	1.19E+04	1.00E+01	2.01E-04	4.47E-06	5.38E-03	3.8%
U-233	4.12E+05	4.12E+01	1.30E+02	9.06E-06	2.01E-07	2.42E-04	0.2%
Total TEDE				5.24E-03	1.17E-04	1.40E-01	100.00%

TABLE 9.2-5

DROP OF HLW WASTE CONTAINER

Assumptions:

Airborne Release Fraction (ARF) [1]	5.20E-06	Damage Ratio (DR)	1.0
Respirable Fraction	1.0	Leakpath Factor (LPF)	1.0
Release Height	60 m		

Receptor Location			1050 m	1050 m	1050 m	
Stability Class, Wind Speed			D, 4.5 m/s	F, 1 m/s	95%	
Dispersion (c/Q)			5.08 E-06 s/m3	1.13 E-07 s/m3	1.36 E-04 s/m3	
Nuclide	Activity per Canister (Ci)	Source Term (Ci)	Off-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Percent Dose Contribution
Am-241	1.91E+02	9.93E-04	8.74E-04	1.94E-05	2.34E-02	62.00%
Sr-90	2.39E+04	1.24E-01	2.73E-04	6.08E-06	7.32E-03	19.40%
Pu-238	2.96E+01	1.54E-04	1.20E-04	2.66E-06	3.21E-03	8.50%
Cm-244	2.73E+01	1.42E-04	6.48E-05	1.44E-06	1.74E-03	4.60%
Pu-239	5.82E-00	3.03E-05	2.61E-05	5.81E-07	6.99E-04	1.85%
Pu-241	2.88E+02	1.50E-03	2.53E-05	5.64E-07	6.78E-04	1.80%
Pu-240	4.19E-00	2.18E-05	1.88E-05	4.18E-07	5.03E-04	1.33%
Cs-137	2.58E+04	1.34E-01	7.26E-06	1.62E-07	1.94E-04	0.52%
		TOTAL TEDE	1.41E-03	3.13E-05	3.77E-02	100.00%

Notes:
[1] Based on DOE-HDBK-3010-94

TABLE 9.2-6

VITRIFICATION PROCESS OFF-GAS OR HVAC SYSTEM HEPA FAILURE

Assumptions:

Airborne Release Fraction (ARF) [1]	5.0E-04	Damage Ratio (DR)	1.0
Respirable Fraction	1.0	Leakpath Factor (LPF)	1.0
Release Height [2]	60 m		

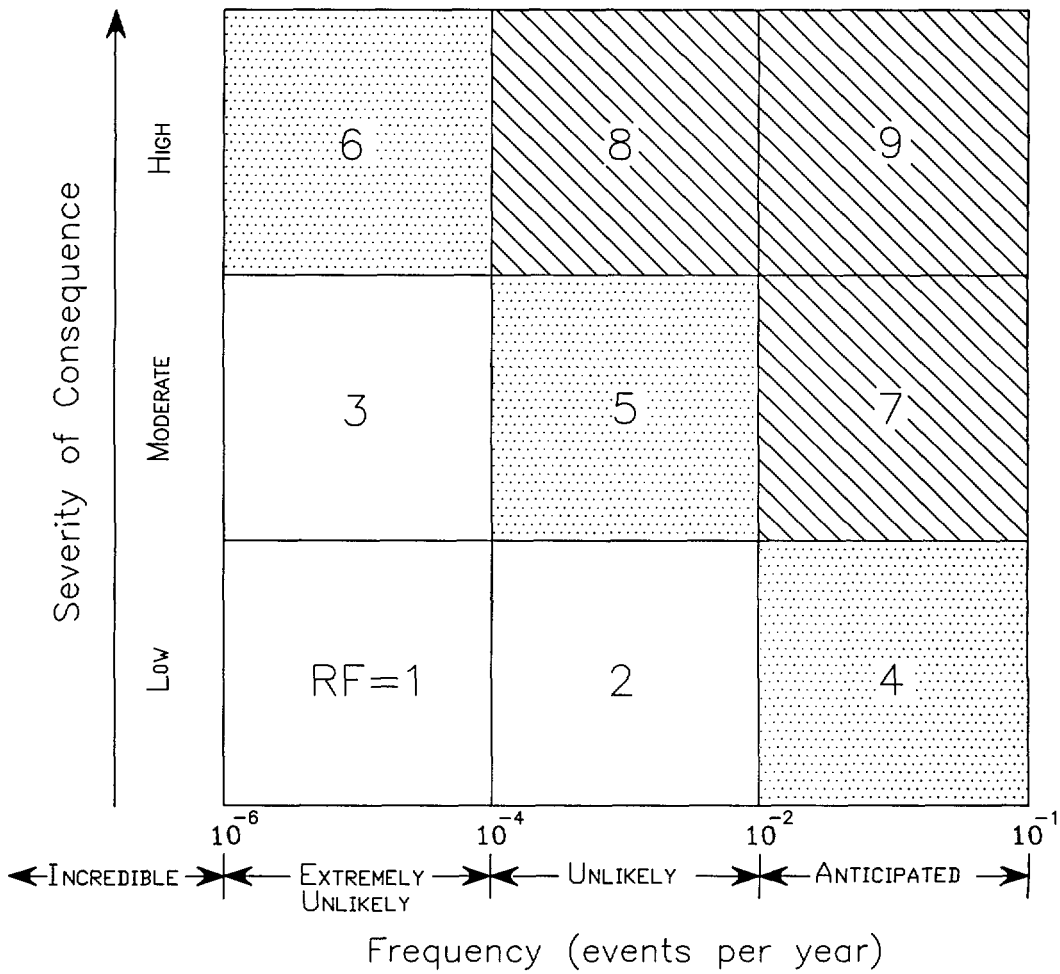
Receptor Location			100 m	100 m	100 m	1050 m	1050 m	1220 m	
Stability Class, Wind Speed			D, 4.5 m/s	F, 1 m/s	95%	D, 4.5 m/s	F, 1 m/s	95%	
Dispersion (c/Q)			1.65 E-03 s/m³	3.06 E-02 s/m³	7.66 E-03 s/m³	2.75 E-05 s/m³	5.67 E-04 s/m³	5.25 E-04 s/m³	
Nuclide	Activity per Canister (Ci)	Source Term (Ci)	On-Site Dose (rem)	On-Site Dose (rem)	On-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Off-Site Dose (rem)	Percent Dose Contribution
Am-241	6.62E-01	3.31E-04	9.46E-02	1.75E-00	4.39E-01	1.58E-03	3.25E-02	3.01E-02	41.30%
Cs-137	8.76E+03	4.38E-00	7.70E-02	1.43E-00	3.58E-01	1.28E-03	2.65E-02	2.45E-02	33.63%
Sr-90	8.30E+01	4.15E-02	2.96E-02	5.50E-01	1.38E-01	4.94E-04	1.02E-02	9.43E-03	12.95%
Pu-238	1.03E-01	5.15E-05	1.30E-02	2.41E-01	6.04E-02	2.17E-04	4.47E-03	4.14E-03	5.68%
Cm-244	9.52E-02	4.76E-05	7.06E-03	1.31E-01	3.28E-02	1.18E-04	2.43E-03	2.25E-03	3.08%
Pu-239	2.02E-02	1.01E-05	2.83E-03	5.25E-02	1.31E-02	4.72E-05	9.73E-04	9.01E-04	1.24%
Pu-241	1.01E-00	5.05E-04	2.77E-03	5.15E-02	1.29E-02	4.62E-05	9.53E-04	8.83E-04	1.21%
Pu-240	1.48E-02	7.40E-06	2.07E-03	3.85E-02	9.63E-03	3.46E-05	7.13E-04	6.60E-04	0.91%
		TOTAL TEDE	2.29E-01	4.25E-00	1.06E-00	3.82E-03	7.87E-02	7.29E-02	100.00%

Notes:
[1] Based on DOE-HDBK-3010-94
[2] The Vitrification Stack is of insufficient height to be considered an elevated release and is therefore considered bounding.

TABLE 9.2-7

SUMMARY OF CONSEQUENCES OF FACILITY ACCIDENTS

Accident	Maximally Exposed Off-Site Individual	Off-Site Evaluation Guideline
Main Ventilation HEPA Bank Failure	2.68E-01 rem	25 rem
Hydrogen Peroxide Spill	1.6 ppm	ERPG-2 (50 ppm)
Energetic Event Involving TRU Waste	3.49E-01 rem	25 rem
Dropping of a Loaded High Integrity Container	2.40E-03 rem	25 rem
Failure of UPC Vessels	1.40E-01 rem	25 rem
High-Level Waste Canister Drop	3.90E-02 rem	25 rem
Process Off-Gas or HVAC System HEPA Failure	7.86E-02 rem	25 rem
Beyond Design Basis Failure of HLWIS Area	No Release Expected	Not Applicable
Beyond Design Basis Crane Falls in HLWIS	5.20E-03 rem	Not Applicable



Combinations of conclusions from risk analysis that identify situations of major concern.

Combinations that identify situations of concern.

Frequency Classification	
Incredible	$p \le 10^{-6}$
Extremely Unlikely	$10^{-6} < p \le 10^{-4}$
Unlikely	$10^{-4} < p \le 10^{-2}$
Anticipated	$10^{-2} < p \le 10^{-1}$

Where p is the probability of a given event per year.

Figure 9.1-1 Process Hazards Analysis Risk Bins

10.0 CONDUCT OF OPERATIONS

Conduct of Operations at the West Valley Nuclear Services Company (WVNSCO) is a philosophy for achieving excellence. To enhance safe operations and deliver a high quality product, WVNSCO follows WVDP-106, *West Valley Demonstration Project (WVDP) Conduct of Operations Manual*, which implements and augments DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*, Change 1. The manual, which is based on the eighteen chapters of DOE Order 5480.19 in sequence, provides guidance for uniform and consistent compliance with the Order. The principles and philosophy of the manual apply to all WVDP activities and are implemented on-site in a graded fashion. The goal of the manual is to promote greater accountability of each individual for their cognizant site activities.

This chapter provides information that will satisfy the requirements of 10CFR830 for organizational and operational issues related to the conduct of operations. The sections of this chapter address the following chapters discussed in DOE Standard DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*.

- Chapter 10 - Initial Testing, In-Service Surveillance, and Maintenance
- Chapter 11 - Operational Safety
- Chapter 12 - Procedures and Training
- Chapter 15 - Emergency Preparedness
- Chapter 16 - Provisions for Decontamination and Decommissioning
- Chapter 17 - Management, Organization, and Safety Provisions

10.1 Organizational Structure

This section summarizes the organizational structure, responsibilities, and interfaces for management of the facility.

The West Valley Demonstration Project (WVDP) Act, Public Law 96-368 (U.S. Congress October 1, 1980), initiated a high-level radioactive waste management project at the Western New York Nuclear Service Center (WNYNSC). Authority to implement the Act was given to the DOE, whose on-site office, DOE-OH/WVDP, reports to the DOE Ohio Field Office (DOE-OH).

A cooperative agreement was signed between DOE and the State of New York, which is the owner of the site. The state is represented in this relationship by the New York State Energy Research and Development Authority (NYSERDA). The WVDP is managed by WVNSCO, under contract to the DOE. WVNSCO is a part of the Westinghouse Government Services Group (WGSG), which was formed following acquisition of Westinghouse in March 1999 by a joint venture of Washington Group International, Inc., and BNFL Inc. (a U.S. subsidiary of British Nuclear Fuels). WVNSCO responsibilities include WVDP management, conceptual design and engineering management, construction management, decontamination and decommissioning of the facilities, and site/facility operation. WVNSCO subcontracts portions of the work to URS, which provides environmental and safety services, and Pinkerton Government Services, which provides security.

DOE-OH/WVDP has overall responsibility for compliance with federal, state, and local government requirements. WVNSCO has the responsibility, authority, and accountability for operation and management of the WVDP, including the performance of operational reviews, audits, and self-assessments. Third-party review and regulatory oversight is provided by the New York State Department of Environmental Conservation (NYSDEC), the New York State Department of

Health (NYSDOH), the New York State Department of Transportation (NYSDOT), the Nuclear Regulatory Commission (NRC), and the U.S. Environmental Protection Agency (EPA). Technical support has been provided on an as-needed basis by Argonne National Laboratory, Alfred University, Brookhaven National Laboratory, Catholic University of America, Idaho National Engineering and Environmental Laboratory (INEEL), Los Alamos National Laboratory (LANL), Materials Characterization Center, Oak Ridge National Laboratory (ORNL), Pacific Northwest National Laboratory (PNNL), Sandia National Laboratory (SNL), Waste Isolation Pilot Plant (WIPP), and Westinghouse Savannah River Company (WSRC).

10.1.1 Westinghouse Government Services Group Organization

WVNSCO is part of the Westinghouse Government Services Group (WGSG), which is owned by Washington Group International, Inc.

Westinghouse Government Services assistance is provided on an as-needed basis when specialized expertise and services are required. Projects requiring significant time and assistance are contracted to other WGSG entities or other contractors.

10.1.2 WVNSCO Organization

WVNSCO is structured to ensure safe and successful completion of project goals. Numerous control systems have been developed to assist in WVDP management. These systems are documented in WVDP-117, *WVNSCO Policies and Procedures Manual* and WVDP-002, *Quality Management Manual*. Specific WVNSCO policies and procedures developed to ensure safe operation, quality assurance, testing, emergency operation, and related activities, including specific procedures and guidance regarding radiological safety and operations, are kept on file and routinely updated by WVNSCO Records and Configuration/Document Control.

The Radiation and Safety Committee (R&SC), whose scope, function, and responsibilities are defined in WV-906, *Radiation and Safety Committee*, is a group of individuals appointed by the WVNSCO President/Project Director to: provide objective and independent review of safety-related operations, systems, and activities; serve in an advisory capacity to the line organizations; and respond to questions and concerns about safety. The management functions of the R&SC members, including the R&SC Chairman, are independent of facility design and operations (i.e., are not related to day-to-day operations and activities) to the maximum extent practicable. Line management has the direct responsibility for conducting activities in a safe manner, in compliance with DOE Policy 450.4, *Safety Management System Policy*, as implemented through WV-100, *Integrated Safety Management and Control of Documents*; WV-110, *Conduct of Operations*; and WVDP-106, *West Valley Demonstration Project (WVDP) Conduct of Operations Manual*.

The WVDP organizational hierarchy is provided in Figure 10.1-1. Figure 10.1-2 is a WVNSCO organization chart indicating the major staff groups. Following is a brief functional description of groups in the WVNSCO organization:

President/Project Director - responsible for overall operations of the WVDP.

- Radiation and Safety Committee - provides objective and independent review of safety-related operations, systems, and activities and functions in an advisory capacity to the line organization and the WVNSCO President/Project Director.

- Quality Assurance - provides quality engineering and inspection services and coordinates project appraisal functions, including assessments and self assessments. The QA manager is at the same or higher organizational level as the highest line manager directly responsible for performing activities affecting quality, and is sufficiently independent from cost and schedule considerations to assure impartiality. The QA manager has the authority to ensure resolution of quality issues, elevating the matter to the President/Project Director of WVNSCO if necessary.
- Radiation Protection (RP) - responsible for radiological engineering, radiological safety, and radiological protection operations. The Radiation Protection Manager is at the same or higher organizational level as the highest line manager directly responsible for performing activities in radiological facilities, and is sufficiently independent from cost and schedule considerations to assure impartiality. The RP manager has the authority to ensure resolution of any radiation protection issue, elevating the issue to the President/Project Director of WVNSCO, if necessary.

Office of the President - responsible for industrial safety, medical program, employee concerns, and community relations.

- Industrial Safety and Medical - responsible for industrial safety, construction safety, and occupational safety and health.
- Employee Concerns - responsible for investigation of employee concerns and performance of internal financial and performance audits.
- Community Relations - responsible for community and environmental relations, education, and media coverage, including dissemination of information to the public and response to public comment and inquiry.

Vice President and Chief Financial Officer of Business Operations - responsible for finance, procurement, human resources, project controls, publications, document control, and information technology.

Environmental, Safety, Health, and Quality Programs - responsible for environmental affairs, decommissioning planning, nuclear safety, emergency management, quality assurance, radiological safety, analytical and process chemistry, and training.

Infrastructure - responsible for plant systems engineering, plant systems operations (PSO), maintenance, and security.

Executive Vice President & SAFSTOR Projects - responsible for Vitrification Cell dismantlement, Process Plant dismantlement, engineering, and field work coordination.

Waste Disposition - responsible for Remote-Handled Waste Facility operations; shipping and disposal services, facility characterization, and waste facilities.

10.1.3 Personnel Qualification Requirements

The staff at each nuclear facility is trained and qualified in a manner consistent with the Performance Based Training Program, which implements DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*. Management at each nuclear facility establishes the minimum qualifications for members of staff. Individuals who operate,

maintain, provide support to, or supervise activities at nuclear facilities receive training appropriate for their specific duties. Training standards are established, implemented, maintained, and documented as part of the Performance Based Training Program.

Resumes and associated documentation for WVNSCO personnel are kept on file in the WVNSCO Human Resources Department. All training and qualification is conducted and documented in accordance with WVNSCO performance-based training procedures.

10.1.4 Liaison with Outside Organizations

The various organizations associated with the WVDP and their interrelationships are illustrated in Figure 10.1-1. All government agencies deal directly with DOE-OH/WVDP in a manner controlled by cooperative agreements or Memoranda of Understanding (MOU). All subcontractors interface through the WVNSCO Purchasing Department and a WVNSCO technical liaison. To resolve specialized questions on technical subcontracts, the Purchasing Department coordinates contacts within the appropriate departments at WVNSCO. WVDP-117, *WVNSCO Policies and Procedures Manual*, provides specific direction for interfacing with subcontractors and suppliers in accordance with DOE directives and federal acquisition regulations.

10.2 Preoperational Testing

10.2.1 Administrative Procedures for Conducting the Test Program

The Startup and Testing phase for structures, systems, or components starts with construction turnover and continues until the facility or system has been turned over to the Operations Department. An Engineering Procedure (EP) contained in WVDP-114, *WVNS Engineering Procedures*, provides instructions on how to identify and control the startup and testing of structures, systems, or components used at the WVDP to verify performance to the specified design and performance requirements. The EP also provides the responsibilities of the organizations which ensure that testing is developed, approved, and performed in compliance with all elements of the test program.

Other Engineering Procedures describe actions and controls required for any experimental or developmental test activity at the WVDP. Inspection and test control, as they relate to Quality Assurance, are discussed in Chapter 12.

WV-368, *Operational Readiness Determination for Startup/Restart*, defines the processes necessary for compliance with startup and restart requirements as they pertain to unreviewed safety questions (USQs), new processes and/or facilities, and pertinent restart actions. This procedure identifies necessary approvals, authorizations, and requirements for performing readiness activities, developing related readiness documentation, and conducting required reviews, verifications, and reporting in accordance with DOE Order 425.1C, *Startup and Restart of Nuclear Facilities*. WV-368 is supplemented by WVDP-342, *Operational Readiness Determination Manual for Startup and Restart of WVDP Facilities*.

All procedures and instructions for conducting the test program and evaluating, documenting, and approving the results are prepared, reviewed, and approved in accordance with WVDP-114, *WVNS Engineering Procedures*, and WVDP-117, *WVNS Policies and Procedures Manual*. Operating records, including procedures, data sheets, and logbooks are maintained for the life of the Project in accordance with WVDP-262, *WVNS Manual for Records Management and Storage*.

10.3 Training Programs

10.3.1 Program Description

The overall objective of the qualification program is to provide qualified personnel to operate the WVNSCO facilities safely in accordance with DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*. Operator candidates who meet the prerequisites for the qualification programs are trained and tested to provide qualified operations personnel. The operator training program for facility operators fulfills the specific needs determined for personnel to operate the facility and process in a safe and efficient manner.

The guiding philosophy underlying the West Valley Nuclear Services training program is the DOE-recognized performance-based training (PBT) model. It is the industry standard for the administration of efficient and cost-effective training. The objective of this program, implemented in WVDP-126, *Performance-Based Training Program Manual*, is to ensure program excellence which will result in well-trained and qualified personnel.

10.3.1.1 Development of Training Programs

The cognizant line manager has the responsibility for overall coordination and documentation of the qualification program. Each department provides on-the-job training (OJT) and classroom instruction on the basic theory, concepts, subsystems, components, and procedures relevant to each facility. This training is supplemented by the use of vendor-prepared materials related to basic functions of equipment, instruments, and other vendor material specific to the facility. Cognizant department personnel develop qualification standards and training aids. The cognizant department also provides instruction, tutorial activities and operator qualification guidance. Departmental trainers provide support in the production of training and qualification materials and the documentation of the programs.

PBT is defined as training based on knowledge and skills directly related to on-the-job performance requirements. PBT consists of five distinct phases: Analysis, Design, Development, Implementation, and Evaluation. The first three of these phases comprise the process by which the technical content of training programs is developed, verified, and validated. These three phases are discussed below:

- ANALYSIS - This phase is used to determine the training requirements. The needs analysis ensures that training is required and identifies the requirements that serve as the basis for the design and development of the training. This phase is supported by approved performance-based-training procedures. The requirements identified in the analysis phase are used to create the framework to accomplish the training goals.
- DESIGN - Activities of the design phase include the creation of objectives, standards, tests, and training plans. The major products of this phase are the learning objectives and the knowledge/skill examinations. This phase is supported by approved departmental procedures.
- DEVELOPMENT - The development phase determines the best methodology to teach the objectives created during the design activities. The major outputs of the development phase are the lesson plans and training aids.

Qualification programs include both knowledge and skill objectives. Supervisors, qualified as on-the-job instructors, oversee the on-the-job training program. This program requires demonstration of proficiencies set forth in the qualification standards. As required in DOE Order 5480.20A, on-the-job training will continue to provide personnel with familiarity in all aspects of the position. Such training includes standard operating procedures, emergency actions, radiation control practices, configuration control procedures, and other requirements. Continuous training on new material is included in both the qualification program and the required requalification program. Included are the required reading programs and the ongoing job training which is specific to maintain proficiency of job skills.

Not all technical support personnel have qualification standards. Those who do not require them are required to complete an indoctrination checklist in accordance with Policy and Procedure WV-538, *Employee Indoctrination and Training*.

Manager and supervisor training encompasses similar subjects as the personnel they supervise. The system supervisors complete the senior operations specialist qualification. Managers also receive training in leadership skills, fiscal management, and integrated facility and interdepartmental operations.

Training and proficiency requirements for other activities, including emergency preparedness, maintenance, criticality safety, hazardous material protection, and quality assurance are discussed in the appropriate sections of this SAR.

10.3.1.2 Maintenance of Training Programs

The fourth phase of the PBT program is Implementation, which takes the materials from the Development phase into the learning setting. Implementation is supported by approved site-wide procedures that provide for:

- Conduct of On-the-Job Training;
- Operations Team Building and Training;
- Proficiency Demonstration;
- Qualification of Operations Personnel; and
- Instructor Training and Qualification.

In addition, training walkdowns are conducted prior to procedure release and distribution. The Cognizant Operations Manager is responsible for verifying that such walkdowns have been conducted prior to procedure use. Changes are reflected in required readings, briefings, courses (lesson plans), and on-the-job training sessions. A formal approved procedure ensures that facility changes and operating experience are incorporated into those training programs leading to certification or qualification of operations, maintenance, and technical support personnel.

10.3.1.3 Modification of Training Materials

WVDP training programs are evaluated by Training and Development personnel, trainees, supervisors, management, auditing groups, and DOE personnel. Scheduled evaluations are conducted to ensure that the training program(s) are achieving the WVDP objectives, to identify corrective actions, and to improve the quality of the training programs. Specific review and evaluation criteria are contained in WVDP-126.

Changes to the training program are initiated for various reasons. Programs are kept current and reflect applicable experience and changes to facility design, Safety Analysis Reports, Process Safety Requirements, procedures, and regulations. Programs are maintained current using a process that reviews facility and procedure changes for effect on knowledge and skill of qualified facility personnel in accordance with WVDP-126.

10.3.1.4 General Training

All new WVNSCO and subcontractor employees and unescorted visitors are required to attend general employee training (GET). The GET program consists of orientation on the scope and purpose of the Project; radiation safety; safety and environmental training; QA orientation; conduct of operations training; security; emergency evacuation response instruction; and an introduction to project organizational responsibilities and management. WVDP personnel receive refresher training in these topics every two years, as applicable.

All new engineering personnel receive an indoctrination in the engineering procedures which govern their work at the project. This indoctrination is conducted and documented in accordance with WVNSCO procedures.

Personnel are not allowed to handle radioactive materials without proper mandatory training. Additionally, they are not permitted to enter any radiologically-controlled area without training and qualification.

10.3.1.5 Radiation Worker Training

Before being authorized to work with or handle radioactive materials (or enter any radiologically controlled area unescorted), personnel at the WVDP are required to complete formal Radiation Worker Training courses. The courses consist of formal classroom training and practical training.

Requalification is required for all radiation workers every two years. Additional information on the training of radiation and nuclear safety personnel is presented in Section 8.5.

10.3.1.6 Operations Training

Operations areas and the scope of training for each are revised as the scope of operations changes. All training and qualification is performed in accordance with DOE Order 5480.20A. Supervisors receive similar operational training as the plant operators and can operate system controls in an emergency. In addition, supervisors receive training in emergency response/management, enhanced training on the basis for Process Safety Requirements (PSRs), occurrence reporting training, and management/leadership training.

Team training and evaluation of shift performance during emergencies is conducted through drills and exercises. All site drills are documented and areas requiring improvement are clearly noted. In addition, operational personnel develop and rehearse various scenarios of system emergencies. These scenarios are performed on-shift and allow supervisors to evaluate and coach their personnel to react and function appropriately during actual site emergencies.

10.3.1.7 Safety Training

Employees receive ongoing safety awareness training and instruction to develop the knowledge and skills they need to understand workplace hazards and protect themselves. Training programs are developed and conducted whenever new hazards are identified as requiring specific safety training. Only individuals who have received proper training and demonstrated the ability (by written test or otherwise) to recognize and control job-related hazards are allowed to do so. Additional information on safety training is presented in Section 8.5.3.

10.3.2 Continuing Training Programs

All occupational workers receive bi-annual GET refresher training covering the scope and purpose of the project, general safety, radiation safety, conduct of operations, QA, orientation, security and emergency alarm response, and an introduction to project organizational responsibilities and management.

All radiation workers are required to complete retraining every two years through the Radiation Worker Training program by satisfactorily demonstrating their knowledge of the program in a written examination with a score of 80% or higher. Refresher training is provided in the off years between retraining.

As part of their requalification, all operators are required to participate in a continuing training program which may consist of required reading (procedures and unusual occurrence reports), proficiency demonstrations, classroom and on-the-job training, and satisfactory completion of a comprehensive written requalification exam(s).

10.3.2.1 Requalification

The requalification program serves to maintain knowledge and skills of the applicable operators. The program is structured commensurate with specific position requirements and administered on a cycle not exceeding two years.

Drills on abnormal or emergency procedures are incorporated into the continuing training program and are used to assess the operators' knowledge of the procedures to follow in emergency or abnormal operating conditions. The drills are as realistic as possible without endangering property or personal welfare.

10.3.3 Administration and Records

Training materials are reviewed for technical accuracy and approved by the cognizant functional manager. Before training materials are released for use, the Training and Development Department reviews them to assure that they satisfy established training criteria in terms of complying with WVDP-126, *Performance-Based Training Manual*.

The Records & Configuration/Document Control Department is responsible for maintaining the training records management system for the program, and maintaining individual training records in an auditable manner. Training records are maintained in accordance with ASME NQA-1-1989, Supplement 17S-1 requirements as lifetime quality assurance records. Training records are stored in one-hour fire-rated file cabinets. Records & Configuration/Document Control is also responsible for maintenance of the training records management system (TRMS) database, which contains the information for completion of initial and requalification training of WVDP personnel. Training record activities are conducted in accordance with WVDP-126, *Performance-Based*

Training Program Manual and WVDP-262, *WVNS Manual for Records Management and Storage*.

10.4 Normal Operations

10.4.1 Procedures

10.4.1.1 Development of Procedures

WVDP procedures ensure safe operations under routine, abnormal, or emergency conditions. Different types of procedures used for the various site activities are contained in appropriate site and department procedures manuals. Procedures required to implement the programs listed in Chapter 11 of this Safety Analysis, and procedures required to implement nuclear facility specific TSR ACs, are established, reviewed, and approved in accordance with WVDP-257, *WVNS Manual for Preparation, Review, Approval, Distribution and Revision of Controlled Documents*. For nuclear facilities written procedures that address the following, as a minimum, are established, implemented, and maintained.

Operations	WV-110, *Conduct of Operations*
Nuclear Criticality Safety	WV-923, *Nuclear Criticality Safety*
Radiation Protection	WV-905, *Radiological Protection*
Worker Safety	WV-900, *WVDP Worker Safety Policy*
Abnormal and Emergency Conditions	WVDP-139, *Emergency Management Implementing Procedures*
Administrative Aspects of Operation	WVDP-257, *WVNS Manual for Preparation, Review, Approval, Distribution and Revision of Controlled Documents*

Selection of procedures and other controlled documents for development, revision, or cancellation is determined by the cognizant manager. Typical reasons for procedure development include lack of an existing program or document that satisfies new or existing requirements; the need to define controls and mechanisms for consistently accomplishing a specific task; activities specified within a document have been determined to be unsafe; or changes to existing requirements require changes to existing documentation.

WVDP-257, describes the ranking of procedures and other controlled documents within a document hierarchy. Reviews of these documents are determined by the relative level of the document within the hierarchy. Designated reviewers, who are individuals responsible for the management and/or operation of areas affected by the procedure, review the procedure.

Routine facility walkdowns, in which differences between facility conditions and procedures are identified, are conducted per the guidance in WVDP-106, *West Valley Demonstration Project (WVDP) Conduct of Operations Manual*.

10.4.1.2 Distribution and Maintenance of Procedures

The Records & Configuration/Document Control Department assures conformance with preparation, review, approval, distribution and control requirements of site-wide and department level procedures and controlled documents.

Additional information on procedure maintenance is presented in Section 10.4.2.2.

10.4.1.3 Safety Basis Review

Of special concern in the development and use of facility work documents (including work instructions and operating procedures) is the safety of workers, the general public, and the environment. To ensure that operations (especially those involving hazardous and/or radioactive material, as well as those performed in a hazardous and/or radiologically contaminated environment) include the appropriate safety considerations, precautions, and controls, WVNSCO has implemented a Safety Review Program. This program establishes the R&SC to review various proposed activities with potential safety impacts. WV-906, *Radiation and Safety Committee*, defines the R&SC's scope, function, and responsibilities. The cognizant manager of a proposed activity (e.g., a facility, program, process, operation, or change thereto) determines whether it involves a level of risk that merits R&SC review.

In addition, adherence to WV-914, *Unreviewed Safety Question Process* (USQP), ensures (1) that proposed activities that would be outside of the approved WVDP Safety Basis are identified and that appropriate actions are taken; and (2) that discoveries that represent conditions that are outside the approved WVDP Safety Basis are identified and that the appropriate actions are taken to remedy the situation. The Safety Review Program complies with and implements the requirements contained in 10 CFR 830, Subpart B.

10.4.1.4 Project Records

The WVNSCO Records Management System is outlined in WVDP-262, *WVNS Manual for Records Management and Storage*. This document describes the actions and activities for controlling the generation, inventory, identification, transmittal, receipt, maintenance, processing, preservation, storage, retrieval, and destruction of WVDP records. The Records Management System has been developed to comply with the requirements of DOE Order 200.1, *Information Management Program*; 36 CFR Chapter XII Subchapter B, *Records Management*; and ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities*. In accordance with WVDP-262, records of staff training, drawing changes, and operating records, including procedures, data sheets, and logbooks, are maintained for the life of a given nuclear facility.

10.4.2 Safety Management Policies and Programs

10.4.2.1 Safety Performance Assessment

The WVNSCO Integrated Assessment Program (IAP) includes departments, facilities, and projects under WVNSCO cognizance for the specific purpose of evaluating performance, reducing risk and identifying improvement opportunities. The IAP applies to all disciplines including, but not limited to, safety and health, operations, maintenance, environmental protection, quality, decontamination & decommissioning (D&D), HLW activities, and management.

The key elements of the IAP are: 1) self-assessment; 2) independent assessment; 3) management assessment; and 4) performance measures.

The WVDP Integrated Assessment Program complies with applicable DOE Directives governing assessment at DOE facilities, including DOE P 450.5, *Line Environment, Safety, and Health Oversight*. Individual departments provide safety performance review through Line Organization Self-Assessment, and department managers review safety as part of their Management Assessments. The Quality Assurance department provides independent assessment of environment, safety, and health (ES&H) programs through its Performance Analysis program and through its audit and surveillance program. The Environmental, Safety, Health & Quality department also provides independent assessment of ES&H programs through its administration of the Integrated Safety Management System.

WVDP-242, *Event Investigation and Reporting Manual*, contains procedures which provide for root cause analysis. Other formal programs such as the Conduct of Operations Surveillance Program, implemented by WVDP-106, *West Valley Demonstration Project (WVDP) Conduct of Operations Manual*, and the Operational Readiness Review (ORR) Program, implemented by WV-368, *Operational Readiness Determination For Startup and Restart of WVDP Facilities*, complement the normal self assessment process described in WV-121.

10.4.2.2 Configuration and Document Control

The WVNSCO configuration and document control program is composed of five major elements:

- Program Management;
- Design Requirements;
- Document Control;
- Change Control; and
- Assessment/Review.

Combined, these elements establish and maintain consistency in design requirements, physical configuration, modifications to a facility or its operation, and facility documentation. The WVDP design basis is established and maintained through design control elements contained in WVDP-002, *Quality Management Manual*. The WVDP safety basis is broader in concept than the design basis and includes managerial, institutional, programmatic, and human factors dimensions as discussed throughout Chapters 8.0, 10.0, and 12.0 of this SAR.

Program management identifies objectives and activities such as the project mission/charter, management approach, and cost and schedule control. To implement these goals, various WVDP Project Plans have been issued. Design requirements are implemented through control of approved engineering procedures and design documents such as design criteria, drawings, specifications, and design basis documentation.

Document control and change control are combined into one program that has been developed in accordance with the requirements of ASME NQA-1. The program describes how to prepare, review, approve, issue, use, and revise documents that either prescribe quality-affecting activities, specify requirements, or establish design. Controlled instructions and procedures are distributed to identified individuals, remote locations, and various central hard copy libraries. In addition, site personnel have access to E-DOCS, which provides capability for on-line viewing and printing of various controlled documents.

Site-wide procedures that define the document control and change control system provide:

- Integrated Safety Management and Control of Documents;
- Document Control;
- Preparation, Review, Approval, Distribution, and Revision of Controlled Documents;
- Work Instruction Preparation;
- Engineering Change Notice (ECN);
- Engineering Release of Documents; and
- Field Change Notice.

10.4.2.3 Event Reporting

Abnormal events at the WVDP are investigated and reported in accordance with WVDP-242, *Event Investigation and Reporting Manual*. WVDP-242 implements the requirements of DOE Manual 231.1-2, *Occurrence Reporting and Processing of Operations Information*; and DOE Order 5480.19, Change 1, *Conduct of Operations Requirements for DOE Facilities*. This policy establishes the requirement for WVNSCO to develop and implement a process for determining, evaluating, reporting, and correcting events and conditions at the WVDP, including those occurrences involving WVNSCO subcontractors. The types of events covered by this process include, but are not limited to, events related to safety, health, security, operations, property, quality assurance or the environment.

10.4.2.4 Safety Culture

WVNSCO has implemented a comprehensive program for worker protection, based on a safety policy that states: "Exceed customer expectations without injury or illness." WVNSCO has formatted its safety program to be an Integrated Safety Management System which is implemented by the guiding principles of the OSHA Safety and Health Management Guidelines. These guidelines are the precursor to DOE Policy 450.4, *Integrated Safety Management*, and DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*. Documents that implement the WVDP Integrated Safety Management System are identified in WVDP-310, *WVDP Safety Management System Description (SMS)*.

WVNSCO has established and formalized the charters of a number of standing committees in order to foster continued improvement in ISMS implementation. The Safety Success Team develops and implements programs to encourage safe work behavior. Additionally, the President, Staff managers, and Operations personnel comprise the Central Safety Committee, which meets monthly to address general or specific safety concerns affecting the WVDP.

There are several avenues available for employees who have safety concerns. The use of the Chain-of-Command, the Safety Department, the Issue Report, and the Central Safety Committee are encouraged as primary methods for reporting concerns. The Employee Concerns Program described in WV-990, *Employee Concerns Program*, was established to provide an opportunity to formally report any condition that was considered to be an environmental, health, safety, fraud, abuse, or quality concern. Workers are trained and encouraged to report concerns without fear of any reprisal.

WVNSCO promotes a strong Conduct of Operations work ethic and a "Stop Work" policy. Simply stated: any worker who believes that work they have been asked to do is unsafe has the right and responsibility to refuse. The issue must be resolved to the worker's satisfaction before the job can proceed.

WVNSCO systematically integrates safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment. This integration is accomplished by implementing an Integrated Safety Management System (ISMS). The DOE has developed seven guiding principles to provide the focus for implementing an ISMS. These principles are:

1) Line Management Responsibility for Safety
2) Clear Roles and Responsibilities
3) Competence Commensurate with Responsibilities
4) Balanced Priorities
5) Identification of Safety Standards and Requirements
6) Hazards Control
7) Operations Authorization

While these principles guide the implementation of an ISMS, five core functions define its make-up. These functions comprise a cycle of activities which, although different in detail, are the same for activities on a program or site level and a facility and work task level. The core functions are:

1) **Define the Scope of Work** - This function includes identifying all tasks associated with the activity and identifying resources needed to perform the activity.
2) **Analyze the Hazards** - On a work task level, this function includes identifying the physical and environmental hazards involved in an activity (radiation level, heat, potential for release of contaminants.) On a facility or program level, this includes developing and maintaining safety analysis documentation.
3) **Develop Hazards Controls** - This function includes administrative and engineering controls, design controls, and training. As examples, the controls can take the form of personnel protective equipment or technical safety requirements.
4) **Perform Work Within Controls** - This function provides the means to ensure that once the controls are developed, the work is performed within the controls.
5) **Provide Feedback and Continuous Improvement** - This function closes the loop for the work activity. Lessons-learned from one activity are identified so that they may be incorporated into subsequent activities. This feedback includes both things that went right as well as things that went wrong.

10.4.3 Maintenance and In-Service Surveillance Program

The WVDP has developed a maintenance and surveillance program consistent with the requirements of DOE Order 433.1, *Maintenance Management Program for DOE Nuclear Facilities*, and DOE Order 430.1A, *Life Cycle Assessment Management*. The maintenance program, which is administered through guidelines set forth in WVDP-274, *Maintenance Implementation Plan,* and WVDP-170, *West Valley Nuclear Services Maintenance Manual*, provides the policy to ensure that maintenance activities are conducted to preserve or restore the availability, operability, and reliability of plant structures, systems, and components important to the safe operation of the facilities. A complete description of the WVDP maintenance program is given in WVDP-170.

An instrumentation surveillance program, which includes an instrument calibration recall system, is implemented through WV-109, *Instrument Data and Recall Tracking System*. This procedure satisfies the recall requirements of WVDP-002, *Quality Management Manual*. A preventive maintenance (PM) tracking

system is implemented by WV-108, *Preventive Maintenance Recall Tracking System and Component Information Input*. These systems use computerized database to document and forecast Incident Report (IR) and PM activity.

Management of the maintenance organization is through the Maintenance Manager, who reports to the Site Services Manager. As indicated in WVDP-170, interfaces have been established between the maintenance organization and several other WVDP organizations.

Training and qualification programs are provided for all maintenance personnel and maintenance supervisors. This training includes general employee training, radiation safety and industrial hygiene (Occupational Safety and Health Administration [OSHA]) training, and training specific to skilled trades. The training qualification standards specify knowledge and performance requirements and designate documentation of the major areas of training with which the maintenance personnel will be involved. Training and proficiency requirements for maintenance personnel are contained in formal Maintenance Qualification Standards.

Specific facilities are designated for nonradiological maintenance activities and for the contact maintenance of contaminated equipment, including manipulators, pumps, etc. Maintenance equipment is stored in a site tool crib.

Routine maintenance activities are conducted per approved procedures. These procedures are identified, developed, documented, and maintained in the same manner as all other site operating procedures, as described in Section 10.4.1. Non-routine maintenance activities are performed per instructions in WIPs.

Post-maintenance testing is performed after corrective maintenance and after some preventive maintenance activities. Specific requirements for post-maintenance testing are incorporated into the work documentation and are reviewed and verified during the approval process. Test results are documented and verified by the QA Department. No safety-related equipment is declared operable until post-maintenance testing is complete.

The program for control and calibration of measuring and test equipment (M&TE) used by the Maintenance Department confirms the accurate performance of facility instrumentation and equipment for testing, calibration, and repairs. Each piece of M&TE is assigned a unique identification number, allowing M&TE data to be recorded and tracked in accordance with WV-109. Only calibration standards that are traceable to the National Institute of Standards and Technology (NIST) are used for calibration of maintenance M&TE. Access to maintenance M&TE is traceable and under the control of the Maintenance Instrumentation and Calibration Group.

A maintenance history and trending program, implemented by both WV-108 and WV-109, is maintained to document data, provide historical information for maintenance planning, and support maintenance and performance trending of facility systems and components.

To identify needed corrections or changes to the M&TE program, trending evaluation of M&TE performance is done each time a unit is inspected and calibrated. Maintenance history is traceable through an electronic database by the unique equipment identification number.

10.4.4 Conduct of Operations

The WVDP has developed a formal conduct of operations program which is consistent with the requirements of DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*. Policy elements of this program, given in WVDP-106, *West Valley Demonstration Project (WVDP) Conduct of Operations Manual*, set forth the DOE philosophy for safe facility operations and specific requirements to be included in facility and site procedures. A matrix for implementing elements of the conduct of operations program is contained in WV-110, *Conduct of Operations*. Specific areas to which conduct of operations apply include the following:

- Shift Routines and Operating Practices

Practices for the safe operation of WVDP facilities consistent with the guidance given in WVDP-106 have been developed and implemented through approved facility procedures. These practices include daily and weekly planning meetings to brief operations personnel on near-term activities affecting the facility, routine surveillance requirements to ensure regular and systematic appraisals of facility conditions, and equipment status boards to indicate the operating status of major equipment.

- Control Room Activities

Control room access in site facilities is maintained through WVDP security restrictions. Control areas are clearly indicated and personnel access to these areas may be restricted beyond security controls if deemed necessary by the facility operations supervisor. Control rooms are manned as facility operations warrant.

- Communications

The WVDP communications system includes a public address system, emergency all-page system, and radio and telephone communication system. These systems are tested frequently to ensure continuous operability for routine and emergency conditions throughout the site. These communication systems are discussed in Section 10.5.1.5.

- Control of On-Shift Training

All facility operations personnel receive on-the-job training as a supplement to formal classroom training. On-the-job training provides trainees direct supervision by qualified trainers/instructors as they perform their actual job function. This training has been factored into the formal operations training programs described in Section 10.3.

- Control of Equipment and Systems Status

Formal approved procedures, consistent with the guidance given in WVDP-106, have been developed for indication and control of the status of facility equipment and systems. Routinely-updated status boards located in each facility's shift office indicate the status of major equipment.

- Lockouts and Tagouts

Formal approved procedures, consistent with the guidance in WVDP-106, implement a site lock and tag program. This program ensures that systems and equipment are locked and tagged to the degree necessary to assure the

protection of personnel during construction, maintenance, repair, decommissioning, and any other operation.

- Independent Verification Practice

Guidance for performing independent verification of facility equipment is provided in WVDP-106. Procedures governing critical equipment are evaluated against independent verification criteria.

- Log Keeping

Operating logs are maintained, used, reviewed, and stored in a manner consistent with WVDP-106. Logbooks are maintained for the life of the facility in accordance with WV-730, *Records Management and Storage Program*.

- Operations Turnover

The WVDP has developed a procedure, consistent with the operations turnover protocol given in WVDP-106, that provides instructions for conducting an orderly and accurate transfer of information regarding a facility's overall status at shift turnover. The information necessary for operations turnover is in the form of a standard checklist and discussion between off-going and on-coming operators. Significant events such as changes in equipment operational status and shift activities are recorded in formal logbooks which are maintained in operations facilities.

- Operations Aspects of Facility Chemistry and Unique Processes

Activities consistent with WVDP-106 are implemented for those aspects of operations involved in chemistry and unique processes.

Required Reading

A required reading program has been implemented in a manner consistent with the guidance given in WVDP-106. Additional guidance for required reading is given in WV-552, *Required Reading for WVNSCO Personnel*.

- Timely Orders to Operators

Timely orders to operators are issued, reviewed, and maintained in a manner consistent with WVDP-106 guidance.

- Operator Aid Postings

Operators aids are developed, reviewed, posted, and logged in a manner consistent with WVDP-106 guidance.

- Equipment and Piping Labeling

A formal approved procedure, consistent with WVDP-106, has been developed for system and component labeling. This procedure ensures consistent, readable, and permanent identification of plant areas, valves, pipes, instruments, breakers, switches, electrical and control panels, and electrical components inside panels.

10.5 Emergency Preparedness Program

10.5.1 Introduction

The WVDP site emergency plan is provided in WVDP-022, *WVDP Emergency Plan*. The site hazards assessment is presented in WVDP-193, *WVDP Hazards Assessment*, and the site hazards survey is presented in WVDP-273, *WVDP Hazards Survey*. WVDP-022 is implemented via a series of implementing and administrative procedures contained in WVDP-139, Vol. I, *Emergency Management Implementing Procedures* and WVDP-139, Vol. II, *Emergency Management Administrative Procedures*. WVDP-171, *WVDP Emergency Readiness Assurance Plan*, contains summaries of current year activities and the five-year plan for emergency management.

10.5.1.1 Purpose

WVDP-022 describes the WVDP emergency planning, preparedness and response program which is designed to respond to and mitigate the potential consequences of an emergency. The emergency plan provides an organized plan of action, identifies authorities and responsibilities of emergency response personnel and organizations, and identifies the manpower and equipment available during operational emergencies at the WVDP.

WVDP-022 has been prepared to meet the requirements of the Department of Energy (DOE) Order 151.1A, *Comprehensive Emergency Management System* and related DOE Emergency Management Guides, the Resource Conservation and Recovery Act (RCRA) contingency plan requirements of 40 CFR 265 Subpart D, *Contingency Plan and Emergency Procedures*, and the requirements of 6 NYCRR Part 373-3.4, *Contingency Plan and Emergency Procedures*.

The primary purpose of WVDP-022 is to provide the direction and approach used to:

- Maximize the safety of on-site personnel;
- Minimize the potential exposure to the general public;
- Minimize environmental impacts; and
- Limit loss or damage to the facility and plant equipment.

The WVDP Emergency Response Organization (ERO) has the required personnel and resources to adequately assess the actual or potential on-site or off-site consequences of an emergency condition, including:

- Timely initial assessment of actual or potential consequences;
- Integration of the initial consequence assessment process with the implementation of emergency categorization and, if required, classification of event;
- Monitoring and evaluation of specific indicators necessary for continual assessment; and
- Coordination with off-site response organizations.

Provisions for protective actions during an emergency are in place to protect the public and on-site personnel. The WVDP uses EPA Protective Action Guidelines (PAGs), the American Industrial Hygiene Association (AIHA) Guidelines, and the Emergency Response Planning Guidelines (ERPGs) in determining or reevaluating protective action recommendations. Temporary Emergency Exposure Limits (TEELs) are used for chemicals that do not have

assigned ERPG values. Chapter 7 of WVDP-022 discusses the use of protective actions during on-site emergencies.

10.5.1.2 Scope

The emergency plan and emergency management implementing procedures provide an organized program of action to cope with emergencies at the WVDP, identify emergency response organizations, personnel, and responsibilities, and list manpower, facilities, and equipment resources available for such situations. The Radiological Assistance Plan (RAP) for DOE Region 1, which includes the New England states, New York, New Jersey, Pennsylvania, Delaware, Maryland, and the District of Columbia, has been incorporated into WVDP-246, *WVDP Radiological Assistance Program Plan*.

10.5.1.3 Emergency Response Organizations

This section summarizes the organizations and staffing that are described in WVDP-022 and WVDP-139.

A "strict order of call" roster of WVNSCO emergency and technical support personnel is contained in the Emergency Management Implementing Procedures which is readily accessible.

10.5.1.3.1 U.S. Department of Energy

The DOE response organization includes the manager of the DOE Field Office and the DOE-OH/WVDP Project Director (DOE-PD). The manager of the DOE Field Office, through the DOE-PD, is responsible for overall executive direction of emergency planning, preparedness, response, and readiness at the WVDP.

10.5.1.3.2 WVDP ERO

The WVDP ERO consists of the following functional groups:

- Emergency Operations Center (EOC);
- On-Scene Command (including emergency response teams); and
- Technical Support Center (TSC).

The members of these groups and their duties are described in WVDP-139.

The Emergency Director (ED) has the ultimate responsibility for all WVDP emergency activities per WVDP-139. During an emergency, the WVDP Site Contractor President acts as the ED. The ED interacts with the DOE-PD and off-site response agencies, but maintains executive control of all emergency situations affecting WVDP operations.

The Incident Commander (IC) is responsible for the activation and overall supervision of on-scene personnel performing emergency response actions. The PSOSS serves as the IC. The IC keeps the EOC informed of all on-scene response actions, directs equipment shutdown or other actions that are required to mitigate emergency situations, and serves as the chief of the WVDP Operations Response Team (Fire Brigade) until the arrival of the West Valley Volunteer Hose Company, Inc. (WVVHC). The WVVHC, which is contacted at the determination of the IC, then becomes part of the WVDP ERO under the control of the IC. Details of the interface, notification, and activation responsibilities of the IC are stated in WVDP-139.

10.5.1.3.3 WVDP Emergency Response Groups

Emergency Response Teams are composed of trained and qualified operators, technicians, and security officers who are organized to respond to an emergency situation at the request of the WVDP ED or IC.

The Emergency Medical Response Team (EMRT) is composed of trained individuals with the responsibility to provide initial first aid to injured personnel until relieved by off-site emergency medical responders. Duties, lines of authority, and interface for this response team are defined in WVDP-139 and WVDP-253, *Emergency Medical Response Team Manual*.

The Radiological Controls Team is composed of the Radiological Protection Operations Supervisor (RPOS) and radiological control technicians. The RPOS is responsible for assigning qualified technicians and providing necessary support/equipment per WVDP-139.

The Environmental Monitoring Team (EMT) is composed of several units, each with a Team Leader and one or more team members. The reports of the team leader are forwarded to the Environmental Laboratory (E-Lab) Manager and then to the Consequence Assessment Manager.

10.5.1.3.4 Medical Facilities

Employee Health Services (EHS) is located in Trailer F across from the Main Plant Process Building. The facility consists of a nurse's station, a first aid station, and a doctor's office. Minor and routine first aid services are performed on-site. A Letter of Agreement (LOA) to provide fire protection and ambulance services for ill or injured patients, including those possibly contaminated with radiological or hazardous materials, exists with the WVVHC, Bertrand Chaffee and Erie County Medical Center Hospitals. In addition, air ambulance transport support for ill, injured, and/or contaminated personnel is provided by Mercy Flight through a LOA.

10.5.1.3.5 Off-Site County and State Agencies

During emergency situations WVNSCO maintains close liaison with appropriate local, county and state officials.

New York State (NYS) Emergency Management Organization:

NYS Emergency Management Office is the state agency authorized to mobilize the state emergency response agencies, if required, per the NYS Emergency Plan.

NYS Department of Health is the state agency responsible for the assessment and evaluation of the emergency condition and for recommending the appropriate protective actions for off-site areas.

NYS Warning Point is the State Agency authorized to receive initial notification from the WVDP. The NYS Warning Point is part of the NYS Police.

NYS Office of Disaster Preparedness is the state agency responsible for the coordination of all state and local activities throughout the emergency.

NYS Department of Environmental Conservation is responsible for administration of the Hazardous Waste regulatory program in New York State.

County Response Organization:

Cattaraugus County and Erie County Offices of Emergency Management. The Emergency Response Directors in Cattaraugus and Erie Counties receive initial notification from the WVDP for an Alert and a Site Area Emergency (SAE). They have the responsibility for initiating any necessary off-site protective actions, based upon available information from the WVDP Emergency Director and the NYSDOH. In addition to overall responsibility, they have the responsibility for direction and control of county emergency resources. The WVDP has established MOUs, documented in Appendix C to WVDP-022, with the Cattaraugus County Office of Emergency Services.

Other Local Agencies. The DOE-PD or ED requests support, as necessary, from the following agencies:

- Cattaraugus County Office of Disaster Preparedness;
- Erie County Sheriffs Department;
- Cattaraugus County Sheriffs Department;
- Cattaraugus County Highway Department;
- Cattaraugus County Department of Health; and
- Western Regional Emergency Medical System.

The WVVHC, by agreement with West Valley Nuclear Services Co., provides fire protection, ambulance service, traffic control when requested, and functions as the HAZMAT team for the WVDP.

10.5.1.4 Emergency Control Facilities

10.5.1.4.1 Emergency Support Facilities

The Emergency Operations Center provides senior management overview and strategic advice to the on-scene command group for resolution of immediate problems at the scene. Interface with outside agencies, public information, extended response planning, and longer range recovery plans are the responsibility of the EOC.

The Technical Support Center provides technical support and information regarding engineering design and/or as-built construction details to the EOC. The TSC manager is in charge of all operations in the TSC.

The News Center (NC) is a facility provided to allow the news media access to information from the EOC.

Emergency Public Information (EPI) facilities support the Telephone Team, the Media Monitoring Team, and Administrative Support. The Telephone Team answers incoming telephone calls from the public and the media and responds to telephone inquiries with approved information. The Media Monitoring Team tracks information being released about the site over television, radio, and print media and relates information back to the EOC. Administrative Support personnel maintain chronological files of press releases/notices and distribute approved information as directed. All of the functions covered within the EPI facilities in Trailer 49 may be relocated to the Joint Information Center (JIC) located in the Office of Emergency Services, Little Valley, NY.

The Alternate Emergency Operations Center is located on the second floor of the ACC, which is located on Route 240 in West Valley, NY. It is used for emergency management in the event the EOC is not habitable.

The Main Gatehouse, houses the Alarm Monitoring Station (AMS). During an emergency condition, WVDP Security is responsible for controlling appropriate movement, ingress, and egress of personnel and vehicles throughout the WVDP; communicating with and assisting local and state law enforcement agencies; providing necessary security to the EOC and the News Media Center (NMC); supporting response teams as necessary; and assisting in personnel evacuation and personnel accountability activities.

10.5.1.4.2 Environmental and Dosimetry Laboratories

Environmental Laboratory. The E-Lab assesses the impact of any release of radioactivity or hazardous material or hazardous waste to the environment and the impact to personnel and property both on and off-site.

WVDP Meteorological System. The meteorological system is designed to provide atmospheric dispersion data specific to the topography of the site. The system consists of two towers and a digital data acquisition and display system.

Dosimetry Laboratory. The facility contains instrumentation necessary for performing whole body counts and processing personnel dosimetry.

10.5.1.5 Communications

During emergencies and recovery operations, communications are maintained (as appropriate to the conditions of the emergency) between emergency response personnel, the TSC, the NC, the EOC, DOE-Headquarters, DOE-OH/WVDP, other federal agencies, and related emergency services (i.e., fire, security, and medical).

10.5.1.5.1 WVDP Communications Equipment

When the EOC is activated, communications with the WVDP Emergency Response Teams are accomplished in the most expedient manner available. Portable radios are the primary equipment, and shall be used to the extent that emergency response groups can maintain clear contact. Other equipment available for communication purposes includes:

- 812 All-Page system;
- 222 Plant Page system;
- Plant Telephone system;
- Power Fail Telephone system;
- Cellular Mobile Telephone system;
- Hand held 2-way Communications Radios;
- Pagers; and
- Facsimile.

WVDP Network

WVDP maintains a portable radio network using FCC-approved frequencies.

Sheriff's Radio

WVNSCO has a mutual aid agreement with the Cattaraugus County Sheriffs Department. Two security patrol vehicles and the Main Gatehouse security personnel have communications capability with the Sheriffs Department. This

radio link can be used to request assistance, or as a source of emergency information.

10.5.1.6 Detection and Warning Systems

Fire, on-site relocation, and sheltering warning signals throughout the WVDP site ensure that trained personnel provide the appropriate response when those alarms/signals are activated.

10.5.1.6.1 Fire

The operating areas are equipped with smoke detectors, fire pull stations, and/or sprinkler alarm systems to signal fire emergencies. In addition to these alarms, WVDP personnel utilize the "812" All Page system to announce the location of fires.

10.5.1.6.2 Radiation/Contamination

Radiation Protection is responsible for the following equipment:

Continuous Air Monitors (CAMs)

CAMs, which have audible and visual alarms, are placed strategically around the plant.

Area Radiation Monitors (ARMs)

ARMs are located throughout the facility in occupied areas where high exposure rates to personnel are expected. Like CAMs, these monitors have audible and visual alarms.

Process Radiation Monitors (PRMs)

PRMs are used to detect high levels of radiation at key locations in process stream(s). The monitors that have a role in identifying operational emergencies at the WVDP are discussed in WVDP-193 and WVDP-139.

Monitors

Environmental Affairs is responsible for the maintenance, sample collection and analysis, calibration, and periodic testing of the following instruments:

- Stack Monitoring. Airborne effluents are monitored at several facilities at the WVDP with continuous isokinetic stack monitors. These instruments monitor gross alpha and beta-gamma activity.

Radiation Protection Operations is responsible for the maintenance, sample collection and analysis, calibration, and periodic testing of the following instruments:

- Personnel Contamination Monitors (PCMs). There are several PCMs located throughout the site at the exits of radiologically controlled areas.
- Portal Monitors. The WVDP has one Portal Monitor, whose use is optional, in the Main Gatehouse entrance. This monitor has local audible and visual alarms.

10.5.1.6.3 On-Site Relocation

On-site relocation is achieved either via the "812" All Page announcement or through local alarms. On-site relocation directions are given in EMIP-101, *Implementing Procedure for WVDP-139*.

10.5.1.6.4 Sheltering Signal

A sheltering signal alerts all personnel to take immediate sheltering action to limit exposure of personnel to releases of hazardous and/or radiological materials. The Sheltering Signal tone lasts thirty seconds. Sheltering instructions are provided in *Implementing Procedures for WVDP-139*.

10.5.1.7 Training, Tests, and Exercises

10.5.1.7.1 Personnel Training

WVNSCO ensures that its employees are adequately trained in emergency preparedness principles and practices. Each new employee permanently assigned to work at the WVDP is given initial orientation training in the contents of WVDP-022 and WVDP-139 (General Emergency Response Training). For employees not assigned specific responsibility or authority under the emergency management procedures, such training, at a minimum, provides information describing the action to be taken by an individual discovering an emergency condition, the location of the assembly areas, the identification of emergency alarms, on-site relocation and the action to be taken on hearing such alarms.

Training of On-Site Emergency Organization Personnel. The Training and Development Manager and the Emergency Management (EM) Manager share the responsibility of providing personnel training and documentation of initial training and annual retraining programs for on-site WVDP Emergency Response Organization personnel. The programs, which include initial indoctrination and subsequent retraining, are outlined in WVDP-139.

Training of Off-Site Emergency Response Personnel. Off-site agencies that may be called upon to provide assistance in the event of an emergency are offered orientation training annually. This training covers basic concepts of radiation and hazardous materials protection, plant operations and security, location of hazards, and response. The following groups are offered these sessions:

- Fire and Rescue;
- Air Ambulance Service (Mercy Flight Helicopter);
- Medical Support;
- News Media; and
- Law Enforcement.

10.5.1.7.2 Equipment Testing

WVNSCO assures reliability under emergency conditions of all emergency equipment and instruments used for the detection and evaluation of emergencies, systems used for warning and directing personnel, and communication systems, by providing routine maintenance and tests as required by technical specifications or operational safety requirements.

Equipment and instruments used for the detection and evaluation of emergencies, systems used for warning and directing personnel, and communication systems are routinely maintained and tested, as required by

technical specifications or by Environmental Management Administrative Procedures (EMAPs), to assure their reliability under emergency conditions. Results of these tests are documented and needed repairs are implemented as soon as possible. Portable instruments are checked periodically for operability and are recalibrated as required by the instrument manufacturer.

10.5.1.7.3 Exercises and Drills

Periodic exercises are conducted in order to test the state of emergency preparedness of participating personnel, organizations, agencies, and equipment.

The results of the exercises form the basis for prescribing actions to eliminate identified deficiencies.

WVNSCO is required to perform a site-wide emergency exercise at least once every three years. The EM department is responsible for developing realistic accident scenarios. Realistic scenarios should test the adequacy of personnel, equipment, plans, and procedures to cope with emergency situations.

Details and specific instructions for drills and exercises are given in WVDP-022 and WVDP-139.

10.5.1.8 Emergency Response Levels

The manner of response and degree of involvement in an emergency depend upon the level of severity of real or potential consequences. Incidents and emergencies at the WVDP that are categorized as Operational Emergencies must be reported to DOE-OH/WVDP, DOE-Headquarters (DOE-HQ), and federal, state, and local agencies. Once the emergency has been categorized by the IC, timely notification of the DOE-HQ-EOC must be achieved within 15 minutes.

10.5.1.8.1 Alert

An ALERT is the classification used to designate the least significant classifiable Operational Emergency at an Operational Emergency Hazardous Material Program (OEHMP) facility. The criteria for classification of nonradiological or radiological releases as an Alert Emergency are given in WVDP-193. The purpose of the Alert level is to assure that on-site and off-site emergency response personnel are promptly advised and available for activation if the situation becomes more serious, to initiate and perform confirmatory monitoring as required, and to assure appropriate notification of emergency conditions to the responsible organizations within WVDP and DOE.

10.5.1.8.2 Site Area Emergency (SAE)

The SAE is a classification that refers to a more significant operational emergency than an Alert.

An SAE is an event in progress or having occurred that involves actual or probable major failures of facility functions that are needed for the protection of on-site personnel, public health and safety, and the environment. The event involves the actual or potential release of radioactive or toxic material that is not expected to exceed the applicable PAG or ERPG at or beyond the site boundary. The criteria for classification of nonradiological or radiological releases as an SAE is given in WVDP-193. The purpose of the SAE level is to assure that the EOC is manned, appropriate monitoring teams are dispatched, personnel required for determining on-site protective measures are available, predetermined protective measures for on-

site personnel are initiated, and current information to DOE-OH/WVDP and consultation with off-site officials and organizations is provided.

10.5.1.9 Notification

10.5.1.9.1 West Valley Demonstration Project

WVNSCO reports any emergency impacting its operations promptly to the DOE-PD and Washington Group International, Inc., Risk Management Staff. The notifications include the emergency response level, magnitude, type, cause of emergency (if known), extent of damage, assistance needed, and areas or personnel affected. This information is read from the Notification Form (found in EMIP-103). The DOE-HQ-EOC and the OH Duty Officer are notified in the most expeditious manner by the DOE Communicator and a preferred means of communication is established.

10.5.1.9.2 Notification of Off-Site Agencies and Authorities

The ED has the responsibility to notify off-site local, county, and state officials of WVDP emergency situations. Notifications are made as soon as crucial information is available to warrant such action. WVDP-139 contains the telephone numbers of agencies to be notified.

10.5.1.9.3 Notification of DOE Headquarters

Notification to the DOE-HQ-EOC is made within 15 minutes after declaration of an Alert, SAE, or for any Operational Emergency (i.e., radiological, hazardous substances/wastes, fire, explosion). Written notification to DOE Headquarters is made as soon as practical, but in any event, within twenty-four hours of categorization of the emergency.

10.5.1.9.4 Notification of New York State

The New York State Emergency Plan for major radiological accidents involving WVDP facilities requires that events resulting in Alert or SAE Classifications shall be reported to the State Warning Point. The State Warning Point notifies the appropriate state and county health departments, and initiates notification of other state agencies. Pursuant to the New York State Plan, these agencies begin to mobilize their resources to react in preventing or minimizing radiological or other hazardous material impacts to the public.

Whenever there is an imminent or actual emergency situation involving hazardous substances, WVDP notifies the State of New York as required in WVDP-139 and WV-915, *Spill/Release Notification and Reporting*. The notification is to the 24-hour oil and hazardous substances spill notification number and the National Response Center.

If a release, fire, or explosion involves a hazardous substance/waste that could threaten human health or the environment occurs outside the facility, the Notification Officer shall immediately notify the EPA National Response Center.

10.5.1.9.5 Special Notification

In the event of an emergency affecting the railway or utility service, the WVDP Notification Officer, at the direction of the ED, notifies the appropriate utilities or railroad.

10.5.1.10 Public Information

10.5.1.10.1 Policy

Information regarding WVDP emergencies is released to the news media as quickly as possible after sufficient details are known to provide a clear and accurate account of the situation. However, depending on the circumstances, to reassure the public and prevent rumors, fear, or panic, it may be necessary to release information before all facts are known. All news releases during activation of the EOC are approved by the ED and the DOE-PD.

10.5.1.10.2 Emergency Operations and Response Concepts

In the event of an emergency, the ED advises the PID of the emergency and the general situation as soon as possible so that a proper response to the media and public can be presented.

10.5.1.11 Emergency Resources

10.5.1.11.1 Emergency Equipment and Resources

Emergency response equipment is maintained at strategic locations throughout the WVDP site for use in all types of potential threats, including fires and releases of radioactive material, hazardous substances, or hazardous waste. Equipment lists and locations are listed in WVDP-139.

10.5.1.11.2 Federal Government Resources

A great variety of emergency resources (manpower and equipment) is available from DOE-OH/WVDP and other DOE sources, as well as from other federal agencies. The resources of DOE and other federal agencies may be called upon to cope with on-site or off-site DOE emergencies. Resources are obtained from the nearest location.

10.5.1.12 Recovery and Reentry

The authority and responsibility for restoring the WVDP facilities or systems to pre-emergency conditions rests with the ED and DOE-PD, as specified in WVDP-139. A written recovery plan must be approved by the ED and the DOE-PD before any recovery action can be taken. The DOE-PD coordinates implementation of the plan with DOE-OH/WVDP and other federal, state and local off-site agencies for on-site and off-site recovery.

Reentry during the recovery phase can only occur after approval from the ED and when emergency response has been terminated, all potential hazards have been eliminated, and a comprehensive checklist of recovery and reentry criteria is met. The reentry is performed by Protective Action and Recovery Entry Team personnel under the direction of the IC. Per WVDP-139, the team establishes preplanned objectives and actions to limit exposure and control access to affected areas.

The WVDP Emergency Implementing Procedures describe the provisions for reentries involving an immediate "search" and those associated with a post-emergency "recovery." Reentry and Recovery differs from SRE in that it entails actions taken after safe shutdown following an operational emergency rather than urgent activities taken during an emergency.

10.5.1.13 Emergency Plan Review

WVDP-022 is reviewed at least annually and revised if necessary. The annual review includes the following items:

- Organizational changes that may affect emergency response.
- Equipment and facility changes.
- Agreements for assistance by off-site organizations.
- Corrective actions from drills and exercises.
- Changes in laws, regulations, DOE Orders, or guidance documents.

WVDP-139 is revised accordingly to incorporate changes in the approved Emergency Plan. Revisions to WVDP-139 do not require approval by the same individuals that approve revisions to WVDP-022.

Document holders (e.g., WVNSCO, DOE, state, local, and federal agencies) receive revisions to WVDP-022 as they are issued. During annual review of WVDP-022, LOA and MOUs are reviewed to determine if they need to be updated.

Changes to WVDP-022 are incorporated in the appropriate section of WVDP-022 at the following revision.

10.6 Decommissioning

10.6.1 Decommissioning Program

Planning for decommissioning of Project facilities is in progress and will include decontamination of existing and new facilities, the facilities used in vitrification, and any material and hardware used in connection with the Project. Once the environmental review process has been completed (*Environmental Impact Statement for Decommissioning and/or Long-Term Stewardship at the West Valley Demonstration Project and Western New York Nuclear Services Center)* and the conceptual approach to decommissioning has been determined, the details of implementation will be developed.

Final decontamination and decommissioning (D&D) plans are dependent on facility closure plans that are yet to be determined. Safety analyses and Unreviewed Safety Question Determinations (USQDs) associated with site D&D activities will be performed as appropriate.

10.6.2 Decontamination

Specific design features for D&D are described in other chapters of this SAR.

10.6.3 Agreements with Outside Organizations

The DOE, as dictated in the WVDP Act, Public Law 96-368 (U.S. Congress October 1, 1980), entered into agreements, which include the D&D program, with the NRC and New York State. The agreement between the DOE and the NRC is in the form of a MOU (Memorandum of Understanding, November 19, 1981) which defines the relationships between these two organizations. The MOU indicated that the DOE will D&D the Project facilities at the end of the Project according to criteria approved by the NRC. Negotiations are currently underway between the NRC, DOE, and NYSERDA to establish these criteria.

DOE also entered into a cooperative agreement with NYSERDA. The Cooperative Agreement and the WVDP Act establish a 90%/10% cost-sharing arrangement between the federal and New York State governments for costs directly related

to the Project scope as defined by the Act. All D&D costs associated with non-Project facilities are the responsibility of New York State. Negotiations are currently underway between DOE and NYSERDA regarding cost-sharing for D&D of the WNYNSC.

In addition, to facilitate compliance with federal RCRA provisions, DOE and NYSERDA entered into a Federal and State Facilities Compliance Agreement (FSFCA) with the EPA and NYSDEC. This agreement establishes the framework for agency interaction with regard to rules and regulations governing hazardous wastes and mixed wastes.

10.6.4 Arrangements for Funding

The total scope of D&D cannot be determined until after the Record of Decision for the final Environmental Impact Statement (EIS) on Project completion. In February 2002, the NRC published the *Decommissioning Criteria for the West Valley Demonstration Project (M-32)* at the West Valley Site. However, the cost of the WVDP, including the D&D of the Project premises only, will be shared by the federal and New York State governments.

After completion of the WVDP, operational control of the Project premises will revert back to the State of New York for institutional control, including continued monitoring and maintenance, if required.

10.7 Human Factors

The discipline of human factors is directed towards the application of behavioral and social science principles to system settings to optimize both human and system performance.

As discussed in WVDP-011, *WVDP Industrial Hygiene and Safety Manual*, the primary focus of HFE (ergonomic analyses) conducted by the Industrial Hygiene and Safety Department is on safety and prevention of injury. Pre-operational testing and ORRs help ensure that HFE has been adequately incorporated into facility operations.

The area of subsystems analysis is addressed throughout Chapter 10 and in other appropriate sections of this SAR. Subsystem analysis is also examined during ORRs.

REFERENCES FOR CHAPTER 10.0

American Society of Mechanical Engineers (ASME). 1989. *Quality Assurance Program Requirements for Nuclear Facilities*, ASME NQA-1. New York: American Society of Mechanical Engineers.

Emergency Response Planning Committee of the American Industrial Hygiene Association. September, 1994. *Emergency Response Planning Guidelines.*

Memorandum of Understanding Between the U.S. Department of Energy and the Nuclear Regulatory Commission: Implementation of the West Valley Demonstration Project Act of 1990. November 19, 1981. Federal Register Vol. 46, No. 223.

New York Code Codes of Rules and Regulations, *Contingency Plan and Emergency Procedure*, 6 NYCRR Part 373 - 3.4, as amended.

U.S. Congress. October 1, 1980. *An Act to Authorize the Department of Energy to Carry Out a High-Level Liquid Nuclear Waste Management Demonstration Project at Western New York Service Center in West Valley, New York.* Public Law 96-368 [S.2443]. Congressional Record, Vol. 126.

U.S. Department of Energy. October 15, 1996. DOE Policy 450.4: *Safety Management System Policy.* Washington, D.C.: U.S. Department of Energy.

_____. March 13, 2003. DOE Order 425.1C: *Startup and Restart of Nuclear Facilities.* Washington, D.C.: U.S. Department of Energy.

_____. March 27, 1998. DOE Order 440.1A: *Worker Protection Management for DOE Federal and Contractor Employees.* Washington, D.C.: U.S. Department of Energy.

_____. October 14, 1998. DOE Order 430.1A: *Life Cycle Assessment Management.* Washington, D.C.: U.S. Department of Energy.

_____. July 21, 1997. DOE Order 232.1A: *Occurrence Reporting and Processing of Operations Information.* Washington, D.C.: U.S. Department of Energy.

_____. August, 1996. DOE Order 151.1A, Chg. 2: *Comprehensive Emergency Management System.* Washington, D.C.: U.S. Department of Energy.

_____. June 1, 2001. DOE Order 433.1: *Maintenance Management Program for DOE Nuclear Facilities.* Washington, D.C.: U.S. Department of Energy.

_____. May 18, 1992. DOE Order 5480.19: *Conduct of Operations Requirements for DOE Facilities, Change 1* . Washington, D.C.: U.S. Department of Energy.

_____. April, 2002. DOE Standard DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.* Washington, D.C.: U.S. Department of Energy.

REFERENCES FOR CHAPTER 10.0
(Continued)

_____. November 15, 1994. DOE Order 5480.20A: *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities.* Washington, D.C.: U.S. Department of Energy.

_____. October 15, 1996. DOE P 450.5: *Line Environment, Safety, and Health Oversight.* Washington, D.C.: U.S. Department of Energy.

_____. January 10, 2001. *Nuclear Safety Management.* 10 CFR 830.

West Valley Demonstration Project Act. October 1, 1980. Public Law 96-368.

West Valley Nuclear Services Co. EP-5-002: *Administration of Work Instruction Packages.* (Latest Revision).

_____. WV-103: *Controlled Distribution Documents.* (Latest Revision).

_____. WV-108: *Preventive Maintenance Recall Training System and Component Information Input.* (Latest Revision).

_____. WV-109: *Instrument Data and Recall Tracking System.* (Latest Revision).

_____. WV-110: *Conduct of Operations.* (Latest Revision).

_____. WV-121: *Integrated Assessment Program.* (Latest Revision).

_____. WV-368: *Operational Readiness Determination for Startup and Restart of WVDP Facilities.* (Latest Revision).

_____. WV-538: *Employee Indoctrination and Training.* (Latest Revision).

_____. WV-544: *Personnel Access Control.* (Latest Revision).

_____. WV-548: *Disciplinary Action.* (Latest Revision).

_____. WV-552: *Required Reading for WVNS Personnel.* (Latest Revision).

_____. WV-730: *Records Management and Storage Program.* (Latest Revision).

_____. WV-900: *WVDP Worker Safety Program.* (Latest Revision).

_____. WV-906: *Radiation and Safety Committee.* (Latest Revision).

_____. WV-914: *Unreviewed Safety Question Process (USQP).* (Latest Revision).

_____. WV-915: *Spill/Release Notification and Reporting.* (Latest Revision).

_____. WV-988: *Employee Right-to-Know Program - Hazard Communication.* (Latest Revision).

_____. WV-990: *Employee Concerns Program.* (Latest Revision).

REFERENCES FOR CHAPTER 10.0
(Continued)

_____. WVDP-002: *Quality Management Manual.* (Latest Revision).

_____. WVDP-010: *WVDP Radiological Controls Manual.* (Latest Revision).

_____. WVDP-011: *WVDP Industrial Hygiene and Safety Manual.* (Latest Revision).

_____. WVDP-022: *WVDP Emergency Plan.* (Latest Revision).

_____. WVDP-106: *West Valley Demonstration Project (WVDP) Conduct of Operations Manual.* (Latest Revision).

_____. WVDP-111: *Quality Assurance Program.* (Latest Revision).

_____. WVDP-114: *WVNS Engineering Procedures.* (Latest Revision).

_____. WVDP-117: *WVNS Policies and Procedures Manual.* (Latest Revision).

_____. WVDP-126: *Performance-Based Program Training Manual.* (Latest Revision).

_____. WVDP-128: *Project Appraisals Procedures.* (Latest Revision).

_____. WVDP-139: *WVDP Emergency Management Procedures, Vols. I and II.* (Latest Revision).

_____. WVDP-157: *Conduct of Security Procedures Manual, Part 1.* (Latest Revision).

_____. WVDP-170: *West Valley Nuclear Services Maintenance Manual.* (Latest Revision).

_____. WVDP-177: *WVDP Fire Protection Plan.* (Latest Revision).

_____. WVDP-178: *Pre-Fire Plan.* (Latest Revision).

_____. WVDP-193: *WVDP Hazards Assessment.* (Latest Revision).

_____. WVDP-218: *Process Safety Requirements.* (Latest Revision).

_____. WVDP-241: *Site Health and Safety Plan.* (Latest Revision).

_____. WVDP-242: *Event Investigation and Reporting Manual.* (Latest Revision).

_____. WVDP-246: *WVDP Radiological Assistance Program Plan.* (Latest Revision).

REFERENCES FOR CHAPTER 10.0
(Concluded)

_____. WVDP-253: *Emergency Medical Response Team Manual.* (Latest Revision).

_____. WVDP-257: *WVNS Manual for the Preparation, Review, Approval, Distribution, and Revision of Controlled Documents.* (Latest Revision).

_____. WVDP-262: *WVNS Manual for Records Management and Storage.* (Latest Revision).

_____. WVDP-273: *WVDP Hazards Survey.* (Latest Revision).

. WVDP-274: *Maintenance and Implementation Plan.* (Latest Revision).

_____. WVDP-310: *WVDP Safety Management System (SMS) Description.* (Latest Revision).

_____. WVDP-342: *Operational Readiness Determination Manual for Startup and Restart of WVDP Facilities.* (Latest Revision).

West Valley Nuclear Services Co. and URS Corporation. August 2002. *West Valley Demonstration Project Site Environmental Report Calendar Year 2003.* West Valley, NY: West Valley Nuclear Services Co.

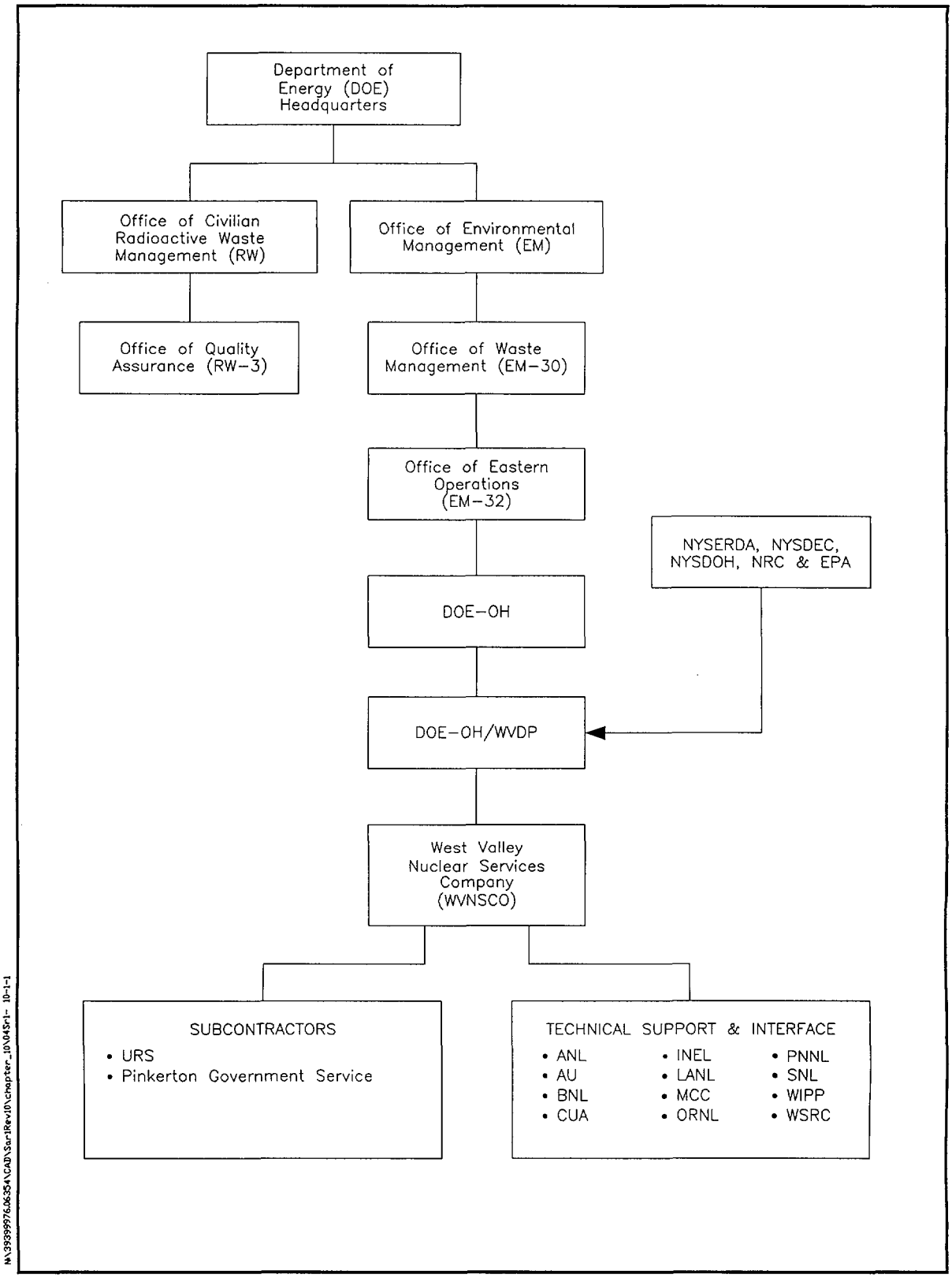


Figure 10.1-1 WVDP Organizational Hierarchy.

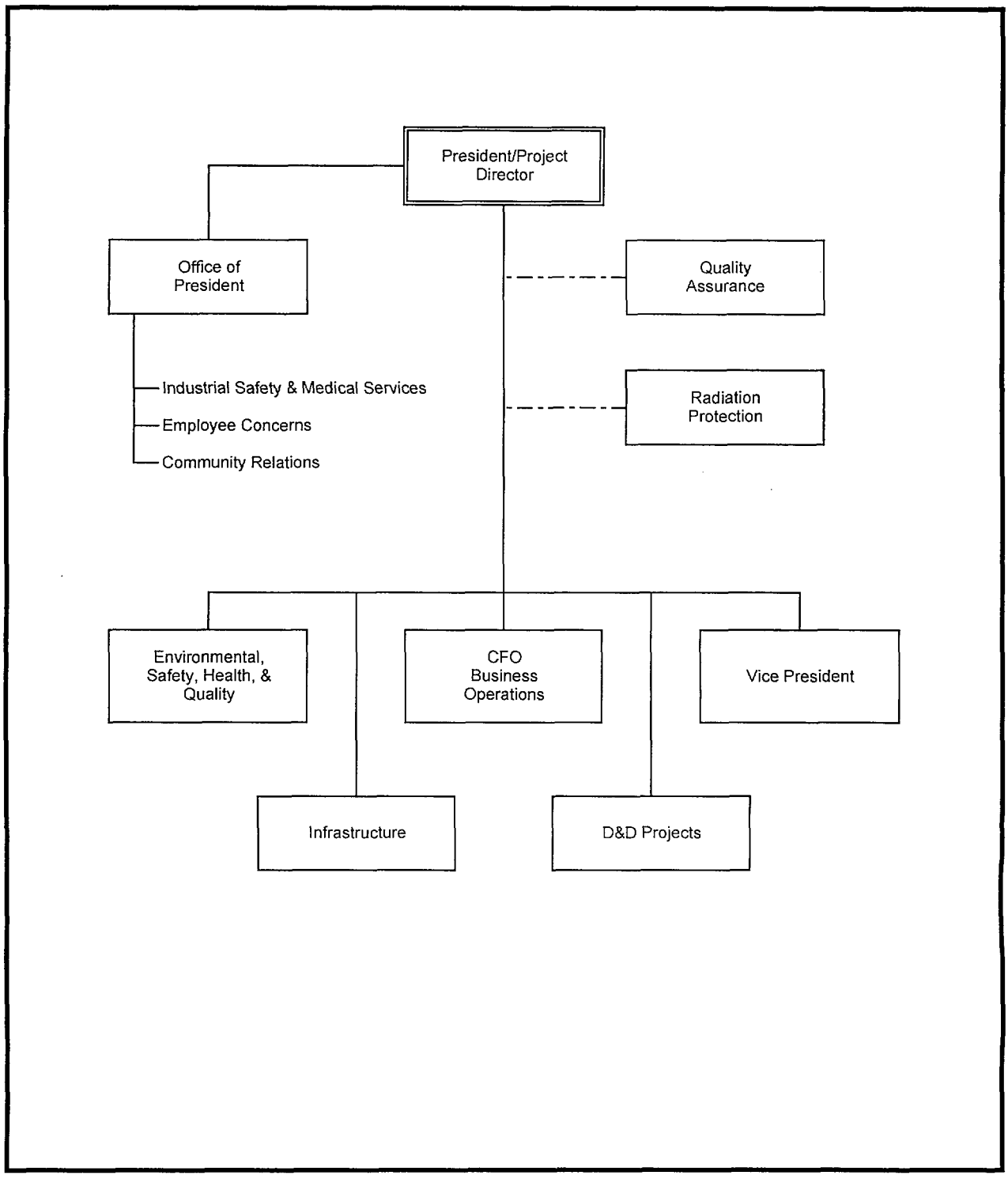


Figure 10.1-2 WVNS Organization

11.0 TECHNICAL SAFETY REQUIREMENTS

11.1 Introduction

The objective of this chapter is to provide information that satisfies the requirements of 10 CFR 830.204(b)(4). This chapter serves the purpose of linking the accident analyses, primarily through descriptions of the safety structures, systems, and components (SSCs), to a Technical Safety Requirement (TSR) document, WVDP-146, *West Valley Demonstration Project Technical Safety Requirements*. The TSR document constitutes an agreement or contract between the Department of Energy (DOE) and West Valley Nuclear Services Company (WVNSCO) regarding the safe operation of the West Valley Demonstration Project (WVDP).

11.2 Requirements

This Safety Analysis Report (SAR) meets the requirements in 10 CFR 830.204 and 830.205 with respect to TSRs.

11.3 Technical Safety Requirement Input

There are no Derivative Design Basis Accidents (DDBAs) that have consequences that challenge the DOE-provided Evaluation Guideline (EG) or WVNSCO best management practice toxicological EG. No Safety Class SSCs or Safety Significant SSCs have been identified.

11.3.1 Safety Limits, Limiting Control Settings, Limiting Conditions for Operation, and Surveillance Requirements

The results of analyses of DDBAs demonstrate that Safety Class and Safety Significant SSCs are not required. Accidents have been evaluated with a reasonably bounding radiological (or hazardous chemical) material at risk. Therefore, no TSR Safety Limits, Limiting Control Settings, Limiting Conditions for Operation (LCOs), or Surveillance Requirements are required for facilities and activities within the scope of this SAR.

11.3.2 Design Features

Regarding the "design features" portion of a TSR document, Section 5.2.5 of DOE Guide 423.1-1, *Implementation Guide for Use in Developing Technical Safety Requirements*, states the following:

> A design features section should be included with the TSR. The purpose of the design features section is to describe in detail those features not covered elsewhere in the TSRs that, if altered or modified, would have a significant effect on safety. The following two areas should be addressed in this section. (1) Vital passive safety SSCs such as piping, vessels, supports, structures (such as confinement), and containers. (2) Configuration or physical arrangement including dimensions, the parameter(s) being controlled, and the reasoning behind the design should be provided as identified in the safety analysis. Examples of such situations are where criticality avoidance is dependent on physical separation and where equipment configuration is used to minimize radiation levels.

Various passive items (e.g., the walls and shield windows of rooms and cells in the Main Plant) contribute to maintaining worker doses to below allowed limits during normal operations. However, passive items are not credited for reducing the potential radiological consequences to the on-site evaluation

point (OEP) receptor or maximally exposed off-site individual (MEOSI) for accidents evaluated in Chapter 9. Shielding is integral to any Radiological Protection Program, and at the WVDP, an integral aspect of complying with 10 CFR 835, *Occupational Radiation Protection*. Additionally, as part of the Radiological Protection Program, surveys are periodically taken of radiation areas to confirm or re-establish the dose rates in those areas. Consequently, passive items that serve a shielding function are (and will be) maintained in a manner consistent with the requirements of the Radiological Protection Program, which is a Safety Management Program (SMP) shown in the TSR Administrative Controls (ACs) portion of WVDP-146. It is noted that certain passive items such as the walls and shield windows of Main Plant cells protect facility workers from direct (gamma) radiation. Analyses contained in this SAR demonstrate the adequacy of these protective features. Modifications to these features would be reviewed through the Unreviewed Safety Question Determination (USQD) process and would be accomplished to ensure that personnel exposure requirements do not exceed limits prescribed in 10 CFR 835. There are no accident conditions such as inadvertent criticality under which shielding beyond that required for normal operations have been identified. Consequently, passive features performing a shielding function have not been identified as a TSR design feature.

There is no hardware at the WVDP of the type that it is believed the author(s) of DOE Guide 423.1-1 intended in their reference to situations where "criticality avoidance is dependent on physical separation." It is considered that the author(s) of DOE Guide 423.1-1 are referring to items such as collars or spacers that maintain a needed amount of separation between canisters containing spent fuel assemblies, and not common items such as drums that contain fissile material bearing wastes. Controls related to containers that can be used to store fissile material bearing wastes are provided by the Nuclear Criticality Safety Program and Safety Document Preparation Program. Both of these programs are TSR AC SMPs as discussed below. Consequently, no SSCs associated with criticality prevention are listed as "design features" based on engineering judgment and consideration of potential added value.

Design criteria and design information are provided in Chapters 4, 5, and 6. More information regarding design features can be found in Section 7.6.5.

11.3.3 Administrative Controls

ACs are defined in 10 CFR 830.3 as "the provisions relating to organization and management, procedures, record keeping, assessment, and reporting necessary to ensure safe operation of a facility." DOE Guide 423.1-1, *Implementation Guide for Use in Developing Technical Safety Requirements*, provides guidance as to the content of the TSR AC section of a TSR document. The TSR AC topics given in Section 5.2.4 of DOE Guide 423.1-1, which are shown below, are addressed in WVDP-146.

1. Contractor Responsibility
2. Contractor Organization
3. Procedures
4. Programs
5. Minimum Operations Shift Complement
6. Operating Support
7. Facility Staff Qualifications and Training
8. Record Keeping
9. Reviews and Audits
10. Deviations from TSRs (i.e., actions and reporting to be taken for deviations from TSRs)

There were no active Safety SSCs identified that require operator actions to ensure safe operations. Consequently, WVDP-146 states that the minimum staffing required to satisfy the TSR AC is zero. For the purposes of conduct of operations, the Operations Manager establishes the "minimum operations shift complement" for routine operations. A "strict order of call" roster of WVNSCO emergency and technical support personnel exists in an Emergency Response Program procedure that is readily accessible. "Deviations from TSRs" entail "event reporting" and possibly initiation of the Unreviewed Safety Question Process (USQP). Additionally, when deviations from TSRs occur, affected facilities shall be placed in a safe and stable configuration in accordance with applicable procedures, and a recovery plan shall be developed that describes the steps that will reinstate compliance with the TSR AC. Procedures required to implement the programs listed below, and procedures required to implement facility-specific TSR ACs, shall be established, reviewed, and approved in accordance with the WVNSCO Records Management System. Written procedures that address the following, as a minimum, shall be established, implemented, and maintained as appropriate for a given facility or activity at the WVDP.

Operations	WV-110, *Conduct of Operations*
Nuclear Criticality Safety	WV-923, *Nuclear Criticality Safety*
Radiation Protection	WV-905, *Radiological Protection*
Worker Safety	WV-900, *WVDP Worker Safety Policy*
Abnormal and Emergency Conditions	WVDP-139, *Emergency Management Implementing Procedures*
Administrative Aspects of Operation	WVDP-257, *WVNS Manual for Preparation, Review, Approval, Distribution and Revision of Controlled Documents*

This SAR and DOE Guide 423.1-1 address the other TSR AC topics and thereby provide the needed bases for developing the relevant sections in WVDP-146.

TSR ACs, as presented in WVDP-146, must include the following SMPs. (These SMPs are the "Programs" shown for item number 4 above.) These SMPs were selected for inclusion because they were identified as making a significant contribution to the safety of facility workers, as noted in Section 9.1.2.3.1. These SMPs are established and maintained to be consistent with the applicable Code of Federal Regulations or DOE Order noted in parenthesis.

1. Safety Document Preparation Program (10 CFR 830, *Nuclear Safety Management*)
2. Worker Safety Program (DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*)
3. Radiological Protection Program (10 CFR 835, *Occupational Radiation Protection*)
4. Nuclear Criticality Safety Program (DOE Order 420.1A, *Facility Safety*)
5. Emergency Response Program (DOE Order 151.1B, *Comprehensive Emergency Management System*)

6. Quality Assurance Program (10 CFR 830, Subpart A, *Quality Assurance Requirements*, and DOE Order 414.1A, *Quality Assurance*)
7. Fire Protection Program (DOE Order 420.1A, *Facility Safety*)
8. Performance Based Training Program (DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*)
9. Maintenance Program (DOE Order 433.1, *Maintenance Management Program for DOE Nuclear Facilities*)
10. Conduct of Operations Program (DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*)
11. Waste Management Program (DOE Order 435.1, *Radioactive Waste Management*)

For the Waste Management Program, WVDP-146 shall stipulate that "approved containers" (as discussed in Section 11.3.2) used for packaging and storing TRU waste that contains greater than one gram of fissile material shall be periodically inspected for leaks, lid installment, structural defects such as severe rusting/corrosion, punctures, swelling, dents, and compliance with relevant criticality control storage configuration requirements.

As a best management practice, and as directed in WVDP-SER-001, the following specific "administrative control" shall be included in WVDP-146. TRU waste that contains greater than one gram of fissile material shall be packaged and stored in "approved containers" (as discussed in Section 11.3.2). Wastes currently stored in the Chemical Process Cell Waste Storage Area (CPC WSA) shall be excluded from this requirement because the waste form has low combustibility and dispersibility; the waste is currently in containers (although some of the containers show signs of corrosion); WVNS-SAR-023, *Safety Analysis Report for the Remote Handled Waste Facility*, analyzes a bounding container handling accident with a conservative radiological material at risk; and container sizes and waste types located in the CPC WSA make it prohibitive to repackage at this time.

11.4 Interface with TSRs from Other Facilities

There are no TSRs from other facilities that interface with the facilities within the scope of this SAR.

REFERENCES FOR CHAPTER 11.0

Code of Federal Regulations. 10 CFR 830. *Nuclear Safety Management*. U.S. Department of Energy.

_____. 10 CFR 835. *Occupational Radiation Protection*. U.S. Department of Energy.

U.S. Department of Energy. September 29, 1999. Change 1 (November 1,2000). DOE Order 151.1B, *Comprehensive Emergency Management System*. Washington, D.C.

_____. September 29, 1999. Change 1 (July 12, 2001). DOE Order 414.1A, *Quality Assurance*. Washington, D.C.

_____. May 20, 2002. DOE Order 420.1A, *Facility Safety*. Washington, D.C.

_____. June 1, 2001. DOE Order 433.1, *Maintenance Management Program for DOE Nuclear Facilities*. Washington, D.C.

_____. July 9, 1999. Change 1 (August 28, 2001). DOE Order 435.1, *Radioactive Waste Management*. Washington, D.C.

_____. March 27, 1998. DOE Order 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees*. Washington, D.C.

_____. July 9, 1990. Change 2 (October 23, 2001). DOE Order 5480.19, *Conduct of Operations Requirements for DOE Facilities*. Washington, D.C.

_____. November 15, 1994. Change 1 (July 12, 2001). DOE Order 5480.20A, *Personnel Selection, Qualification, and Training Requirements for DOE Nuclear Facilities*. Washington, D.C.

_____. October 24, 2001. DOE Guide 423.1-1, *Implementation Guide for Use in Developing Technical Safety Requirements*. Washington, D.C.

_____. February 2004. WVDP-SER-001, *Safety Evaluation Report for Waste Processing and Support Activities and the Remote Handled Waste Facility*. Rev. 2.

West Valley Nuclear Services Co. WV-110, *Conduct of Operations*. (Latest Revision).

_____. WV-900, *WVDP Worker Safety Policy*. (Latest Revision).

_____. WV-905, *Radiological Protection*. (Latest Revision).

_____. WV-923, *Nuclear Criticality Safety*. (Latest Revision).

_____. WVDP-139, *Emergency Management Implementing Procedures*. (Latest Revision).

_____. WVDP-146, *West Valley Demonstration Project Technical Safety Requirements*. (Latest Revision).

REFERENCES FOR CHAPTER 11.0
(Concluded)

_____. WVDP-257, *WVNS Manual for Preparation, Review, Approval, Distribution and Revision of Controlled Documents.* (Latest Revision).

_____. WVNS-SAR-023, *Safety Analysis Report for the Remote Handled Waste Facility.* (Latest Revision).

12.0 QUALITY ASSURANCE

This section describes how the West Valley Nuclear Services Company (WVNSCO) Quality Assurance (QA) Program (QAP) is being applied in compliance with 10 CFR 830 Subpart A, *Quality Assurance Requirements* and DOE O 414.1A. The Department of Energy (DOE)-approved WVNSCO QAP has been established, approved, and implemented to ensure that site missions are accomplished while minimizing hazards to the public, site or facility workers, and the environment. The program is applied to all activities affecting quality at the West Valley Demonstration Project (WVDP) site, including both nuclear and non-nuclear areas. In particular, the WVDP scope of work consists of:

- Project management and administrative support activities;
- Design, construction, and modification of facilities;
- Processing, interim storage, and disposal of nuclear wastes (waste characterization, sludge mobilization, supernatant processing, waste vitrification, and high-level waste storage);
- Shutdown and maintenance operations; and
- Decontamination and decommissioning (D&D) activities (low-level waste treatment and disposal, transuranic waste segregation, storage and shipping, and radwaste volume reduction).

As stated in Section 1.1, this SAR is an overview. In keeping with this application of a graded approach, not all aspects of the WVNSCO QAP are described.

As described by the WVNSCO QAP document WVDP-111, *Quality Assurance Program*, the WVNSCO QAP incorporates grading through use of Quality Levels established by risk-based evaluation of safety, environmental, and programmatic factors. An important feature of the WVNSCO grading process is the level of effort or degree of program application is determined by review of items or activities. The assigned Quality Level provides a key basis for determining the degree of application of QA Program requirements, in accordance with factors influencing responsible work process control and work acceptance such as complexity, consequence of failure, and degree of uncertainty. The WVNSCO graded implementation is consistent with 10 CFR 830.3, *Definition of Graded Approach*, and 10 CFR 830.7, *Description of Graded Approach*.

The WVNSCO QAP has been developed using the format and content of ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities*, and the appropriate requirements from DOE O 414.1A, *Quality Assurance*. The WVNSCO QAP, as described in WVDP-111, has been approved by DOE (Jackson, April 5, 2004) and provides for a functioning program for compliance to the QA Rule, 10 CFR 830.122. Requirements identified by WVDP-111 are implemented by policies contained in WVDP-002, *Quality Management Manual*, and selected portions in WVDP-117, *WVNS Policies and Procedures Manual*.

In order to implement the QA Rule, the WVNSCO QAP is based on the appropriate criteria specified in DOE 0 414.1A, *Quality Assurance*. Other guidance documents provided by the DOE include DOE G 414.1-1, *Implementation Guide for Use With Independent and Management Assessment Requirements of 10 CFR 830.122 and DOE O 414.1 Quality Assurance*; DOE G 414.1-2, *Quality Assurance Management System Guide for Use With 10 CFR 830.122 and DOE O 414.1*; DOE G 450.4-1, *Integrated Safety Management System Guide*; and DOE G 440.1-6, *Implementation Guide for Use With Suspect/Counterfeit Items Requirements of DOE O 440.1A*.

WVDP-074, *WVNS Quality Assurance Program for High Level Waste Form Production Through Acceptance* and DOE-WVDP-002, *West Valley Area Office Quality Assurance Program Description for WVDP High Level Waste Form Production Through Acceptance,* were prepared and implemented to be consistent with the requirements of DOE/RW-0333P, Rev. 0, *Quality Assurance Requirements and Description*. These documents, which describe the QAP for high-level radioactive waste acceptance process and production activities at the WVDP, also describe the QAP as implemented at the Department of Energy, Ohio Field Office (DOE-OH)/WVDP, and the WVNSCO contractor level.

The following documents were used as guidance to implement Quality Assurance Program Requirements:

- ASME NQA-1-1989, *Quality Assurance Program Requirements for Nuclear Facilities;*
- DOE G 450.4-1, *Integrated Safety Management System Guide;*
- DOE O 440.1A, *Worker Protection Management for DOE Federal and Contractor Employees;*
- DOE O 414.1A, *Quality Assurance;*
- DOE Order 5480.19, *Conduct of Operations;*
- DOE P 450.4, *Safety Management System Policy;*
- DOE G 440.1-6, *Implementation Guide for Use With Suspect/Counterfeit Items Requirements of DOE O 440.1A;* and
- DOE/RW-0333P, *Quality Assurance Requirements and Description*, Rev. 0.

12.1 Organization

The WVNSCO organization is shown in Figures 10.1-1 and 10.1-2, and described in associated text in Chapter 10. Other participants, including suppliers, consultants, subcontractors, and laboratories are a part of the overall WVNSCO program by virtue of WVNSCO-delegated QAP elements. All such delegated Quality Assurance functions are identified by appropriate contractual requirements with accountability for acceptable implementation retained by WVNSCO. WVNSCO performs initial approval of the organizational structures and QA programs of all major project participants. WVNSCO also performs scheduled, periodic overviews of these organizational structures and QA programs via audits, surveillance, or other appropriate methods.

12.1.1 Responsibilities

WVDP-002 and selected portions of WVDP-117 document the responsibilities and authority of persons and organizations that: 1) perform safety functions, 2) ensure that the QAP is established and implemented, and 3) verify that activities affecting quality have been correctly performed and documented in accordance with WVNSCO implementing procedures. These responsibilities are summarized below:

12.1.1.1 WVNSCO Responsibilities

WVNSCO is responsible for:

- Establishing the Project QAP requirements and responsibilities during the design, procurement, construction, installation, modification, testing, operation, and D&D phases of the Project, in accordance with the WVNSCO QAP, to meet the requirements of 10 CFR 830.122.

- Establishing, documenting, and implementing a program for control of Project activities affecting quality in accordance with the WVNSCO QAP;
- Developing design criteria and safety analysis reports;
- Monitoring and reviewing the Environmental and Safety Services activities;
- Assuring completion of D&D activities for Project premises; and
- Processing and safe disposal of wastes.

12.1.1.2 WVNSCO President/Project Director Responsibilities

The WVNSCO President/Project Director is responsible for:

- All functions of WVNSCO, including establishment and implementation of the QAP;
- Reviewing the QAP and causing corrective action, when necessary, to be taken by the responsible West Valley Nuclear Services Company organizations.

12.1.1.3 Manager, Environmental, Safety, Health & Quality

The Manager, Environmental, Safety, Health & Quality, is responsible for:

- National Environmental Protection Agency (NEPA) compliance, environmental assessment, facility assessment, environmental monitoring programs and geotechnical operations, environmental and subcontract laboratories.

12.1.1.4 WVNSCO Quality Assurance Organization Responsibilities

The WVNSCO QA Organization is responsible for:

- Establishing the WVNSCO QAP to meet the requirements of 10 CFR 830.122;
- Providing Project support in quality assurance activities;
- Reviewing test documentation;
- Performing audit and assessment activities of WVNSCO and subcontractors to determine compliance with the Project requirements;
- Recommending quality assurance hold points in system operability test procedures and coordinating the release of these hold points;
- Identifying deficiencies in the QAPs of the subcontractors and suppliers; and
- Monitoring activities of the subcontractors.

12.1.1.5 URS Responsibilities

The Environmental and Safety Services subcontractor, URS, is responsible for:

- Conducting work in accordance with the WVNSCO QAP;
- Collecting environmental samples and processing, validating, evaluating, and interpreting environmental data for the Project as directed by WVNSCO;
- Preparing safety analysis reports, Facility Hazard Categorizations, Nuclear Critical Evaluation; and
- Preparing Process Safety Requirement (PSR) criteria and the resulting PSRs.

12.1.1.6 Other Departments within WVNSCO

Other departments within WVNSCO are responsible for:

- Compliance with the WVNSCO QAP as documented in WVDP-002, *Quality Management Manual*, and for implementing the portions of the manual applicable to them. The WVNSCO departments are structured to effectively administer the design, procurement, construction, installation, modification, testing, and operation phases.

12.1.1.7 Site Personnel

Site personnel are responsible for:

- Expressing quality allegations up to the President/Project Director of WVNSCO, or the Director, DOE-OH/WVDP, without fear of reprisal. A well-publicized policy provides the provisions for reporting such allegations or concerns.
- Stopping work if continuing would jeopardize safety or quality and bringing this condition to management.

12.1.1.8 Pacific Northwest National Laboratories Responsibilities

The Commercial Waste Treatment Program (CWTP) contractor, Pacific Northwest National Laboratories (PNNL), is responsible for:

- Preparing and implementing a QAP during the design and process phase of the Project that is based on the appropriate requirements of DOE/RW-0333P.

Responsibilities of PNNL during earlier phases of Project development included: providing design and support for overall management; providing laboratory studies (e.g., melter runs and glass formulation studies); and providing the design, procurement, fabrication, and shipment of the Component Test Stand (CTS) equipment.

12.1.1.9 Review of Quality Assurance Manuals

Subcontractors' and selected suppliers' QAPs are reviewed by WVNSCO. Their implementation procedures and instructions are reviewed by WVNSCO, as appropriate.

12.2 Quality Assurance Program

Definition and description of the WVNSCO QAP is provided by the DOE-approved WVNSCO document WVDP-111, *Quality Assurance Program*, which is the QAP document required by the QA rule, 10 CFR 830.122, *Quality Assurance Requirements*. WVDP-111 and its implementing procedures provide identification of the applicable requirements of the WVNSCO QAP to be used in determining compliance to the QA Rule.

The core documents providing policy and program implementation procedures for the WVNSCO QAP are WVDP-002, *Quality Management Manual,* and select WVs contained in WVDP-117, *WVNSCO Policies and Procedures Manual*. WVDP-002 details the established policies, requirements, and organizational responsibilities for the WVNSCO QAP. The *Quality Management Manual* requirements are implemented by written procedures and instructions, most of

which are implemented at the department level with either company or department procedures or manuals. WVDP-002 is approved by the President/Project Director of WVNSCO and is continuously evaluated during reviews by DOE. Figure 12.2-1 presents the hierarchy of QA documents at the WVDP.

The QA Rule, 10 CFR 830.122, identifies ten requirements. These ten requirements are embodied in the WVNSCO QA program, as defined by WVDP-111. Table 12.2-1 is a matrix showing these ten requirements and the sections in this SAR discussing their implementation at the WVDP.

The WVNSCO President/Project Director is the senior manager responsible for ensuring adequacy, implementation, and continuing assessment of the WVNSCO QAP. The President's staff managers responsible for operational, administrative, technical, engineering, and quality assurance functions provide the top-level of line management responsible for work processes and work performance in compliance with QAP requirements. The requirements of the QAP apply to all WVNSCO organizations performing activities affecting quality. As appropriate, WVNSCO QAP requirements are imposed upon subcontractors and other project participants by WVNSCO contractual delegation. WVDP-002 provides a definition of organizational structure and responsibilities as applied to individual QAP authorities and functions.

The WVDP QAP policies and requirements for the Project are established by WVNSCO. The QAP for the Project complies with the provisions of 10 CFR 830.122, as applicable to design, procurement, construction, installation, modification, testing, operation, and D&D. The quality required for the Project scope of work is achieved by work performed and verified in accordance with approved procedures.

Quality requirements are applied to the WVDP and suppliers by including appropriate quality and documentation requirements in contractual provisions and in technical specifications.

The QAP is implemented for quality-related activities. The degree of control and verification of the QAP to the WVDP work scope is consistent with criteria delineated by implementing procedures and work instructions. These criteria were developed using the following considerations:

- The importance, complexity, or special nature of the item or activity.
- The degree of uncertainty regarding operational and performance characteristics.
- The need for special controls and surveillances over associated processes and equipment.
- The degree to which functional or performance compliance can be demonstrated by inspection or test.
- The quality history and degree of standardization of an item, system, or process.
- The risk potential for health and safety, environmental, or programmatic impact as the result of failure, error, or inadequacy of the item or activity (service).
- The difficulty of repair or replacement of an item.
- The need for calibrated tools, instruments or measuring and test equipment (M&TE) to verify accuracy, acceptance, or determine conformance to specified requirements.

12.2.1 Design Control

The quality required for Project design control is achieved by ensuring that the design of structures, systems, components, assemblies, test equipment, processes, and facilities is adequately defined, controlled, and verified in accordance with design control procedures. These procedures comply with DOE Order 4700.1A, and with 10 CFR 830.122.

The extent of independent design verification depends upon the safety aspects of the item, the complexity of the design, the similarity of the design to proven designs, and the present state of the art. Acceptable verification methods include (but are not limited to) one or a combination of: design reviews, alternate calculations, and qualification testing.

Design changes are processed in accordance with design control procedures. These procedures provide for the independent review of designs and for control of the review, approval, and release of drawings and specifications.

12.2.2 Procurement Document Control

DOE-OH/WVDP has delegated prime authority for the procurement and the administration of contracts to WVNSCO. The preparation and processing of procurement documents are performed in accordance with policies and requirements of WVDP-117, *WVNSCO Policy and Procedures Manual*, WVDP-002, *Quality Management Manual*, WV-620, *Purchase Requisitions and Supplements*, and WV-695, *Procurement Card Purchases*. These policies ensure that procurement documents contain appropriate technical and quality requirements. To the extent necessary, procurement documents require contractors and suppliers to have quality assurance programs that are adequate to control the quality of the items or services.

The procurement documents specify the scope of work, technical requirements, and application of QA requirements including identification of suspect/counterfeit items (S/CI) requirements. The appropriate procurement documents with QA requirements specified therein are reviewed and approved by the WVNSCO QA organization. Procurement documents are controlled by WVNSCO's standard procurement procedures and practices. Changes to procurement documents are controlled by written WVNSCO procedures.

To the extent of an item's importance to safety and quality, procurement documents require that suppliers and their subtier suppliers have quality assurance programs consistent with the requirements contained in the purchase documents. The requirements are commensurate with the Quality Level of the item or activity. Suppliers are surveyed and evaluated to assure that sufficient and appropriate systems, procedures, and personnel are available to meet the programmatic and technical requirements of the purchase order prior to the initiation of work activities covered by the QAP. Records are maintained on all suppliers surveyed to show those quality assurance attributes available within their QAP. The WVNSCO Purchasing organization obtains approval of potential suppliers from the Engineering and Quality Assurance organizations.

Following the preparation and approval of a procurement document and selection of an acceptable supplier, the purchase order is prepared and issued along with the supporting procurement documents. If verification of the quality of supplied items cannot be performed at receiving inspection, work performed by the supplier is verified by WVNSCO during the course of procurement, ensuring

that the purchase order requirements are met. Verification activities conducted by the QA Organization may include auditing, receiving inspection, surveillance, or inspection at mandatory hold points during processing, final inspection, and shipping.

12.2.3 Instructions, Procedures, and Drawings

Components, systems, structures, and associated services that are important to the safe and reliable operation of the WVDP are designed, fabricated, erected, inspected, and tested in accordance with approved specifications and drawings. Instructions, procedures, and drawings are issued and controlled for the performance of the work scope in accordance with the considerations specified in appropriate QA programmatic requirements. The documents prepared by the issuing organization are approved by the WVNSCO QA organization and other interfacing organizations. Where appropriate, the documents contain quantitative and qualitative acceptance criteria that form the basis for verifying that all quality-related activities are satisfactorily accomplished.

12.2.3.1 Document Control

The preparation, issuance, and revisions to documents that implement the considerations specified in accordance with appropriate QA programmatic requirements are controlled to assure that correct documents, including the proper revision level, are being used. These documents, including any changes, are reviewed for adequacy and approved for use.

WVNSCO has established and implemented appropriate measures to control the preparation, review, approval, and issuance of site documents such as standard operating procedures, safety analysis reports, drawings, procedures, specifications, instructions, and changes that prescribe activities affecting quality. Documents are controlled to assure that correct and applicable documents are available at the location where they are to be used. Any changes to controlled documents are reviewed and approved by the same organizations that performed the original review and approval unless other organizations are specifically designated.

Additional information on document control may be found in Section 10.4.2.2.

12.2.4 Control and Identification of Purchased Material, Equipment, and Services

Measures have been established and implemented at the WVDP to ensure that purchased materials, equipment, and services conform to the requirements outlined in the procurement documents. Control of purchased materials, equipment, services, and supplier selection is implemented in accordance with the considerations specified in appropriate QA programmatic requirements. Where appropriate, these measures include contract provisions for source inspections, receiving inspections, monitoring of site construction activities, equipment installation activities, acceptance testing, and objective evidence of compliance submitted by contractors and suppliers to demonstrate compliance with contract requirements.

Before a purchase order is issued, the selected supplier, if required, is evaluated by WVNSCO to assess the adequacy of the supplier's quality assurance program, technical abilities, and the facilities and organization necessary to produce an acceptable item or service. Evaluation and selection of sources of supply prior to award of the purchase order are defined by procedure. Qualified personnel survey and evaluate proposed suppliers of quality-related services and items based on the Quality Level of the item being procured. The

survey is documented. The QA organization concurs with the proposed accepted supplier prior to issuing the procurement package for supplier quotations. For specific major or critical procurements, the QA organization participates in the entire supplier selection process, including the proposed bid evaluation.

Surveillance at suppliers' facilities or performance assessments are planned and conducted during the life of the contract by the WVNSCO QA organization or a representative, based on the items' importance to safety and the suppliers quality history. These surveillances/assessments are performed to verify compliance with the procurement quality assurance requirements. Surveillances may include independent source inspection and release of items at the supplier prior to shipment.

When required, purchase orders contain the requirements for suppliers to submit documents and revisions thereto (i.e., technical specifications, drawings, processing procedures, inspection and test plans, procedures and quality programs/procedures) for WVNSCO review and approval.

Mandatory supplier hold points may be identified to facilitate QA determination of the acceptability of the item or service. Instructions issued with the hold point direct the supplier not to proceed beyond the hold point until the work has been released by a WVNSCO representative. Hold points may be identified at receiving, during processing, and at final inspection and shipping.

12.2.4.1 Identification and Control of Items

WVNSCO has established measures to identify and control materials, parts, and components to ensure only correct and acceptable items are used and installed at the WVDP.

Procedures implement requirements for traceability from receipt to the end-use or installation of items with considerations specified in accordance with appropriate QA programmatic requirements. To maintain traceability throughout the supplier's work scope and shipping cycle, applicable requirements for the identification and traceability of supplier-furnished materials, equipment, and services are included in the purchase order.

Physical identification is used, where appropriate, to provide for clear and legible identification that does not affect the function or service life of an item. When physical identification is not practical, other administrative controls such as tagging, physical separation, and lot or batch control are employed to maintain traceability.

12.2.4.2 Control of Processes

Provisions for the control of processes (i.e., welding, nondestructive examination, installation, construction, and testing phases) are incorporated into the Project. Processes that affect the quality of final items or services are controlled in accordance with their Quality Level classifications, as discussed in Section 12.3. Special processes that control or verify quality are performed by qualified personnel using qualified procedures in accordance with applicable requirements.

Requirements for control of supplier processes are included in the procurement documents. The process control provisions included in the technical specifications vary depending on the importance and complexity of the involved process, component, system, or structure. As appropriate, the specified control includes the use of documented procedures and qualification of procedures, personnel, and equipment.

12.2.5 Inspection, Surveillance, and Testing

12.2.5.1 Inspection

Measures have been established and implemented by WVNSCO to ensure that inspections required to verify acceptance of an item, test, or service are performed in accordance with documented requirements. Inspection plans include measures to ensure that qualified procedures and personnel are provided to perform the following inspection activities during the procurement, installation, construction, and testing and operation phases of the Project:

- Source surveillance and inspection;
- Receiving inspection, including examinations for S/CI;
- Fabrication, assembly, or installation inspection;
- On-site construction inspection;
- Test verification;
- Process hold point surveillance; and
- Operating procedure surveillance.

Personnel performing inspection activities for the purpose of product acceptance are qualified and trained to perform the inspection task and are independent of the group performing the activity being inspected. Inspector training and qualification for WVNSCO personnel is formally prescribed, defined, maintained, and documented. These records are maintained by the Training and Development Department. Training and proficiency requirements include activities such as inspections, surveillances, and QA documentation and records. Formal training requirements are also prescribed for QA program lead auditors and for personnel performing nondestructive examination, inspection, and test activities.

WVNSCO QA Organization inspection planning is documented, showing each characteristic to be inspected, methods to be used, the acceptance criteria, and providing for the recording of objective evidence of inspection results. When sampling is used to verify acceptability of a group of products, the sampling plan is based on a recognized standard practice and the sampling results are documented.

Final inspection performed for the Project includes a review of all previously performed inspections, reworks, repairs, or recalibrations, and the resolution of nonconformances. Quality records are also examined for acceptance and accuracy prior to final acceptance of the product.

12.2.5.2 Test Control

Measures have been established and implemented at WVNSCO to assure that tests necessary to verify conformance of items or services to requirements are performed in accordance with documented procedures. Tests are performed by trained and qualified personnel. The results are documented and evaluated against approved acceptance criteria. Test programs are established to ensure that components, systems, and structures perform safely, that operational

functions are satisfactory when in service, and that the testing is identified and documented in written test procedures that incorporate or reference the requirements and acceptance limits contained in applicable design documents.

Requirements for the performance of tests by WVNSCO personnel or by Project suppliers are included in the procurement documents. The procurement documents specify, when necessary, those procedures required to be submitted to WVNSCO for review, approval, or information. Test requirements and acceptance criteria are included in design documents.

12.2.5.3 Control of Measuring and Test Equipment

Measures have been established at WVNSCO to ensure that gauges, instruments, measuring devices, and testing equipment used to determine conformance with specified requirements of drawings and specifications, or for obtaining test data, are of the proper range, type, and accuracy. To ensure accuracy, measuring and test equipment is calibrated at established intervals against certified standards that have a known valid relationship to nationally recognized standards. Purchase orders may be issued for calibration of measuring and test equipment through a qualified supplier. Calibration records include (if appropriate) an Instrument Data Card and a History of Repair Card for each instrument used for acceptance or testing. The calibration system provides for recall of equipment for recalibration. Additional information about control of measuring and test equipment may be found in Section 10.4.3.

12.2.5.4 Handling, Storage, and Shipping

Procedures are established to control the handling, storage, and shipping of items and materials by WVNSCO to prevent damage or deterioration. Handling, storage, packaging, preservation, and shipping requirements contained in government and industry safety codes and standards apply as required by the contract. In special circumstances, the specific requirements may be cited in the technical specifications for material, parts, components, or equipment involved.

Controls are established to ensure that special handling tools and lifting equipment are inspected and tested at required intervals to show that these items are adequately and safely maintained. Personnel who operate and maintain special handling tools and lifting equipment are trained in the use of the equipment. Purchase orders may be issued for load testing of lifting equipment and special handling tools through a qualified supplier.

Purchase orders include appropriate requirements for qualification of suppliers to ensure that items are protected to prevent damage during handling, shipping, and storage. WVNSCO QA personnel perform surveillances during handling, storage, and shipping activities for critical items.

12.2.5.5 Inspection, Test, and Operating Status

Measures established to determine the status of inspection and test activities are identified in documents traceable to the items. Controls are established to identify nonconforming, inoperative, or malfunctioning components or systems and to prevent items from being processed beyond the required inspections, tests, or installation. Controls also prevent inadvertent use of the items.

Status of items is maintained on the processing documents or test plan. Equipment status is also maintained by use of shop documents or visible indicators. Review of suppliers' QAPs and procedures is conducted by WVNSCO to verify that the status of inspections and tests is adequately addressed.

WVNSCO QA personnel perform surveillances and audits of the suppliers for conformance to documented procedures regarding the identification of inspection status of work in process by inspection records, tags, markings, stamps, labels, shop travelers, or other appropriate means. A WVNSCO procedure has been established to: 1) designate status of items or equipment as "accepted," "hold," or "rejected"; 2) control application and removal of inspection tags by authorized persons; and 3) prevent bypassing of required inspections, tests, or other critical operations.

12.2.6 Nonconforming Materials, Components, and Fabrication and Construction Features

Materials, parts, components, equipment, structures, and systems that deviate from approved specifications, drawings, codes, or other applicable documents are considered nonconforming items and are identified and controlled to prevent inadvertent use or installation. If identification of each nonconforming item is not practical, the container, package, or segregated storage area, as appropriate, is identified. Nonconforming items discovered during manufacture, fabrication, shop test activities, or operations are controlled and documented in accordance with written procedures. WVDP-357, *WVDP Issues Reporting Program Manual*, provides formal procedures for resolving non-conformance issues.

WVNSCO provides requirements for suppliers' procedures for control and reporting of nonconforming items in procurement documents. Suppliers' and major Project participants' procedures are reviewed by WVNSCO as part of the overall review of their QAP. These procedures address, as applicable: identification, tagging, and segregation of nonconforming items; documentation of nonconforming items; disposition of the nonconformance; notification of affected organizations; rework or repair requirements; and reinspection and retest requirements.

12.2.7 Corrective Action

Measures are established and implemented by WVNSCO and major Project participants to ensure that adverse conditions such as failures, malfunctions, deficiencies, deviations, or defective material or equipment are promptly identified and corrected. In the case of significant conditions adverse to quality, the measures ensure that the cause is determined and that appropriate corrective action is taken by the responsible organization to prevent repetition or recurrence.

Identification of situations that may require corrective action are accomplished through periodic review of supplier surveillance activities, QA surveillance and monitoring programs, QA audits, and issue reports. Issue reports for significant issues document the identification of all significant conditions adverse to quality, including the cause of the condition, corrective action taken, and cost and/or schedule impact (when applicable). Corrective actions are reported to appropriate levels of management. Final verification or follow-up is documented by responsible parties.

Performance data, internal and external failures, and other quality-related information are analyzed to identify trends that adversely impact quality and to identify opportunities to improve items and processes. This analysis

considers information from external sources and is not limited to one type of work, one facility, or one contractor. The extent of cause analyses for nonconforming items and processes is commensurate with the importance or significance of the problem.

12.2.8 Quality Assurance Records

The WVDP QA Records Program includes requirements and responsibilities for identification, filing, transmittal, receipt, storage, retention, maintenance, retrieval, and disposition of QA records. The system addresses the records associated with design, QA, and procurement, including duration for each type of record. Sufficient information is provided to enable traceability to the item or activity to which it is associated.

QA Records are classified as either lifetime or nonpermanent. Criteria for classifying records are contained in WVDP-262, *WVNS Manual for Records Management and Storage*, which incorporates guidance contained in ASME NQA-1 and DOE/RW-0333P. Lifetime records are maintained for the life of the particular item.

Nonpermanent records are records that do not meet the criteria for lifetime records but are required as evidence that an activity was performed in accordance with the applicable requirements. Nonpermanent records need not be retained for the life of the item because they do not meet the criteria for lifetime records.

QA records provide sufficient information to permit matching of the record and the item(s) or activity to which it applies. This includes the following information as applicable: document title, number, revision, date, reference to appropriate contract, purchase order, work order numbers, references to appropriate drawings, specifications, procedures, and instructions. Records are indexed and maintained to provide for the retrieval of information within a reasonable time. The Project QA records include but are not limited to the following: results of reviews, inspections, tests, audits, monitoring of work performance, personnel qualifications, drawings, specifications, calculations, procurement documents, calibration procedures, nonconformance reports, and corrective action reports.

Inspection and test records identify the data, type of observation, results, acceptability, and the action taken with regard to any deficiencies noted.

12.2.9 Audits

A comprehensive program of planned and periodic WVNSCO audits is conducted under the direction of the QA Organization to verify compliance with the various aspects of the QAP and to determine the effectiveness of the program. The audits include review of indoctrination and training activities, processes, and items, and review of documents and records of corrective actions, calibrations, and nonconforming items control. The audits are conducted during design activities and procurement, construction, installation, system acceptance testing, operation phases, and D&D of the WVDP Project. The program includes audits of suppliers and major Project participants' activities in support of the Project.

Reviews and audits of nuclear facilities are performed. As part of the Integrated Safety Management System established at the WVDP, the assessment program includes intra-departmental self-assessments, independent assessments (which are performed by an organization that assess compliance with requirements that they do not implement), and management assessments. The

Radiation and Safety Committee role in review and approval of project activities is defined in WV-906, *Radiation and Safety Committee*. The WVNSCO Quality Assurance Department provides independent assessment of environmental, safety, and health-related programs through its performance analysis and audit and surveillance programs. Procedures identify the necessary approvals, authorizations, and requirements for performing readiness activities, developing related readiness documentation, and conducting required reviews, verifications, and reporting in accordance with DOE Order 425.1C, *Startup and Restart of Nuclear Facilities*. WVNSCO line management self-assessments are performed prior to the startup of a new nuclear facility, or restart after a shutdown that was directed by the DOE. Reviews "performed by facility personnel to ensure that day-to-day activities are conducted in a safe manner" are performed within the context of the Conduct of Operations Program discussed in this Chapter.

Audits are performed in accordance with written procedures or checklists by appropriately trained and qualified personnel within the QA organization and/or audit representatives and technical specialists from other organizations who do not have direct responsibility for the areas being audited. Audit results are documented and reviewed by management personnel having responsibility for the area being audited. Responsible management personnel ensure timely and appropriate action to correct and prevent recurrence of deficiencies revealed by the audit.

12.3 Quality Level Classification of Structures, Systems, and Components

The QAP provides guidance for determining the graded applicability of quality assurance standards to items, systems, or services. Structures, systems, and components that are covered by the QAP are graded and identified by quality level, which is based upon safety, environmental, health, and other programmatic considerations. The methodology for classification, and rationale for establishment of quality levels are identified in WVDP-002 (QM-2). With activities clearly identified by quality level, existing WVNSCO procedures and practices provide a mechanism and process for graded quality assurance. The quality level system consists of four quality levels:

Quality Level A

Quality Level A is assigned to activities affecting structures, systems, subsystems, components, or services where predicted consequences of failure, error, or other inadequacies are judged to have major or severe environmental, public health and safety, or programmatic impact.

Quality Level B

Quality Level B is assigned to activities affecting structures, systems, subsystems, components, or services where the predicted consequences of failure, error, or other inadequacies are judged to have significant on-site environmental, health and safety, or programmatic impact.

Quality Level C

Quality Level C is assigned to activities affecting structures, systems, subsystems, components, or services where the predicted consequences of failure, error, or other inadequacies are judged to have limited on-site environmental, health and safety, or programmatic impact. This category applies to activities that do not require categorization as Quality Level A or B, but that may have reportable, site-generated environmental or health and safety impact.

Quality Level N

Quality Level N applies to activities affecting structures, systems, subsystems, components, or services where the consequences of predicted failure, error, or other inadequacies are not judged to have significant environmental, health and safety, or programmatic impact. Application of quality assurance program controls is not required, but may be applied as determined appropriate and cost-effective by the cognizant performing organization.

REFERENCES FOR SECTION 12.0

American Society of Mechanical Engineers. *Quality Assurance Program Requirements for Nuclear Facilities.* ASME NQA-1. New York: American Society of Mechanical Engineers.

Jackson, T.J. April 5, 2004. *Review and Approval of the West Valley Nuclear Services Company Quality Assurance Program.* WVDP-111. Revision 9.

U.S. Department of Energy. September 29, 1998. DOE O 414.1A: *Quality Assurance.* Washington, D.C.: U.S. Department of Energy.

_____. August 1996. DOE G 414.1-1: *Implementation Guide for Use with Independent and Management Assessment Requirements of 10 CFR 830.122 and DOE O 414.1 Quality Assurance.* Washington, D.C.: U.S. Department of Energy.

_____. June 17, 1999. DOE G 414.1-2: *Quality Assurance Management System Guide for Use with 10 CFR 830.122 and DOE 414.1.* Washington, D.C.: U.S. Department of Energy.

_____. October 14, 1998. DOE Order 430.1A: *Life Cycle Asset Management.* Washington, D.C.: U.S. Department of Energy.

_____. June 30, 1997. DOE G 440.1-6: *Implementation Guide for Use with Suspect/Counterfeit Items Requirements of DOE O 440.1A.* Washington, D.C.: U.S. Department of Energy.

_____. November 26, 1997. DOE G 450.4-1: *Integrated Safety Management System Guide.* Washington, D.C.: U.S. Department of Energy.

_____. March 27, 1998. DOE Order 440.1A: *Worker Protection Management for DOE Federal and Contractor Employees.* Washington, D.C.: U.S. Department of Energy.

_____. May 18, 1992. DOE Order 5480.19: *Conduct of Operations Requirements for DOE Facilities*, Change 1. Washington, D.C.: U.S. Department of Energy.

_____. October 15, 1996. DOE P 450.4: *Safety Management System Policy.* Washington, D.C.: U.S. Department of Energy.

_____. April 15, 1994. *Implementation Guide for Use With 10 CFR Part 830.122 Quality Assurance.* G-830.122. Washington, D.C.: U.S. Department of Energy.

_____. December 18, 1992. *Quality Assurance Requirements and Description.* DOE/RW/0333P. Washington, D.C.: U.S. Department of Energy, Office of Civilian Radioactive Waste Management.

_____. *Quality Assurance Requirements, 10 CFR 830.122.*

_____. *Definition of Graded Approach, 10 CFR 830.3.*

_____. *Description of Graded Approach, 10 CFR 830.7.*

REFERENCES FOR SECTION 12.0
(Concluded)

West Valley Nuclear Services Co. DOE-WVDP-002: *West Valley Area Office Quality Assurance Program Description for WVDP High Level Waste Form Production Through Acceptance.* (Latest revision.)

_____. WV-120: *Quality Assurance Policy.* (latest revision).

_____. WV-923: *Nuclear Criticality Safety.* (latest revision).

_____. WVDP-002: *Quality Management Manual.* (latest revision).

_____. WVDP-002: *Quality Management Manual. QM-2: Quality Assurance Program.* (Latest Revision).

_____. WVDP-074: *WVNS Quality Assurance Program for High-Level Waste Form Production Through Acceptance.* (latest revision).

_____. WVDP-099: *Environmental Compliance Manual.* (latest revision).

_____. WVDP-111: *Quality Assurance Program.* (latest revision.)

_____. WVDP-117: *WVNS Policies and Procedures Manual.* (latest revision.)

_____. WVDP-204: *WVDP Quality List "Q-List".* (latest revision.)

_____. WVDP-262: *WVNS Manual for Records Management and Storage.* (latest revision.)

_____. WVDP-310: *WVDP Safety Management System (SMS) Description.* (latest revision.)

_____. WVDP-357: *WVDP Issues Reporting Program Manual.* (latest revision.)

TABLE 12.2-1

COVERAGE OF DOE-STD-3009-94 QUALITY ASSURANCE REQUIREMENTS
IN WVNS-SAR-001

WVDP-111 Criteria	DOE-STD-3009-94 QA Criteria	Coverage in SAR-001
1	Program and Organization	Sections 12.0, 12.1, 12.2
3	Quality Improvement	Sections 12.2.6, 12.2.7
4	Documents and Records	Sections 12.2.2, 12.2.3, 12.2.8
5	Work Processes	Sections 10.4.3, 12.2.3, 12.2.4.2, 12.2.5.3, 12.2.5.4
6	Design	Sections 4.0, 10.4.2.2, 12.2.1
7	Procurement	Sections 12.2.2, 12.2.4
8	Inspection and Acceptance Testing	Sections 12.2.3, 12.2.4, 12.2.5
10	Independent Assessment	Sections 12.2.6, 12.2.7, 12.2.9

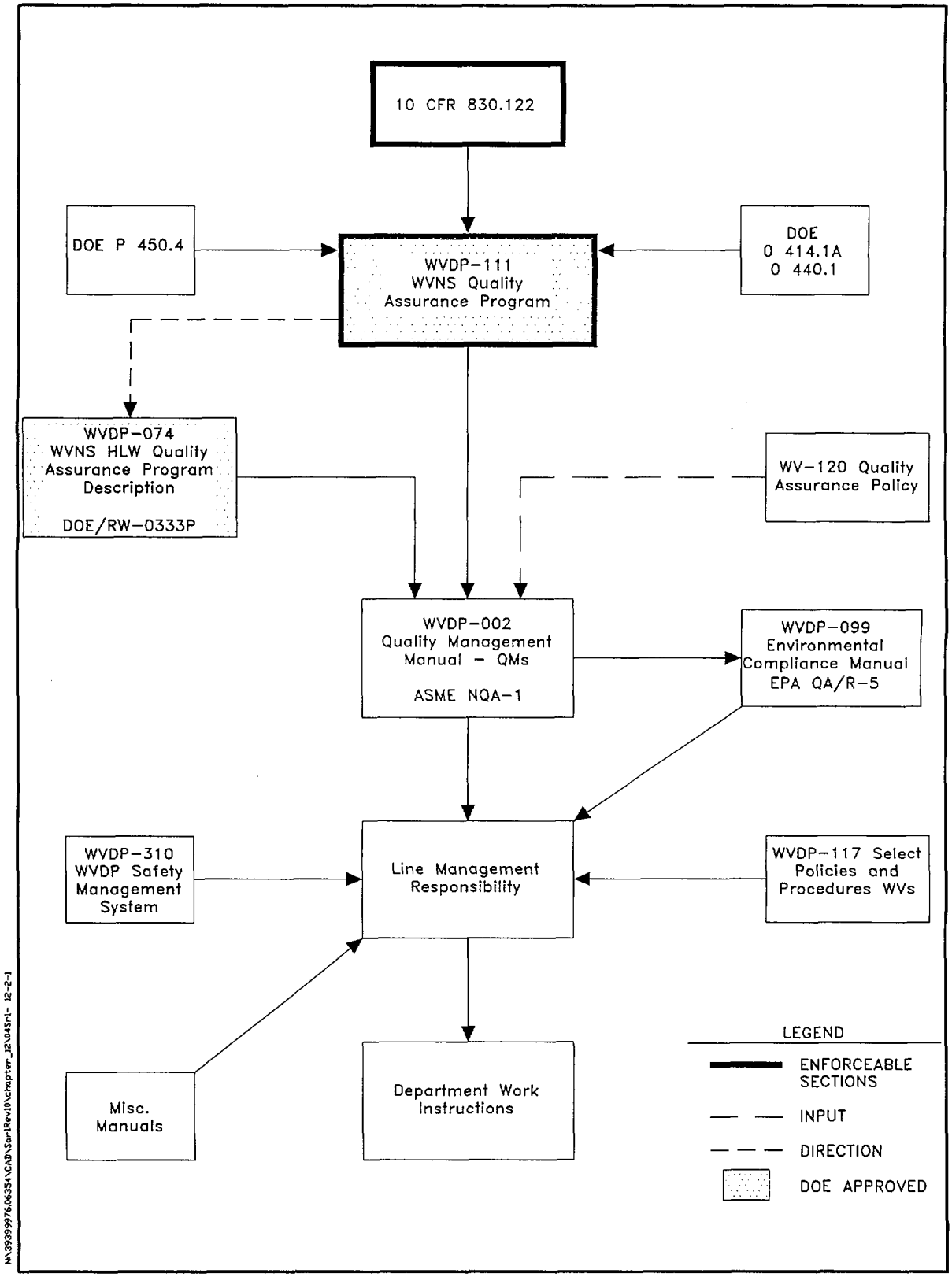


Figure 12.2-1 Quality Assurance Program Implementation Hierarchy

WVNS RECORD OF REVISION

Rev. No.	Description of Changes	Revision On Page(s)	Dated
0	Original Issue	All	08/88
1	Complete Rewrite - Per ECN #4847	All	08/93
2	Complete Revision - Per ECN #9233	All	08/96
3	Annual Revision - Per ECN #10901 (To comply with DOE Order 5480.23, Section 9, Paragraph c.)	As Indicated	08/14/97
4	Annual Revision - Per ECN #11600 (To comply with DOE Order 5480.23, Section 9, Paragraph c.) Changes in Rev. 4 reflect new or updated site documentation, organizational changes, new guidance (DOE Orders, ANSI/ANS standards, Implementation Manuals, etc.), and changes in site programs. The descriptions of the responsibilities of the Radiation & Safety Committee and the purpose of WV-914, *Unreviewed Safety Question Determination* (USQD), were enhanced and clarified. In addition, a discussion of the Integrated Safety Management System (ISMS) at the WVDP has been incorporated into this revision of the SAR. The section on emergency management has been updated to more fully reflect the transition to DOE Order 151.1, *Comprehensive Emergency Management System.*	As Indicated	08/26/98
5	Annual Revision - Per ECN #12181 All chapters were updated to reflect current site practices, procedures, and configurations. In addition, each chapter was updated to reflect changes in DOE guidance. Chapter 10 was revised to reflect recent WVNSCO corporate changes as well as WVDP organizational changes. A section was also added to describe the status of Y2K compliance. The section on Preoperational testing was streamlined to eliminate redundancy with WVDP-114, *WVNS Engineering Procedures.* The section on Agreements was updated to reflect recent negotiations between NRC, DOE, and NYSERDA. The agricultural information on milk production, meat production, and feed production was revised, along with Lake Erie commercial and sports fishery data. Cattaraugus Creek sport fish stocking data was updated, and the number of deer harvested in 1998 on the WNYNSC was added. Changes to the status of threatened and endangered fish and wildlife species were made, as were additions to the WVDP drilling projects table.	All	08/30/99

WVNS RECORD OF REVISION CONTINUATION PAGE

Rev. No.	Description of Changes	Revision On Page(s)	Dated
6	Per ECN #12783 Annual Revision - All chapters were updated to reflect current site practices, procedures, and configurations. In addition, each chapter was updated to reflect changes in DOE guidance. Chapter 10 was revised to reflect recent WVNSCO corporate changes as well as WVDP organizational changes. The section on Emergency Management was substantially revised to reflect the current program.	All	08/30/00
7	Per ECN #13188. Annual Revision - All chapters were updated to reflect current site practices, procedures, and configurations. In addition, each chapter was updated to reflect changes in DOE guidance. Chapter 10 was revised to reflect recent WVNSCO corporate changes as well as WVDP organizational changes. Chapter 3 was updated to reflect recent demographic and land use data. The section on Emergency Management was substantially revised to reflect the current program. WVNS-SAR-001, Rev. 7, was neither issued nor formally approved by DOE-OH. (REF. DW:2002:0162) See Revision 8 for additional information.	All	NA
8	Per ECN #13539. DOE-OH has granted approval of WVNS-SAR-001, Rev. 8 in letter DW:2002:0500 dated October 18, 2002 from Elizabeth A. Lowes, USDOE Ohio Field Office, to J.L. Little, President WVNS. WVNS-SAR-001, Rev. 7, was neither issued nor formally approved by DOE-OH. However, OH/WVDP deferred review of the annual updates of WVNS-SAR-001, -002, and -003 because of the upcoming review and approval of the consolidated SAR (i.e., WVNS-SAR-001, Rev.8). See Letter DW:2002:0162, dated April 4, 2002, from Brian C. Bower, OH/WVDP to file. This annual revision represents a consolidation and integration of WVNS-SAR-001, WVNS-SAR-002 (including Addendum 4), WVNS-SAR-003, and WVNS-SAR-012. All chapters were updated to reflect current site practices, procedures, configurations, and regulatory guidance. Figures were updated for clarity throughout. 10 CFR 830 was cited throughout and references to DOE Orders 5480.22 and 5480.23 were deleted. References to "authorization basis" were replaced with references to "safety basis" to comply with terminology used in 10 CFR 830. Repetitive text within and between SARs was deleted pursuant to consolidation. The summary of accidents in Chapter 2 was deleted to allow reference to the appropriate accident summary tables in Chapter 9, thereby eliminating repetition of tables. Substantial additions to Chapter 4 were made to make clear current DOE design requirements and guidance, and the hierarchy of DOE documents was provided regarding	All	11/13/02

WVNS RECORD OF REVISION CONTINUATION PAGE

Rev. No.	Description of Changes	Revision On Page(s)	Dated
8 (cont.)	design for natural phenomena hazards. Several figures that were in Chapter 5 of WVNS-SAR-003 were deleted based on the graded approach to SAR development and the fact that the vitrification campaign is essentially complete. Extensive changes were made throughout, especially in Chapters 5 and 6, to reflect the fact that storage racks and canisters are no longer present in the fuel storage pool and that spent nuclear fuel is not stored in the FRS Building. These changes included deletion of figures that showed details of a storage rack, a canister, and the canister crane. Chapter 6 was modified to discuss gas sampling of loaded SNF shipping casks in the FRS facility. The seismic category of the Diesel Generator Room inlet damper and outlet damper was revised from I to II per USQD 001-USQ-043. A major revision (including a substantial expansion) was made to the Process Hazards Analysis (PHA) table for the Vitrification Facility (VF) to make it resemble the PHA table in WVNS-SAR-002. The revised VF PHA table incorporates the information contained in the "original" VF PHA table. The "Accident Selection" section of Chapter 9 was amended to list the VF accidents that were evaluated in detail, and to make clear why those accidents were selected. Text was added to the "Consequence Analysis" section of Chapter 9 to address certain technical aspects associated with variances in the accident consequence analyses. A section was added to Chapter 9 to summarize VF accidents.	All	
9	Per ECN 25880, Approval letter: DW:2004:0085 This annual revision to WVNS-SAR-001 contains changes that reflect the substantially reduced hazards and accident-related risk at the site because of (1) the termination of the vitrification campaign, and hence the solidification of essentially all liquid high-level waste that existed in high-level waste tanks; (2) the lay-up of Tanks 8D-1 and 8D-2 and deactivation of the Supernatant Treatment System; (3) the removal of all spent nuclear fuel assemblies from the site and draining of the fuel storage pool and cask unloading pool; (4) the clean-up of the General Purpose Cell and Process Mechanical Cell; and (5) the removal from the site of hazardous substances such as ammonia and nitric acid which were use to support vitrification operations. Extensive amounts of text and numerous tables and figures were deleted in consideration of these changes at the site. Several accidents that received detailed evaluation in Chapter 9 have been deleted because they are either no longer possible or represent a level of risk that no longer warrants detailed analysis. Additions were made to the discussion in Section 9.2.1.4 (which addresses consequence analysis methodology) to make clear that χ/Q values used in the consequence assessments are the values provided in the current	All	03/08/04

WVNS RECORD OF REVISION CONTINUATION PAGE

Rev. No.	Description of Changes	Revision On Page(s)	Dated
9 (cont.)	revision to WVDP-065 or larger. For all accident consequence assessments that involve the failure of HEPA filters, a more technically accurate and defensible airborne release fraction was used. Substantial changes were made in Section 8.7 (which addresses prevention of inadvertent criticality) to more accurately portray current inadvertent criticality risks at the site and the analyses and measures that have been developed to address those risks. All chapters were updated to reflect current site practices, procedures, configurations, and regulatory guidance.	All	
10	Per ECN 26398 this routine annual update of WVNS-SAR-001 provides an update of facilities and operations at the WVDP, current as of September 30, 2004. This SAR update incorporates applicable facility and operations changes previously-evaluated in Unreviewed Safety Question Processes (USQPs) 03-USQ-091 through 04-USQ-050. Specific changes addressed in the SAR are discussed below. This annual revision to WVNS-SAR-001 establishes the WVDP as Hazard Category 3, and contains changes that reflect this designation of the WVDP. With this revision of WVNS-SAR-001, there are no longer any Hazard Category 2 facilities at the WVDP. Downgrading of several WVDP facilities from Hazard Category (HC) 2 to HC3 justified the deletion of a significant amount of outdated and/or superfluous information based on application of the graded approach to SAR development. This information included text, tables, and figures related to the affected facilities. Information provided in Chapter 3 was dramatically reduced based on implementation of guidance provided in DOE-STD-3009-94 for the description of site characteristics for a Hazard Category 3 facility. Information in Chapters 5 and 6 was significantly revised to reflect the current status of the deactivated Vitrification Facility, as well as the current status of IRTS and Main Plant areas. The status of D&D in these areas was reflected, and the discussion of Facility Decontamination and Deactivation in Chapter 6 was revised to make it more generally applicable. The discussion of Vitrification Facility areas and operations was significantly reduced for consistency with the graded approach that has been applied to the discussion of facilities and operations associated with the IRTS and Main Plant. The discussion of the Lag Storage Facility in Chapter 7 was updated to reflect current operations, and several other changes were made in Chapter 7 to update the information provided therein. The discussion of facility hazards contained in Chapter 8 was fully updated and the discussion of criticality safety was revised to incorporate information from all existing Nuclear Criticality Safety Evaluations (NCSEs).	All	01/23/06

WVNS RECORD OF REVISION CONTINUATION PAGE

Rev. No.	Description of Changes	Revision On Page(s)	Dated
10 (cont.)	Changes in Chapter 9 include: (1) Replaced reference to "Evaluation Basis Accident" with "Derivative Design Basis Accident" to be consistent with terminology given in DOE-STD-3009-94; (2) Deleted the accident analysis of a transformer leak/rupture (i.e., spill of PCBs) because potential consequences of this accident are negligible; (3) Abandoned frequency-dependent Evaluation Guideline (EG) for DOE-recommended MEOSI EG of 25 rem TEDE independent of accident frequency, as given in DOE-STD-3009-94 (4) Documented WVNSCO best management practice in comparing chemical concentrations at the MEOSI location to the ERPG-2/TEEL-2 value as a toxicological EG; (5) Revised accident calculations as necessary such that only χ/Q values provided in the latest revision of WVDP-065 are used, and to provide doses for a receptor at the revised on-site evaluation point (OEP) of 100 meters, as stipulated by DOE as a Condition of Approval, as discussed in WVDP-SAR-001, Rev.2 (see below); (6) Revised the hydrogen peroxide spill accident to model a pool 6 mm deep, since a 1 mm pool depth as previously modeled yields an unrealistic pool area given site topography and drainage features; and (7) Revised the HLW canister drop accident so as to model the release as being out of the Main Plant stack since all the canisters are now located in the HLWIS area.	All	

This routine annual update addresses the following Conditions of Approval given in Section 7.0 of WVDP-SER-001 (Rev. 2) that are applicable to the analysis contained in WVNS-SAR-001:

Applicable Conditions of Approval:

2) WVNS-SAR-001 and WVNS-SAR-023 shall be updated to also reflect a comparison to a non-frequency dependent Evaluation Guideline in accordance with guidance provided in Appendix A of DOE-STD-3009. These updates shall be accomplished no later than the next annual update of both SARs.

Incorporation: Section 9.1.3 of the SAR has been revised to reflect that the Evaluation Guideline to be used for comparison of off-site doses is 25 rem, independent of accident frequency, as indicated in Appendix A of DOE-STD-3009.

3) WVNS-SAR-001 and WVNS-SAR-023 shall use a 100 meter distance when performing consequence evaluations to on-site receptors. Since the Review Team concluded that overall results of the current hazard and accident analysis do not change, these updates shall be accomplished no later than the next annual update of both SARs.

Incorporation: Tables 9.2-2, 9.2-3, and 9.2-5 have been revised to state doses at the 100 meter distance. Doses to receptors at 100m are not reported for accident consequences summarized in Tables 9.2-1and 9.2-4 or for the consequence summarized in Tables 9.2-6 through 9.2-8 as these relate to accidents with elevated releases.

WVNS RECORD OF REVISION CONTINUATION PAGE

Rev. No.	Description of Changes	Revision On Page(s)	Dated
	In these instances the plume passes well above the breathing zone for an individual at the 100m evaluation point and therefore no doses from these releases are incurred by on-site receptors.		
	4) WVNS-SAR-001 shall recognize TRU waste containers for TRU waste containing greater [than] one (1) gram fissile material as a TSR Design Feature. Passive features and performance requirements described in Section 6.2 of this SER shall be used as the derivational basis for this control, until such time that the DSA is updated. The DSA shall update Chapters 7, 9 and 11 to reflect this Design Feature, and such changes shall be made no later than the next annual update of the DSA.		
	Incorporation: Sections 7.6.5, 9.2.2.3.4, and 11.3.2 of the SAR have been revised to address this commitment.		
	5) WVNS-SAR-001 shall recognize an additional administrative control that requires TRU wastes containing greater than one (1) gram of fissile material to be stored in approved non-combustible containers. Section 6.2 of this SER shall be used as the derivational basis for this control, until such time that the DSA is updated. The DSA shall update Chapter 9 and 11 to reflect this administrative control no later than the next annual update of the DSA.		
	Incorporation: Sections 9.2.2.3.4 and 11.3.3 of the SAR have been revised to address this commitment.		
	DOE Approval Letter: DW:2005:0234 dated 12/16/05		