SALT WASTE PROCESSING FACILITY

OPERATIONS REQUIREMENTS DOCUMENT

DELIVERABLE: 3.4

Contract No. DE-AC09-02SR22210
Phase II

Function: **Operations Requirements**
Doc. No.: **P-ESR-J-00011**
Revision: **3**
Date: **04/22/2015**

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SUMMARY OF CHANGES

Revision No.	Date	Description of Change
0	07/13/06	Issued for Approval
1	07/23/07	Issued for DOE Approval
1A1	04/10/09	Issued for Intradiscipline Check
1B	01/06/10	Issued for DOE Formal Review
2	01/27/10	Revised per DMR-0762 incorporating DCN-0465 (delete requirement to have a crane to support cell cover removal installation – cell covers not used.) Interdiscipline Review was not required per V-ESR-J-00022 (ICD-22). Issued for DOE Approval.
2A1	10/26/10	Revised per DMR-1572 updating document based upon comments on DCN-0780. Issued for Intradiscipline Check
2A2	10/27/10	Issued for Interdiscipline Review
2B	01/19/11	Issued for DOE Formal Review (Not issued for Formal Review due to DOE Action on P-SPC-J-00001, *SWPF Functional Specification*)
2A3	10/24/2013	Reissued for Interdiscipline Review
2B	12/12/2013	Issued for DOE Formal Review
2B1	08/20/2014	Issued to DOE for informal review. Incorporated DOE informal comments.
2B1A	12/17/2014	Issued to DOE for informal review. Incorporated DOE comments from 11/5/14 meeting.
2B1B	2/26/2015	Issued to DOE for informal review. Incorporated 1 additional comment from 11/5/2014 meeting.
3	4/06/2015	Issued for DOE Approval.
3	04/22/2015	Re-issued for DOE Approval

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LIST OF ACRONYMS AND ABBREVIATIONS

%	Percent
°F	degrees Fahrenheit
AFF	Alpha Finishing Facility
AFP	Alpha Finishing Process
ALARA	As Low As Reasonably Achievable
ASP	Alpha Strike Process
BOI	Batch Operator Interface
BOP	Balance of Plant
BPCS	Basic Process Control System
CAT	Consolidated Annual Training
CCA	Cold Chemical Area
CCTV	Closed-circuit Television
CFR	Code of Federal Regulations
CMMS	Computerized Maintenance Management System
CR	Control Room
CRB	Commissioning Review Board
Cs	Cesium
CSE	Cognizant System Engineer
CSS	Clarified Salt Solution
CSSX	Caustic-side Solvent Extraction
D&D	Decontamination and Decommissioning
DCS	Distributed Control System
DOE	U.S. Department of Energy
DSA	Documented Safety Analysis
DSS	Decontaminated Salt Solution
DWPF	Defense Waste Processing Facility
E&I	Electrical and Instrumentation
EDMS	Electronic Data Management System (EDMS)
EPC	Engineering, Procurement, and Construction
ESH	Environmental, Safety and Health
ESH&Q	Environmental, Safety, Health, and Quality
ft	Feet/foot
g/L	Grams per liter
GET	General Employee Training
HEPA	High-Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
I&C	Instrumentation and Control
ICD	Interface Control Document
ISMS	Integrated Safety Management System
ISOT	Integrated System Operational Test
JA	Job Analysis
kV	Kilovolt
LRW	Liquid Radioactive Waste

LIST OF ACRONYMS AND ABBREVIATIONS (cont.)

LTO	Long-term Operator
LW	Liquid Waste
M&TE	Measuring and Test Equipment
Mgal	Million gallons
MSDS	Material Safety Data Sheet
MST	Monosodium Titanate
O&M	Operations and Maintenance
OJT	On-the-Job Training
ORD	Operations Requirements Document
OSC	Operations Support Center
OSHA	Occupational Safety and Health Administration
P&VG	Pump and Valve Gallery
QA	Quality Assurance
RAMI	Reliability, Availability, Maintainability, and Inspectability
RPP	Radiation Protection Plan
SCR	South Carolina Regulation
SDS	Safety Data Sheet
SEHT	Strip Effluent Hold Tank
SIS	Safety Instrumented System
SOT	System Operational Test
SPF	Saltstone Production Facility
sq. ft	Square feet
Sr	Strontium
SRS	Savannah River Site
SSC	Structure, System, and Component
SSFT	Salt Solution Feed Tank
SWPF	Salt Waste Processing Facility
TSR	Technical Safety Requirement
UPS	Uninterruptible Power Supply
WAC	Waste Acceptance Criteria
wt%	Weight Percent

1.0 INTRODUCTION

The U.S. Department of Energy (DOE) selected Parsons as the Engineering, Procurement, and Construction (EPC) Contractor to design, construct, commission, and operate for one year the Salt Waste Processing Facility (SWPF) at the Savannah River Site (SRS). The SWPF is intended to remove and concentrate the radioactive strontium (Sr), actinides, and cesium (Cs) from the bulk salt waste solutions in the SRS liquid radioactive waste (LRW) tanks. The sludge and strip effluent from the SWPF that contain concentrated Sr, actinide, and Cs wastes will be sent to the Defense Waste Processing Facility (DWPF), where they will be vitrified. The decontaminated salt solution (DSS) that is left after removal of the highly radioactive constituents will be sent to the Saltstone Facility for immobilization in a grout mixture and disposal in grout vaults.

Phase I of the EPC Contract (DE-AC09-02SR22210, *Design, Construction, and Commissioning of a Salt Waste Processing Facility [SWPF]*[1]) (Contract) required completion of the SWPF Conceptual Design and preparation of the "Preliminary Baseline Range" Cost and Schedule Estimate for Phase II. Parsons was then selected as the EPC for Phase II of the Project. The Phase II scope of work includes Preliminary and Final Designs, Construction, Startup and Commissioning, and one year of operations. As part of the Phase I Conceptual Design, the EPC determined the operational requirements to be incorporated into the Facility design.

During Phase II, the EPC must complete Design and Construction and Commission the Facility. SWPF testing after system turnover to the Commissioning and Testing group extends from acceptance testing of installed components and systems to cold testing with a salt waste simulant, and finally to hot operational testing with radioactive salt waste. This is followed by hot operational period of one year. Following the one-year operational period, Operations will be transitioned to a selected long-term operator (LTO).

This Operations Requirements Document (ORD) establishes the Operations and Maintenance (O&M) philosophy and requirements for the life cycle of the SWPF. To ensure that O&M needs are used in the design of SWPF, O&M personnel participate in the design, procurement, and hazards/safety analysis processes.

The ORD will also provide the framework for development of P-SUP-J-00001, *SWPF Commissioning Plan*[2].

The following objectives were considered in development of the ORD:

1. Verify that the SWPF operating performance meets or exceeds DOE requirements specified in Standard 5 of the Contract (DE-AC09-02SR22210[1]);

2. Field-validate O&M procedures;

3. Conduct performance demonstrations to verify that the Operations staff has been adequately trained and qualified;

4. Verify that operational support services and equipment are adequate for Hot Operations;

5. Verify that the Documented Safety Analysis (DSA), including the Technical Safety Requirements (TSRs), have been implemented;

6. Verify that sampling and analysis plans, procedures, and equipment are adequate for assessing compliance with SWPF feed and product Waste Acceptance Criteria (WAC);

7. Verify that environmental permit conditions are satisfied;

8. Verify that program(s) are in place to confirm and periodically reconfirm the condition and operability of safety systems;

9. Assess the adequacy of the management assessment and quality assurance (QA) oversight programs and verify that programs are in place to identify, evaluate, and resolve deficiencies;

10. Verify Integrated Safety Management System (ISMS) implementation. Ensure that ISMS functions, assignments, responsibilities, and reporting relationships are clearly defined, understood, and effectively implemented;

11. Evaluate management processes for control of the Facility configuration and operating envelope, as described in the DSA and environmental permits. Verify that proposed tests and changes to procedures and structures, systems, and components (SSCs) are reviewed for unreviewed safety questions;

12. Verify that modifications to the Facility are reviewed for potential impacts on procedures, operator training, and overall plant performance; and

13. Verify that SWPF Design, Construction, and Commissioning test documentation is complete for transition to the selected LTO.

2.0 PURPOSE AND SCOPE

The SWPF design basis is described in the EPC's P-DB-J-00003, *SWPF Process Basis of Design*[3], and P-DB-J-00004, *SWPF Balance of Plant Basis of Design*[4]. These documents identify process requirements, regulatory requirements, safety requirements, interface requirements, and O&M requirements. This ORD provides a detailed explanation of the O&M and testability requirements.

2.1 Purpose

The ORD establishes the O&M philosophy and requirements for the life cycle of the SWPF. These requirements have been incorporated into the design basis. The O&M requirements were developed to maximize equipment reliability, operability, and maintainability, and to minimize safety risks and operator exposure to hazardous materials, while minimizing life-cycle cost. These O&M requirements, coupled with the other design requirements from the EPC's P-SPC-J-00002, *SWPF Functional Specification*[5]; S-EIP-J-00001, *SWPF Environmental Plan*[6]; and S-RCP-J-00001, *SWPF Standards/Requirements Identification Document*[7], are considered to be direct inputs into the SWPF basis of design

2.2 Scope

The scope of this ORD includes all elements of Standard 3, Section (b)(3) of the Contract (DE-AC09-02SR22210[1]). The ORD also provides the initial planning basis for staffing, training, and testing during Startup, Commissioning and One Year of Operation.

2.3 Configuration Control

The ORD is a required Contract (DE-AC09-02SR22210[1]) deliverable and is subject to change control in accordance with V-ESR-J-00022, *SWPF Document Control Interface Control Document (ICD-22)*[8] As the SWPF design evolves, some O&M requirements identified in the ORD may require revision. As an example, P-CRT-J-0014, *SWPF Operations Assessment and Tank Utilization Model*[9], developed in Phase I has been refined in Phase II. The final Phase II document (P-ESR-J-00003, *SWPF Operations Assessment and Tank Utilization Models*[10]) may require changes to reliability, availability, maintainability, and inspectability (RAMI) requirements in order to improve plant availability. The RAMI assumptions used in P-ESR-J-00003[10] to achieve the optimum plant availability have been incorporated into this ORD, P-DB-J-00003[3], and P-DB-J-00004[4]. Similarly, P-TPL-J-00001, *SWPF Construction, Procurement, and Acceptance Testing Plan*[11], and P-SUP-J-00001[2] will identify specific constructability, testing, and O&M requirements. In cases where discrepancies exist between the ORD and these documents, the discrepancies shall be evaluated and action taken to reconcile the discrepancies. Reconciliation of the discrepancies may require a design change to be initiated.

2.4 Application

The ORD shall be used as the O&M basis for designing the SWPF and provide a planning basis for development of future commissioning and O&M plans, procedures, and cost estimates. Specific design requirements stemming from the ORD have been captured in P-DB-J-00003[3] and P-DB-J-00004[4]. These documents and associated requirements are under configuration control. Any changes to O&M requirements or any other design requirements in P-DB-J-00003[3] and P-DB-J-00004[4] will require Formal Review and Approval.

3.0 PROCESS DESCRIPTION

Nuclear material production operations at SRS resulted in the generation of LRW that was sent to the F- and H-Area Tank Farms for storage. Approximately 37 million gallons (Mgal) of this waste is currently being stored on an interim basis in 47 existing underground waste storage tanks in the F- and H-Area Tank Farms. The LRW in these tanks includes approximately 3 Mgal of sludge containing precipitated solids and insoluble waste and 34 Mgal of salt solution liquor and crystallized salts. Prior to final treatment for disposal, the salt waste fraction will require pretreatment to separate radioactive constituents (Cs, Sr, and actinides) from the salt solution. The key processing facilities associated with disposition of the salt waste are described below.

3.1 Waste Feed from Tank Farms

Waste in the LRW tanks is comprised of three forms:

1. Precipitated Sludges – approximately 3 Mgal of primarily metal oxides containing over one-half the total inventories of radioactive material within the LRW tanks;
2. Saltcake – approximately 16 Mgal of salt precipitate; and
3. Supernate – approximately 18 Mgal of salt liquor.

There is considerable liquid mixed interstitially with the solid precipitated sludge and saltcake. The interstitial liquid is estimated to be 22 percent (%) of the saltcake volume and 70% of the sludge volume. Additionally, water will need to be added to the tanks to dissolve the saltcake prior to its removal from the waste tanks. The slurry water added for waste removal and the continued generation of LRW by other SRS facilities will significantly increase (2x to 3x) the total salt solution volume to be processed.

The SWPF is involved with the disposition of liquid forms of saltcake and supernate only.

The baseline quantities to be processed by the SWPF will depend on DOE's final salt waste processing strategy.

The supernate and any high-curie dissolved saltcake solutions removed from various LRW tanks will be sent to a tank for blending in batches. After characterizing a batch in the blending tank, the waste will be transferred to the SWPF Feed Tank, where it is staged for delivery to the SWPF. Transfers to SWPF are currently planned to be in mini batches of 23,200 gallons. Note that this quantity, as well as other parameters such as 12-hour strike time, concentration to 5 weight percent (wt%), Organic to Aqueous ratios are design parameters. The Facility may be operated with different parameters under approved operating procedures.

3.2 Salt Waste Processing Facility

The SWPF takes salt waste feed directly from the SWPF Feed Tank. The material being sent to SWPF will contain concentrations of Cs, Sr, and actinides. The feed constituent and curie concentrations will vary on a batch-to-batch basis. The feed will be analyzed for chemical and radionuclide concentrations in a blending tank prior to delivery to the SWPF Feed Tank.

Three basic unit operations (Alpha Strike Process [ASP], Caustic-side Solvent Extraction [CSSX], and Alpha Finishing Process [AFP]) will be used to pre-treat the high-curie salt waste at the SWPF. The ASP is the initial stage. In this stage, the Sr and actinides are sorbed onto Monosodium Titanate (MST) and the resultant slurry is filtered to remove the MST and insoluble solids. The ASP is operated in a batch-wise process, in which MST is added to the waste feed solution and then mixed for a sufficient duration to allow time for Sr and actinide adsorption onto the MST. This process is referred to as a "strike". The mixed slurry is then filtered to reach a nominal solids concentration of 5 wt%. The MST and insoluble solids (MST/sludge) are sent to

the DWPF for vitrification. The clarified salt solution (CSS) is sent to the second SWPF stage for Cs removal.

The second SWPF pretreatment stage uses a CSSX process to remove Cs from the salt solution. This is a continuous flow process utilizing 36 contactor stages for extraction, washing, stripping, and scrubbing of aqueous and organic streams. The Cs is captured by contacting the aqueous salt solution with a specially engineered extractant in an organic phase. The Cs is then stripped from the organic phase by contacting the organic with an acidic strip solution. The strip effluent (containing a high concentration of Cs) is sent to the DWPF for vitrification. The DSS from the extractant stages is sent to the Saltstone Facility to be solidified with a cementitious grout mixture.

The final unit operation, the AFP, is located after the CSSX process in the Alpha Finishing Facility (AFF) and will be used when multiple MST strikes are required to treat the feed material. The operation of the AFP is identical to the ASP, but is a contact-handled process due to its placement downstream of the CSSX process where the majority of the radioactivity is removed from the feed material.

Although process operations for the SWPF are not overly complex, monitoring and controlling the process chemistry will be essential to ensuring that product specifications are met and ensuring that the processes are performing optimally. This monitoring will be done with some continuous measurements and periodic analyses of samples.

3.3 Saltstone Facility

The Saltstone Production Facility (SPF) receives the DSS product stream from the SWPF directly or from the tank farm (and other facilities) and mixes it with cementitious constituents.

The DSS product generated by the SWPF must meet the specified Saltstone WAC limits. Note that DSS may be transferred to H-Tank Farm for interim storage before being transferred to SPF. In this case the H-Tank Farm WAC must be met. Reference to SPF in this document includes this interim H-Tank Farm storage and WAC requirements. MST performance test data indicated that MST concentrations of 0.4 grams per liter (g/L) in the Alpha Sorption Tank-A should be adequate for most batches (.2 g/L for modified MST), and that multiple strikes of 0.4 g/L will be sufficient for the worst-case feed batches.

3.4 Defense Waste Processing Facility

The DWPF will receive highly concentrated MST/sludge and strip effluent from the SWPF.

The SWPF products being directed to the DWPF must be sampled and analyzed to verify compliance with the DWPF WAC and provide other needed information on the product constituents. The SWPF process should minimize the volume of MST delivered to DWPF to minimize canister production.

4.0 OPERATIONS AND MAINTENANCE – RELIABILITY, AVAILABILITY, MAINTAINABILITY, AND INSPECTABILITY PROVISIONS

The key to efficient and cost-effective long-term operations is to incorporate RAMI requirements into the Facility design. This section covers specific RAMI requirements that will be applied to the SWPF.

4.1 Reliability

Reliability provisions relate to the ability of individual plant components to operate when required. The selection of reliable equipment must be considered in the design phases and carried through to SWPF operations. Specific factors for obtaining reliability follow:

1. Matching equipment characteristics to needed functional characteristics with the specified machinery. Reasonable conservatism on specification of equipment dynamic performance characteristics is necessary.
2. Specification of materials for equipment fabrication to prevent failure due to corrosion, structural fatigue, radiation damage, and other mechanisms.
3. Design reviews of selected equipment and subsystem configurations and specifications by personnel knowledgeable in both plant operation and maintenance.
4. Procurement of equipment designed and fabricated in accordance with recognized industry codes and standards.
5. Inspection and factory testing of fabricated equipment by the vendor and witnessed by QA and Commissioning personnel as needed to ensure compliance to design specifications.
6. Installation and acceptance testing during construction. Typical testing includes:
   - Non-destructive examination of welds,
   - Hydrostatic and pneumatic testing of fluid systems,
   - Motor phase rotation checks and rotational bumps,
   - System cleaning and flushing,
   - Insulation resistance measurements on low voltage feeder and branch circuits,
   - Continuity and ground isolation tests on control and communications circuits,
   - Testing of 13.8 kilovolt (kV) and 480 volt electrical system components and equipment per the requirements of American National Standards Institute/InterNational Electrical Testing Association (ANSI/NETA) ATS-2006, *Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems*[12], and
   - Initial component and system operation and balancing of heating, ventilating, and air conditioning (HVAC) systems installed by subcontractors.

7. System Operational Tests (SOTs) and Integrated System Operational Tests (ISOTs). This testing will verify that 1) the plant systems perform as expected, and 2) equipment operates reliably under normal operations and upset conditions.
8. O&M procedures that incorporate vendor recommendations for maintaining and improving equipment reliability.
9. Cold Commissioning tests using waste simulants. The plant control systems and time phasing of process steps will be optimized.
10. Hot Commissioning test and operational runs that verify the process operations perform as expected with actual salt waste feed.
11. Predictive and preventive maintenance requirements schedule, in accordance with manufacturer recommendations and industry practice. Standard software for maintenance scheduling will be used to provide information and a database of records that will facilitate transfer of information to the LTO prior to the end of the one year of Operations.
12. Overhaul or replacement of equipment during scheduled outage periods.
13. Operational Assessment Modeling results that predict overall plant availability, based on historical equipment performance data and actual test data. These results will identify systems and individual components that have low mean-time-to-failure or high mean-time-to-repair characteristics based on prior operational experience and testing, which will require design improvements or a rigorous preventive/corrective maintenance regimen.

4.2 Availability

Availability is defined as the annual percentage of time the SWPF is operating at the plant design production rate and producing acceptable product. The SWPF target availability value is 75% annually, which corresponds to the system operating at rated capacity for 270 days per year. Specific means of achieving or exceeding this level of Facility availability follows.

1. Redundant or back-up systems or components are provided to permit process change-over in the event of a component or subsystem failure when that component could cause a processing delay. A particular example is the product transfer pumps for strip effluent and DSS from the SWPF to the DWPF and SPF. They are redundant and 100% capacity each. This pump redundancy provides greater assurance that the product liquid can be rapidly transferred to the downstream Facility when needed. It also ensures that the SWPF product tanks are not filled to capacity, causing a plant shutdown due to unavailable product storage volume. The redundant systems are typically in separate labyrinths to allow for As Low As Reasonably Achievable (ALARA) maintenance on one portion of the system, while the other portion continues to operate. In cases where the upstream vessel may have to be de-inventoried to support maintenance, or the system is not continuously operated, the redundant systems may be co-located in a labyrinth and operated until a convenient outage is available. The vessels have multiple methods of being de-inventoried to ensure maintenance can be completed. The labyrinth design meets this requirement.
2. Provision for extra waste tank storage to provide a buffer between major unit operations. This allows continued operation of the remaining parts of the plant, if one part of the plant is

shut down. The Salt Solution Feed Tank (SSFT) provides a buffer between the ASP and CSSX process.

3. The contactors have provision for "in-place" maintenance. These provisions include:
   a) Internal "Clean-in-Place" nozzles – These nozzles flush the contactor rotor cavity to prevent accumulated solids buildup that could potentially limit or stop contactor operation; and
   b) Internal/Drive Motor Replacement – The contactor design provides for removal of the drive motor and/or the internal rotor assembly (as one piece).
4. Operations personnel will be cross-trained in SWPF operational control duties and functions. This will allow ready substitution of operations personnel and assignment of additional staff to areas of the plant requiring special attention during changes in operating modes or production levels.
5. Each shift will include on-duty personnel with additional skills beyond process control. This will include an engineer qualified as Shift Technical Advisor/Shift Technical Engineer, Radiological Control Technicians, maintenance personnel, and analytical laboratory personnel. Additionally, key systems engineers and maintenance personnel will be on-call to assist with any difficult technical or equipment problems that may arise.
6. P-ESR-J-00003[10] identifies systems and components that contribute significantly to plant unavailability. These systems and components will be subject to a more rigorous preventive/corrective maintenance regimen.
7. A spare parts list shall be developed for parts and equipment, based on expected failure rates and procurement lead times. These spare parts shall be procured by the EPC. Storage of the spare parts is also the responsibility of the EPC.
8. Corrective maintenance procedures and qualified maintenance personnel shall be available for rapid repair/replacement of equipment prone to failure.

4.3 Maintainability

Maintainability is defined as the design features of the SWPF process and equipment that provide for routine planned maintenance and corrective maintenance for failed equipment. Maintenance in either planned or unanticipated situations is necessary to ensure a high level of plant availability and adequate product quality. The following maintainability features will be incorporated into the SWPF design and operational planning.

1. Standard Connections – Mechanical and electrical connections will be standardized to the greatest extent possible. Electrical and Instrumentation (E&I) jumpers, if used, will use standard pin connectors.
2. Quick Disconnects – Piping connections for non-radioactive removable components will utilize standard industrial quick disconnects.
3. Replaceable Items/Radiation Resistance – Radiation damage to replaceable items (such as gaskets and seals) will be considered. Teflon will not be used in applications in which it will

be exposed to high levels of radiation, except as allowed in P-DB-J-00003[3]. Materials selected for use in high radiation fields will be designed to withstand the anticipated cumulative dose over their design life.

4. Decontamination – Equipment shall be designed to facilitate decontamination. Piping runs will be evaluated to minimize locations where suspended solids or precipitate from waste solution can accumulate. Decontamination area and process cells will use stainless steel liners or a chemical- and radiation-resistant coating (such as epoxy paint) to facilitate decontamination. Process tanks shall be equipped with internal spray nozzles or other water flushing capability to facilitate decontamination. Process piping shall be sloped in accordance with P-DB-J-00004[4]. High point vents and low point drains shall be provided everywhere necessary to fill and drain process equipment and piping.
5. Material Handling– Equipment will be designed to be installed/removed using a single crane or lifting machine and standard rigging equipment.
6. Mock-Ups/Maintenance Trials – Mock-ups, Maintenance Trials, or test fixtures of process equipment requiring remote removal/replacement or disassembly/reassembly will be used as needed for verifying equipment maintainability and as training aids. Maintenance trials will be carried out prior to Hot Commissioning to confirm maintenance can be carried out successfully. The trials will give a realistic estimate of the time required to conduct the specific maintenance activities for future dose management planning. In addition, the maintenance trial will validate the maintenance instructions and provide training for maintenance technicians.
7. Portable Shielding – Provisions shall be made for portable or modular shielding for use in maintenance and inspection.
8. Accessibility – Layout of plant equipment shall include provisions for contact maintenance and have sufficient clearance to provide access and to allow for the installation of temporary shielding (as applicable) to support maintenance on items that cannot be adequately flushed. General guidelines on necessary clearances are included in Sections 9.2 and 9.3.
9. Designated Maintenance Areas – The process area design shall provide for the removal and replacement of components. The following capabilities shall be provided:

   a) Laydown area to accommodate the staging of equipment during removal and installation, and

   b) Decontamination equipment/tools to perform decontamination of process equipment.

   The equipment laydown, decontamination and maintenance areas shall be sufficient to accommodate the largest maintainable removable cell component. The capability shall be provided to unload/load contaminated and clean equipment for shipment, including the ability to handle, package, and survey the equipment, as appropriate. Stands, jigs, and hoists shall be provided to handle, transport and repair equipment.

   Capability shall be provided for decontamination and maintenance of the hot cell crane(s) and/or manipulators.

10. Draining/Flushing – Fluid components (tanks, pumps, contactors, related piping, etc.) shall be designed to be drained and flushed. A collection tank for the drained fluid will be provided. Isolation (stop) valves shall be provided to permit isolation of specific components to facilitate maintenance. Double isolation (two valves) will be used when needed (e.g., waste transfer line isolation) to provide an appropriate level of safety. The valves shall include leakage minimization features.
11. Instrumentation – Provisions for maintenance or calibration of instrumentation shall be a major factor in selection of equipment for use in the SWPF. Specific guidelines for maintainability are included in Sections 9.1, 10.5, 10.6, and 10.8.
12. Liquid Waste Collection – Provisions shall be included for collection, sampling, storage, and transfer of miscellaneous waste liquids. This shall include, but not be limited to: floor and equipment drains; cell sumps; liquids from decontamination operations; HVAC condensate; and off-spec chemicals, etc. Contaminated and non-contaminated liquid systems shall be maintained separately.
13. To the extent possible, process equipment that will become contaminated during operation, and may require replacement, shall be sized to fit in standard waste disposal containers. Where this is not practicable, special waste disposal containers should be procured for disposal of contaminated equipment.
14. Maintenance Records Database - A Computerized Maintenance Management System (CMMS) shall be utilized to provide maintenance history on plant equipment. The CMMS shall be utilized to prompt all Preventive Maintenance tasks, track trends in equipment failure, spare parts used, as well as repair times for work performed. The CMMS will facilitate the EPC's transfer of information to the LTO at the conclusion of one year of operations.
15. Operating Records/Logs – Records shall be maintained on system configuration changes, status of major equipment, and operational mode changes and adjustments to control settings. These records will be used when necessary to identify the root cause of operational upset conditions or equipment failure.

4.4 Inspectability

Inspectability is defined as the capability of performing equipment inspections or process performance measurements necessary to ensure environmental compliance, safe operation, and product acceptability. Process systems and components, especially those performing safety-related functions, shall be designed and arranged so they can be adequately inspected, tested, and maintained (as appropriate) before being placed in service and at suitable and regular intervals thereafter. The Facility design shall provide for non-destructive, in-service inspections of safety- and mission-related equipment by contact and/or remote inspection. The following provisions shall be included in the design and operating procedures to facilitate inspectability.

1. Environmental Compliance – Facility design shall support the environmental monitoring and sampling requirements set forth in S-EIP-J-00001[6] and V-ESR-J-00019, *SWPF Permitting and Monitoring Requirement Interface Control Document (ICD-19)*[13].

2. Product and In-Process Monitoring and Sampling – Product storage tanks for liquid streams being directed to the DWPF and Saltstone will have sampling systems to obtain samples and transport them to the SWPF Analytical Laboratory for analysis to verify that SWPF product specifications are met. Also, key locations in the process (process feed input, various process tanks, CSS to CSSX, etc.) will have provisions for sampling (Section 11.0). Samples will be collected from these locations and analyzed at these locations to determine process efficiencies and changes in the radiochemical composition of the process streams during batch processing. In some cases, real time on-line monitoring of select chemical or radiation parameters within the process streams will be used to determine if significant process anomalies are occurring that require immediate action.
3. Instrumentation Surveillance – Instrumentation shall be designed and installed to provide accessibility for maintenance, calibration, and periodic on-line surveillance testing and troubleshooting. Instrumentation shall be located outside shielded cells, where possible. Instrumentation that must be located inside a shielded cell shall be designed to allow remote installation, removal, maintenance, and operations.
4. Valve Position Indication – Valves that are controlled remotely shall be provided with means to indicate (e.g., limit switches) whether the valve is fully open or fully closed.
5. Maintenance of Instruments – Radioactive process tanks and inaccessible equipment shall be instrumented such that sensing devices and instrument signal conditioning devices can be maintained, calibrated, and replaced without requiring entry into a high-radiation area.
6. Leakage Monitoring – A secondary containment system shall be provided for detection of leakage from in-process liquid waste storage and intra-Facility transfer equipment. The secondary containment shall be designed to direct leakage to an appropriate leak detection device and drain path or sump for subsequent removal of any accumulated waste.
7. Process Cell Surveillance – Radiation-hardened cameras shall be provided to allow monitoring of in-cell conditions. The cameras are only inserted into the cell on an as needed basis. The camera shall be controlled remotely from the Control Room (CR) or locally and have pan, tilt, and zoom capabilities; they will be placed to allow as complete cell coverage as possible.
8. Monitoring and Control Features for Safe Process Operation – Safe operation and control of the SWPF will require control systems that provide surveillance of the key safety and performance features of the plant. The design features that provide this will include the following.
   a) Instrumentation and Control (I&C) system shall provide for remote monitoring and control of process systems and critical support systems. The SWPF shall be configured in such a way as to provide the capability for a safe and controlled emergency shutdown of the Facility from the CR or the SWPF Safe Shutdown Panel.
   b) The Facility shall provide a CR, arranged to support human factors principles and guidance. All major process operations shall be controlled from the CR through a Distributed Control System (DCS).

c) Transfer of fluids from the Tank Farms to the SWPF, and from the SWPF to the DWPF and Saltstone, shall be monitored from the CR. The CR Operator shall have the capability to remotely terminate any transfer. Any interlocks or remote transfer termination capability shall be mutually acceptable to the Liquid Waste Operator and EPC to ensure that damage to transfer lines will not be caused by the actions initiated.

d) Equipment connected to the DCS will go to the failsafe position, when applicable, upon loss of power/communications with the system.

e) Select process parameters data and control input commands from the DCS shall be recorded on appropriate media to allow for future retrieval of process information and to trend equipment performance.

9. Chemical Inventory – An inventory system shall be maintained, providing for management of data on chemical materials contained within the Facility. Process chemicals such as solvents, and other process, laboratory, and miscellaneous chemicals (such as janitorial supplies) shall have Material Safety Data Sheets (MSDSs) or Safety Data Sheets (SDS) available for reference within the SWPF. Provision shall also be made for inspection of cold chemicals while in storage.

10. Laboratory Operations Surveillance – Analytical Laboratory procedures shall be developed for:

    a) O&M of laboratory equipment and instrumentation;

    b) Sample handling and analysis;

    c) Chemical reagent handling, used sample disposition, etc.;

    d) Sample accountability and recording of analytical results data with appropriate QA controls; and

    e) Analytical data from all samples shall be entered into a computer database to allow future retrieval of results and to trend performance.

11. Solid Waste Storage – A suitable location shall be provided for segregation, packaging, sampling (including external container assays), and interim storage of radioactive solid wastes. This area shall be used for waste handling activities prior to waste removal from the SWPF for disposal.

5.0 OPERATION AND MAINTENANCE PHILOSOPHY

The SWPF Operations organization consists of the Commissioning and Testing group and the Plant Operations group. The Commissioning and Testing group has primary responsibility for conducting startup testing that consists of component, system and integrated system testing. The Plant Operations group supports the Commissioning and Testing group during the startup testing phase. Upon completion of startup testing all systems are turned over to the Plant Operations group to conduct testing with waste simulant and preparing the plant and staff for hot operations. The EPC's philosophy is to integrate Operations personnel into the overall design from the initial phases of the SWPF Project. Accordingly, Operations staff personnel have been part of the EPC Team from the Conceptual Design phase and will continue to be until the eventual turnover of

the plant to the selected LTO. In the design phase, the EPC's Operations staff was involved in the design development when making key decisions on Facility layout, component selection, operations, and maintenance. During Acceptance Testing required for construction mechanical completion, the Construction organization shall have lead responsibility with Operations support as needed.

During System Operational Testing and Integrated System Operational Testing, the Commissioning and Testing organization shall have lead responsibility for testing and controlling system status and design and operational configuration. Systems shall be under the control of Commissioning and Testing organization when turned over from Construction. The Commissioning and Testing organization shall be supported by Plant Operations staff and Cognizant System Engineers (CSEs) assigned from the Engineering staff. Commissioning and Testing shall be responsible for valve and switch manipulations necessary to accomplish the tests. Equipment modifications and repairs required during the System Operational Testing and Integrated System Operational Testing shall be controlled by the Construction or Maintenance organization based on jurisdictional control of the equipment.

During Cold and Hot Commissioning, Plant Operations shall be responsible for controlling system configuration, operating plant equipment, directing and/or performing TSR surveillance tests, removal of systems from service for maintenance, and directing or conducting post-maintenance tests. Equipment repair and minor plant modifications will be performed by the Maintenance staff, in accordance with Work Packages under a Work Control administrative program.

During startup testing and commissioning, operators shall complete practical factor requirements for qualification. TSR Surveillance Tests and Predictive/Preventive Maintenance procedures shall be field-validated. Operations support staff shall also complete training and qualification during Cold Commissioning. This includes Operations Engineering Support, Radiological Protection, Laboratory Chemists and Analysts, Emergency Preparedness, etc. The independent Readiness Review conducted near the end of Cold Commissioning shall demonstrate that the plant has been properly tested, O&M procedures and management systems and procedures have been validated and implemented, and the Operations and related support staffs have been trained and qualified.

Hot Commissioning will be performed under the controls used during Cold Commissioning, but with Documented Safety Analysis (DSA) TSR controls and Radiological Protection, Environmental Monitoring, and Emergency Preparedness programs fully implemented. The Operations organization shall start up and operate the plant in accordance with the approved operating procedures and the Hot Commissioning test plans and procedures.

Following Hot Commissioning and one-year of extended Hot Operations, the remaining Operations staff will assist in transition of the operating plant to the control of the selected LTO.

5.1 General Operational Guidelines

In keeping with the Project workplace priorities, which place safety and quality ahead of schedule and cost, a consistent operating philosophy will be applied to the SWPF, with primary considerations focused on maintaining personnel radiation exposure ALARA, safety of workers and the public, protection of the environment, and protection of the facilities. Operations will be conducted within the limits of the DSA and in compliance with applicable DOE and other Federal, State, and local laws and regulations.

SWPF operations will be conducted in a formal manner, with the goal to deliver a high-quality product through an environment of professionalism and teamwork. This goal will be achieved through establishing formal standards, providing sufficient resources, periodically assessing performance, providing feedback for continuous improvement, and holding personnel accountable for safety and operating performance.

SWPF administrative procedures for operations will implement the conduct of operations requirements provided in DOE O 422.1, *Conduct of Operations*[14]. The SWPF Work Control, Radiological Protection, and other administrative programs and the Facility training program shall be developed to implement the ISMS process, as described in P-EIP-J-00001, *SWPF Integrated Safety Management System Description*[15].

The plant will generally be operated on a 24-hours-per-day, seven-days-per-week basis, with the required number of O&M personnel. The SWPF feed receipt and product transfer operations shall be coordinated with LW (Liquid Waste) System operations, including the Tank Farms, DWPF, and the SPF.

5.2 Operational Design Factors

1. SWPF systems will provide appropriate detection and diagnostic information that will allow the plant operator to identify abnormal conditions, recover from situations quickly and safely, and return the plant to normal operation.
2. After setting batch processing control parameters, provisions for automating routine operations through DCS should be available.
3. If unsafe conditions are detected, the plant process systems shall automatically be placed in a safe shutdown condition, without operator intervention.
4. The CR shall be provided with the capability to remotely place the plant process systems in a safe shutdown condition.
5. The CR shall be capable of monitoring and trending key process control and safe shutdown parameters and display system status information under anticipated normal and abnormal conditions.
6. Standardized monitoring and control systems shall be utilized throughout the plant to the maximum extent possible.

7. Simple, common sense modes of operational control will be factored into the design to ease operability in both normal and abnormal situations.
8. Alarm panels, operator controls, control panels, and other Human-Machine Interfaces shall be designed in accordance with industry-accepted Human Factors requirements.
9. Actuators need not be provided for remote valve operation for valves that are not operated frequently, such as maintenance flush valves.
10. Data and information on process conditions will be provided as a portion of the Basic Process Control System (BPCS).
11. Capability for monitoring of environmental conditions in the CR will be provided to help coordinate incident response.
12. System design will utilize in-line measurements for process control when data must be available in real time. Examples include radiation monitoring of the process stream entering the AFF or the Strip Effluent Hold Tank (SEHT), turbidity monitoring of the process stream entering the DSS Hold Tank for WAC compliance, and dynamic mixing of scrub solution and deionized water to produce strip solution.
13. The SWPF design will incorporate radiological zoning to confine radioactive material. Occupancy zones based on hazards shall meet applicable code requirements.
14. Liquid waste collected from floor drains and process cell sumps that is potentially radioactive shall be recycled for processing, where possible, to minimize secondary waste generation.
15. Provisions shall be made for the remote operation of equipment where radiation levels dictate such provisions.
16. Equipment and components will be designed to minimize the potential for radioactive contamination, and will include features to facilitate appropriate decontamination techniques.
17. Recovery operations are supported by a wide range of design features including Standby Diesel Generator, extensive drain and flush capability, ability to access the dark cells and all other portions of the plant.
18. SWPF operations will be integrated with the SRS LW System operations.

5.3 General Maintenance Guidelines

The maintenance program establishes requirements for performing maintenance of equipment and systems. This program utilizes established maintenance principles for effective implementation and control of maintenance activities. The ISMS principles will be an inherent part of work control planning and scheduling. ISMS core functions and guiding principles shall be an integral part of work practices at all levels.

Routine maintenance operations will commence upon transition of individual systems from the Construction organization to the Commissioning organization. A process will be established to protect assets that have been procured prior to the asset being placed into service. This process will ensure assets requiring preservation maintenance are preserved and maintained prior to Commissioning to prevent damage and degradation of the procured asset.

The predictive and preventive maintenance program will address manufacturer and equipment supplier requirements and recommendations, as well as engineering evaluations. The CMMS is a commercial-off-the-shelf client-server application, which provides a platform for users to prioritize tasks, assign work based on the availability of necessary parts and labor, and analyze equipment failures to implement appropriate preventive/predictive maintenance measures. The CMMS will track and schedule preventive maintenance activities.

Where possible, equipment that will require preventive maintenance or is likely to fail during the plant life cycle shall be located outside high-contamination and high-radiation areas to allow hands-on maintenance. In instances where this is not practicable, provisions shall be made to thoroughly drain and flush the system components and isolate them for maintenance. Layout of components shall facilitate access and the placement of temporary shielding to allow component removal. Decontamination capabilities that will accommodate the largest maintainable component shall be provided within the Facility.

A work control system shall be implemented prior to the first system turnover to Operations to allow for performing maintenance in a safe, timely, and controlled manner. The work control system will allow the Operations staff to control the plant configuration and establish lockout/tagout boundaries for maintenance. It also provides management with an accurate status of maintenance planning and outstanding maintenance activities. Work activities are scheduled by use of a priority system. Work to be accomplished will be clearly defined by a Work Package that includes applicable permits and maintenance procedures or instructions. Troubleshooting activities will also be controlled by applicable Work Packages and instructions. Maintenance instructions shall be developed for all preventive maintenance, TSR-required surveillances, and anticipated corrective maintenance activities.

Work planning will include considerations such as materials, tools, manpower requirements, schedule and coordination, safety, radiological protection, and quality control. Advance planning of work will be performed and routinely updated for scheduled and unscheduled outages. ALARA concepts will be used in work planning to minimize worker exposure. Maintenance personnel shall be intimately involved in pre-planning maintenance activities. The ISMS principles will be used to involve maintenance personnel in hazard identification and in developing hazard mitigation actions.

The work control process will ensure that maintenance tasks are thoroughly preplanned, maintenance activities are properly authorized, maintenance is performed in accordance with written work instructions, and post-maintenance testing is performed when required. Completed Work Packages will be reviewed to verify that prescribed maintenance was completed and properly documented, and that post-maintenance testing was performed, if required.

Post-maintenance testing will be performed when the maintenance involved could have affected equipment/system operation in a way that could not be detected by simple external inspections or observation. Post-maintenance or post-modification testing will verify the corrective maintenance activity or system modification corrected the original problem, the system or systems have been returned to original operating specifications, and no new problems were

introduced. Any testing following maintenance will be specified in the Work Package or other work-authorizing document.

5.4 Maintenance Categories

Maintenance is planned and scheduled, based on the type of maintenance. The three types of maintenance (preventive, predictive, and corrective) are described in this section.

5.4.1 Preventive Maintenance

Preventive maintenance includes routine maintenance intended to prolong the life of the equipment or to assess the present operating condition of the equipment. Examples of such activities include replacement of lubricating oil and filters and verifying operation of signal conditioning equipment and relays, etc. In-service inspections of equipment will be part of the routine operation of the Facility and will be incorporated in the Operators' round sheets to the extent practicable. Where necessary, some of the in-service inspections may be performed via closed-circuit television (CCTV) (e.g., in the Pump and Valve Gallery [P&VG] labyrinths) or during an outage when the equipment is more accessible. In-service inspections in the process cells will be not be required, due to the absence of any equipment that would require maintenance. The preventive maintenance program will be developed by evaluating preventive maintenance needs for every piece of equipment on the Master Equipment List. Regulatory codes and standards, TSR requirements, vendor recommendations, and industry experience with similar equipment will be used to establish the initial preventive maintenance program. As operating experience is gained and data becomes available on equipment performance and preventive and predictive maintenance results, the preventive maintenance activities and frequencies will be adjusted.

The purpose of the preventive maintenance program is to ensure that equipment necessary for safe and reliable Facility operations performs within required limits and for an extended period of time. The preventive maintenance program should be comprehensive and thorough to preclude unscheduled corrective maintenance on equipment that would result in entry into a Limiting Conditions for Operation or a reduction in plant capacity. Preventive maintenance may also be performed on other non-critical equipment where the benefit obtained from extending the operating life of the equipment outweighs the cost of performing the preventive maintenance. In cases where a positive cost/benefit relationship is not evident (essentially equipment whose failure will not lead to a plant operational stoppage), the equipment will be operated on a run-to-failure basis.

5.4.2 Predictive Maintenance

Predictive maintenance shall be integrated into the overall preventive maintenance program so "proactive repair" planned maintenance may be performed before equipment failure. Not all equipment conditions and failure modes can be monitored; therefore, predictive maintenance will be selectively applied. Reliable predictive maintenance is normally preferable to periodic internal inspections or equipment overhauls. In addition, corrective maintenance efficiency may be

improved by directing repair efforts (manpower, tooling, and parts) at problems detected by using predictive maintenance techniques.

To identify equipment for predictive maintenance, consideration shall be given to equipment cost, rebuild time, lead time for procurement, accessibility, and other factors.

5.4.3 Corrective Maintenance

Corrective maintenance will consist of those actions performed to restore failed or malfunctioning equipment to service. Corrective maintenance activities will ensure the condition that caused the failure is identified, corrected, and documented. Where appropriate, analysis will be performed to determine the root cause of failure and the corrective action that will be taken, including feedback into the preventive and predictive maintenance programs and maintenance training and qualification programs. The establishment of priorities for corrective maintenance will be based on plant objectives and the relative importance of the equipment. Corrective maintenance will be performed to accomplish timely repair of failed or malfunctioning equipment, systems, or facilities in order to restore their intended function or design condition.

The Work Control program shall provide for identification and timely repair of improperly operating or failed equipment. The work control and maintenance history database shall be used to track equipment performance and make changes to the predictive maintenance, preventive maintenance, and routine equipment overhaul/replacement schedules.

5.4.4 Measuring and Test Equipment

The control and calibration of measuring and test equipment (M&TE) will be consistent with the EPC's QA requirements. The M&TE program will be developed to ensure that only calibrated and controlled M&TE, when required is used. M&TE includes tools, gauges, instruments, devices, and systems used to inspect, test, calibrate, measure, or troubleshoot for verifying the conformance of an instrument or piece of equipment to specified requirements. M&TE does not include permanently installed Facility process or control instrumentation, nor does it include test equipment used for preliminary checks where data obtained will not be used to determine acceptability or verify conformance to established criteria.

M&TE selected for use will have the precision necessary to ensure that Facility instrumentation and equipment will operate within design accuracy requirements and be durable enough for their intended application. Control and calibration requirements for M&TE apply to both onsite and offsite calibration facilities and non-facility contractor or subcontractor groups engaged in maintenance activities.

Calibration standards that are traceable to the National Institute of Standards and Technology or other nationally recognized standards will be used for calibration of M&TE. If repair or calibration of a standard is necessary, the recalibration will be traceable to the National Institute of Standards and Technology or to the standard of record for the M&TE. Calibration standards maintained at the Facility will be kept in the calibration facilities at designated storage locations.

5.4.5 Testability and Diagnostics

The design shall provide for testability and diagnostics, where appropriate (typically for electronic control and data recording systems). Rapid advances in system complexity have reduced the effectiveness of conventional testing and diagnostic techniques in some cases. Accordingly, it will be necessary for some systems to make provisions for enhancing diagnostic techniques and include built-in tests or built-in test equipment. The application of new techniques is not restricted to electronic systems. New techniques will be considered for mechanical systems diagnostics, or "condition monitoring of mechanical systems", combining the measurement of performance and the detection of damage with diagnostics to eliminate unnecessary and premature replacement of system components. System testability will be factored into the design for cost effectiveness.

5.5 Operations and Maintenance Procedures

Administrative programs and procedures shall be established to control the preparation, review, approval, and use of administrative, Health Physics, O&M, and engineering procedures. Procedures form the basis for correct and safe operation of the processes and facilities. Procedures also authorize activities within the DSA, assist in communicating hazards, and provide performance consistency. SWPF personnel shall be held accountable for compliance with approved procedures.

Procedure compliance is mandatory. When instructions/procedures are inadequate or incorrect for the task assigned, all related work will stop. Supervisory personnel will be notified and an appropriate review conducted to correct the inadequacy.

Procedures for testing and O&M will be developed by the Operations staff, with assistance and review of Engineering and other support groups. In certain test areas, procedures will be developed by test/system engineers assigned from the Engineering staff and reviewed by the Operations staff. A procedure will be developed as part of the Operations Program that will determine the process to be followed for preparation, review, and approval of new procedures, and for revisions to existing procedures.

5.6 Salt Waste Processing Facility Staff Training

The purpose of the SWPF training program is to ensure that personnel are properly trained and/or qualified to perform assigned tasks in order to minimize: risk to themselves, co-workers, and the public; negative impacts to the environment; and the risk of damage to facilities, systems, and/or equipment. Specific guidance for the development and implementation of effective, quality training programs will be developed and specific details will be defined in the SWPF Training and Qualification Plan developed during Phase II. General training guidelines are presented in Section 8.0.

5.7 Commissioning Approach to Operability

A variety of tests will be performed on plant SSCs as the SWPF transitions from Construction to Commissioning and then to steady-state operation. Table 5-1 is a listing of the categories and types of tests that will be performed.

Table 5-1. SWPF Testing Summary

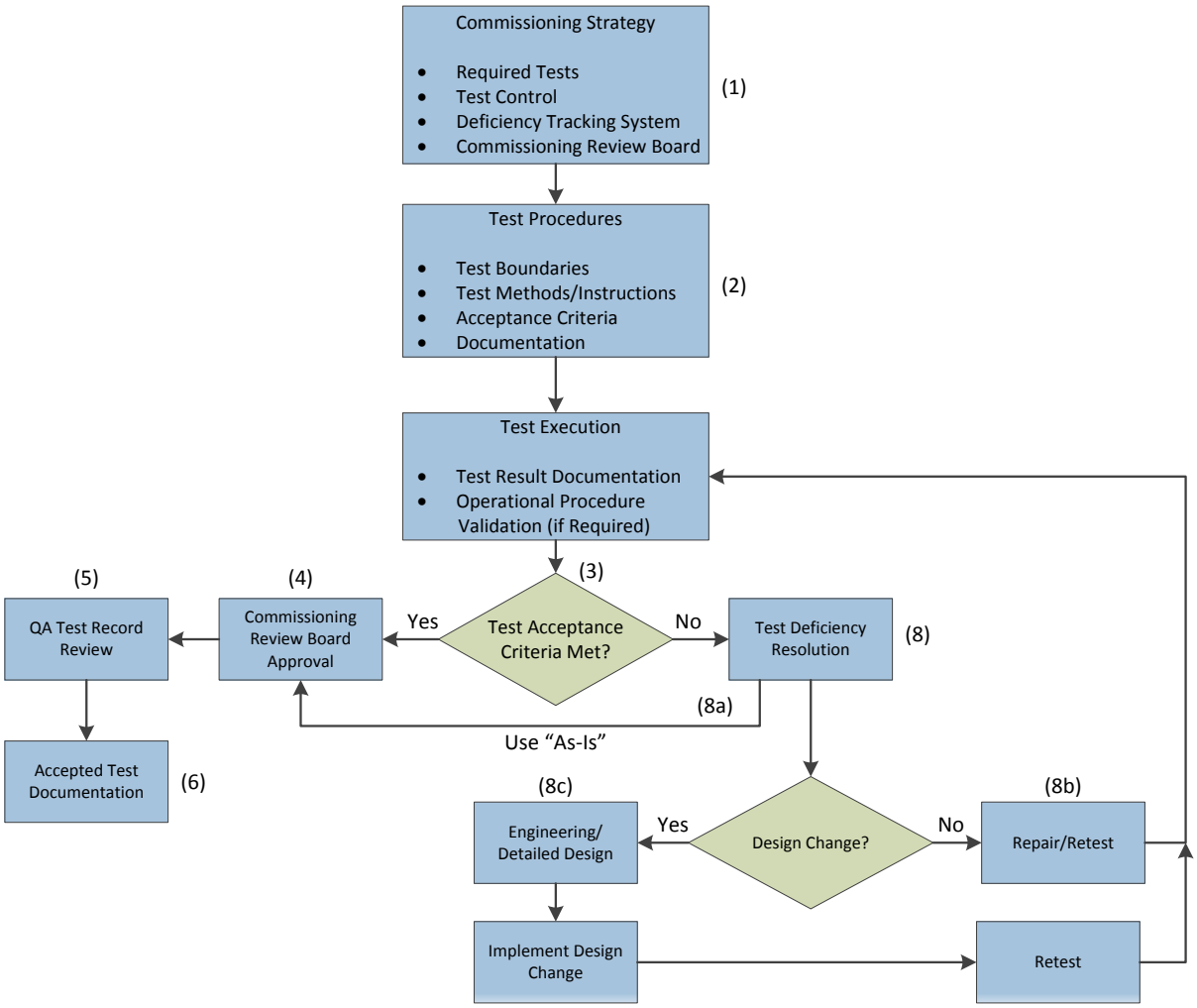
Type	Project Phase	Test Descriptions
Factory Acceptance Test	Procurement	• Nondestructive Examination inspections of welds • Hydrostatic and pneumatic leak tests • Load tests • Component flushing and cleaning verification • Operability checks and performance tests at vendor Facility
Receipt Inspection	Procurement	• Verification of Material Receipt • Vendor Certificate of Compliance review • Procurement documentation review • Visual inspections
Mockup Testing	Procurement/ Construction/ Commissioning	Testing under simulated operational conditions at vendor, EPC or SRS-provided Facility
Construction Acceptance Testing	Construction	• Nondestructive examination of welds • Hydrostatic and pneumatic testing of fluid systems • System cleaning and flushing • Insulation resistance measurements on low voltage feeder and branch circuits • Continuity and ground isolation tests on control and communications circuits • Testing of 13.8 kV and 480 volt electrical system components and equipment per the requirements of American National Standards Institute/InterNational Electrical Testing Association (ANSI/NETA) ATS-2006[12] • Initial component and system operation and balancing of HVAC systems installed by subcontractors • Motor phase rotation checks and rotational bumps
Calibration, Grooming and Alignment	Commissioning	• Connection of instruments to the DCS • Equipment and instrument calibration • Valve cycling • Alarm test/initiation • Verification of failure position for DCS equipment and components

Table 5-1. SWPF Testing Summary (continued)

Type	Project Phase	Test Descriptions
System Operational Tests (Including ISOTs)	Commissioning	• HVAC balancing – Through SOT and ISOT • High-efficiency particulate air (HEPA) filter assembly testing • Diesel Generator Operability Test • Maintenance tests • System startup/shutdown • System operational performance testing • Validation of O&M procedures
Integrated Water Runs	Commissioning	• Complete operational test of major systems (including MST/alpha and filtration system, CSSX System, utility systems, and tank transfer systems), using water • Using simulant, validate significant testable attributes on those systems that cannot be commissioned with water (e.g. Air Pulse Agitators)
Cold Commissioning	Commissioning	• Operator Proficiency • Process Verification Tests • MST/sludge filtration test (ASP and AFF) • Alpha Strike test of Sr removal efficiency using non-radioactive Sr simulant (ASP and AFF) • CSSX performance tests with non-radioactive Cs simulant • Verification of product chemical composition • Design Capacity Performance Test • Off-Standard Operational Testing (evaluation of off-standard conditions) • Process upset/restart tests • Maintenance tests (Supplemental to SOTs) • Validation of O&M procedures (Supplemental to SOTs)
Hot Commissioning	Commissioning	• Product Verification Tests • Shielding Verification • Process Capacity tests • Environmental Performance Tests
Hot-Extended Operations/Capacity Verification	Extended Operations	• Environmental permit monitoring • Extended one-year operational test at (or above) nominal capacity

The EPC will use a disciplined process for test documentation control and for review and acceptance of completed testing. The steps required for test documentation development and test result evaluation are shown in Figure 5-1 and further detailed in the text following the figure.

Figure 5-1 Test Result Disposition



1. P-SUP-J-00001[2] has been developed for the SWPF. This plan identifies the tests required to verify that all design requirements can be met. P-SUP-J-00001[2], also provides the administrative framework for test control and any resolution of test deficiencies.
2. Tests shall be performed in accordance with approved procedures. Test procedures shall identify the test acceptance criteria, which must be non-ambiguous and directly measurable. At the completion of testing, the completed test procedure and data sheets shall be reviewed and approved and placed under configuration control.
3. A determination is made by the Systems Engineer and the Lead Test Engineer at the conclusion of the test regarding the acceptability of the test performance and results.
4. If test results are determined to be acceptable, the completed test procedure and test are approved and results are submitted to the Commissioning Review Board (CRB).

5. Following CRB approval, test results are accepted.
6. The Project QA organization shall also perform a QA verification of the test records and evaluate how test data were recorded and controlled.
7. Completed test documentation is transferred into the Project document files. The approved information is used as a portion of the basis for the Operational Readiness Review and for transition to the successor LTO.
8. If the Systems Engineer, Lead Test Engineer, or CRB determines that the test results were not acceptable, a different sequence of actions is required. Possible test deficiency resolutions include the following.
   a) Accept-as-is: Determination made that the deficiency will not affect SWPF performance or environmental, safety, health, and quality (ESH&Q) compliance. In this case, the use of as-is justification will be approved by the CSE and forwarded to the CRB for final approval.
   b) Rework and Retest: The test deficiency can be resolved by rework of the equipment and return to its initial design condition. The affected portions of the test are then re-performed.
   c) Repair and Retest: The test deficiency can be resolved by repair of the equipment and return to an acceptable condition, but not its initial design condition. The affected portions of the test are then re-performed.
   d) Design Change: The test design results indicate that a design change is required for the equipment to perform properly. The design change package is subject to formal review The design change will be implemented and the affected portion of the system will be retested.

6.0 STAFFING FOR COMMISSIONING AND OPERATIONS

This section identifies staffing requirements for SWPF Commissioning and Operation.

6.1 General Guidelines

During the Final Design phase, the EPC shall prepare an O&M Staffing Plan to identify the O&M and Operations Support organizations for Commissioning and long-term Operations.

The Operations staff will increase as the Project progresses through Design, Construction, acceptance testing, SOTs/ISOTs, Cold Commissioning, and Hot Commissioning. The EPC anticipates that the trained and qualified staff will largely transition to the selected LTO, following the SWPF turnover period. Select members of the EPC Team will be made available for up to six months after transition to provide a smooth continuance in SWPF operation during the turnover period.

During Project Design phases, the Operations staff will provide key input on matters that affect plant operability and maintenance. This prior experience will be used in determining equipment features, operating space allocations, process controls, CR human factors, and other O&M

features to be addressed in the design. During SWPF Construction, additional startup and O&M personnel will be added to the Operations staff to provide oversight of selected vendor factory acceptance tests and post-installation acceptance tests performed by the Construction organization. Operations staff with skills in training and procedure development will also be added. The Systems Engineers will be matrixed to the Commissioning staff from the Engineering Department as the Testing/Commissioning phase of the Project starts.

Also included is the Environmental, Safety, and Health (ESH) and QA staff, which reports independently to the SWPF Project Manager, but will directly support the Commissioning activities. The Operations staff will be trained and qualified during the Construction period. This training will include classroom training on operations fundamentals and on the plant systems. Final qualification for Hot Operations will require hands-on practical-factor performance. These practical factors will be completed in parallel with the operations procedure validation during the systems operational tests and integrated plant Cold Commissioning tests. Various O&M staff will be cross-trained in other SWPF operational areas to ensure a personnel inventory of skills necessary for smooth plant operations.

Prior to Cold Commissioning, personnel will be placed in a rotating 4-shift schedule to support 24-hours-per-day, and 7-days-per-week (24/7) staffing of the SWPF. Shift rotations and work hours will be established to allow for training periods and provide relief to on-shift crews.

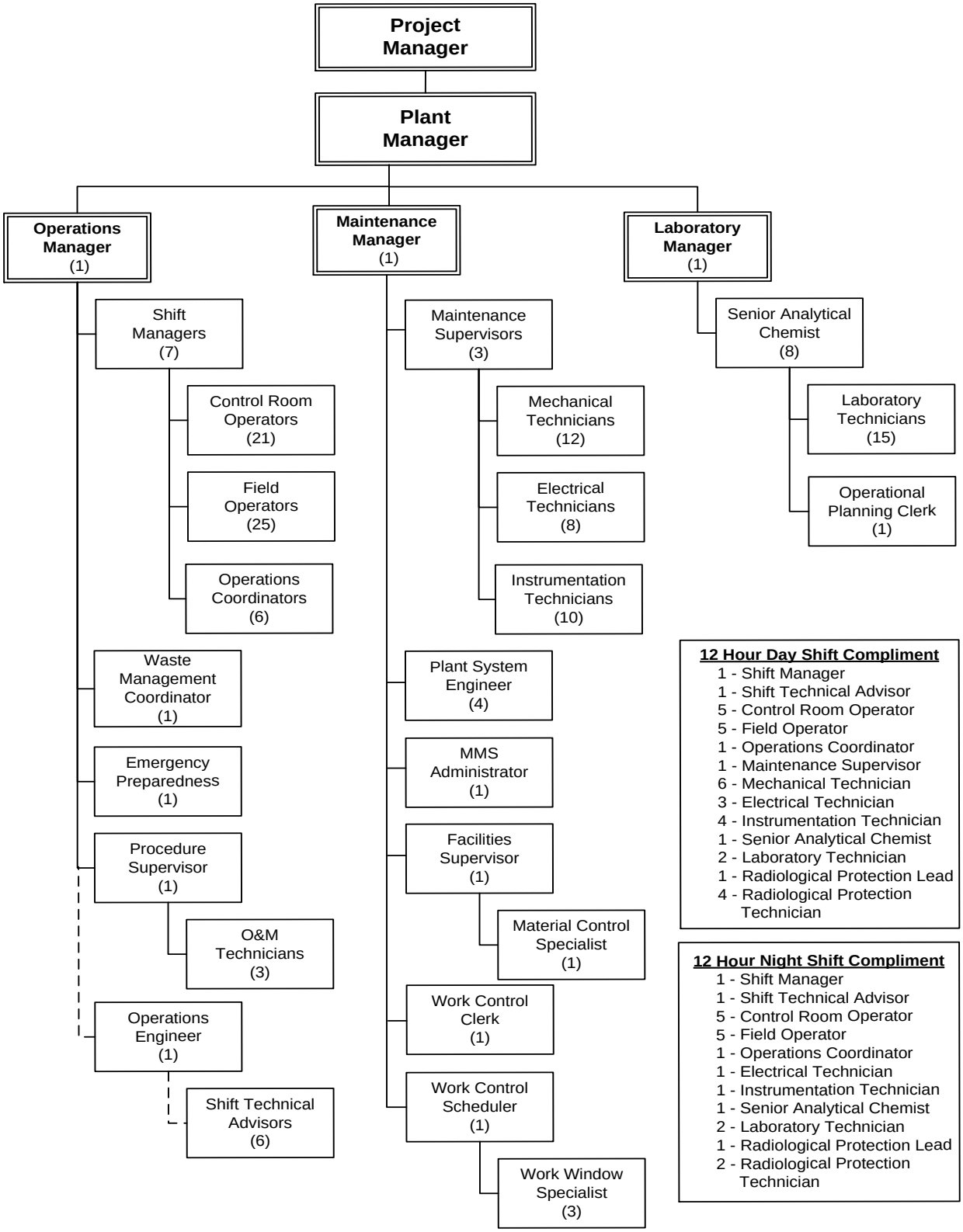
6.2 Staffing Labor Mix

Figure 6-1 provides a summary of estimates of SWPF Operation and Maintenance for One Year of Operations. During Construction and acceptance testing, the number of test support, O&M, and Operations support personnel will increase significantly. As Commissioning nears completion, the staffing levels will decrease, as the organization transitions to normal operations. It is noted that as the plant transitions to One Year Operations and the project evolves, that additional changes to the Staffing Labor mix may occur.

6.3 Operating Shift Requirements

The EPC will design the SWPF CR and prepare operational procedures with a view toward human factors and operational efficiency. Figure 6-1 identifies the estimated shift complement for normal operations. Additional personnel will be assigned to shift support work, such as work control and administration, and may not be included here. Additional operators, maintenance, and support personnel will be available during weekday day shifts. During Cold and Hot Commissioning testing, it is anticipated that additional staffing beyond normal routine operations will be required to obtain necessary testing data and ensure rapid resolution of any unexpected problems that could occur.

Figure 6-1 Operations and Maintenance Staffing One Year Operations



7.0 FACILITY LAYOUT

General layout requirements for various SWPF areas to support O&M are identified in this section and are recommended for incorporation into the SWPF design. This section highlights specific building space allocation requirements primarily to facilitate SWPF operations. It is expected that good industrial/nuclear industry practices will be used in the specific layout of process areas and equipment arrangements.

7.1 General

The Facility layout shall provide separation of administrative and support personnel from the operations and process activities. Facility layouts shall be based on segregation of functional areas. The first level of segregation shall separate process areas from non-process areas. Within process areas, rooms that have no radioactive material shall be separated from rooms that contain radioactive material. Material and equipment flow patterns shall be considered in development of the Facility general arrangements. Consideration shall be given to removal, decontamination, repair, and replacement of failed equipment. Durable materials shall be selected for working surfaces subject to degradation resulting from equipment movement and normal operations.

The SWPF shall provide adequate space allocation for performing the primary process operations and its direct support operations. The Process Building shall contain the process equipment (process vessels and interconnecting piping, pumps, valves, and instrumentation); a cold chemical receipt and storage area; process/plant support systems (HVAC, process water, electrical distribution, etc.,); and essential O&M support areas (CR, decontamination and maintenance areas, radiological areas, and access control points). Other Facility support functions may be provided in adjacent facilities and/or utilize available resources at SRS.

7.2 Process Building and Alpha Finishing Facility

All radioactive and hazardous chemicals shall be processed and stored in the Process Building and AFF, which shall provide containment and confinement capabilities. Confinement barriers and associated ventilation systems shall maintain continuous airflow from the environment to the occupied non-contaminated areas to the potentially contaminated/contaminated areas and finally exhausted via HEPA filters to the environment.

Mechanical equipment utilized in the main process operations (ASP and CSSX) shall be placed in separate cells. The equipment layout within the cells shall be organized in a logically sequential fashion, and tailored for process optimization and process flow.

7.2.1 Process Areas

The following general guidance shall be followed in the design of process areas:

- The process cells shall contain minimal equipment with moving parts that could fail in service.

- Equipment located within process cells that could potentially fail in service (e.g., cross-flow filter cartridges) shall be remotely removable through shield plugs or plates in the Operating Deck floor.
- Process cells shall be accessible during Cold Commissioning via man-way entries or normally sealed covers in the Operating Deck floor.
- The CSSX contactor area shall be accessible for contact-handled maintenance following CSSX shutdown and contactor line draining and flushing.
- Normally sealed covers shall be installed in the Operating Deck floor to provide direct remote access to the cells for accident recovery and Decontamination and Decommissioning (D&D) operations.
- The ventilation system shall maintain each process area at a negative pressure.
- Process areas shall utilize concrete walls for gamma shielding. Shielding analysis that defines concrete wall thickness shall consider worst-case situations and be based on limiting dose rates external to the cells to acceptable levels, as defined in Section 16.5.
- In localized high-dose areas, the use of steel or concrete shielding enclosures should be utilized.
- Installation and placement of equipment shall consider the following:
  - Seismic effects on equipment operation,
  - Destructive vibrations due to proximity to other rotating equipment,
  - Maintenance access and clearances (see Section 9.0),
  - Avoid interferences and dismantling of other equipment to gain access for maintenance or for removal/replacement,
  - Allowance for remote operations in high-radiation areas, and
  - Visibility for CCTV camera coverage.
- Provisions shall be made for equipment drainage, storage of collected fluids, and detection of leaks. The floors of process cells shall be sloped to allow fluids to be collected and recycled back into process operations.
- A P&VG shall be provided directly external to the process cells. This gallery shall provide direct maintenance access to the equipment when the process fluid is transferred and the equipment drained.
- A sump shall be provided at each labyrinth for removing any leakage fluids and transferring it back to process operation.

7.2.2 Cold Chemicals Receipt and Storage

The following general guidance shall be followed in the design of the chemical storage areas:

- Isolation berms shall be placed around chemical tanks to contain possible tank leakage, spills, and possible mixing of incompatible chemicals (acids and bases);
- Emergency safety showers, eye wash stations, and other safety provisions common to chemical handling shall be available in close proximity to those areas where chemical handling occurs, including in the vicinity of chemical holding tanks, chemical addition stations, etc.;
- Building floors and walls shall be coated with a surface suitable to prevent damage in the event of spills (e.g., epoxy paints);
- The chemical storage area shall have access to an unloading dock roadway where chemical supply trucks can transfer chemicals to the storage area;
- A walled segregated area shall be included for a Cold Chemicals Laboratory. At least 120 square feet (sq. ft) of floor space shall be allocated. The laboratory shall have provision for typical chemical supplies and analysis equipment for performing the required cold chemical analyses; and
- Areas shall be designated for storage of gas bottles. Oxygen monitoring shall be considered where there are significant quantities of inert gases.

7.2.3 Analytical Laboratory

The SWPF will be processing salt waste received from the Tank Farms. Samples collected in the process cells will require remote handling. For this reason, direct transfer of samples from the Process Building to a separate laboratory building would involve a number of risks, as well as higher overall construction and O&M life-cycle costs. Space for a hot laboratory shall, therefore, be included within the Process Building. The complete requirements for the Analytical Laboratory are contained in P-FDD-J-00001, *SWPF Analytical Laboratory Design Requirements Document*[16]. The following provisions and guidelines are minimum requirements that shall be included in design of the laboratory area:

- Capability shall be provided for receipt of radioactive samples.
- The laboratory and interconnecting building areas shall be configured to allow for receipt of shielded hot samples and transfer of these samples to the SWPF Analytical Laboratory, as well as for packaging and shipment of process samples or exhausted chemicals/waste samples from the SWPF to external laboratory facilities.
- Gloveboxes for handling laboratory samples shall be provided; all gloveboxes shall be exhausted through a redundant HEPA filter train via the Hot Cell.
- Special utilities for supporting radiochemical sample processing and counting equipment shall be provided in the Analytical Laboratory.

- A radioactive liquid waste collection system shall be provided to service the Analytical Laboratory.
- The Analytical Laboratory shall be configured to allow for storage and packaging of radioactive solid wastes generated by sample analysis activities.
- The Analytical Laboratory shall be located in an area of the plant that would allow for receipt of highly radioactive samples and for transfer of packaged radioactive solid wastes for treatment/disposal external to the SWPF.
- Laboratory space ventilation systems shall maintain these spaces at a negative pressure, with respect to occupied areas; the laboratory exhaust shall be vented to the stack exhaust.
- Adequate space shall be provided for analytical equipment and work areas to perform complete feed material analysis in less than 30 days.
- Adequate Hot Cell space for handling highly radioactive (gamma) samples shall be provided.
- Capability will be provided to receive, package, and ship clean chemical and radioactive process samples.

7.2.4 Process/Plant Support System

The following requirements shall be considered in the Process/Plant Support System layout:

- Building HVAC systems shall be sized to keep the average temperature in occupied areas between 60 degrees Fahrenheit (°F) and 95°F (note that individual process cells and the CR may require special temperature control).
- Access and clearance shall be provided around power machinery to facilitate maintenance and removal.
- System operational controls shall be located in centralized areas adjacent to the system.
- Provisions shall be made for berms or cells for secondary containment to collect/control process leakage.
- A Process Vessel Vent System shall be provided to ventilate the head space of tanks containing high-activity waste to prevent accumulations of flammable gas.
- Vibration and operating noise shall be considered in the placement and installation of equipment.
- Space shall be provided for interim storage of radioactive solid waste.

7.2.5 Miscellaneous Facilities and Offices within Process Building

Guidelines are provided below for design of miscellaneous Facility areas, other than direct process and operating areas within the Process Building.

7.2.5.1 Health Physics Areas

Areas shall be provided close to the change rooms and main entrances to the operating/process areas for Health Physics personnel (these spaces may be used for other purposes, such as Industrial Safety) and shall include the following provisions.

- A personnel ready room to be used as the primary staging area for the Health Physics staff. This room shall be equipped with worktables and chairs. Adequate space shall be provided for bookcases and file cabinets for storage of Health Physics-related procedure manuals and other reference material.
- An office for Health Physics personnel.
- A storage area for portable survey instruments and other radiological monitoring equipment.
- A radioactive material handling area shall be provided for survey/release of tools/equipment being removed from radiological controlled areas. This area will also be used for accumulation of some solid radioactive low-level waste.
- Radioactive source storage area that meets requirements of the Radiation Protection Program.
- A counting room (or area) for counting samples (such as smears, wipes, and filters). The room shall be equipped with appropriate alpha and beta/gamma counting equipment and instrumentation. This room can be combined with laboratory space (Section 7.2.3), if practical. Space and support utilities shall be provided for a computer workstation, sample counting instruments, and other support equipment.
- A personnel decontamination room shall be provided. The decontamination room shall be provided with the following features:
    - Sufficient space for decontamination of two or more individuals of opposite sex at one time;
    - Equipped with cabinets, counter space, showers, and portable monitor(s);
    - Adequate storage space for decontamination supplies and radiation monitoring and survey equipment used in this area;
    - Shower and sink drains shall be routed to a contaminated liquid waste handling system; and
    - Sinks that facilitate personnel decontamination.

7.2.5.2 Change Rooms

Facilities shall be provided for changing personal clothing to and from work attire and/or modesty clothing. Change rooms should be located adjacent to the Controlled Area Boundary. The number of radiological worker personnel to utilize the change rooms shall be considered in determining the number and size of the change room(s). Additional specific requirements shall include the following:

- Change rooms shall have showers, lockers, and benches;
- Lockers shall be sized for storage of worker personal clothing, including coats and shoes; and
- A 70/30% male/female worker ratio, with an additional 20% contingency (for varying ratios) should be assumed for determining numbers of lockers and change room floor space.

7.2.5.3 Break Room

A break room shall be provided for usage by up to 20 operational staff. The break room shall be furnished with refrigerator, microwave ovens, sinks, counters, and storage cabinets for kitchen supplies. Kitchen appliances shall not be built-in to facilitate easy repair and replacement. Space shall also be provided for food and beverage vending machines.

7.2.5.4 Control Rooms (Safe Shutdown Panel Room)

The requirements for a CR and Safe Shutdown Panel Room for the SWPF are discussed in Section 10.1 and Section 10.3. Provisions shall include space for operator consoles and other human-machine interface devices, chairs, tables to read prints and maintain narrative logbooks, bookcases for procedures and reference materials, and communications equipment.

7.2.5.5 Office Space

Office Space shall be provided as follows:

- CR Office – This office shall be directly accessible to the CR and available for the shift turnover briefings and pre-job meetings.
- DOE Office – This office shall provide office space for two DOE representatives. It shall be in close proximity to the CR. The space allocated shall be at least 200 sq. ft.
- Work Release Office – This office shall have at least 300 sq. ft of floor space. It will be used for control of ongoing work and storage of locks and tags.
- Laboratory Office – This office shall be located next to the Analytical Laboratory. The space shall be sufficient to provide sample receipt activities and desk space for a minimum of six lab personnel.

7.2.5.6 Maintenance Work Areas

A maintenance work area will be provided within the SWPF Process Building and located in close proximity to the change room/locker rooms. Four different closed room workshops shall be provided:

- Mechanical maintenance shop,
- Electrical maintenance shop,
- Instrument calibration shop, and

- General maintenance shop.

The mechanical, electrical and general shops shall have a minimum of 1,000 sq. ft of floor space. The instrument calibration shop shall have a minimum of 700 sq. ft of floor space. Details of the equipment to be included on each area will be developed during Phase II design activities. The following general guidelines shall be adhered to:

- Overhead doors will be supplied with openings at least 7 feet (ft) wide and 8 ft high;
- Door openings shall permit equipment up to 10 ft long by 6 ft wide to be moved from the general maintenance shop into the mechanical and/or electrical shop;
- An area for general maintenance of equipment shall be provided. The general maintenance area shall have access to the closed room maintenance shops.
- The shop floors shall be coated with epoxy, and walls coated with enamel;
- The maintenance shop shall have ready access to a tool "crib" area needed for routine maintenance; and
- The maintenance areas shall have provision for moving and lifting heavy items. Suitable cranes, aisle space, work benches, etc., shall be provided.

7.2.5.7 Decontamination Area

The decontamination areas shall be designed in accordance with "good" practice for this type of work and will include, as a minimum:

- Epoxy coating of the floors and walls to facilitate decontamination of spilled liquids and
- Sloped floors that direct liquids to a central sump.

7.2.5.8 Storage Areas

The following storage areas shall be provided within the Process Building:

- Hot Storage – An area shall be designated for storage of radioactive contaminated failed equipment. This storage area will be used pending either decontamination prior to contact-handled maintenance or packaging for offsite shipment as radioactive waste.
- Solid Waste Storage – An area shall be designated for storage of failed or used equipment prior to offsite shipment for disposal. Typical equipment types stored will include contaminated air or liquid filters.
- Parts Issue/Storage – An area shall be designated for storage of consumables. This storage area shall be located in close proximity to the maintenance shop area.

7.3 Other Facility Support Systems/Areas (External to SWPF Process Building)

Personnel offices and miscellaneous rooms (such as a conference room, restrooms, lunchroom, and janitor closets) shall be provided in a separate Administration Building. Provisions shall include the following:

- With the exception of field personnel such as operators and maintenance craft, full-time staff members shall be provided individual or shared offices. Space for 65 people shall be provided.
- The administration area shall contain offices, restrooms, a conference room, lunchroom, and centralized reproduction and office supply space. These areas should be in a separate building from the SWPF Process Building. Office space shall be provided for the exclusive use of four full-time DOE personnel in the administration area. The conference room(s) should provide space for up to 25 people, including audio/visual equipment.

7.3.1 Training Facilities

The SWPF will be located in J-Area in close proximity to the H-Area Central Training Facility. Because the H-Area Central Training Facility is in close proximity to the SWPF location, additional office space or facilities for training need not be provided within the SWPF. As shown in Figure 6-1. Figure 6-1 the normal complement of Operators and Shift Engineers is approximately 60 to 65. At a minimum, Operations personnel shall be trained and qualified to the standards prescribed in DOE O 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*[17]. Given the number of Operators requiring training and the scope of the qualification and requalification training programs, the additional training burden imposed by SWPF operations should not significantly impact the space allocation in the existing H-Area Central Training Facility. The EPC's V-ESR-J-00020, *SWPF Training Interface Control Document (ICD-20)*[18] documents agreements between the appropriate Site Contractor(s) and the EPC, with respect to use of Site training services and facilities.

Space shall be provided in the Administration Building for a simulator and associated classroom to train CR Operators and other shift personnel. The space allocated for the simulator shall be equivalent in size to the comparable area in the SWPF CR, and shall mimic the CR to the extent practicable.

7.3.2 Warehouse Space

Space shall be provided for storing spare parts that require a controlled atmosphere or protection from the elements. Space may be allocated as a portion of the SWPF Administration Building, the SWPF Process Building, or other suitable locations to be determined. The items to be stored were initially established in P-CRT-J-0070, *SWPF Spare Parts List*[19]. A 15,000 sq. ft warehouse (763-S) has been placed in service to support SWPF needs.

8.0 TRAINING

The EPC shall develop a formal training program for SWPF operations prior to Commissioning. The training program shall identify the specific training and qualification requirements for Operations, Maintenance, Technical Staff, Radiological Control, and other Operations Support personnel. The training program shall address both classroom training and On-the-Job Training (OJT) for both initial qualification and requalification of Operations personnel, Maintenance craft, radiological control personnel, and line management.

Facility-specific training shall be provided for all personnel with unescorted access to the SWPF. This training shall focus on the general nature of SWPF operations, the hazards involved in these operations, and the actions required for any emergency condition. Permanently assigned SWPF operational, maintenance, or technical support staff shall also be required to complete General Employee Training (GET), Radiation Worker Training I or II, and other specialized training courses required for their job functions. The SWPF Training Program shall identify training, education, experience, and other qualification requirements for each position within the SWPF organization.

The general training objectives and requirements for the SWPF staff are provided in Sections 8.1 and 8.2.

8.1 Training Goals and Objectives

The EPC will establish an SWPF staff training program that satisfies the following goals and objectives.

- Establish a training organization with skilled staff to develop and implement a training program focused on the specific needs of the SWPF Project.
- Coordinate the SWPF training program development with the SRS training staff to the extent feasible or practical. Existing SRS training courses and facilities should be incorporated into the SWPF training program to preclude conflicting requirements and minimize training costs.
- Identify basic Operator and Maintenance training requirements based on a Job Analysis (JA) and ensure that specific classroom training or practical factor requirements are provided for all tasks.
- SWPF training staff, including subcontractors, will possess the technical knowledge, experience, and developmental and instructional skills required to perform their assigned duties.
- Identify specific needs of the SWPF organization and necessary qualifications when developing the curriculum and training requirements for each staff position.
- Develop training schedules to ensure that SWPF staff is trained and qualified in time to support the needs of Commissioning and extended Hot Operations of the SWPF.
- Incorporate lessons learned from SWPF operations, other SRS operations, and DOE and commercial chemical and nuclear industries into the SWPF training program.

- Coordinate with SWPF operations, maintenance, technical, and ESH, and QA supervision to ensure that training requirements and staff training needs are updated as the SWPF Project continues. Training needs identified during commissioning shall be incorporated into the training program.
- Maintain accurate records on personnel training and qualification completion.

8.2 Training Requirements

The EPC intends to implement a disciplined and thorough training program for the SWPF staff. General requirements for the training process are provided below. Specific implementation methods shall be identified in the SWPF Training Program to be developed in Phase II.

- Minimum requirements for entry into the program may be established by a testing program (e.g., minimum mathematics skills).
- Training for SWPF personnel shall be sufficient to ensure that staff members can perform their job functions in a competent, efficient, and safe manner and comply with all regulations.
- Existing SRS training facilities, computerized training programs, and training staff may be utilized for non-Facility-specific training functions to ensure compliance with existing SRS training requirements and if the potential exists to minimize training costs.
- In addition to classroom training, training for operational personnel will include simulation or actual operation of installed equipment and systems and use of SWPF operational, maintenance, and testing procedures.
- Operator training shall be based on a JA for all normal and off-normal operations.
- Training aids will be developed that are realistic, cost-effective, and also satisfy unique training requirements of the SWPF.
- Training and qualification of operational personnel will be coordinated with appropriate SWPF managers and supervisors. This will include (in selected instances) cross-training of operators in more than a single job function to provide flexibility in shift manning, provide for Operator advancement, and ensure a breadth of operational competency during shift operations.
- Training schedules will be developed that ensure training is performed in advance of actual SWPF scheduled needs.
- Training records and qualifications will be maintained and controlled to ensure they are current and testing and training is adequate. Periodic QA audits will be made to ensure that the training program meets DOE standards. At a minimum, training records and documents will undergo a comprehensive audit prior to the start of Hot Commissioning and immediately before scheduled transition of the plant to the successor LTO.
- A “Lessons Learned” program shall be established in accordance with DOE O 210.2A, *DOE Corporate Operating Experience Program*[20] (e.g., Occurrence Reports, Management Self

Assessments, QA surveillances, and Occupational Safety and Health Administration [OSHA], U.S. Nuclear Regulatory Commission, and International Petroleum Institute event reports).

8.3 General Training Requirements

General types of training required by the SWPF staff are summarized below. Additional training will be identified by the SWPF management as specific needs arise.

8.3.1 Site General Employee Training and Consolidated Annual Training

Site GET and Consolidated Annual Training (CAT) are common to all personnel working directly at SRS. GET encompasses basic Site regulations, general radiological and industrial safety hazards, and emergency response procedures. CAT is conducted annually for updates and as a refresher. Training of staff may also include use of pre-existing SRS computer training programs when available or practical for usage. This is also common in Sections 8.3.2 through 8.3.8.

8.3.2 SWPF-Overview Training

This training provides a general overview of the SWPF process and SWPF interlinks to other SRS LW operating facilities and Facility-specific hazards and emergency response.

8.3.3 Radiological Worker Training

All persons who require unescorted access to SWPF Radiological Controlled Areas will complete training in accordance with the applicable requirements of 10 Code of Federal Regulations (CFR) 835.901, *Radiation Safety Training*[21]. Additionally, respiratory protection training will be required for personnel whose jobs may require the use of a respirator, based on radiological or environmental conditions.

8.3.4 Industrial Safety Training

This training is also required for all SWPF personnel with direct access to process operations or equipment. Select SWPF personnel will complete training courses for Hazardous Energy Controls (lockout/tagout), Confined Space Entry, Competent Person (excavation/trenching safety), Fire Watch/Fire Observer, and Waste Handler/Waste Verifier (waste packaging/handling).

8.3.5 Technology Fundamentals

This training covers specific areas of chemistry, physics, and basics of SWPF component design/operations that provide necessary background information to operations personnel. Operations and other personnel, as deemed necessary by job description, will be required to complete this training as part of their qualification process.

8.3.6 SWPF Operator Training and Qualifications

This is required training for Operators and Shift Operations Managers and covers all aspects of the: basis of design; design and operational limits of all equipment; interlocks; control systems; startup, shutdown, and normal and off-normal operation of individual systems and the plant; DSA; and emergency operations. This training program will be developed by the EPC during Phase II. Operations personnel will be required to complete OJT and successfully pass a comprehensive written and oral examination (CR personnel) prior to qualification. The Operations personnel who will be assigned to operate equipment independently during Hot Commissioning shall be fully qualified.

8.3.7 SWPF Maintenance Training and Qualifications

Training and qualification of maintenance personnel shall be consistent with their area of expertise. Facility-specific training will include some OJT for complex maintenance operations.

8.3.8 Radiological Control Technician Training and Qualification

Radiological Control personnel (Health Physicists, Radiological Engineers, Supervisors, and Technicians) assigned to support the SWPF Project shall meet the requirements of 10 CFR 835.103, *Education, Training and Skills*[21], DOE O 426.2[17], DOE-STD-1107-97, *Knowledge, Skills and Abilities for Key Radiation Protection Positions at DOE Facilities*[22], and DOE-HDBK-1122-2009, *Radiological Control Technician Training*[23].

8.4 Training Aids and Mockups

During Phase II design, the EPC's Engineering and Commissioning staffs will jointly evaluate the need for specialized training aids and mockups required for Operator or Maintenance personnel training. The decision on training aids requirements will be focused on incorporation of the simulation capabilities for complex operational or maintenance tasks that are not performed on a routine basis or where the risk inherent to the activity is high.

9.0 EQUIPMENT ACCESSIBILITY FOR OPERATIONS AND MAINTENANCE

Equipment accessibility is necessary for both safety and work efficiency. The following guidelines should be considered in the SWPF design.

9.1 General Requirements

- Equipment located in closed cells that may fail in service shall be designed for remote removal and replacement.
- Equipment intended to be decontaminated prior to removal or repair shall be designed to withstand the decontamination process without any reduction of functionality through degradation of the electrical, mechanical, or any other components involved.
- Permanently lubricated sealed-for-life components shall be used wherever possible in order to reduce maintenance requirements.

- Isolation and flush and drain valves shall be included in the design to allow for isolation, repair, and testing of systems, subsystems, and components.
- A laydown area shall be provided to accommodate the staging of equipment during removal and installation.
- Adequate flushing and draining capabilities shall be incorporated into the design to ensure that system components can be flushed/drained sufficiently to allow contact maintenance.
- Decontamination equipment and contact handled maintenance areas shall be provided to accommodate the largest maintainable component(s) within the Process Building.
- Adequate clearances shall be provided to allow O&M personnel to access equipment for in-place maintenance or for removal/replacement, as appropriate.
- A safety boundary (i.e., clear space around the equipment) shall be available to move around rotating equipment. The size of the safety boundary should be developed by considering actual maintenance requirements.
- Equipment and plant structural elements (such as columns and beams) shall be arranged with respect to one another to allow for access to equipment by maintenance personnel.
- The equipment layout design for high radiation areas shall provide adequate space and floor loading margins to allow installation of temporary shielding.
- Equipment, instrumentation, and electrical components that are located greater than six feet above or below floor level should have provisions for a permanent work platform with fixed-ladder access to perform maintenance. If a permanent work platform is not practical for operability and maintainability reasons other provisions may be utilized.
- Space shall be provided to allow for packaging waste and failed equipment for shipment. Where possible, equipment in potentially contaminated areas should be sized to fit within contaminated waste disposal boxes.
- Provisions shall be made to allow instrument calibrations, preventive maintenance, and periodic functional testing of protective circuits, while the plant is in normal operation.
- Equipment and instruments requiring personnel access for periodic calibration or preventive maintenance shall be located in areas where personnel exposures are ALARA.
- Single-point power source isolation should be provided for instruments and equipment whenever possible. Equipment isolation points shall be capable of accepting a lock.
- Systems shall be designed to allow testing at the component, system, and integrated system levels.
- Equipment intended to be maintained shall have access panels for replacement of parts that may fail.
- The SWPF design shall incorporate drain and flush capability and appropriate isolation valves for process vessels/piping to support line break operation.

- Process system piping and instrumentation design should strive to use the same configuration for the same functions, to minimize O&M interface problems.
- Where in-place handling and maintenance is not practical, carrier systems should be installed for transport of components between the maintenance and staging areas to the operating areas of the plant.
- Process systems and components, especially those performing safety-related functions, shall be designed and arranged so they can be adequately inspected and tested before being placed in service and at regular intervals thereafter.
- Equipment located within gloveboxes shall be accessible for operation, inspection, and planned maintenance without breaching glovebox integrity.
- Decontamination cells shall have service connections pre-plumbed/wired.

9.2 Maintenance Facilities

- Maintenance Shop(s) should be provided within the SWPF Process Building. Only maintenance tools and equipment necessary for anticipated preventive or corrective maintenance will be provided in the SWPF Maintenance Shop(s). A complete evaluation of SWPF maintenance needs will be performed in Phase II. These maintenance needs (staff, tools, shop space, etc.) will be compared to the existing Site maintenance resource availability to determine if any, or all, of these needs could be met more cost effectively by existing Site resources. The SWPF Maintenance Shop(s) should be separated by partitions for instrumentation, electrical, mechanical, and welding work. The shops should contain the following, as appropriate:
  - Space for hand/powered tools, toolboxes, storage cabinets, and utilities (compressed air, water, and electrical power);
  - Welding Area with layout tables, welding rod ovens, and both gas and electric welding equipment;
  - A method for controlling and securing M&TE shall be provided;
  - Workstations for I&C technicians shall be provided with the instrumentation to allow calibration of instruments and specialty items;
  - Electrical shop with workbenches, toolboxes, and storage cabinets for test equipment;
  - Contactor Rebuild Area with contactor test stand;
  - Mechanical shop with drill press, hydraulic press, grinders, work benches, band (metal) saw, cut off saw, tool boxes, test bench for pressure testing, and storage cabinets; and
  - Computers for maintenance personnel to access maintenance systems and records.
- Space shall be provided for a limited supply of consumables, tools, and shop utility supplies (e.g., air compressor(s) and compressed air supply, regulated Alternating Current and Direct Current power supply, etc.);

- Dedicated areas shall be provided for decontamination of equipment to acceptable levels, and disassembly of equipment (if required), prior to performing repair; and
- Decontamination of equipment by flushing of internals, followed by appropriate packaging and shipment to suitable offsite (permitted and radiological-qualified) maintenance shops is an acceptable option and should be considered.

9.3 Remote Operability Requirements

- Stacking of process vessels shall be avoided and access shall be provided to maintainable process equipment.
- E&I jumpers, if used, shall use standard pin connections with upper and lower holder assemblies.
- When designing components for remote maintenance, consideration shall be given to ease the disassembly and assembly. These considerations shall include using standard threads on bolts and studs, accessibility of bolts and studs, and the ability hold impact wrenches in place, if necessary. Bolts on equipment requiring remote maintenance should also be captured to prevent their loss during removal and installation.
- Standard nozzles and jumpers shall be used throughout the SWPF cells, if utilized in the design.
- Standard locating dowels shall be utilized in the assembly and disassembly of remotely operated maintained equipment.
- All equipment within the SWPF process cells that may require maintenance during the life of the project shall be designed to be maintainable from outside the process cells.
- Valve assemblies, pumps, filters, contactors, and specialized equipment shall be fitted with lifting devices to allow them to remain in the proper orientation during removal and installation.
- Capability shall be provided for in-place maintenance of the CSSX contactors. This equipment would include the following.
  - Clean-in-Place Capability – A water cleaning line is directed to the contactor bowl to flush accumulated solids, using internal nozzles.
  - Drive Motor Removal – The contactor supplier design should provide a means for access to the drive motor to permit decoupling and replacement of the motor.

9.4 Crane Requirements

- Cranes shall not have dual drive axles.
- Overhead cranes shall have provision for being both remotely operated from a remote CR and locally controlled.
- A radiation-hardened camera shall be provided that can be lowered to the process cell floor by the overhead crane. The camera shall be controlled remotely and will have pan, tilt, and

zoom capabilities. Camera movement shall assume that the camera is attached to the crane, but is separately controlled and independent of crane movement.

10.0 CONTROL SYSTEMS

This section discusses control design and operational requirements for the Facility. Operational control of the SWPF process shall be from a CR. An Operations Support Center (OSC) shall be specified to handle emergency operations.

10.1 Control Room(s)

The SWPF shall be operated from its own CR located within the Process Building. The CR shall be designed for manning by up to four CR Operators and a Shift Operations Manager during normal operations. The CR will be the primary location for monitoring and control for the process systems and monitoring of Balance of Plant (BOP) systems. Systems that interface with the CR (local control stations, information management systems, etc.) shall have compatible network wiring, components, connections, and communication protocols throughout the Process Building, as well as any remote locations.

To allow integrated control of the overall Facility, remote process monitoring and control capability shall be included in the CR. Remote monitoring and data recording shall be used where possible in order to minimize the life-cycle costs associated with field monitoring.

The CR shall have the following capabilities:

- Control and monitoring of startup, operation, and shutdown of the ASP, CSSX, and AFP processes;
- Control and monitoring of ventilation system startup, operation, and shutdown;
- Control and monitoring of salt waste primary waste and SWPF product transfer operations;
- Control and monitoring of services and utilities operations (where appropriate);
- Fire detection and suppression system status;
- Indication of local area radiation monitors, airborne radioactivity detection systems, and sump alarms;
- Environmental monitoring and data collection, for exhaust stack emissions;
- Safe shutdown initiation and indication;
- Monitoring of protection interlocks and Safety Instrumented System (SIS) status;
- Operator console mimics depicting real-time status of all process systems (i.e., valve position indication, pump status, flow rates, pressures, etc.);
- Dedicated communications lines to the H-Area Tank Farm, DWPF, Saltstone Control Rooms, OSC and to the SRS Operations Center;
- Public address and area/building evacuation communication;

- Computerized access to necessary O&M documentation;
- Access to Analytical Laboratory and Cold Chemicals Area analyses results;
- Access to plant information databases (e.g., controlled drawings, procedures, maintenance records, etc.), including the data historian;
- CCTV systems for monitoring purposes;
- Stack emission monitoring system indication and equipment status; and
- Radio communications with all Process and BOP Operators. The radio system utilized shall be compatible with the system used in the interfacing facilities.

10.2 Operations Support Center

The OSC is required to stage area emergency response workers who may be called upon to assist in mitigation activities or support functions. A plant office or other suitable plant location external to the main Central Process Area may serve as the Operations Support Center. OSC shall have sufficient space to accommodate 20 people. The OSC shall be compliant with EMPP-6Q-008, *Standards for Facility/Area Emergency Response Facilities*[24].

OSC shall have the following capabilities:

- Public address speaker;
- Four telephone lines including a dedicated communication line to the SWPF CR; and
- Radio communications for local field monitoring and recovery teams;
- Computerized access to J-Area computer network.

OSC shall also have provisions for the following:

- Floor space/wall space for status boards.

10.3 The Safe Shutdown Panel Room

The Safe Shutdown Panel Room will have the following capabilities:

- Startup and shutdown of major equipment and systems;
- Indication of major parameters for all equipment/systems under the Operator's control;
- Computer Operator Console depicting real-time status of all major equipment/systems under the Operator's control;
- Emergency stop initiation for selected components and subsystems, with feedback to the CR;
- Direct actuation for mechanical handling equipment (where appropriate); and
- Telephone and radio communications with the CR.

10.4 Cold Chemical Area Operator Work Station

The Cold Chemical Area (CCA) Operator Work Station will monitor and control the functions inside the CCA.

10.5 Instrumentation and Control Systems

Systems used to monitor and control plant processes and equipment shall include the following provisions, as appropriate.

- The SWPF DCS shall be capable of automatically initiating a sequence of control actions to place the plant in a safe shutdown mode. The safe shutdown sequence will be initiated automatically by the DCS for conditions (if any) that will be specified in the DSA. The safe shutdown sequence shall be capable of being initiated by an operator from the DCS.
- The design of the Human-Machine Interface for operators and control of the SWPF (CR and Local Control Station environment[s]) shall incorporate human factors, engineering principles, and operating experience to promote safety and high operational reliability. The design should incorporate the appropriate I&Cs to provide Operators with diagnostic and mitigation capability.
- Hardware and software for controls and instruments standardized to the extent practicable for like processes to achieve consistency in operation, and reduce spare parts inventories.
- Redundancy shall be considered for application to the control network and system hardware.
- Documentation necessary to support testing and O&M shall be available in the CR.
- I&C systems shall be engineered to fail to a safe condition to the extent practical.
- Power surge suppression of primary system components shall be installed to increase reliability of the control system.
- Software security shall be a requirement for the electronic data management systems (EDMSs), where applicable. Controlled levels of access to the DCS equipment and operating system shall be maintained throughout the Facility. Controls shall include a network firewall to protect against unauthorized access to process computing devices.
- Designs shall be provided that will limit the total number of interlocks, in order to prevent difficulty in plant startup and inadvertent plant shutdowns.
- Access to control systems shall be protected physically, administratively, and by password or other security measures.
- Interlock hierarchy and high-level access for override operations shall consider both defense-in-depth principles and operability/recovery of the Facility.
- Design shall provide for individual devices and independently packaged control systems to be placed in a mode so they can be operated by Operators rather than by sequences, as long as they do not prevent automatic safety system or safe shutdown actuation.

- Devices operated at local control points shall be subject to device and independent protection interlocks.
- Sufficient software diagnostics shall be provided so the reason for control sequence hold-up or sequence trip can be quickly determined.
- To aid in maintenance, sequences shall be capable of stepping through each step while in the manual mode, as long as they do not prevent safety systems or safe shutdown actuation.
- Control system documentation shall be available for use in CRs and equipment rooms.
- The control system should have the capability to provide a hard copy print-out of all actions, alarms, and pre-selected parameters with time and date of initiation.
- Trending, availability, and utilization data shall be stored for instrumented plant items.
- The Project shall provide or have necessary access to a development control system mimicking to the extent practical the primary BPCS. This development system is separate from the process system and used for software development, testing, verification, and demonstrations in an off-line capacity prior to software being installed in the Facility. This development system shall be equipped with input/output racks that will be used to test and/or troubleshoot control system hardware prior to field installation.

10.6 Software Maintenance

Software maintenance is the modification of a software product after delivery to correct faults, improve performance or other attributes, or adapt the product to a changed environment. Because much of a system's cost occurs over the operational lifetime of the software, maintenance features shall be incorporated during development of the software and shall comply with the requirements of V-QP-J-00001, *SWPF Quality Assurance Plan*[25].

- Specialized programs or software that are not commercial off-the-shelf shall have annotations and development standards imposed. Source code, testing, and editing tools shall be included with all software that is non-standard to the Project, to make future software or hardware upgrades or modifications possible without recreating or reverse-engineering the system.
- Source code for specialized software shall be supported by clear, complete, and concise documentation.
- Programming tools shall make use of self-documenting features wherever possible including auto-generation of structure charts, program flow diagrams, and cross-reference lists. If self-documenting features are not available, maintenance information shall be manually generated throughout program development.
- Tools used to create or maintain codes, charts, and diagrams shall be delivered with the applications.
- Software shall be standardized with commercial off-the-shelf systems whenever possible.

- Designs shall provide for self-diagnostics with report-back features to the Operator for failures on all automated systems.
- Software shall have access limited to only qualified staff.

10.7 Type of Control

This section addresses the overall configuration and capabilities of the SWPF DCS.

10.7.1 System Configuration

The overall control system shall contain the following features, as appropriate.

- The DCS will provide real-time control and monitoring of the majority of process equipment.
- The BPCS will be a plant-wide system for monitoring and control of process, ventilation, and services within the Facility. The BPCS is an integral part of the DCS and shall provide the following functions:
  - Startup, closed-loop control, and monitoring of continuous processes;
  - Monitoring of electrical services will be provided via a trouble alarm from an integrated power management system;
  - Monitoring of independent protection trips; and
  - Device interlocks.
- A method shall be provided for bypassing independent protection trips and interlocks with appropriate physical and procedural controls.
- The BPCS shall provide monitoring of status of independently controlled services and utilities.

10.7.2 Control Methods

Process operations will be automated where possible, with a minimum number of control steps requiring Operator initiation. The degree of automation will depend on the degree of administrative control and positive Operator action required for the process involved. Typically, process operations will be controlled by sequence logic until Operator intervention is required.

The normal mode of operation shall be via the control systems and be subject to protective interlocks. The degree of automation will depend on the particular area of the plant. Normal mode shall include the following:

- Operator-initiated startup, monitoring, and shutdown of a continuous process;
- Operator-initiated sequence control of a batch and mechanical process;
- Direct device control where automation is considered inappropriate. Following initiation, operations continue until a normal end condition or operator intervention occurs; and

- Tracking and any appropriate inventory information is automatically preserved throughout normal mode operation.

Manual mode shall be controlled via the control system and is intended for direct device operation outside of the automatic sequence control. Manual mode is considered the normal control mode of any control loops or devices not operated by a sequence. It shall be possible to shut the process down in manual mode to a quiescent safe state. Where used for process recovery, manual mode shall allow the process to be placed in a known state so sequence control can be resumed. Control system startup shall default to manual mode.

The design shall allow for individual process devices to be placed in manual mode so they can be operated by Operators rather than by sequences. Operations requested by the Operator in manual mode shall be automatically recorded by the control system; a diagnostic display and printout of these manual operations shall subsequently be available.

The balance of Facility services and utilities shall be independently packaged control systems monitored from the CR. These systems shall have the capability to be placed in manual mode so individual devices can be selected and operated at local control points.

Maintenance control shall be available as a means of operating devices independent of the control systems from a local panel, or where appropriate. It will be used in the event of control system failure or to perform operational tests as a result of equipment repair or maintenance.

10.7.3 Operator Interface Requirements

The design shall provide CR consoles consisting of high-resolution screen terminals providing detailed plant mimics/graphic screens, sequence initiation, alarms handling, diagnostics, and trending information to provide a flexible and consistent operator interface. These consoles shall provide for normal and manual operation of the ASP and CSSX processes, ventilation systems, waste transfers, cold chemicals transfers, and BOP systems.

A local Operator interface shall be provided for the Cold Chemical Operator. These panels (control nodes) shall provide control in normal and manual modes and display plant mimics. Hardwired interfaces may be provided for systems that are independent of the normal control systems (such as public address, building evacuation, and fire surveillance).

10.7.3.1 Alarm Categorization

To ensure effective operator response, all alarms shall be categorized as the basis for alarm prioritization within the CR. Alarm categories shall include the following:

- Critical Alarms: Critical alarms indicate conditions exist that challenge the Authorization Basis, indicate entry into a Limiting Conditions for Operation, or are entry conditions for emergency events. SIS alarms also annunciate on the BPCS as a critical alarm. Critical Alarms require operator action to prevent demands on the important-to-safety SSCs.

- Warning Alarms: Warning alarms will prompt the operator to take action to mitigate the situation to prevent equipment damage. Warning Alarms indicate that operating limits have been exceeded and operator action is required. Warning Alarms are warning that operating limits are being approached or that an operation has halted due to an abnormal condition. Operator shall determine if action is required

- Advisory Alarms: Serve to notify the operator when operational parameters are outside of the normal range or hardware/interlock abnormalities exist.

- Operator Prompt: Non-intrusive messages informing operator of normal device state changes, sequence phase changes, and operator prompts.

- Log Events: Record information in the Event Chronicle, logging normal DCS control functions during various evolutions.

10.7.3.2 Alarm Annunciation

- Critical:

  Will annunciate on the BPCS workstations as a blinking red alarm in the alarm list and alarm banner. Its position in the alarm list and banner will be based on priority. The alarm requires an acknowledgement and once acknowledged will turn a solid red. Once the condition causing the alarm has been cleared and the alarm has been acknowledged, the alarm will be removed from the alarm list and banner. The alarm will also be logged in the BPCS Historian.

- Warning:

  Will annunciate on the BPCS workstations as a blinking yellow alarm in the alarm list and alarm banner. Its position in the alarm list and banner will be based on priority. The alarm requires an acknowledgement and once acknowledged will turn a solid yellow. Once the condition causing the alarm has been cleared and the alarm has been acknowledged, the alarm will be removed from the alarm list and banner. The alarm will also be logged in the BPCS Historian.

- Advisory:

  Will annunciate on the BPCS workstations as a blinking purple alarm in the alarm list and alarm banner. Its position in the alarm list and banner will be based on priority. The alarm does not require an acknowledgement. Once the condition causing the alarm has been cleared, the alarm will be removed from the alarm list and banner. The alarm will also be logged in the BPCS Historian.

- Operator Prompt:

  Will annunciate on the BPCS workstations as a white message in the prompt banner on displays associated with the prompt. It will also be displayed in the prompt list on the Batch Operator Interface (BOI) on the BPCS workstations. Once the prompt has been answered, the

prompt will be removed from the BOI prompt list and any associated prompt banners. The prompt will also be logged in the BPCS Historian.

- Log Event:

  Log events are not annunciated on the BPCS workstations, however they will be logged in the BPCS Historian.

10.7.3.3 Safety Instrumented System

Independent SIS panels shall be installed for the Facility. Each safety significant alarm must be acknowledged. Alarms shall not clear until the condition causing a trip has been cleared and manually reset.

10.7.3.4 Distributed Control System

The DCS is the real-time control and data acquisition platform responsible for process operation and control, as well as alarming and notification functions within the Facility. The DCS includes the following systems:

- BPCS and
- SIS.

An alarm-handling scheme shall be implemented to meet the following requirements.

- Alarms shall be prioritized to ensure that a suitable level of Operator attention is achieved. Priority assigned to alarms shall take into account the resultant consequences if the Operator fails to respond in the time available to respond to the alarm.
- Consistency shall be maintained between alarm colors and alarm priorities throughout the Facility.
- Alarms shall be grouped by the area and annunciated on relevant Operator and supervisory consoles.
- Non-process related alarms, such as fire and radiation, shall be separate and not annunciated at the process console unless deemed critical to the operation.
- Alarms for systems that have been shut down through normal operation or are involved in maintenance and commissioning should be capable of being suppressed.
- A supervisory control station shall be provided to temporarily suppress repeated and irritating alarms from noisy signals, or for alarms hovering around an alarm set point where the condition cannot be immediately corrected. Alarm deadbands shall be used to minimize the number of nuisance alarms.
- Each alarm will require minimal Operator actions (for example, keystrokes) to navigate to the most appropriate display for dealing with the condition causing the alarm.

- Provisions to time-stamp and log all alarms, suppressed or not, and query alarms in an ordered fashion to assist Operators in event analysis shall be included.
- Ensure that alarms present during normal operations are those due only to equipment failures and deviations from normal operations.
- Alarm modules shall:
  - Provide an alert that a process or system deviation exists,
  - Inform operating staff of the priority and nature of the deviation, and
  - Provide confirmation, in a timely manner indicating if the Operator response corrected the deviation.

10.7.4 Facilities for Maintenance

Sufficient software diagnostics shall be provided so the reason for control sequence hold-up or sequence trip can be quickly determined. Control system documentation to support maintenance shall be available in key locations via the EDMS or comparable system. User-friendly search and retrieval facilities shall be provided.

10.8 Reliability

Control system reliability will be evaluated for the SWPF in accordance with the following requirements.

10.8.1 Control System Design

Control systems shall be designed to meet the following requirements:

- Redundancy shall be provided where appropriate, and redundant systems shall be independent such that failure of one does not affect another.
- A DCS shall be provided that monitors and controls the majority of the process equipment. The system shall consist of a distributed control system and may include a number of networks of programmable logic controllers.
- The Facility shall provide sufficient space for control system input/output cabinets that have 20% spare capacity.
- Design shall provide dedicated, redundant Local Area Networks for the BPCS and SIS.
- Design shall provide protection, so that failure of any component in the control system shall not jeopardize the integrity of plant systems.

10.8.2 Control System Architecture

A failure in one control system shall not adversely affect the operation of any other. Control redundancy shall be considered for application to the control network and system hardware to

allow CR workstations and local Operator interfaces to control and monitor more than one system concurrently for the Facility, should a control system component failure occur.

10.8.3 Control System Power Supplies

The DCS shall be powered by an uninterruptible power supply (UPS) system. UPS batteries shall be sized for 100% output for 30 minutes during a power interruption.

10.9 Data Management

Collection of certain categories of information is required to provide support of Facility operation and product data to the customer and regulatory bodies. Software systems will be used to support the following:

- Production planning and scheduling;
- Maintenance management, including material warehousing and stores;
- Laboratory information management;
- Waste tracking and inventory management (both product and secondary waste); and
- Data warehousing of process and production data in order to satisfy data recording, archiving, and reporting requirements intrinsic to the following:
  - Operations,
  - Management,
  - Customer (DOE),
  - Regulatory,
  - ESH,
  - QA
  - Engineering, and
  - Maintenance.

The data historian equipment should be specified to be commercial off-the-shelf wherever possible. Software security should be provided for the EDMSs, where applicable. Engineering drawings, procedures, etc., will be maintained in accordance with the EPC's V-QP-J-00001[25]) to prevent unauthorized change or loss.

10.9.1 Production and Performance Records

Daily and shift reports shall be capable of being produced and shall detail production achievements and inventory. The DCS applications shall collect data relevant to Facility operation and provide reporting capabilities necessary to accommodate user requirements. Categories of information collected by the DCS and software support systems shall include the following:

- Waste processing and tracking,
- Product quality - laboratory analyses,
- Tank levels and temperatures,
- Equipment status and availability,
- Safety information,
- Environmental and radiological monitoring,
- Facility and equipment maintenance data, and
- Secondary waste data.

10.9.2 Status/Mapping Data

Inventory tracking and recording of data associated with treated product, as well as inlet feed rates being managed in the Facility, will be tracked by the DCS and software support systems. These systems shall compile production records associated with routine inventory-related activities, including the following:

- Cold chemicals inventories;
- In-process additive chemical inventories;
- Inlet feed inventories including Alpha Sorption Tank;
- Product inventories including Sludge Solids Receipt Tank, SEHT, and DSS Hold Tank; and
- In-process batch inventories (Wash Water Hold Tank, SSFT, Solvent Hold Tank, etc.).

10.9.3 Feed and Product Data

Information associated with process material (feed and product) will be recorded at various stages in the Facility process and made available to operations personnel via DCS and software support systems. Movement of the process liquid streams shall be monitored and volume transfers recorded. This function includes tracking through the processing history from receipt of LRW tank feed to disposition of products (sludge solids, strip effluent, and DSS product). It also includes monitoring and recording data associated with the processing and movement of related cold chemicals, including solvent constituents within the Facility, and defining the physical, chemical, and radionuclide contents of each storage vessel and all wastes transferred from the Facility. The data collected forms part of the product quality record and shall include the following:

- Analytical data (including all associated sampling analyses performed on a given waste batch),
- Real-time status of batch (including process parameters and mass balance information),
- Feed sample constituent results, and

- Product sample constituent results (including comparison to associated WAC).

10.9.4 Maintenance Data

The maintenance management system, a component of the Business System, shall serve as the repository for equipment data collected and shall provide for planning and scheduling of maintenance work. A primary purpose of the data collection function shall be to facilitate the development of equipment maintenance histories. Preventive maintenance schedules, diagnostics and troubleshooting regimens, sparing strategies, and similar reports will be based on data obtained from these equipment histories. Maintenance management system functions include:

- Work order generation and tracking (manual- and system-generated);
- Equipment maintenance scheduling and resultant data/status (including planned, predictive, and corrective maintenance);
- Inventory and organization of equipment by hierarchy;
- Equipment vendor information and documentation;
- Equipment performance history data;
- Equipment testing and calibration scheduling and histories;
- Equipment failure reporting; and
- Work Package status (e.g., Planning, Parts Hold, Approved for Work, Field Complete, Post Maintenance Test, and Closed).

10.9.5 Plant Data Warehousing and Reporting

The plant data warehousing and reporting system application of the data historian shall be designed to function as the overall data repository for all report-related data collected at the DCS layer. It serves as a common report generation environment for developing and issuing standard reports required by the various entities, both internal and external to the Facility.

The plant data warehousing and reporting system shall be designed to accommodate and satisfy all reporting requirements identified in the scope of the Business System. The intent is to provide a single common platform for report development and generation. In addition, by providing a common report-generating tool set to users, consistency and maintainability between groups shall be maintained.

10.10 Electronic Document Management System

The Business System will also facilitate EDMS functions for Facility documentation information storage and retrieval. This feature shall enable a user at specified workstation locations to retrieve previously stored plant documentation (e.g., O&M procedures and drawings) and accommodate subsequent printing. Engineering drawings for the SWPF (including as-built) will be maintained in the computerized Business System (as noted in Section 10.9) and will be

accessible via selected user stations. The EDMS will incorporate hardware and software for scanning, importing, converting, and managing new documents.

10.11 Building Access Control System

The building access control system shall control, monitor, and record personnel movement into and out of the Facility. Electronic key card access may be utilized for access control. Locks, security checkpoints, or other administrative controls may be used to administratively control access to the Facility and to critical areas of the plant.

10.12 Instrumentation

Instrumentation design shall consider the following.

- In general, on-line monitoring is required on contaminated process streams. Piping contaminated fluids or gases to remote locations for purposes of monitoring shall be avoided.
- Warning and alarm systems shall be designed to ensure they can be heard over the local noise levels of the area they are intended to cover. Flashing lights shall be used in high-noise areas.
- In-line measurement shall be provided where real-time measurements are needed for in-process control, rather than extracted samples requiring movement to sampling laboratory (see Section 11.0).
- Instrumentation installed in piping normally expected to contain solids shall be designed to prevent plugging by feed solids.
- Indicators shall be visible on the DCS and where needed, local indicators shall be positioned to give a clear line-of-sight and allow safe accessibility.
- Instruments and sensing line valves shall be positioned to allow access from the floor or permanent platform or other suitable method. All instrument valves shall be uniquely identified and tagged.
- Valves/valve internals and in-line instrumentation shall be accessible to facilitate safe and efficient removal.
- When thermal insulation is required around valves and in-line instruments, it shall be sectionalized to allow easy removal and replacement.
- Valves and instruments shall be protected from adverse environmental conditions such as excessive heat, corrosion, vibration, and mechanical damage. Instrumentation shall be selected with environmental ratings that envelop design conditions expected at their installed locations for the operating modes they are required to support.
- Instrumentation shall be selected to be compatible with process chemistry, flow, and pressure at its installed locations and to prevent failure.
- Instrumentation/controls and valves shall go to a safe state on loss of power or motive force.
- Redundant thermocouples shall be provided in the dark cells and considered elsewhere.

- Remotely controlled valves and valves within shielded cells, except Isolock samplers shall be provided with means to indicate whether the valve is fully open or fully closed.
- Instrumentation shall be designed and installed to provide accessibility for maintenance, calibration, and periodic on-line surveillance testing and troubleshooting.
- Instrumentation shall be installed in low-radiation areas, where practical, to allow testing and calibration from outside process cells or other high-radiation areas.
- Instrumentation shall be located outside shielded cells where possible. Instrumentation that must be located inside inaccessible cells shall be designed to allow removal for maintenance.

10.13 Communications

Telephone, public address, and computer communication systems shall be installed and connected to existing SRS communication systems. A back-up communication system shall be provided that does not rely on normal or emergency power for communication with the CR. Communication systems shall not interfere with, or be adversely affected by, process equipment.

11.0 GENERAL SAMPLING AND ANALYSES

Where deemed appropriate in SWPF operations, in-line instrumentation will be used in place of sampling. However, grab samples of various process fluids and cold chemicals will be required for process control, feed and product qualification, and environmental monitoring. The requirements for in-line monitoring and for sampling and analysis within the SWPF are described in detail in the EPC's P-FDD-J-00001[16].

12.0 HUMAN AND ERGONOMICS FACTORS

This section defines the basic philosophy and requirements for integrating human factors and ergonomics considerations into SWPF design. The objective of these requirements is to provide an operational environment that is conducive to maintaining Operator performance at peak levels by minimizing or eliminating Facility features that could promote fatigue, error, or jeopardize personnel safety.

12.1 Human Factors

The SWPF shall be designed to ensure that good human factors principles, guidelines, and methods are integrated throughout the system design, and that controls are in place for subsequent implementation. During the design process, the EPC will identify and define functional and performance requirements and derive solution-dependent requirements to ensure that human factors are integrated into the process designs. The objective of Human Factors Engineering is to ensure designs are compatible with the capabilities and limitations of the personnel who will operate and maintain the plant. Human factors require that the design minimize characteristics that require: extensive cognitive, physical, or sensory skills; the performance of unnecessarily complex tasks; tasks that unacceptably impact manpower or training resources; or result in frequent, repetitive, or critical errors.

The SWPF design human factors will seek to reduce and eliminate the possibility of human error and provide a high-quality and safe workplace environment. This shall be achieved by taking into account human interfaces (particularly operators, laboratory personnel and maintenance technicians) for all operational modes (startup, normal operation, shutdown, and emergency response) and maintenance. OSHA standards will be followed to ensure a safe working environment is established. Senior operational personnel will review O&M procedures during their development and identify potential problem areas during SWPF design.

Priorities for implementation of human factors considerations are described below.

- Engineering and Design Controls – Engineering controls involve altering physical items in the workplace, including actions such as modifying workstations, obtaining different equipment, or changing tools.
- Administrative Controls – Administrative controls involve altering work organization or work requirements. These approaches usually are less expensive than engineering controls, but are also less dependable.
- Work Practice Controls – Work practice controls involve training and encouraging a specific method of task performance to reduce worker errors.

The EPC's objective is to place highest priority on engineered controls. Administrative and work practice controls will be implemented, as needed, following job analyses.

12.2 Process Control Considerations

Human factors and ergonomics for process control promote maximum productivity, while ensuring that operational safety and environmental requirements are met. Integration of ergonomics in the SWPF design will center on the balance between SWPF automation and manual control. The design of the Human-Machine Interface for operations and control of the SWPF will incorporate engineering principles and operating experience to promote safety and high operational reliability. The design will incorporate appropriate I&C to provide Operators with diagnostic and mitigation capability. In particular, the design and configuration of the CR shall also follow good engineering practices, as well as sound human factors principles. All areas of the operational workplace (including lighting, environmental conditions, workstation positioning, work space arrangement, user interface screens, and system operation and navigation) will be engineered taking into consideration the guidance of U.S. Nuclear Regulatory Commission Regulation, NUREG-0700, *Human-System Interface Design Review Guidelines*[26].

Operating data will be accessible from consoles connected to the DCS, which provide appropriate access control and security. The DCS will also provide for interfaces to the SWPF operational database that will collect management data for use in O&M and Engineering disciplines.

To the extent practical, automated safety and processing control systems (employing hardware and software that meet design criteria for the appropriate safety classification) will be employed. These will be designed to an appropriate level of architectural and functional independence so

they will function through power disturbances and other operational and external occurrences. They will be designed to an appropriate level of redundancy and are intended to be fail-safe and highly reliable. They will be passive and not rely on short-term Operator decisions and will maximize the use of automated systems. A cost-effective approach will be taken that will weigh risks, benefits, and the resulting operational safety.

The majority of operations of the proposed SWPF will be accomplished from a centralized location (the CR). The CR console groupings will be primarily dedicated to operating a designated Facility segment (such as ASP, CSSX, BOP, etc.). Every console will be functionally equivalent and have the capability to run major Facility segments independently or concurrently.

The CR will minimize the use of audible alarms, employing the "dark board" concept. This means an alarm display will have a blank screen unless there is an alarm occurring. Alarm management subroutines must classify and sort alarms by priority, indicating time tags to show sequences, and will point to root cause malfunctions rather than simply providing raw data for the Operator to decipher.

Other control features that provide good human factors and ergonomic practice include the following.

- Facility and process control and monitoring – Provide plant Operators with the capability to monitor and control the status and modes of the plant in a safe and efficient manner. It will enable control from a central location, as well as local control stations located closer to the subsystems and equipment.
- Object-oriented graphics – Provide the capability of creating and using object-oriented graphical displays and other Operator interface screens.
- Regulatory Control – Provides regulatory control to the proposed Facility. This is a fundamental control, whereby variations of process variables from present limits require appropriate adjustments to process controls to bring variables back to permissible conditions in accordance with the DSA and other regulated conditions.
- Save and restore capability – Provides capability to save the operational status of the process and other systems and restore that status upon request. At a minimum, this capability will save all relevant set points.
- Self-checks and diagnostics – Provide capability for the system to characterize final control element performance, monitor its own status and performance, and notify when degradation occurs.
- Alarm management – Provide the capability to monitor and point to problems immediately as they arise. Prioritize alarms based on severity, system status, or mode of operation.
- Archival and retrieval – Provide a flexible data archiving and retrieval system. The system will be capable of gathering and storing data at regular timed intervals, specified event(s), or upon request. This will also allow the capturing of Operator actions on the system.

- Automatic sequencing – Provides the capability of automatic startup, fault-recovery sequences, and data-taking routine.
- "Bumpless" transfer redundancy – Provides the capability of transferring control to redundant systems without any interruptions or failures of the process.
- Mode control – Provides the capability of operating the SWPF in various operating modes (e.g. single-strike or double-strike) using different system logic. Various modes of O&M will include startup, shutdown, rate change, sequence change, and auto-to-manual transitions. These transfers between modes must be made with a minimum of process upsets.
- Data acquisition and distribution – Provide a flexible means to acquire data, both synchronously and asynchronously, and to pass data to relational databases and off-line programs.

12.3 Environmental Factors

The following environmental factors will be incorporated into SWPF design.

- Heat Stress – The Facility will be designed to minimize the heat stress impact on the human body. The HVAC system will be sized adequately to account for external environment temperature extremes and heat generation from equipment to provide a comfortable working environment.
- Cold Stress – The HVAC design will account for external environment temperature extremes to provide a safe working environment.
- Whole body vibration – Equipment and workstations will be designed to minimize the body impact from vibration exposure. Dampeners will be utilized as needed to reduce vibration resulting from process equipment.
- Lighting – Lighting throughout the Facility will be designed to particular work functions being performed. For example, work that requires high visual acuity and contrast sensitivity will be given high levels of illumination. Offices will have low background lighting coupled with separately controllable non-glare task lighting.
- Noise – Noise levels will be minimized to the extent practical in work areas/stations where frequent work functions are performed. OSHA guidelines for noise levels and reduction will be followed throughout the SWPF.
- Radiation – ALARA optimization principles will be incorporated into the design in accordance with the Radiation Protection Plan (RPP).

12.4 Physical Factors

The following physical factors will be incorporated into design of the SWPF.

- Lifting – Work functions that require lifting by the Operator will be minimized in the SWPF. OSHA guidelines and requirements for industrial lifting will be followed. Work functions that require transporting heavy loads will utilize mechanical methods.

- Climbing/Height – Working at heights will employ the use of mezzanines and catwalks to avoid unnecessary climbing and use of ladders. Permanent stairways will be installed where activities are required, in order to minimize the use of movable ladders.
- Slips/Falls – OSHA requirements will guide the design for slip and fall protection. Treaded walkways and stairs will be used to prevent unnecessary injuries due to slips. Handrails will be installed throughout the SWPF to avoid falls from heights.
- Duration/Exertion – Work that involves performance of tasks from one postural position for an extended duration will be minimized.
- Repetition/Posture – Activities that require an awkward posture will be avoided. Workplace dimensions will be designed such that normal work functions do not exert an abnormal force on the body.

12.5 Lighting Considerations

- Internal lighting shall be provided in accordance with standard architectural practice in office areas, maintenance shops, and corridors.
- CR lighting shall be conducive to comfortable viewing of computer monitor screens. The CR lighting should be designed to reduce monitor glare and still provide good lighting for reading procedures and recording information in logbooks. There shall be capability for dimming the lights and lighting shall be arranged in zones.
- Adequate lighting shall be provided for remote operation and removal/replacement of equipment in hot cells.
- Emergency (egress) lighting shall be provided at appropriate locations to aid safe evacuation, facilitate initiation of alarms, and identify fire equipment. In addition, emergency lighting shall be provided to facilitate safe shutdown, when performed at the Safe Shutdown Panel.

13.0 SPARE PARTS

Spare parts and replenishable supplies (cold chemicals, solvent, etc.) will be required for SWPF operations. Specific parts and equipment and supply needs, will be assessed using a spares optimization software package taking into account manufacturer and supplier recommendations, lead time as well as the importance of the equipment to the process and consequence of not having needed spares, and eventually augmented by actual operational experience. General guidelines for the spare part needs and inventory, procurement practices, and spare part control are discussed below.

13.1 General Guidelines

A spare parts program shall be established to determine the list of spare parts, store them properly, and replenish them for use by the successor LTO. The spare parts program shall take into consideration equipment delivery lead-time that could cause unacceptable impact to operational availability of the facilities. It shall also take into consideration the option of equipment having an adequate available backup or the capability to repair/rebuild. In addition,

definition and procurement of specific items and quantities will be based on vendor recommendations and operational staff judgment. Work space shall be provided for the proper storage and maintenance of the spare parts.

Of particular concern in developing of a spare part inventory for the SWPF are the following:

- Safety Components – The potential long lead-time and high cost of this type of equipment require that an extensive evaluation be made of precise SWPF needs. The lead time/cost factors are a direct result of both QA requirements and the limited number of suppliers who furnish equipment to meet the QA requirements typically specified for nuclear applications;
- Components Impacting Plant Availability – Potential failure of certain components in the SWPF process (such as the centrifugal contactors and drive motors) have a significant impact on availability. The EPC will evaluate and recommend that certain complete "spare" system assemblies be maintained to permit rapid replacement; and
- Solvent and MST –These unique process chemicals may only be supplied by one chemical supplier. An evaluation will be made of both usage rate and chemical cost when determining the needed supply to be available on-hand at the SWPF.

13.2 Spare Parts Replacement

A spare parts inventory will be generated for "normal-wear" replacement items to be maintained in the SWPF. Equipment O&M manuals and manufacturers' recommendations will be utilized as aids to determine the spare part kits required. The spare part items will be maintained onsite for rapid replacement of affected equipment. Examples of replacement spare parts items include gaskets, seals, valve packing, valve and pump assemblies, valve operators, bearings, filters, fans, relays, solenoids, sensors, signal conditioning devices, breakers, etc.

The EPC's Operations Assessment Mode will be used to predict system and Facility availability given assumed failure rates and mean time to repair. The result of this modeling will be used to improve availability by providing redundancy, designing equipment for longer service life or ease of repair or replacement, and by specifying critical spare part needs for those components most likely to fail and disrupt plant operations. The equipment identified will be included in the spare parts inventory at the Facility to shorten downtime, if a major equipment failure occurs. Examples of process equipment to be included in this inventory are:

- Alpha strike filters;
- Alpha strike circulating pumps;
- CSSX contactor;
- Drive motors, including Variable Frequency Drives;
- Mixing pumps;
- Transfer pumps;
- Ventilation System Blowers; and

- Selected instruments, Programmable Logic Controls, and control boards.

13.3 Spare Part Procurement

A component-level database will be developed for SWPF spare parts. This database will include or refer to relevant procurement specifications. It will also enable information to be organized, stored, and retrieved to enable the expeditious procurement of needed parts. At a minimum, the database shall include information for each spare that includes:

- Quantity required;
- Typical lead time;
- Manufacturer(s);
- Model/Part Number;
- Quality level of the component(s);
- Codes and standards requirements;
- Inspection, vendor testing, and quality requirements;
- Material certifications, Certificate of Conformance, and other documentation required from suppliers;
- Calibration requirements;
- Equipment process identification; and
- Unique inspection or testing requirements/methods.

13.4 Spare Part Storage and Control

A spare parts storage and control system shall be developed to provide for organized and rapid retrieval of spare parts from inventory. The parts shall be stored at the SWPF or other suitable location, used and replenished, and provided to the future LTO. Preliminary minimum and maximum quantities shall be established for the parts. A program shall be developed for the receipt, proper storage, and replenishment of parts needed for use in the plant, considering the following criteria:

- Methods for spare parts receipt and storage,
- A policy for rejection or evaluation for disposition of items if not received within QA acceptance criteria,
- Provision for periodic inspections and maintenance during storage,
- Environmental requirements for storage (temperature and humidity control) requirements,

- Segregation of hazardous materials, and
- Identification and control of non-conforming parts or materials.

14.0 ENVIRONMENTAL COMPLIANCE REQUIREMENTS

During the Construction, Commissioning, and Operation phases, the SWPF must comply with numerous DOE, Federal, and State regulations related to environmental protection and monitoring. Environmental monitoring and compliance requirements are described in detail in the EPC's S-EIP-J-00001[6]. S-EIP-J-00001[6] is the governing document in all matters relative to environmental protection. Interface requirements between the EPC and the Site Management and Operating are contained in V-ESR-J-00019[13].

14.1 Waste Handling and Disposition

The requirements for handling and disposal of solid waste materials from the SWPF are presented in V-ESR-J-00003, *SWPF Radioactive Solid Waste, Mixed Waste, and Hazardous Waste Interface Control Document (ICD-03)*[27].

Summarized below are the storage requirements for solid waste at the SWPF.

- The use and storage of hazardous materials shall be limited to a practicable minimum through design restrictions. These materials shall be controlled and located so any accident or release of the materials will not jeopardize safe conditions in the SWPF. Chemicals that have potential to react shall be physically separated during storage.
- The generation of secondary wastes shall be minimized including radioactive solid wastes, hazardous wastes, and non-radioactive and non-hazardous liquid effluents.
- Segregation of waste shall occur as near the source of the waste as practical.
- Suitable temporary storage areas for contaminated laboratory samples, laboratory glassware, and degraded solvent shall be provided.
- Temporary accumulation of hazardous/mixed solid waste at the SWPF shall be as noted in South Carolina Regulation (SCR) 61-79.262, *Standards Applicable to Generators of Hazardous Waste*[28].
- Spent (contaminated) solvent will be handled in accordance with V-ESR-J-00005, *SWPF Radioactive Liquid Effluents Interface Control Document (ICD-05)*[29].

15.0 HEALTH AND SAFETY REQUIREMENTS

15.1 Safety Requirements

SWPF is committed to the concepts of ISMS as defined in DOE P 450.4, *Safety Management System Policy*[30], with the intent to meet 10 CFR 851, *Worker Safety and Health Program*[31], requirements. Operational and maintenance safety concepts shall be implemented throughout the design and construction phase with input from operational and safety professionals. S-CIP-J-00003, *SWPF 10 CFR 851 Worker Safety and Health Program*[32], outlines the process and procedures to meet the requirements of 10 CFR 851[31] and V-ESR-J-00019[13]. Operations and ESH programs will be established to ensure proper tracking, monitoring, and reporting, as required.

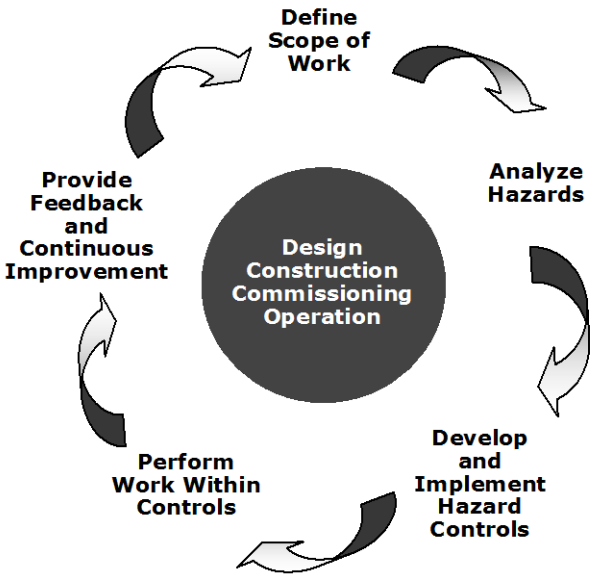
16.0 HEALTH AND SAFETY REQUIREMENTS

16.1 General

Operation of the SWPF will be commensurate with the goal of zero accidents. A systematic approach shall be adopted during SWPF Commissioning to identify safety hazards associated with the Facility. Where practical, hazards shall be removed. In cases where this is not possible, operational control features and administrative measures shall be developed, implemented, and suitably tested prior to the possibility of the hazard existing.

The SWPF ISMS, initially implemented during the Conceptual Design phase, meets the requirements of DOE P 450.4[30] and will be used in conjunction with a formal safety program to meet the requirements of 10 CFR 851[31]. The specific safety management system requirements applicable to the SWPF Project are provided in P-EIP-J-00001[15]. The information provided below is intended to provide an overview of the SWPF ISMS. P-EIP-J-00001[15] takes precedence on all matters related to safety management for the SWPF. The ISMS core safety functions are shown in Figure 16-1. These core safety functions are applicable to all life-cycle phases of the SWPF Project.

Figure 16-1. Integrated Safety Management System-Core Functions (Commissioning Operation)



The general principle for safety at the SWPF is that each employee has responsibility for his/her personal safety, as well as the safety of fellow employees. As a condition of employment, each individual within the organization will be expected to conduct daily tasks in a manner consistent with the philosophy of this policy. Responsibilities for ESH&Q are shared, as follows.

- The EPC, as the employer, accepts responsibility for leadership of the environmental, safety, and health program, its effectiveness and improvement, and for providing required safeguards to ensure safe work conditions.
- Management personnel are responsible for developing proper attitudes toward environmental, safety, and health in themselves and in those they supervise, and for ensuring that appropriate controls to protect the safety and health of all involved personnel and the environment have been implemented into their operations prior to performing work.
- Employees are responsible for taking active roles in performing their work safely and stopping work if unsafe conditions exist. Employees are expected to take part in planning work, complying with rules and regulations, and continuously practicing safety and health while performing their duties.

Implementation of the ISMS policy will be the top priority during operation. Management commitment and employee involvement are key elements of the EPC's safety management system and are implemented through the following actions.

- The ISMS and policy statements are communicated through the organization. The EPC will conduct employee training of ISMS fundamentals and company implementation.
- Managers are held accountable for safety performance.
- Managers emphasize the importance of individual accountability for performing work safely.
- Managers emphasize the significance of integrating safety into work processes and products. This is especially important during the Commissioning and Operations phases of the Project.
- Employees at all levels are encouraged to participate in development and implementation of the ISMS. In order to maintain a high level of employee commitment, "all employees" safety meetings will be held at regular intervals. Specific aspects of safety, incident awareness, and means of complying with safety provisions on a daily basis will be emphasized.

In addition to OSHA requirements, safety requirements shall include the following.

- Minimizing industrial safety risk in plant operating areas. For example, high-noise equipment shall be eliminated (consistent with OSHA regulations) or the emanating sound dampened, to comply with industrial safety standards for continuous occupancy.
- Providing monitoring equipment to areas that have potential air quality problems (e.g., carbon monoxide monitors in diesel rooms).
- Where inerting gases are used, oxygen monitors shall be used before allowing personnel access into confined spaces.
- Manual lifting of equipment or materials as a part of routine operations shall be evaluated (2005 American Conference of Governmental Industrial Hygienists Threshold Limit Values [TLVs] and Biological Exposure Indices [BEIs]), taking into consideration items such as number of times to be lifted, location, how far load is to be carried, and so forth.
- Working at heights greater than six feet for routine operations shall consider means to prevent falls, slips, and use of caged ladders, safety harnesses, etc.
- Engineered safety features shall be the primary method used to minimize exposure to carcinogens and prevent their release into the work environment.
- Asbestos, asbestos-containing materials, or materials containing refractory ceramic fibers shall not be used at the SWPF.
- SWPF design shall comply with the safety requirements of 10 CFR 851[31].

16.2 Safety Program

In accordance with ISMS philosophy (illustrated in Figure 16-1), the operational safety process is divided into five specific principles that are summarized below.

16.2.1 Define Scope of Work

Each individual Functional Area Manager will be charged with developing specific requirements for performance of duties. Accordingly, each planning document will include details on safety provisions and required resources. Examples of planning documents are shown in Table 16-1.

Table 16-1. SWPF Requirements Planning Documents

Project Phase	Basis	Planning Document
Commissioning	DE-AC09-02SR22210 (Contract[1]) DOE O 413.3, *Program and Project Management for the Acquisition of Capital Assets*[33]	P-SUP-J-00001[2] V-RPT-J-0107, *SWPF WBS Dictionary*[34]
Operations	DE-AC09-02SR22210 (Contract[1]) DOE O 413.3[33]	P-SUP-J-00001[2] V-RPT-J-0107[34]

The implementing documents will become more detailed and specific as the Project progresses.

16.2.2 Analyze Hazards

The objective of hazard analysis is to develop an understanding of the potential for a hazard to affect the health and safety of the worker, the public, and the environment. Hazards associated with the SWPF include radiological, industrial, chemical, and natural phenomena.

Table 16-2 describes different types of SWPF hazards, the sources, associated risks, and analysis bases and output to be utilized to determine the hazard significance. Results of these hazard analyses provide the basis for determining the magnitude of controls to be implemented to prevent or mitigate the risks.

Table 16-2. SWPF Hazards and Risks

Hazard	Source	Potential Risks	Analysis Basis	Analysis Output
Nuclear/ Radiological	Actinides (i.e., ^{238}Pu, ^{241}Am, etc.) ^{90}Sr ^{137}Cs	• Release of radiation or radioactive material resulting in exposure to the public or Facility workers • Criticality • Environmental contamination	10 CFR 830.200 10 CFR 835 DOE STD-1027 DOE-STD-3009	SWPF Hazard Classification Document, RPP, PHA, PDSA, DSA
			10 CFR 21	SEIS
Chemical	Caustic (NaOH) HNO_3 $H_2C_2O_4$ MST BOBCalixC6 Cs-7SB Trioctylamine Isopar®L	• Explosion • Fire • Health implications to employees • Environmental release	29 CFR 1910.119	PHA, PDSA, DSA
			10 CFR 21	SEIS
Industrial	Material handling equipment Rigging/Lifting Excavation Confined Spaces High voltage Temperature duress Vehicle traffic	Injuries and illness to employees	29 CFR 1910 29 CFR 1926 10 CFR 851 DOE O 440.1A	Worker Safety and Health Plan, Job Hazards Analysis, EPC's Industrial Safety Plans
Natural Phenomena	Earthquake Tornado Flood	Exposure to public, employees, and environment	10 CFR 830.200 DOE-STD-1027 DOE-STD-3009	SWPF Hazards Classification Document, PHA, PDSA, DSA
			10 CFR 21	EIS

The process of analyzing hazards continues throughout SWPF Commissioning and Operations. Some requirement sources/references are given in Table 16-3.

Table 16-3. Hazard Analysis References

SWPF Phase	Basis	Analysis Steps
Commissioning	10 CFR 830.200 29 CFR 1926 29 CFR 1910 10 CFR 851	• Unresolved Safety Question Determinations • Job Hazard Analysis • ALARA Evaluations
Operations	10 CFR 830.200 29 CFR 1926 29 CFR 1910	• Unresolved Safety Question Determinations • Job Hazard Analysis • ALARA Evaluations

Of particular importance are the industrial hazards documented in JHAs. The JHA is a basic tool for analyzing and reviewing operations and procedures to identify potential worker protection hazards and deficiencies. These hazard analyses are performed by experienced teams consisting of specialists experienced in hazard analysis, Facility and systems engineers, and process

Operators. The JHA performed during Commissioning of the SWPF will consist of walkdowns of the entire Facility and installed equipment to identify and analyze potential hazards. The results of the JHA will be documented and then audited at a later date to ensure that mandatory findings and recommendations are satisfactorily implemented.

16.2.3 Develop and Implement Controls

Before work is performed, appropriate controls are developed and an applicable set of safety standards and requirements is identified. These standards and requirements are tailored to the SWPF Project. Developing and implementing hazard controls for the SWPF includes:

- Identifying applicable standards and agreed-upon sets of requirements,
- Identifying controls to prevent/mitigate hazards,
- Establishing boundaries for safe operations (establishing the Safety Basis), and
- Implementing and maintaining configuration of controls (e.g., TSRs and operational safety requirements).

The hierarchy of controls to be used for the SWPF is first and foremost engineered into the Facility design, followed by administrative controls, and the last control is personal protective equipment. These controls are applied in a risk-based manner. In general, administrative controls are not used if the effectiveness and value of engineered controls can be demonstrated.

Table 16-4 identifies the basic controls used to prevent or mitigate hazards/risks associated with the SWPF. The implementing documents for the controls are identified in the EPC's S-RCP-J-00001[7].

Table 16-4. SWPF Hazards, Risks, and Controls

Hazard	Source	Potential Risks	Control Mechanisms
Nuclear/ Radiological	Actinides (i.e. ^{238}Pu, ^{241}Am, etc.) ^{90}Sr ^{137}Cs	• Release of radiation or radioactive material resulting in exposure to the public or Facility workers • Criticality • Environmental contamination	• Design (prevention and mitigation features) • TSR (prevention and mitigation) • RadCon Program (prevention) • Criticality Safety Program (prevention) • Safeguards and Security (prevention and mitigation) • Environmental Protection Program (prevention and mitigation) • Permitting (prevention) • Monitoring (prevention) • Industrial Safety Program (prevention and mitigation) • Personnel Protective Equipment (prevention)
Chemical	Caustic (NaOH) HNO_3 $H_2C_2O_4$ MST BOBCalixC6 Cs-7SB Trioctylamine Isopar®L	• Explosion • Fire • Health implications to employees • Environmental release • Injuries and illness to employees	• Design (prevention and mitigation features) • Chemical Control Program (prevention) • Personnel Protective Equipment (prevention and mitigation)
Industrial	Material handling equipment Rigging/lifting Excavation Confined spaces High voltage Temperature Duress Vehicle traffic	• Exposure to public, employees, and environment • Loss or damage to property	• Design (prevention and mitigation features) • Chemical Control Program (prevention) • Industrial Safety Program (prevention and mitigation)
Natural Phenomena	Earthquake Tornado Flood	• Exposure to public, employees, and environment • Loss or damage to property • Life - Safety	• Design (mitigation features)
All Hazards	All Sources	All Risks	• Waste Management (prevention and mitigation) • Fire Protection (prevention and mitigation) • Occupational Health Program (prevention and mitigation) • Emergency Management (mitigation) • Configuration Management (preservation) • Maintenance (preservation) • Training and Qualification (prevention and mitigation) • QA Program (prevention)

Methods for protecting human health include: engineered controls (shielding, remote handling, ventilation, and secondary containment); administrative controls (radcon procedures, medical surveillance, training, and Hazard and Operability Review); and personal protection equipment controls (respirators, face shields, chemical-resistant gloves, boots, and aprons).

Methods for protecting employees from typical industrial hazards include: engineered controls (installing eye washes and showers, chemical replacement, ventilation systems, and fire retardant materials); administrative controls (pre-operational checklists, training, testing, and workplace inspections); and personal protection equipment (hard hats, safety-toed shoes, and respirators).

Methods for environmental safety include: engineered controls (ventilation systems, secondary containment, subsurface structures, and treatment of wastes); and administrative controls (monitoring, spill response, emergency response, and material transfer procedures).

A specific listing of controls to be implemented is presented in Table 16-5.

Table 16-5. Safety Controls

Life Cycle	Basis	Control	Implementing Mechanisms
Commissioning	29 CFR 1910 10 CFR 830.200 10 CFR 835 10 CFR 851 DOE O 414.1D	• Design Features • Radiological Control Program • Environmental Protection Program • Emergency Management • Safeguards & Security • Waste Management • Configuration Management • Chemical Control Program • Industrial Health and Safety Program • Safety SSC • Fire Protection Program • Maintenance Program • Training & Qualification • Packaging & Transportation • QA Program	• Safeguards and Security Procedures • Startup, Operation, and Maintenance S-RCP-J-00001[7] • Operations Training and Qualification Program • Operating Procedures • Work Control Program • Maintenance Procedures • TSRs
Extended Hot Operations	10 CFR 830.200 29 CFR 1910 10 CFR 835 10 CFR 851		

16.2.4 Perform Work

A Readiness Review of any operation involving hazardous conditions is required to be performed and verified by the work supervisor prior to starting work. Pre-job briefings are conducted by the work supervisor prior to initiating construction, maintenance, or operations activities not addressed in pre-approved procedures. At the programmatic level, a formal Readiness Review is required prior to transition from one life-cycle phase of the Project to another. Verification that Project plans and procedures are in place prior to these transitions is performed as part of the Critical Decision process described in DOE O 413.3[33].

The Commissioning phase includes Cold Commissioning and Hot (radioactive) Commissioning performance testing. These readiness activities are governed by DOE O 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities*[35]. The operational readiness process will be documented in the EPC's procedures. Startup authorization must be received prior to Hot Commissioning testing with actual salt waste. Following successful completion of Hot Commissioning startup and testing, radioactive operations will be conducted for one full year. After the one year of operation is complete, the SWPF activities will be transitioned to the successor LTO.

Work in the SWPF will be performed to approved work instructions and procedures that are maintained under configuration control. Pre-job briefings and walkdowns will be used as mechanisms to determine readiness prior to performing work, ensuring that workers understand the work tasks and requirements.

Operational work will be performed in accordance with approved procedures for operations, testing, and maintenance. Operators and maintenance staff will:

- Participate in development of the procedures;
- Be trained, tested, and periodically re-trained on procedures;
- Identify shortcomings, need for change, etc., due to operation and experience; and
- Participate in revising and then training on the revised procedures.

A key aspect of employee involvement in controlling hazards is having the operational staff participate in establishing safety objectives and performance measures, as well as identifying and correcting workplace hazards. Operational employees will also be encouraged to conduct walkdowns of their workspaces and job functions and will receive hazard recognition training. When workers discover conditions that may expose them to imminent danger or other serious hazards or violate the DSA, they will notify their supervisor(s) to get the issue resolved and have the authority to stop work if the danger is imminent. Supervisors are accountable for ensuring the safety of their workers. The process for stop work will be documented in a procedure and communicated to the operational staff.

Specific DOE and Federal regulations defining operations and safety requirements include those in Table 16-6.

Table 16-6. Operations and Safety Defining Orders and Regulations

SWPF Phase	Document
Commissioning	DOE O 425.1D DOE O 422.1 DOE O 426.2 10 CFR 830.120 10 CFR 851 10 CFR 835
Extended Hot Operations	DOE O 422.1 DOE O 426.2 10 CFR 830.120 10 CFR 851 10 CFR 835

16.2.5 Feedback and Improvement

Feedback and improvement complete the ISMS loop by connecting the practical experience of work conducted to planning for future work. The feedback and improvement function is intended to:

- Identify and correct processes or deviations that lead to unsafe or undesired work outcomes;
- Confirm that desired work outcomes were obtained safely; and
- Provide managers and workers with information to improve the quality and safety of subsequent similar work.

The feedback and improvement function applies to each ISMS function and principle and to each organizational level (institutional, Facility, and activity). These concepts apply to: people working in the system (observation of work performance, conditions, equipment, etc.); hardware (equipment performance); and software (plans, procedures, policies, instructions, computer software).

The EPC will take a proactive approach to identifying and correcting safety deficiencies and providing early detection and intervention. Deficiencies are identified through the EPC's assessment process. Assessments are conducted to confirm administrative controls such as procedures and manuals that reflect the work to be performed, control the hazards/risks, and ensure work is performed within the established DSA. Different types of assessments performed include management assessments, independent assessments (which could involve corporate and external consultants), and routine Facility walkdowns (some scheduled and some unannounced). Determination of what is to be assessed is based on trends, risks, lessons learned, and the work being performed. Results of the assessments contain significance statements, in order to facilitate prioritization of corrective actions.

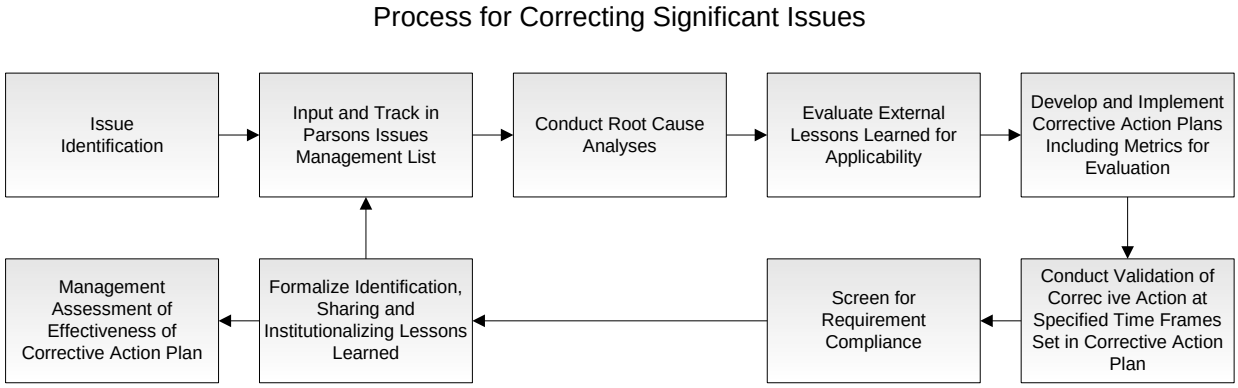
Table 16-7 presents the finalized structure used for assessment.

Table 16-7. Feedback and Improvement Assessment

SWPF Process Phase	Basis	Feedback and Improvement Mechanism	Implementing Documents
Commissioning	29 CFR 1910 10 CFR 830.200 10 CFR 830.120 DOE O 540.1 DOE O 426.2 DOE O 210.1 10 CFR 835 10 CFR 851	Plan-of-the-Day Meetings Bi-weekly Safety Meeting Procedure Validation O&M Procedure Development Program Pre-job Briefings (Maintenance) Walkdowns and Inspections Acceptance Testing Environmental Monitoring Safety Committee	O&M S-RCP-J-00001[7], P-SUP-J-00001[2], and Test Procedures TSRs Operation Training Plan Work Control Program JHA
Extended Hot Operations	10 CFR 830.200 10 CFR 830.120 29 CFR 1910 DOE O 426.2 DOE O 210.1 10 CFR 835 10 CFR 851	Plan-of-the-Day Meetings Bi-weekly Safety Meeting Pre-job Briefings (Maintenance) Walkdowns and Inspections Acceptance Testing Environmental Monitoring Safety Committee	S-RCP-J-00001[7] TSRs O&M Procedures ALARA Evaluations JHA Work Control Program O&M Training Plan

Safety deficiencies that may be identified by the assessment processes are tracked, screened, trended, and assigned to the appropriate manager for resolution. Safety issues are categorized into two areas: 1) "Go-Do" and 2) significant issues. Go-Dos have clear and immediate fixes. Significant issues include any off-normal event, "timeout for safety" work stoppage, near misses, or reportable events. These issues will be formally investigated. Corrective actions are developed that focus on preventing the same or similar events from recurring. The Corrective Action Implementation Process is shown in Figure 16-2.

Figure 16-2. Corrective Action Implementation Process



16.3 Engineered Provisions for SWPF Safety

16.3.1 Industrial Safety

SWPF safety provisions will comply with 10 CFR 851[31], which implements OSHA standards, and be implemented in the SWPF design. The following are examples of general principles to be employed.

- Noise – High-noise equipment shall be eliminated, consistent with OSHA regulations, or sound-isolated to comply with industrial safety standards for continuous occupancy.
- Electrical – Lockout/Tag-out procedures will be employed. Personnel accessing or maintaining electrical equipment will have suitable training in this area.
- Air Quality – Monitoring equipment will be provided to areas that have potential air quality problems. Where inerting gases are used, oxygen monitors shall be provided prior to entering confined spaces.
- Carcinogens – Engineered safety features shall be the primary method used to minimize exposure to carcinogens and prevent the release of carcinogens into the work environment. Asbestos, asbestos-containing materials, or materials containing refractory ceramic fibers shall not be used at the SWPF. MSDSs or SDSs will be available in a designated central location for review when any unfamiliar chemical is accessed during operational/maintenance work.
- Operational Steps – Operations/maintenance supervisor training shall include instruction in lifting and working at heights. They will evaluate the following (see Section 16.1) if they occur during operations/maintenance activities:
  - Lifting, including repetitive lifting of light loads; and/or
  - Accessing or climbing to any position greater than six ft above normal operational surfaces.

16.4 General Health Protection

The following provisions will be utilized in the SWPF design and operation. The design of the Facility and the selection of materials shall include features that facilitate operations, maintenance, and D&D.

- Monitoring equipment shall provide means for calibration to appropriate standards. Alarms and warning systems that are required to function during a loss of power shall be provided with UPS, unless demonstrated that the system can tolerate a temporary loss of power without loss of data and alarms are provided with standby power. Determination of the power supply and quantity shall be based on the safety classification of the monitoring system or device.
- During periods of normal operation, confinement barriers and associated ventilation systems shall maintain continuous airflow from the environment to the building and from non-

contaminated areas of the building to potentially contaminated areas, the normally contaminated areas, and finally through HEPA filters prior to release to the environment.

- Special features shall be considered for access through confinement barriers to minimize the impact of Facility access requirements on the ventilation system and prevent the release of airborne radioactive materials.
- Spill prevention and control shall be considered in the design stage of the Facility to minimize the possibility of accidentally releasing hazardous waste to the environment. O&M procedures will also assess the possibility and perform inspection for process fluid leakage during operations or loss during maintenance operations.
- System alignments, which include normal flow path and inadvertent flow, shall be verifiable without requiring personnel entry into high radiation areas.
- Remote handling equipment shall be considered where it is anticipated that exposures to hands and forearms would approach extremity dose limits or where contaminated puncture wounds could occur.
- Warning and alarm systems shall be designed, installed, and tested to ensure they are heard in the ambient condition of the area they cover. Safety alarm systems, such as evacuation alarms, shall annunciate inside and outside a monitored area to identify hazardous conditions to anyone inside or outside in the vicinity of the monitored area. The use of visual and audible alarms shall be evaluated. Safety alarms in high-noise areas shall be provided with audible and visual alarm systems.

16.5 Radiological Safety Requirements

The Facility shall be designed, constructed, and operated in compliance with the requirements of 10 CFR 835[21] as implemented through S-CIP-J-00004, *SWPF Radiation Protection Program (RPP) for 10 CFR 835*[36]. Radiation exposure to workers shall be maintained ALARA, economic and operational practicality factors taken into account, and no exposure shall be authorized without the expectation of a net positive benefit from the activity.

16.5.1 ALARA Provisions

ALARA principles shall be applied to both collective and individual doses, as well as to general area dose rates. Guidance for ensuring compliance with radiological design requirements is provided in S-EIP-J-00004, *SWPF Final Design ALARA Review Report*[37].

16.6 Emergency Services

SWPF will utilize the existing SRS Fire Department to provide fire response, emergency medical services and emergency security/law enforcement response. Offsite communications and support services required for emergency response will be managed by the SRS Operations Center. Arrangements shall be made for a contractor to provide medical care for non-life-threatening injuries. The on-shift crew complement shall also have at least two people assigned who have been trained in first aid and cardiopulmonary resuscitation.

During Construction, a significant number of construction craft will be present and the potential for emergency medical services will be higher than during normal operations. During Construction, the EPC may contract first aid and first response medical care services to be provided at the construction site. After Construction completion, staffing levels at the SWPF will decrease and existing Site services should be adequate for all emergency medical service needs. The support services requirements for emergency response are specified in the EPC's V-ESR-J-00012, *SWPF Emergency Response Interface Control Document (ICD-12)*[38].

Fire hazard analysis will identify major fire protection features that must be included in the design to satisfy the National Fire Protection Association code requirements. The Fire Protection Program for the SWPF will be developed during Phase II and implemented during Commissioning and Operations. The operational staff will be trained to the appropriate fire emergency response procedures and use of the installed fire protection equipment.

Emergency response at the SWPF will be provided by the on-shift crew, augmented by on-call SWPF staff that will cover various emergency response positions at the SWPF Operations Support Center. The Shift Operations Manager will act as the Area Emergency Coordinator until relieved by the on-call individual assigned to fill this position. All support needs and off-site notifications will be managed by the SRS Operations Center.

17.0 DECONTAMINATION AND DECOMMISSIONING

Provisions for ultimate D&D of the SWPF will be included in the EPC's design. The requirements associated with deactivating and decommissioning the SWPF should be identified in the Preliminary D&D Project Plan (to be developed by the LTO prior to the SWPF mission completion) and in other planning and work execution documents specified in DOE G 430.1-3, *Deactivation Implementation Guide*[39], and in DOE G 430.1-4, *Decommissioning Implementation Guide*[40].

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