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1. INTRODUCTION AND GENERAL DESCRIPTION OF INSTALLATION

1.1. Introduction

1.1.1. Overview

The High Temperature Gas Cooled Reactor (HTGR) at Fort St. Vrain (FSV) was permanently shut down in August 1989. Public Service Company of Colorado (PSCo) removed the fuel and other radioactive reactor components from the Prestressed Concrete Reactor Vessel (PCRV). For safe, onsite dry storage of the spent reactor fuel and irradiated core components, PSCo designed and built the FSV Independent Spent Fuel Storage Installation (ISFSI) as shown in Figures 1.1-1, 1.1-2, and 1.1-3.

The ISFSI was designed for storage of up to 1,482 fuel elements which are known as standard fuel elements, control fuel elements, and bottom control fuel elements. These three types of fuel elements are shown in Figures 1.1-4, 1.1-5, and 1.1-6. There are 1,458 elements of this type in storage. Since there are six spent fuel elements stored in a fuel storage container (FSC), there are 243 FSCs storing standard, control, or bottom control spent fuel elements at the FSV ISFSI.

The ISFSI also was designed for storage of up to 37 keyed top reflector control rod elements. This type of element is shown in Figure 1.1-7. The reflector elements were planned to be stored as "other radioactive material associated with ~~spent~~ fuel ~~storage~~assemblies" ~~as defined~~ in accordance with the 10 CFR 72.3 definition of *spent nuclear fuel*. PSCo originally had planned to store the 37 keyed top reflector control rod elements in the ISFSI, since it was considered likely that these elements would fall under the greater than Class C (GTCC) waste designation. The GTCC waste designation would have precluded their shipment to a low-level waste (LLW) disposal facility. However, it was determined that these 37 keyed top reflector control rod elements were not GTCC waste, so they were removed to a LLW disposal facility, and are not stored at the ISFSI.

In addition, the ISFSI was designed to safely store six neutron source fuel elements containing Californium-252 (Cf-252) neutron sources. Each of these six neutron source fuel elements originally contained an encapsulated source near the center of the element as shown in Figure 1.1-8. Planning for storage of these neutron source fuel elements at the ISFSI required the design and construction of a special storage well to adequately shield the neutron flux from these elements. However, the neutron sources were removed from the elements prior to the transfer of the elements to the ISFSI. Therefore, although there are six neutron source fuel elements in storage at the ISFSI, these elements do not contain the Cf-252 sources. The six fuel elements that formerly contained the neutron sources are not included in the 1,458 spent fuel elements discussed above and bring the total to 1,464 elements in 244 FSCs stored at the FSV ISFSI.

Design and analysis of the ISFSI for storage of the 37 keyed top reflector control rod elements was completed before PSCo determined that the top reflector elements and the neutron sources could be removed from the site and not stored in the ISFSI. Therefore, the provisions for their storage were an integral part of the analysis of the ISFSI as reflected in this Safety Analysis

Report (SAR) when submitted for review and approval. ~~Since~~ Because the ISFSI has been licensed to store these elements, discussion of these elements has been retained throughout this SAR.

The FSV ISFSI uses the Modular Vault Dry Store (MVDS) system. The MVDS system is designed to safely hold all types of irradiated fuel for intermediate storage periods. A design for light water reactor fuels was submitted to the U.S. Nuclear Regulatory Commission (NRC) for licensing approval in The Energy Applications Division of Foster Wheeler Energy Corporation [formerly Foster Wheeler Energy Applications, Inc. (FWEA)] Topical Safety Analysis Report (Ref. 1) and approved by the NRC in March 1988 (Ref. 2).

On February 1, 1991 PSCo received an Environmental Assessment from the NRC with a Notice of Issuance and Finding of No Significant Impact associated with constructing and operating the FSV ISFSI (Ref. 3). On November 4, 1991 PSCo received a twenty year, renewable, NRC License pursuant to 10 CFR Part 72 (Materials License No. SNM-2504) to receive, possess, store, and transfer FSV spent fuel in the ISFSI (Ref. 4). PSCo began loading the ISFSI with FSV spent fuel on December 26, 1991. Loading of FSV spent fuel into the ISFSI was completed on June 10, 1992.

In December of 1995, the U. S. Department of Energy (DOE) notified the NRC of its intent to procure the ISFSI from PSCo, to take possession of the fuel stored in it, and to transfer the license to DOE. An Agreement in Principle was incorporated by a contract modification between DOE and PSCo (Contract No. DED-AC07-96-ID134265) on February 9, 1996. With this agreement, DOE immediately took possession of the FSV fuel stored in the ISFSI. PSCo managed the spent fuel in accordance with the license SNM-2504 until June 1999 when the license was transferred to DOE.

This report is supported by technical appendices listed in Table 1.1-1 and the references listed at the end of each Section.

1.1.1.1.General

The FSV MVDS is designed for interim storage of Fort St. Vrain HTGR fuel for 40 years in a contained shielded system. The design provides for up to six fuel elements or up to 12 reflector elements stacked vertically in each FSC. There is a matrix of 45 fuel storage positions within each concrete vault module (for a total of 270 storage positions), which provides shielding and the conditions to prevent criticality. The MVDS provides storage for a maximum of 252 FSCs. Of these FSCs, up to 247 are allotted for the 1,482 fuel elements, up to four are allotted for the 37 reflector elements, and one is allowed for the six neutron source elements. The six vault modules accommodate the complete FSV core. The 37 reflector elements were sent to a LLW disposal facility and are not stored at the FSV ISFSI. The six neutron sources were removed from the neutron source elements at the FSV Reactor and sold by PSCo and are not stored at the FSV ISFSI. The elements that contained the sources are stored at the FSV ISFSI. Because three shipments of the FSV core loading were shipped to the Idaho National Laboratory (INL) before DOE was restrained from making further shipments by a court order, only 244 of the available storage positions contain elements. Each position contains six elements making a total of 1,464 elements stored at the FSV ISFSI. The fuel storage medium within the FSC is air, and the decay heat is removed by a once-through buoyancy driven ambient air system flowing across the exterior of the FSCs. Three storage wells are provided; separate from the six vault modules. One of these wells is designed to provide storage for the six neutron source elements although no Cf-252 neutron source elements are stored there. These three wells provide a means to store and seal an FSC that has developed a leak. All three wells are identical in construction and can be individually sealed. In addition, these wells provide a means to transfer fuel elements from a leaking FSC to a new FSC. These three storage wells are functionally SSWs. On drawings and in procedures they may be referred to as SSW or NSSW.

The fuel, in its FSC, was transported to the MVDS from the FSV Reactor Building in a transfer cask. The transfer cask was received in the transfer cask reception bay (TCRB) where it was removed from the transfer cask trailer by the MVDS crane and positioned in the cask load/unload port (CLUP) for unloading. The transfer cask was prepared for unloading by having its outer closure removed and an isolation valve positioned above the transfer cask. A depleted uranium shield plug (DUP) was removed from the top of the FSC using a uranium shield plug handling device (USPHD). A shield plug handling device (SPHD) was used to remove the charge face shield plug in conjunction with the isolation valve at the FSC storage position in the vault module. A shielded container handling machine (CHM), carried by the MVDS crane, is provided that removed the FSC and placed it in the vault module storage matrix in conjunction with an isolation valve. See Figures 1.1-1, 1.1-2 and 1.1-3.

1.1.1.2. Principal Design Features of the MVDS Installation

1. The Fuel and Fuel Storage Containers.

The design provides for the fuel elements, neutron source elements, and reflector elements to be stored in the FSCs in an air environment that is compatible with the maximum predicted fuel temperatures and the properties of graphite. The neutron sources and reflector elements are not stored at the FSV ISFSI (see Section 1.1.1).

The FSCs are tubular, closed at the lower end and sealed at the top. They are vertically located and supported at their lower ends on the floor of the concrete vault module and supported at their upper ends by the charge face structure that also provides shielding for the charge hall. A shield plug is positioned in the charge face structure above each FSC to provide shielding. Vertical storage in the vault module matrix is the same orientation for which the fuel was designed to operate in the reactor.

FSCs are positioned in an array of up to 45 to form a module surrounded by massive concrete shielding. The vault module unit is the basis of the modular construction of the MVDS.

~~The storage position for the FSC that was designed for loading with neutron source elements is set apart from the other FSCs in the vault module.~~

2. Vertical Handling and Storage of Fuel Storage Containers.

The CHM was used to remove the FSC from the transfer cask and relocate it to its storage position in a vault module. All handling of FSCs with the CHM maintains a vertical position.

3. Passive Cooling of Stored Fuel Storage Containers.

The fuel in the FSCs is cooled by a passive self-regulating cooling system that induces buoyancy driven ambient air to flow across the exterior of the FSCs. There is no contact between this cooling air and the fuel.

4. Shielding.

The fuel is shielded during storage by massive concrete walls, and is shielded by the CHM during transfer. This facilitates the reduction of radiological impacts to ALARA and within the requirements of 10 CFR Part 72 (Ref. 5) and 10 CFR Part 20 (Ref. 6).

5. Confinement.

The fuel is confined by the sealed FSC throughout the period of storage.

6. Criticality.

Criticality is prevented by the inherent geometry of the array of FSCs within the vault modules and the dry storage conditions for the fuel within the FSC.

7. Modular Construction.

The MVDS is made up of six vault modules, three storage wells, and a TCRB for receiving the transfer cask. The TCRB is situated at access road level with vault access at approximately 20 ft. Directly above this reception bay are facilities for CHM parking and the CLUP.

8. Fuel Transfer to the MVDS.

Fuel movement from the FSV Reactor Building to the MVDS has been completed.

9. Transfer of Fuel Within the MVDS.

The CHM is a high integrity shielded, natural thermosyphon cooled machine for handling the fuel contained in the sealed FSCs. This machine was used to move fuel from the transfer cask to the selected FSC storage position in the vault module. The CHM also will be used for any fuel movements required if leakage occurs and when emptying the MVDS prior to decommissioning using a reverse procedure.

10. Fire Protection.

The design of the MVDS, and its construction of steel and concrete, provides no means for the initiation and propagation of major fires. Minor local electrical or hydrocarbon fires will be dealt with by local extinguishers. There are no anticipated situations where these types of minor fires can compromise the long term integrity of the fuel and its protective systems.

11. Heating and Ventilation.

Heating at the MVDS is accomplished using electric radiant space heaters. The heating and ventilation of the working area is provided for operator comfort only and is not required for radiological protection.

12. Standby Facilities.

Three standby storage wells (SSWs) are located adjacent to one of the vault modules. These wells are provided to enable 'off-normal' events involving FSCs to be dealt with and to provide a secondary confinement.

The SSW is a closed ended tube set into an enclosure that provides necessary radiation shielding. It can be closed and sealed using a charge face shield plug and cover plate.

Decay heat from a loaded FSC in an SSW is dissipated to the surrounding air by a once through buoyancy driven air flow that is ducted out of and back into the adjacent vault module structure surrounding the wells.

13. Surveillance and Monitoring.

The MVDS is subject to routine manual surveillance and monitoring. Security access monitoring and surveillance also are conducted.

14. Decommissioning.

The MVDS design is arranged to contain any potential contamination during operation and to facilitate its removal at the decommissioning stage. The individual items of MVDS equipment are designed for easy decontamination and dismantling.

The FSCs and their contents will be in the as received condition and may be removed from the MVDS by the same steps used to load them.

15. Waste.

Solid radioactive waste is minimal with the MVDS design. There are no gaseous or liquid wastes produced under normal operation.

Table 1.1-1 Supporting Technical Appendices.

Appendix Reference	Title
A3-1	Thermal Hydraulic Analysis of the MVDS
A4-1	Structural Analysis of the MVDS
A4-2	Analysis of the MVDS Load/Unload Equipment
A7-1	Shielding Assessment for the MVDS
A8-1	Missile Penetration Through MVDS Openings
A8-2	Seismic Analysis of Equipment
A8-3	Analysis of Impacts on the Charge Face Structure
A8-4	Not used
A8-5	Not used
A8-6	Analysis of Impacts on the Fuel Storage Container (FSC)
A8-7	Analysis of Impacts on Container Handling Machine (CHM)
A8-8	Impact Loads onto Civil Structure
A8-9	Radiological Release Assessment
A8-10	Shielding Assessment of Direct Radiation Dose Rates in Accident Conditions
A8-11	Thermal Analysis for Reduced Air Flow through the MVDS Vault Modules

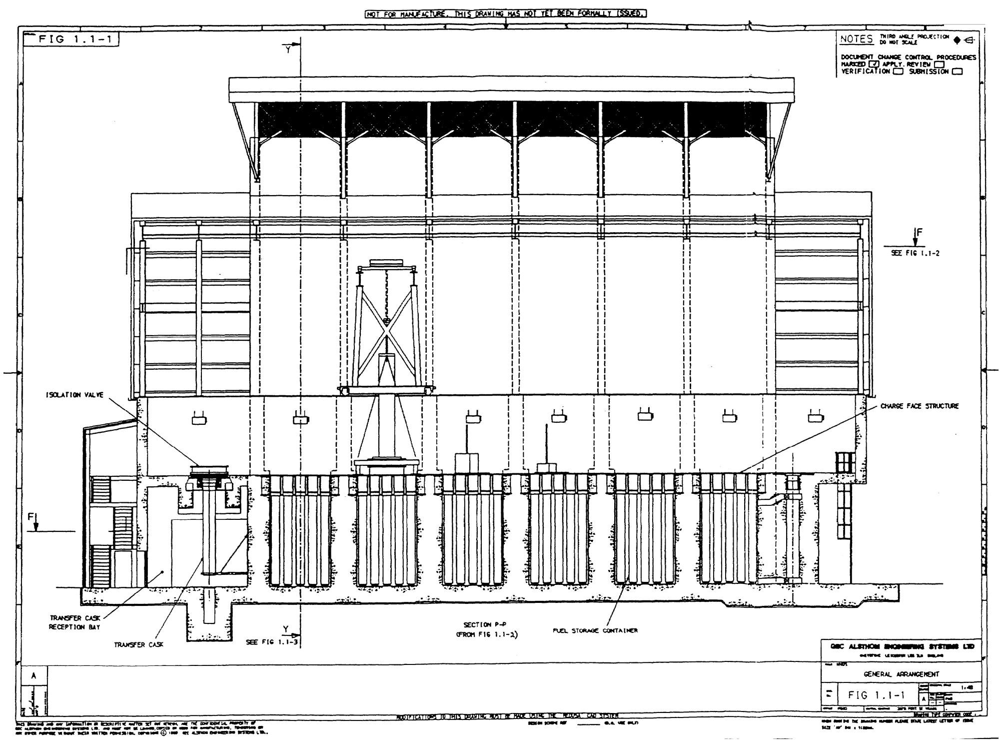

Figure 1.1-1. General Arrangement.

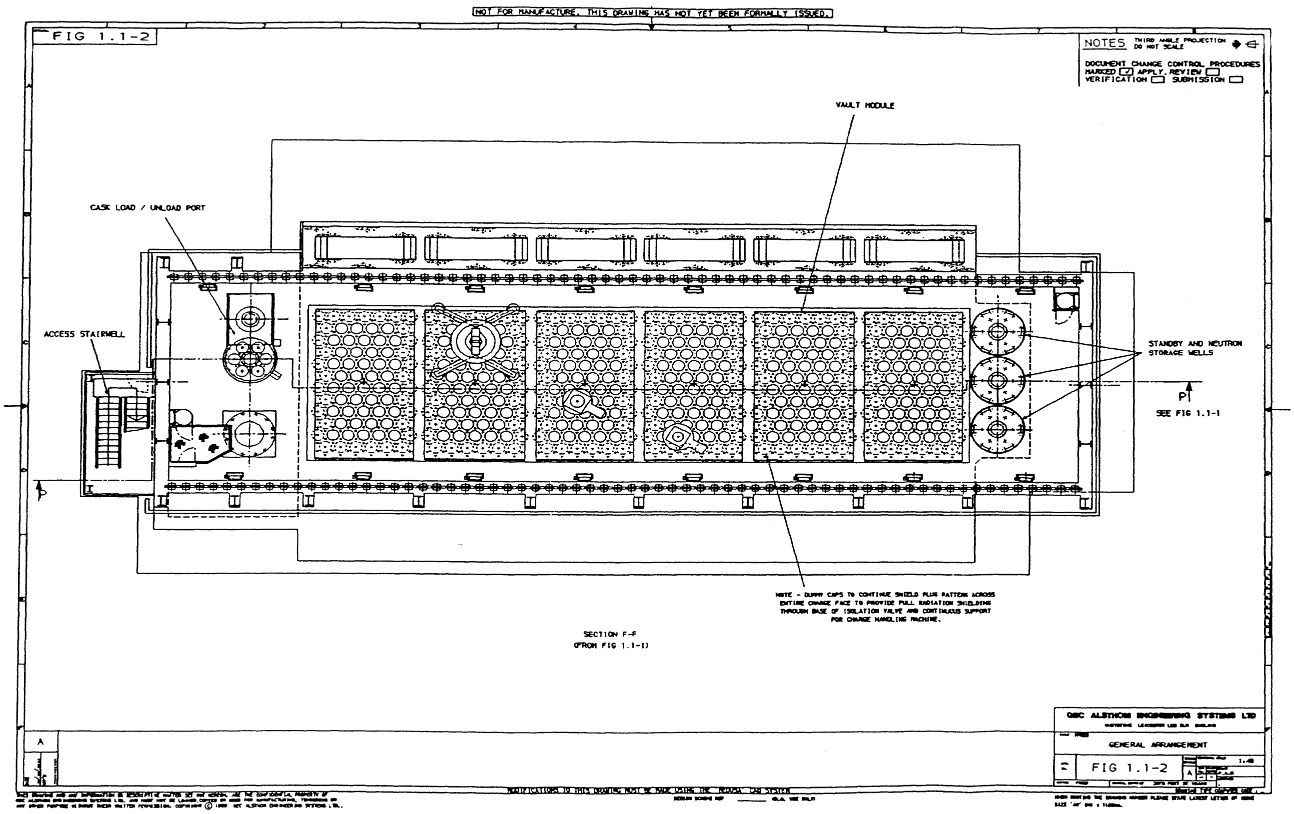

Figure 1.1-2. General Arrangement.

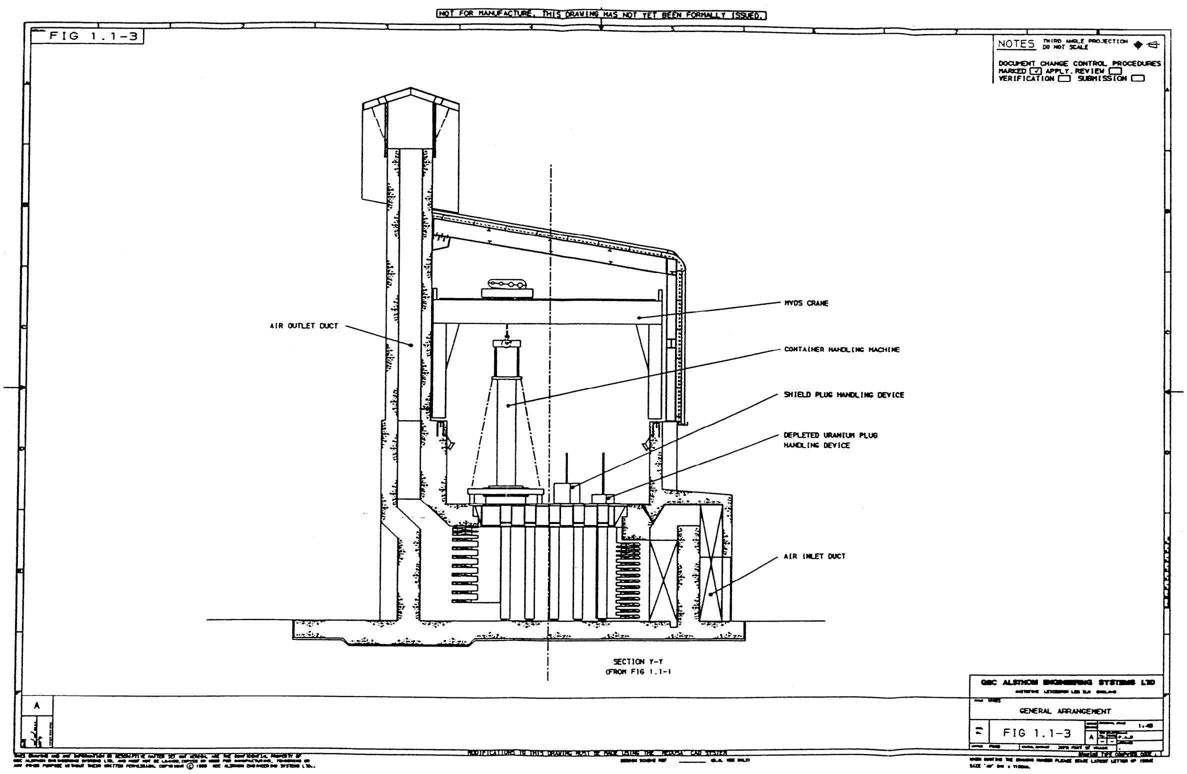

Figure 1.1-3. General Arrangement.

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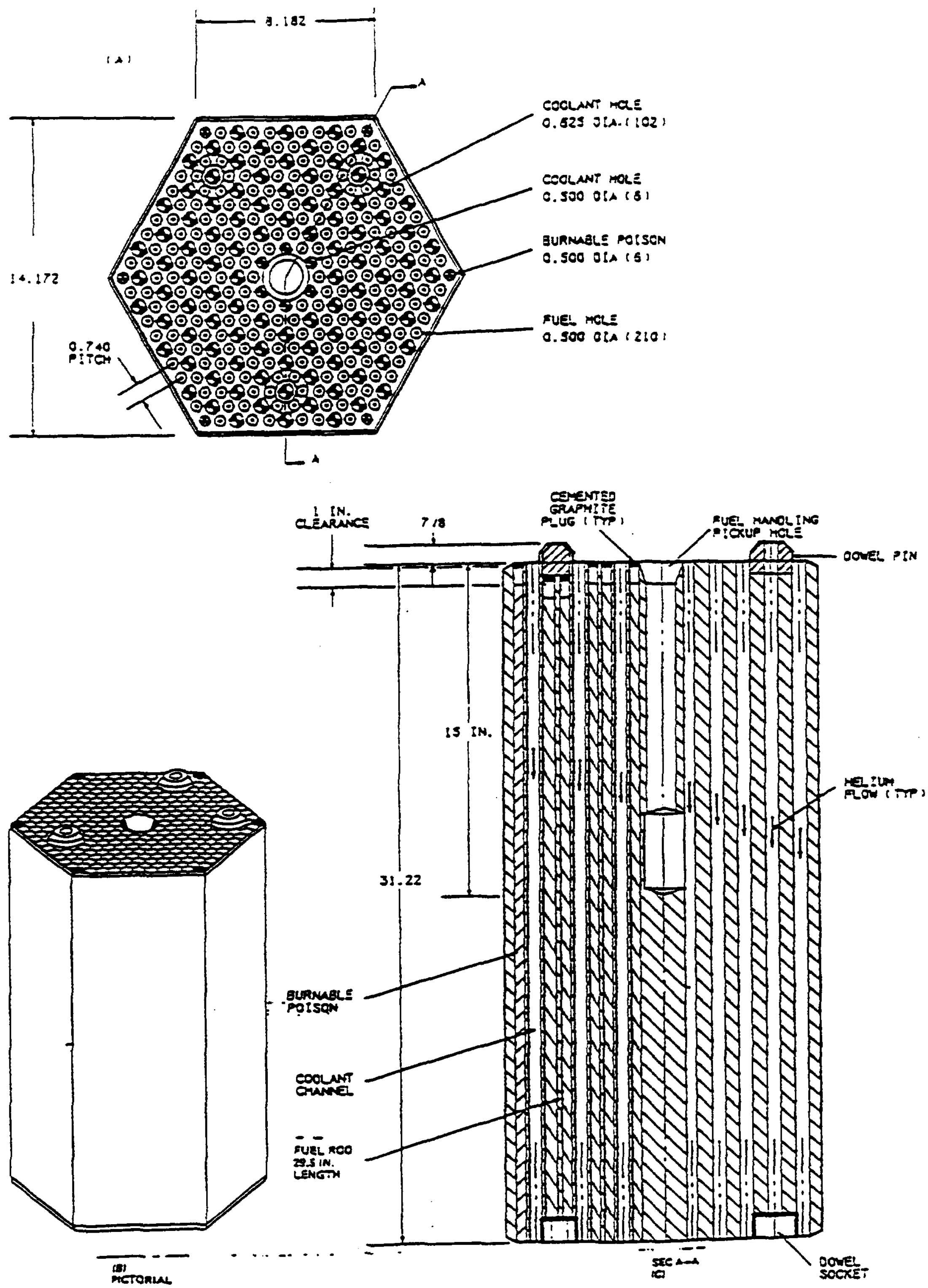

Figure 1.1-4 Standard Fuel Element

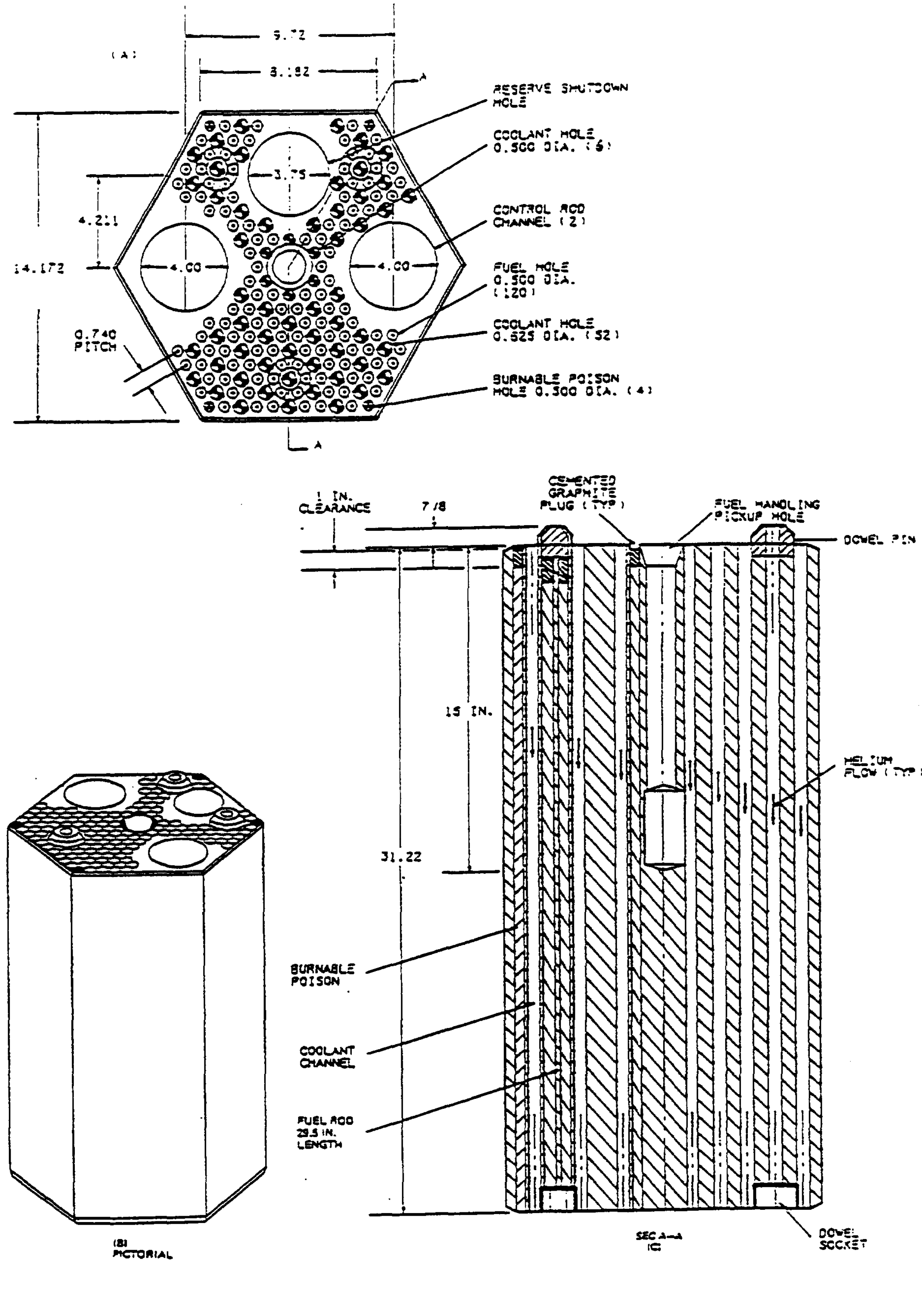

Figure 1.1-5. Control Fuel Element.

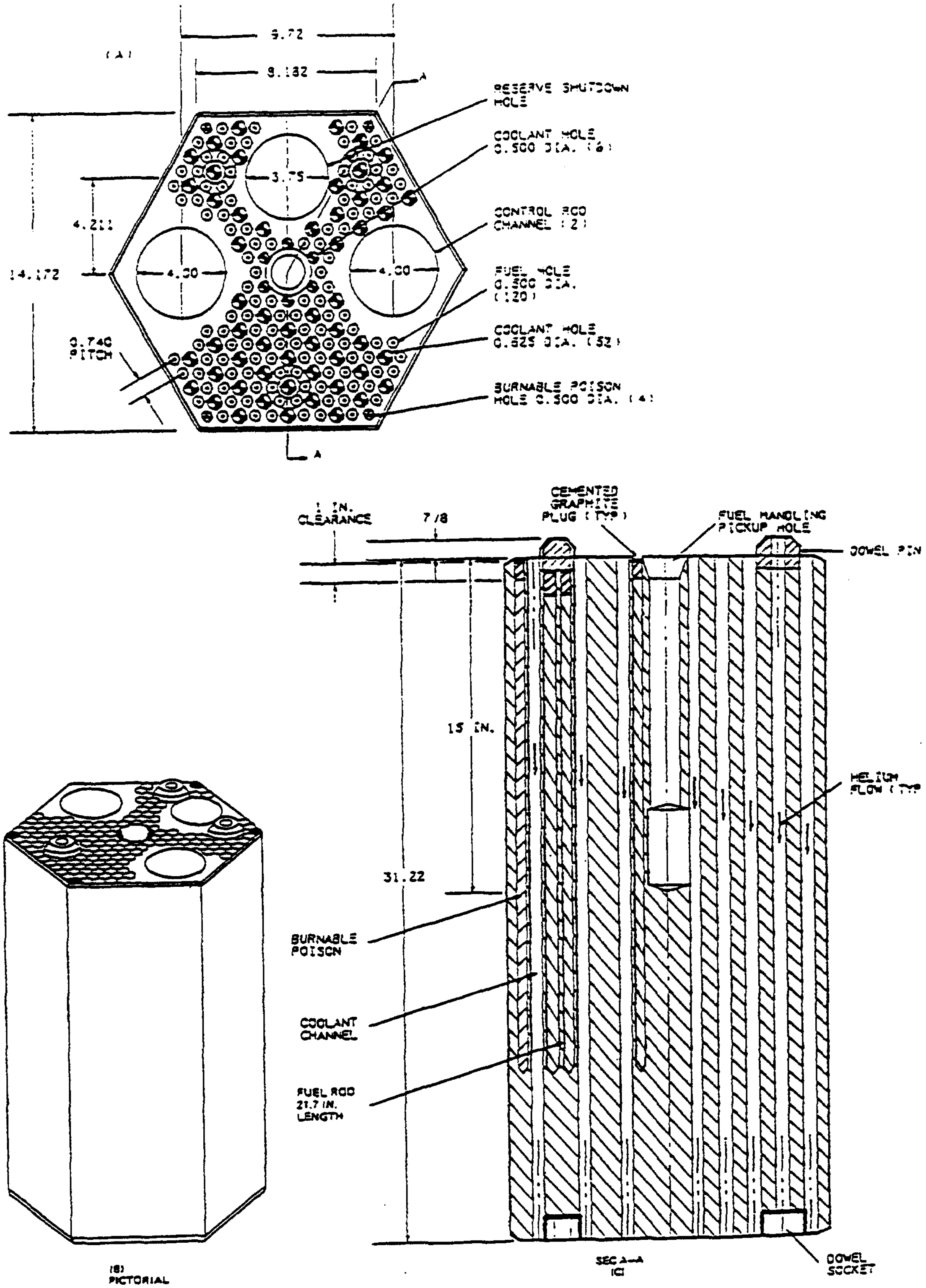

Figure 1.1-6. Bottom Control Fuel Element.

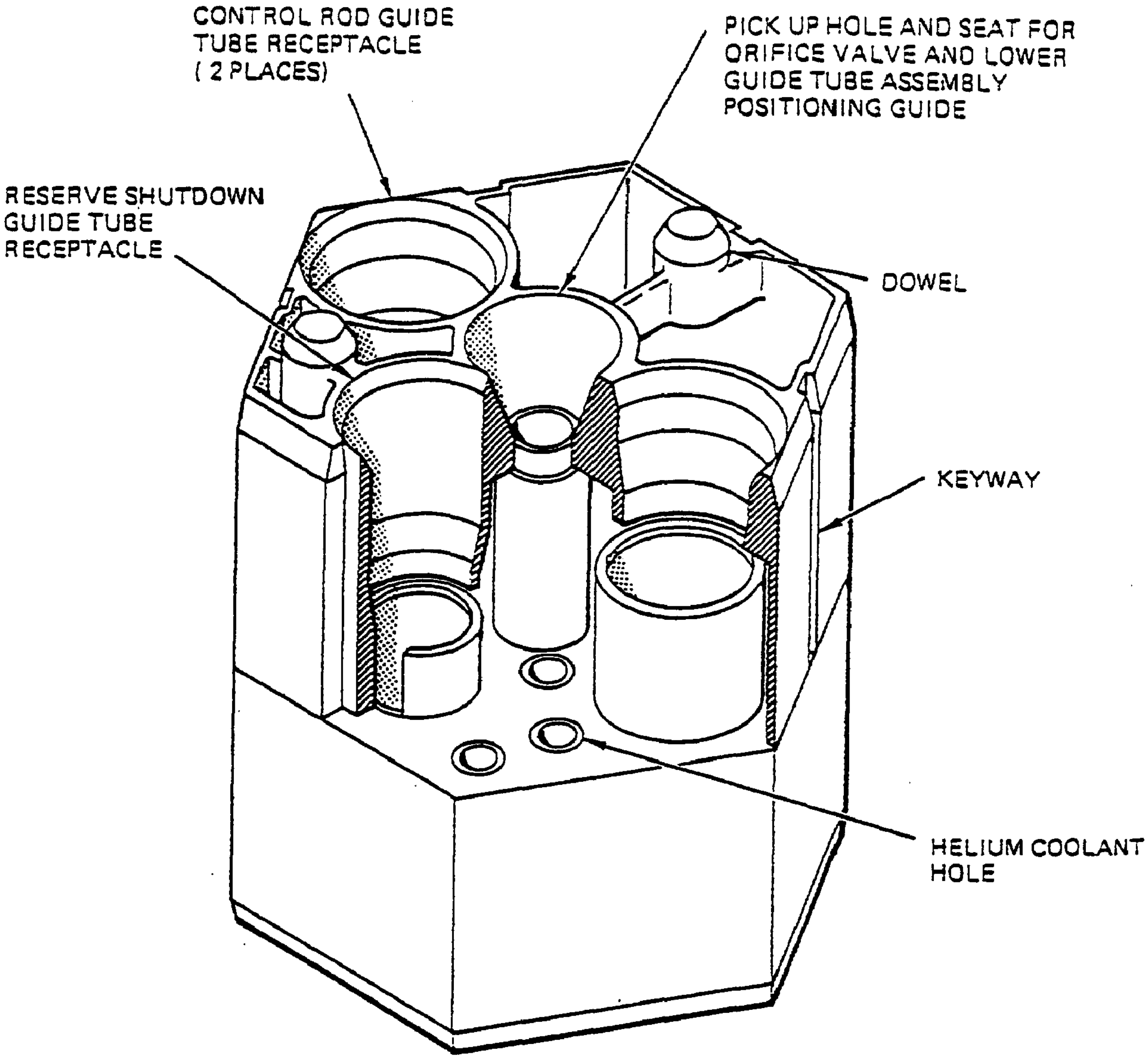

Figure 1.1-7. Keyed Top Reflector Control Rod Element.

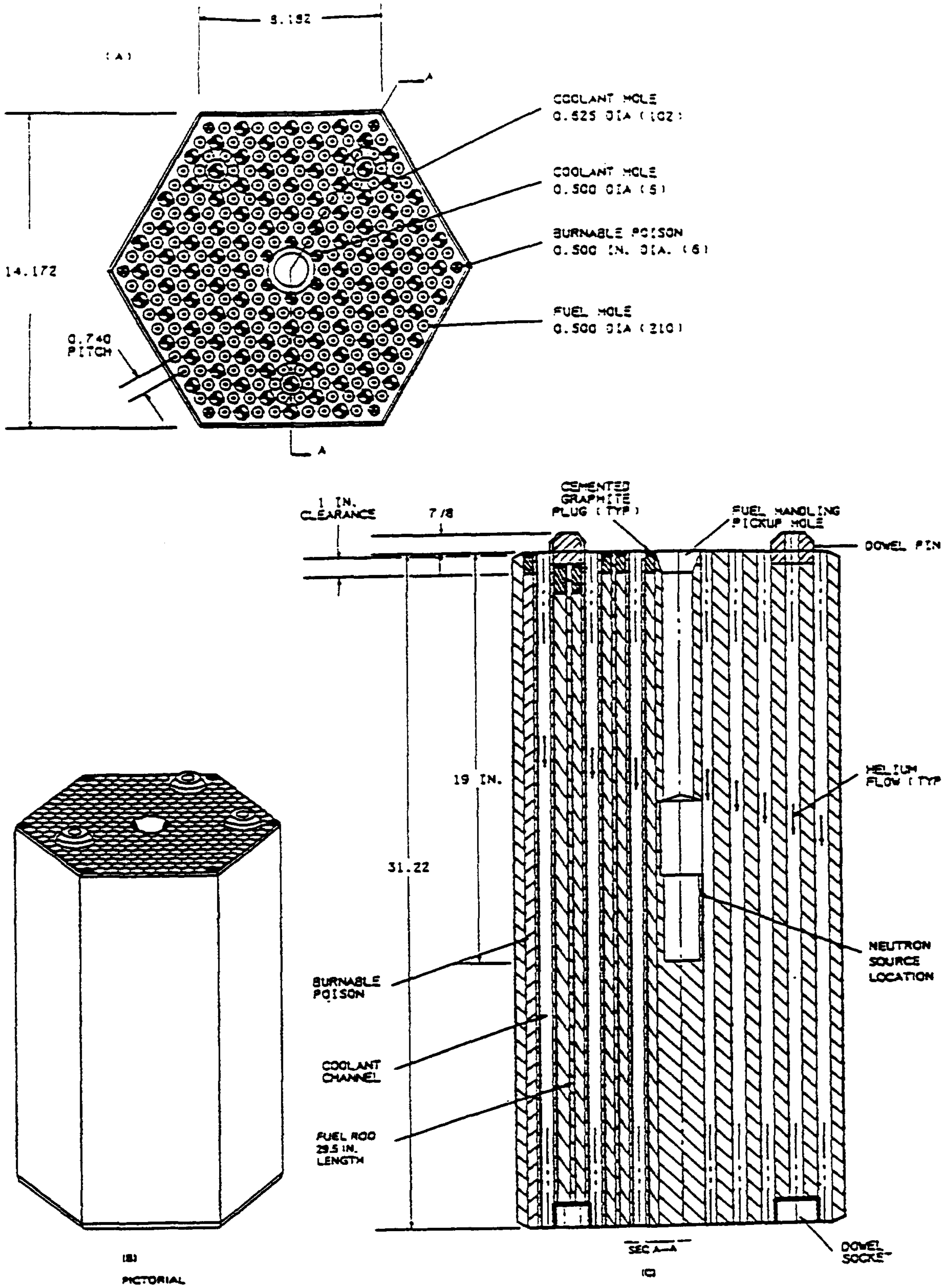

Figure 1.1-8. Neutron Source Element.

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1.2. General Description of Installation

1.2.1. General

The MVDS provides for vertical, dry storage of irradiated graphite fuel elements, reflector elements, and neutron source elements in a reinforced concrete structure covered by a clad steel framework. The neutron sources and reflector elements are not stored at the FSV ISFSI (see Section 1.1.1). The MVDS contains a TCRB, charge face, CHM, charge face isolation valve, MVDS crane, cooling air outlet chimney, and cooling air inlet structure. See Figures 1.2-1 and 1.2-2 for pictorials of the MVDS.

A fully loaded FSV reactor core consisted of six fuel segments. The FSV ISFSI currently is licensed to store the amount of fuel contained in six fuel segments, in addition to the reflector elements and the neutron source elements (Ref. 7).

Along with the MVDS, the ISFSI facility was originally licensed with provisions for installation of an entrance building, which would perform security functions. This building has been installed by DOE and serves as the administration building. A safety evaluation completed by PSCo identified no safety issues with the administration building installation. Layout of the installed administration building is shown in Figure 2.1-3.

The DOE security facility containing the alarm station is located at the south end of the MVDS.

The fuel elements were loaded into FSCs in the FSV Reactor Building. The FSCs were sealed before leaving the reactor, transferred to the ISFSI, and placed in the MVDS.

1.2.2. Principal Site Characteristics

The FSV ISFSI is located on part of the original FSV Nuclear Generating Station site which is about three and one-half miles northwest of Platteville, CO. Platteville is located in Weld County and is about 35 miles north of Denver. DOE owns the 3.83 acres of land on which the ISFSI is located and has easements for access and control of the immediate area. The ISFSI is located approximately 1500 feet northeast of the PSCo fossil-fueled, power plant building.

Population density in the rural area surrounding the site is relatively low. The nearest town is Platteville which had a 2000 Census population of 2,370. The nearest population centers with populations greater than 25,000 (based on the 2000 census) are Longmont (population 71,093), Greeley (population 76,930), and Loveland (population 50,608). The nearest boundaries of Longmont, Greeley and Loveland are all about 14 miles from the ISFSI location.

The majority of the land within five miles of the site is agricultural. The area within a few miles of the site is characterized by irrigated farm land and pasture land with gently rolling hills.

1.2.3. Principal Design Criteria

The principal design criteria and parameters for the MVDS are shown in Table 1.2-1. As previously mentioned, the MVDS is designed to store fuel elements, neutron source elements, and reflector elements. The neutron sources and reflector elements are not stored at the FSV ISFSI (see Section 1.1.1).

1.2.4. Operating and Fuel Handling Systems

MVDS fuel handling procedures will be used for all fuel handling operations using certified fuel handlers. (Ref. 5)

1.2.5. Safety Features

The safety features incorporated into the design of the MVDS include criticality prevention, containment of the fuel, and maintaining the fuel temperature below oxidation limits for air storage (which is well below fuel damage temperature limits).

1.2.6. Radioactive Waste and Auxiliary Systems

1.2.6.1. Auxiliary Systems

The MVDS cooling system is passive and does not require electrical power. Equipment used at the MVDS for fuel transfer or unloading requires electrical power for the CHM and TCRB operations. The electrical power source is a 220 kVA 13 kV/480 Volt, three phase, padmount transformer supplied by a 13 kV distribution line.

Backup power, which is used for security purposes only and is not tied to the MVDS, is supplied by batteries. Loss of electrical power to the MVDS will not degrade safety during normal operations, off-normal operations, and accident conditions.

1.2.6.2. Radioactive Wastes

There are minimal quantities of solid or liquid radioactive wastes generated at the MVDS. There are no gaseous or liquid wastes produced under normal operation.

The solid wastes are limited to small filters for the filtration system on the CHM and isolation valves (used during an off-normal event should individual fuel elements need to be handled) that are exchanged using standard techniques, and general "house-keeping" items such as clothing, swabs, vacuum-bags, etc.

Table 1.2-1 Fort St. Vrain MVDS Design Parameters.

Parameter	Value
Heat Load per Fuel Element	85 Watts (average)
Decay Period	600 days
Ambient Temperatures	-32 degrees F to 120 degrees F
Flood Level	6 ft.
Design Basis Earthquake Ground Acceleration	0.1 g
Tornado Generated Missile/Velocity	NUREG-0800 (Ref. 8)
Design Basis Tornado	Reg. Guide 1.76, Region 1 (Ref. 9)
Snow Loading	30 psf

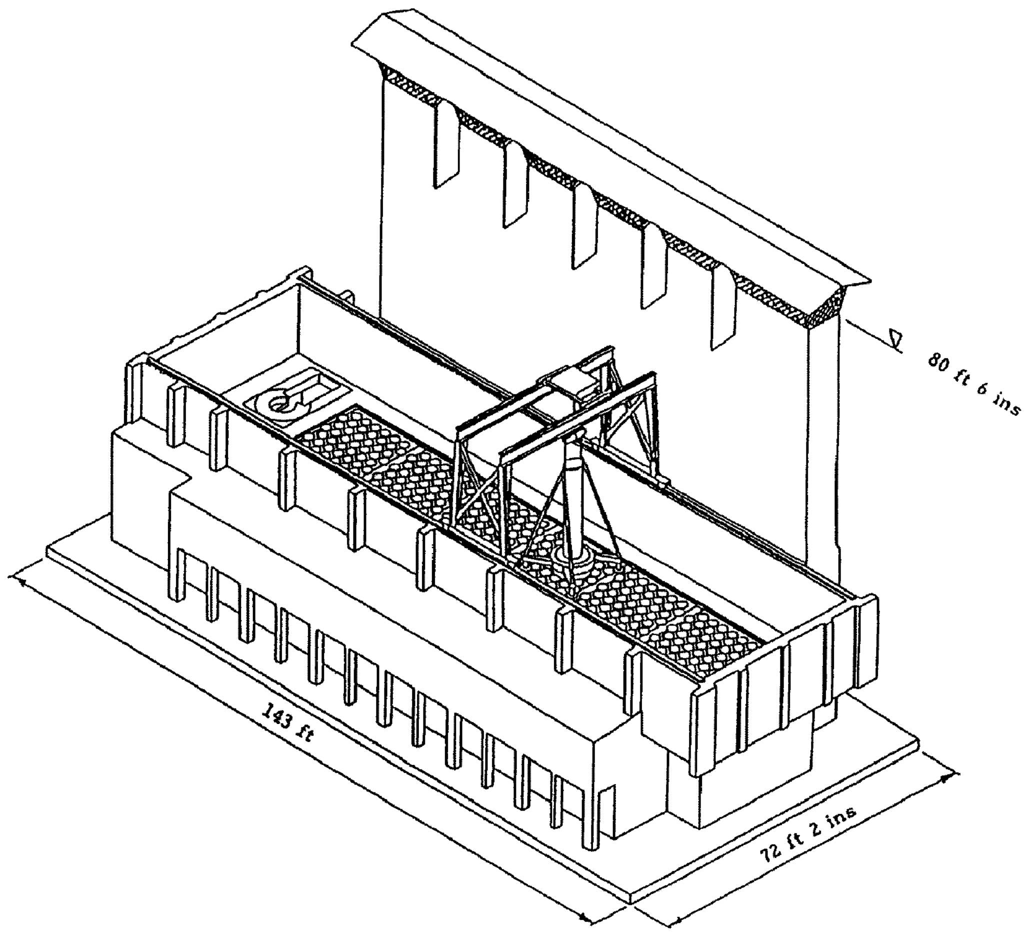

Figure 1.2-1. MVDS Fort St. Vrain (without roof structure).

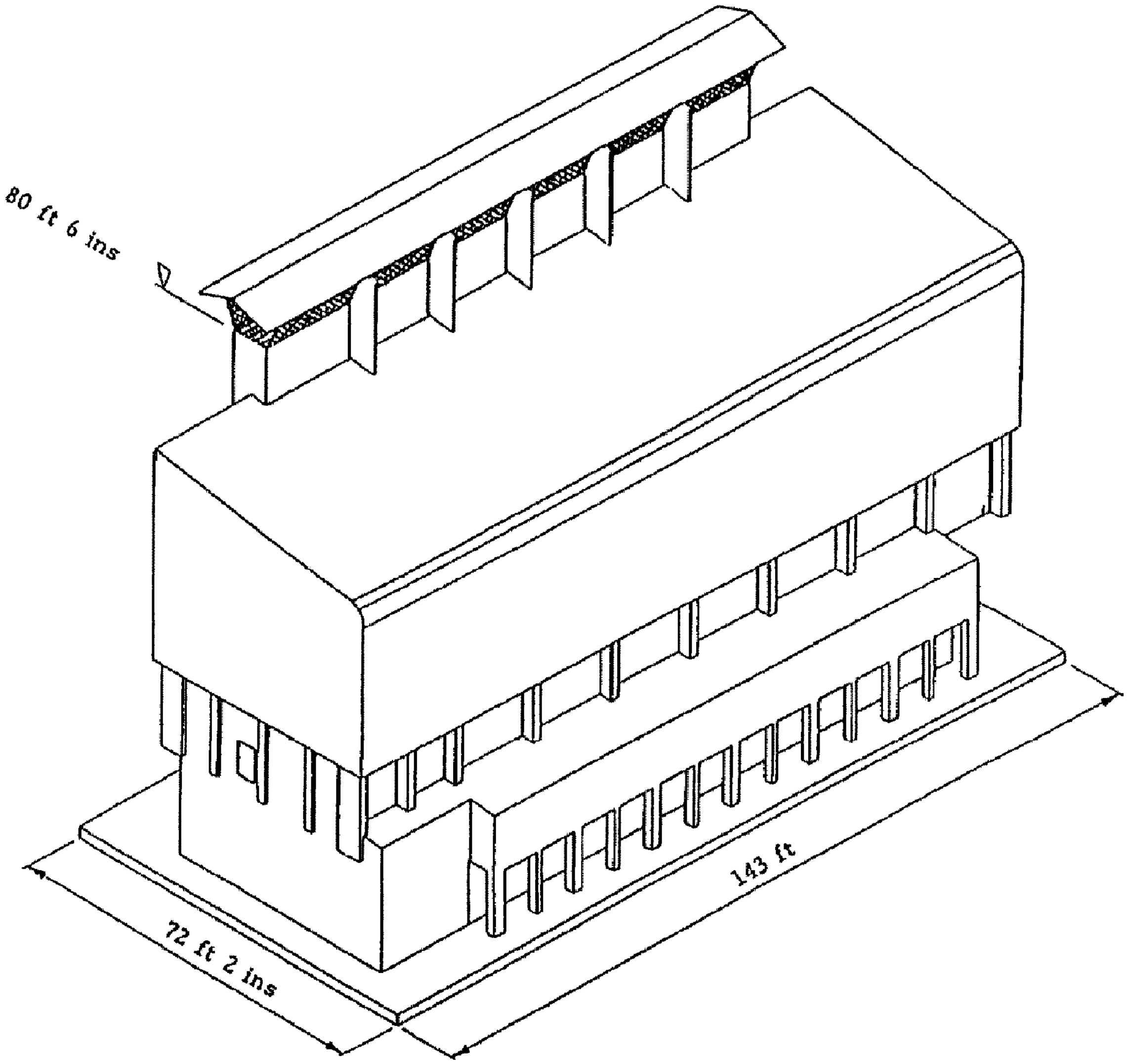

Figure 1.2-2. MVDS Fort St. Vrain.

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1.3. General Systems Description

The major structures, system, and components of the FSV ISFSI are addressed in this Section.

1.3.1. MVDS Structure

The general arrangement of the MVDS structure is shown in Figures 1.1-1, 1.1-2, and 1.1-3. The MVDS structure is comprised of vault modules, a TCRB, and a foundation structure.

Structural portions of the MVDS are designed to meet the requirements of American Concrete Institute (ACI)-349 (Ref. 10) and are constructed to ACI-318 (Ref. 11).

1.3.1.1. Vault Module

The vault module provides shielding around the array of FSCs and provides for defined cooling air inlet/outlet flow paths. The vault module structure is supported by an integral foundation system. Cooling air enters the vault module (a common inlet plenum exists for all modules) through a mesh covered opening, which prevents the ingress of birds, small animals, large debris, and also is used as a security barrier. The labyrinth arrangement of the cooling air inlet structure provides radiological shielding for the stored fuel. Cooling air distribution across the outside of FSCs is improved by means of precast concrete collimators that are set into grooves in the structure walls. The collimators also provide a contribution to the radiological shielding of the stored fuel. The cooling air leaves the vault module through a second set of concrete collimators, which serve the same functions as those at the inlet, and is exhausted to the atmosphere through a concrete cooling air outlet chimney.

A steel canopy is provided on the top of the cooling air outlet chimney to prevent the ingress of rain and snow. The opening of the outlet chimney is fitted with wire mesh. The ambient cooling air does not come into contact with the fuel in the FSCs so that the internal walls of the vault module will remain radiologically non-contaminated.

The floor of the vault module is sloped for drainage and provided with drainage connections. Inset and grouted into the vault module floor are supports for the FSCs.

A construction recess is provided in the top of the vault module walls, which supports the charge face structures. The charge face structure is set into each vault module to form the roof of the vault and provide lateral support for the array of FSCs. Bearing pads are cast into the concrete vault module recess to transmit charge face structure vertical loads into the building structure.

The charge face structure is shop fabricated, filled with concrete (for radiological shielding) at the site and positioned in the vault module using a construction crane.

Above and running along each side of the charge face structure, the vault module incorporates encast embedments to support the MVDS crane rails. The embedments transmit loads from the crane to the building structure.

The structural members of the MVDS concrete were designed and detailed in accordance with ACI 349-85 (Ref. 10) and constructed in accordance with ACI 318-83 (Revised 1986) (Ref. 11) using an enhanced quality QA program. The structural design of the MVDS meets or exceeds the requirements of Regulatory Guide 3.60 (Ref. 12). The structural steelwork has been designed in accordance with the American Institute of Steel Construction (AISC) Manual of Steel Construction: Allowable Stress Design, Ninth Edition (Ref. 13).

The Design Basis Tornado (DBT) criteria have been established using Regulatory Guide 1.76 (Ref. 9) and American National Standards Institute (ANSI) A58.1 (Ref. 14). Tornado missiles considered are in accordance with NUREG-0800 (Ref. 8).

Construction of the steel structure is in accordance with the AISC Manual of Steel Construction, Allowable Stress Design, Ninth Edition.

The cladding/sheathing is considered to be of proprietary design although the attachments to the main structure meets the requirements of the AISC Manual of Steel Construction, Allowable Stress Design, Ninth Edition.

1.3.1.2. Transfer Cask Reception Bay

The TCRB is alongside and integral with the vault module structure. The bay provides an access tunnel for the transfer cask trailer and tow vehicle. A rectangular access penetration through the roof of the bay is provided for movement of the transfer cask to the charge face.

1.3.1.3. Foundation Structure

The foundation structure is designed to support the MVDS against the imposed loads created by the structure weight, operating loads, environmental loadings and design basis earthquake.

1.3.1.4. Power Distribution and Lighting

Power is distributed to the MVDS crane, the CHM, power outlet sockets on the charge face edge, power outlet sockets in the TCRB for MVDS heating and ventilation, and to a lighting system for the charge face and the TCRB. Heating at the MVDS is accomplished using electric radiant space heaters. The incoming main breaker and the individual circuit breakers are in an enclosure inside the TCRB.

1.3.2. MVDS Equipment

FSV fuel was received at the MVDS via the transfer cask, which had an inner container (FSC) designed to hold up to six FSV fuel elements or up to 12 keyed top reflector control rod elements. The FSC is similar to the inner container used for shipping fuel off-site in the licensed FSV-1 spent fuel shipping casks, which were used to transfer fuel from the FSV Reactor Building to the ISFSI, as described in Section 4.3.

Fuel handling on the MVDS charge face is accomplished using a traveling electric MVDS crane to effect movement of the transfer cask, CHM and other MVDS equipment.

The structural design provides for storage of the container handling equipment and the complete weather-proofing of the MVDS charge face and TCRB during the years of passive fuel storage.

1.3.2.1. Fuel Storage Container

The FSC replicates the functions and features of the 10 CFR Part 71 (Ref. 15) licensed FSV-1 spent fuel shipping cask inner container and provides a high integrity containment boundary for the stored fuel. The FSC is the inner container that will be used in the more recently licensed TN-FSV spent fuel shipping casks, discussed in Section 4.3.

Double metal O-ring seals between the closure and FSC body provide a high integrity and leak checkable sealing arrangement designed to withstand exposure to radiation during the storage period without the need for maintenance. A sealable O-ring interspace tapping allows container sealing to be confirmed.

Empty and new FSCs are stored in the MVDS vacant vault positions.

The storage environment within the FSC is air, which is compatible with the maximum analyzed fuel element temperatures and the properties of graphite.

The carbon steel body of the FSC is protected from atmospheric corrosion by application, during manufacture, of a flame sprayed coating of aluminum to the outside surfaces. This method of protecting FSCs has been used for many years in Europe, and the technique was validated by the American Welding Society following a 19 year duration test program. The FWEA MVDS Topical SAR (Ref. 1) referred to this experience, and NRC approval was given for the use of carbon steel containers in MVDS where so protected (Ref. 2).

1.3.2.2. Container Handling Machine

The CHM provides the means of raising/lowering the FSCs from the transfer cask and lowering/raising them into the vault storage locations. In the handling machine the container is fully shielded, and the fuel decay heat is dissipated from the machine exterior surfaces. The handling machine is moved over the storage vault using the MVDS crane.

The CHM is comprised of three major units that are described in the following:

1. Main Shield Tube

This lead-in-steel fabrication provides the necessary radial shielding for the FSC during handling in the machine. A gusseted flange and spigot on its lower end allows the tube to be assembled and bolted to the machine isolation valve. Two trunnions are incorporated near the top end of the tube to provide a lifting feature for the whole machine.

2. Raise/Lower Mechanism

The raise/lower mechanism provides a high integrity means by which the FSC can be raised into or lowered from the machine using a grapple. The mechanism and grapple are designed to be single failure proof. Thus, failure of any single component will not result in the dropping of a FSC.

This mechanism comprises an acme thread leadscrew, drive unit, trunnion mounted nut, guide system, duplex chains, sprockets and equalizing beam.

The FSC grapple is raised/lowered by the leadscrew/nut through two duplex chains. The chains are connected at one end to the top of the grapple and at the other to an equalizing beam mounted at the top of the machine. Each chain runs over a sprocket mounted on the nut trunnion block and over two sprockets mounted on top of the machine body.

3. Controls

The CHM is controlled from a control panel located at the base of the machine, and the panel will contain all the necessary contactors and relays. Control push buttons, displays and warning lights are mounted on the face of the control panel.

Interlocks are provided between the CHM, the charge face isolation valve or CLUP isolation valve and the MVDS crane such that:

i) The machine cannot be lifted unless the isolation valves are closed.

ii) The isolation valves cannot be closed unless the machine hoist is fully up.

iii) The machine hoist cannot lower unless the isolation valves are open.

iv) The machine hoist cannot lower if hoist weight sensing indicates that the winch load is less than the grapple weight.

In the unlikely event of failure of the MVDS crane hoist system while supporting the machine, the drop height onto the charge face structure is limited to minimize the risk of damage to the structure, fuel stored in the vault modules, and fuel that is contained in the CHM.

1.3.2.3. Isolation Valve

The isolation valves provide the necessary interface between the following:

1. Transfer cask load/unload and CHM

2. Charge face and CHM

3. Charge face and SPHD

4. Charge face and USPHD

They also provide the necessary shielding for charge face shield plug removal and replacement, the removal of empty FSCs, and insertion of full FSCs into the vault during operational modes.

The isolation valves are moved into their required positions using the MVDS crane and dedicated slings such that potential drop height of the valves onto the charge face is limited.

The design incorporates a feature which interacts with the CHM to release its mechanical interlocks. When the CHM is parted from the isolation valve, with gate valves in closed position, the isolation valve in the handling machine is mechanically locked in the closed position.

1.3.2.4. Charge Face Structure and Shield Plugs

The charge face structure is the shielding structure used to close the top of the storage vault and to create the MVDS charge face. The charge face structure locates the top of each FSC in the vault, maintaining the geometry of the fuel storage array. The charge face structure is a carbon steel fabrication filled with concrete. The top plate includes threaded holes for bolting the charge face isolation valve to the various positions on the charge face structure. The charge face structure resists the imposed loads from the handling machine during a seismic event.

The charge face shield plugs complete the radiation shielding within the charge face structure penetrations in conjunction with the FSC.

The shield plug is handled using the SPHD.

1.3.2.5. Fuel Storage Container Support

This simple component provides the spigot feature on the vault floor for the support and lateral restraint of the base of the FSC.

1.3.2.6. Shield Plug Handling Device

The SPHD is designed to remove the charge face shield plugs using the MVDS crane and an isolation valve. The device provides necessary shielding during the shield plug removal operation. With the isolation valve gate open, the central lifting rod of the device can be lowered and screwed into the shield plug top face allowing the shield plug to be raised and the isolation valve gate closed. The device lifting rod is raised/lowered using the MVDS crane hoist.

1.3.2.7. Standby Storage Wells

Three SSWs are incorporated into the MVDS structure at the north end of the storage module. The SSWs are included so the MVDS has operational flexibility for all anticipated potential faults.

The functions of the SSWs are as follows:

1. Allows isolation of a defective FSC from the vault cooling system after removal from the vault.

2. Allows total individual FSC leak checking throughout the storage period in a location remote from the radiation fields associated with the storage vault(s).

3. Provides basic provision to change fuel elements from one FSC to a spare unit in the unlikely event of FSC failure.

4. Provides basic provision to move fuel elements from FSCs and discharge these into a shipping cask for movement ~~to a federal repository~~ sometime in the future.

A SSW comprises a simple closed ended liner tube set into an enclosure created by the MVDS structure, which provides necessary radiation shielding. The tube is designed to house a FSC and support its base in a manner identical to that used in the storage vault. The charge face level top plate allows for the level positioning and bolting of an isolation valve at the SSW locations. The SSW can be closed using a charge face shield plug and sealed using a cover plate. A sampling point, at charge face level with a self sealing coupling, allows the storage well volume to be evacuated for total FSC leak testing.

If the SSW is occupied by a loaded FSC, the decay heat is dissipated to the surrounding air.

One SSW can be equipped with a spare FSC. The second and third will normally remain empty unless a full defective FSC is removed from the vault.

1.3.2.8. MVDS Crane

The MVDS crane operates over the MVDS charge face and provides lifting for all operations. Failure of the MVDS crane and subsequent dropping of the transfer cask, the handling machine or the isolation valves will not result in the release of radioactivity, and the load handled by the MVDS crane is not designated as critical. The MVDS crane structure and upper limit on hoist travel will control the potential drop height of the CHM onto the charge face structure. The MVDS crane is conservatively and seismically designed to retain and control the load during the seismic event. The gantry and trolley are designed to remain in place on their respective runways with their wheels prevented from leaving the tracks during a seismic or tornado event.

The operation of the MVDS crane is not critical to the safe handling of the FSCs/fuel elements at the MVDS. Failure of the MVDS crane while handling the CHM or other components does not result in a drop on to the charge face of greater than 4". The CHM is restrained from toppling by secondary restraints which are attached to the crane structure from the CHM top plate. The 4" drop is the maximum clearance between the charge face/shield plugs and the CHM support legs.

Design calculations for the 4" drop of the FSCs are included in the ISFSI SAR for the postulated case of a FSC being dropped within the grapple release band on to a support stool, and the FSC remains readily retrievable. This postulated drop is considerably less than the 22 feet drop addressed for the FSC from the upper datum on to the vault floor for which calculations and compression testing demonstrate that the FSC will not rupture and remains recoverable.

Therefore, the 4" drop of the CHM on to the charge face is bounded by the above calculations and does not result in unacceptable radiation doses, criticality does not occur, and the FSC/fuel remains readily retrievable.

Criticality and radiological aspects of accidents associated with failure of the MVDS crane have been analyzed and are discussed in ISFSI SAR Section 8.

1.3.2.9. Transfer Cask Load/Unload Port

The CLUP allows the transfer cask to be supported at the MVDS charge face level for FSC loading/unloading operations. The port allows the loading port isolation valve to be located and bolted into position over the transfer cask. Within the TCRB and below the port position, cask restraint clamps are used to restrain the cask lower end for the seismic event.

1.3.3. ISFSI Facilities

The administration building is located on the west side of the MVDS as shown in Figure 2.1-3. It consists of facilities to support ISFSI operations. There are no MVDS design or safety requirements associated with the administration building. The Alarm Station is located at the south end of the MVDS. See the FSV ISFSI Physical Security Plan for access control details.

Domestic water is supplied to the administration building from the Central Weld County Water District. A septic system and leach field are located west of the administration building such that any required maintenance may be performed without entering the protected access area. This system is designed in accordance with Weld County requirements.

The administration building is electrically heated and cooled to provide comfort for the occupants.

Electrical power is supplied from the 13 kilovolt (KV) overhead distribution line southeast of the ISFSI facility. This line is fed from the Vasquez Substation. The ISFSI facility is fed via an underground feeder to a 220 KVA 13KV/480V pad-mounted transformer located at the ISFSI.

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1.4. Identification of Agents and Contractors

In accordance with 10 CFR 72.16(b), the Secretary of Energy has designated the Manager of the DOE Idaho Operations Office (DOE-ID) as DOE's authorized representative for filing the FSV ISFSI license transfer application and as the license holder. The DOE utilizes a contractor for the activities controlled by DOE-ID, including the FSV ISFSI.

As the facility owner and licensee, DOE retains ultimate responsibility for the safe operation of the facility and compliance with all license conditions. DOE contractually assigns day-to-day operation of the facility to a qualified DOE contractor, formerly known as the Management and Operating (M&O) contractor. Due to changes in contract nomenclature, this contractor will simply be referred to as the "contractor." The NRC is formally notified in writing upon the selection of a replacement contractor tasked with ISFSI operation, when such contract changes occur – per License Condition No.14.

To exercise its ultimate responsibility, DOE will: (1) retain responsibility for and perform independent audits of the contractor's FSV ISFSI Quality Assurance (QA) Program (both the achievement of quality by contractor management and the verification of quality by contractor QA personnel), (2) ensure the license requirements for the facility are included in the contract, (3) assess the performance of the contractor against the terms of the contract, (4) retain the responsibility to budget funds necessary and sufficient to safely operate the facility, and (5) retain the authority to revise the contract in the event contract deficiencies are found relative to proper implementation of license conditions.

The prime contractor for the design and analysis of the FSV ISFSI was Energy Applications Division of Foster Wheeler Energy Corporation of Livingston, New Jersey in conjunction with GEC Alsthom Engineering Systems Limited of Whetstone, England.

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1.5. Material Incorporated by Reference

1. FWEA MVDS Topical Safety Analysis Report, Revision 1, submitted to the NRC on November 12, 1987.

2. Those items listed in the Reference Section for each SAR Section.

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1.6. References

1. Foster Wheeler Energy Application, Inc. Topical Report for The Modular Vault Dry Store (MVDS) for Irradiated Nuclear Fuel, Revision 1.

2. NRC letter dated March 23, 1988, Roberts to Pickering (Foster-Wheeler Energy Applications, Inc.); Subject: "Limited Proprietary Review of Nuclear Regulatory Commission (NRC) Staff's Final Safety Evaluation Report (SER) for the FW Energy Applications, Inc., Topical Report for The Foster Wheeler Modular Vault Dry Store (MVDS) for Irradiated Nuclear Fuel, Revision 1."

3. NRC letter dated February 1, 1991 (G-91018), Haughney to Crawford; Subject: Notice of Issuance and Finding of No Significant Impact and "Environmental Assessment Related to the Construction and Operation of the Fort St. Vrain Independent Spent Fuel Storage Installation."

4. NRC letter dated November 4, 1991 (G-91230), Haughney to Crawford; Subject: Fort St. Vrain Independent Spent Fuel Storage Installation Materials License No. SNM-2504 and Safety Evaluation Report.

5. 10 CFR 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, Radioactive Waste, High Level Radioactive Waste, and Reactor Related Greater than Class C Waste."

6. 10 CFR 20, "Standards for Protection Against Radiation."

7. NRC letter dated March 21, 1996 (G-96020), Travers to Crawford; Subject: Organizational Changes and Revised Possession Limits.

8. NUREG-0800, Section 3.5.1.4, "Missiles Generated by Natural Phenomena," Rev. 2, July, 1981.

9. Regulatory Guide 1.76-1974, "Design Basis Tornado for Nuclear Power Plants."

10. "Code Requirements for Nuclear Safety Related Concrete Structures," ACI 349-1985 and "Commentary," ACI 349R-1985.

11. "Building Code Requirements for Reinforced Concrete," ACI 318-1983 (Revised 1986).

12. Regulatory Guide 3.60 - 1987 "Design of an Independent Spent Fuel Storage Installation (Dry Storage)."

13. AISC Manual of Steel Construction: Allowable Stress Design, Ninth Edition, 1989.

14. ANSI A58.1 - 1982 "Minimum Design Loads for Buildings and Other Structures."

15. 10 CFR 71, "Packaging and Transportation of Radioactive Material."

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