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## 1.0 INTRODUCTION AND GENERAL DESCRIPTION OF INSTALLATION

### 1.1 INTRODUCTION

During the last 40 years, the U.S. Department of Energy (DOE) and its predecessor agencies have generated, transported, received, stored, and reprocessed spent nuclear fuel (SNF) at DOE facilities nationwide. This SNF was generated from various sources, including the DOE's production reactors; Naval Nuclear Propulsion Program reactors; government, university, and other research and test reactors; special-case commercial power reactors; and foreign research reactors. In 1992, the DOE ceased its reprocessing operations.

Approximately 265 metric tons heavy metal of SNF resides at the Idaho National Laboratory (INL). Most of this SNF is in wet storage at a site that overlies the Snake River Plain Aquifer, a major water source for the region. A Settlement Agreement dated October 17, 1995, between the DOE, the U.S. Navy, and the State of Idaho requires the transfer and dry storage of a portion of these fuels until they can be removed from Idaho (Ref. 1-1).

The DOE contracted with Foster Wheeler Environmental Corporation (FWENC) to design, license, construct, and operate an Independent Spent Fuel Storage Installation (ISFSI) at the INL to provide interim dry storage for a portion of the SNF covered by the Settlement Agreement (Ref. 1-2). FWENC designed and licensed the Idaho Spent Fuel Facility under the requirements of 10 CFR Part 72, however the DOE decided to modify the contract with FWENC prior to the start of construction and major procurements. As part of the contract modification, FWENC has consented to transfer of the NRC license to the Department of Energy.

This Safety Analysis Report (SAR) supports DOE's license transfer application for the Idaho Spent Fuel (ISF) ISFSI under the provisions of Title 10, Code of Federal Regulations (CFR), Part 72.50 (Ref. 1-3). The technical content of this SAR is unchanged and was prepared in accordance with U.S. Nuclear Regulatory Commission (NRC) Regulatory Guide 3.48. The SAR demonstrates the ISF Facility's compliance with the criteria specified in NUREG-1567 (Refs. 1-4 and 1-5).

#### 1.1.1 Principal Function of the Installation

The ISF Facility is designed to provide safe interim dry storage for SNF currently stored or scheduled for storage at the INL. The ISF Facility provides interim storage for SNF from the Peach Bottom and Shippingport reactors, and a relatively small amount of SNF from Training, Research, and Isotope reactors built by General Atomics (TRIGA).

The ISF Facility is designed to receive, repackage, and provide interim dry storage for:

- 1601.5 elements of Peach Bottom reactor SNF (13.3 percent by weight of total heavy metal)
- 2971 rods of Shippingport reactor SNF (85.3 percent by weight of total heavy metal)
- approximately 1600 elements of TRIGA SNF (1.4 percent by weight of total heavy metal)

The Peach Bottom and Shippingport reactors ceased operation in 1974 and 1983, respectively. Because of the lengthy cooling period since final operation, these fuels produce relatively low decay heat compared

to typical commercial SNF. The TRIGA SNF originated from TRIGA research reactors worldwide. Although the age of the TRIGA SNF varies, it also generates very low decay heat, because of the design and operational characteristics of the TRIGA research reactors.

The ISF Facility provides for receipt and repackaging of the SNF into sealed storage canisters that are compatible with the DOE's program for a standard canister design suitable for disposal at a permanent repository. The ISF canisters provide the primary confinement boundary for the SNF. These canisters ensure ready retrievability of the SNF and facilitate transfer of the SNF to a repository for eventual permanent disposal, without the need for further direct handling or repackaging.

The loaded and sealed ISF canisters are stored in individual storage tubes that have a bolted lid with double metallic seal rings. The storage tubes provide a redundant confinement boundary for the SNF. The Storage Area provides radiological shielding, passive natural convection air-cooling, and easily retrievable storage capability for the ISF canisters.

The SNF will remain in storage until a high-level waste geologic repository becomes available. The ISF canisters may then be removed from the facility, loaded into a transportation cask (to be licensed in accordance with 10 CFR 71), and transported off site (Ref. 1-6).

### **1.1.2 Location of the ISFSI**

The ISF Facility is located within the 890-square-mile INL, a DOE-controlled site in southeast Idaho. The INL site consists of eight primary facility areas situated on otherwise undeveloped high-desert terrain. Buildings and structures are clustered within these primary facility areas, which are typically less than a few square miles in size and separated from each other by miles of mostly undeveloped land.

The ISF Facility is adjacent to the Idaho Nuclear Technology and Engineering Center (INTEC), a DOE facility with the mission to receive and store nuclear fuels and radioactive waste. The DOE operates a separate ISFSI for the storage of Three Mile Island-2 (TMI-2) SNF within the INTEC. The TMI-2 ISFSI is licensed by the NRC (Ref. 1-7). The INTEC occupies about 120 acres of the south-central portion of the INL and is approximately 42 miles west of Idaho Falls. The ISF Facility site will occupy approximately 8 acres adjacent to the INTEC, as shown in Figure 1.1-1.

The DOE will transport the SNF from its existing storage locations in the INL to the ISF Facility. The SNF transfer will occur completely within the boundaries of the INL and will be conducted in accordance with INL procedures and DOE orders. Movement and transfer of SNF within the ISF Facility site will be conducted under the provisions of 10 CFR 72 (Ref. 1-3).

## 1.2 GENERAL DESCRIPTION OF INSTALLATION

The ISF Facility is a fully enclosed building complex that allows for year-round operations to receive, store, and as a part of the storage, repackage SNF. Throughout this Safety Analysis Report (SAR), references to the transfer and repackaging of SNF at this facility should be understood to be an integrated part of storage. The ISF Facility consists of three principal areas: the Cask Receipt Area, Transfer Area, and Storage Area. A common Transfer Tunnel provides for the movement of SNF throughout the facility via rail-mounted trolleys. Figure 1.2-1 shows the external appearance of the facility.

### 1.2.1 Cask Receipt Area

The general layout of the major areas of the ISF Facility is shown in Figure 1.2-2. The Cask Receipt Area provides the equipment necessary to transfer incoming DOE Peach Bottom Transfer Casks from truck-mounted transporters to a rail-mounted cask trolley for subsequent movement into other areas of the ISF Facility. The Cask Receipt Area incorporates a single-failure-proof cask receipt crane to lift the Peach Bottom Transfer Cask from its transport vehicle and place it on the cask trolley. The cask trolley moves within the enclosed Transfer Tunnel that connects the Cask Receipt Area with the Transfer Area and Storage Area. The Transfer Area and Storage Area are described below.

### 1.2.2 Transfer Area

The Transfer Area provides the facilities for unloading the SNF from the Peach Bottom Transfer Cask and repackaging it into specifically designed ISF canisters. The ISF canisters are constructed of stainless steel and are vacuum dried, backfilled with helium, and welded closed to provide an inert storage atmosphere for the SNF.

Under normal circumstances, SNF is handled entirely by remote manipulation within the Fuel Packaging Area (FPA), a sub-area of the Transfer Area. SNF is manipulated using a specially designed fuel handling machine (FHM) that includes a single-failure-proof hoist and a power manipulator system (PMS). The FHM hoist is used to lift and move SNF. Master/slave manipulators (MSM) and the PMS are used to perform any required remote manual operations. The FPA also features shielded windows and a closed-circuit television (CCTV) system to aid operator viewing from the operating gallery outside of the FPA.

### 1.2.3 Storage Area

The Storage Area provides for interim dry storage of the SNF. The Storage Area consists of a passively cooled concrete vault housing 246 metal storage tubes, as shown in Figure 1.2-3. The area above the concrete vault is an enclosed, metal-sided building that provides weather protection and permits year-round SNF loading operations. Each storage tube provides interim storage for a single ISF canister. A canister handling machine (CHM) moves individual ISF canisters from the Transfer Tunnel to their storage tube location, and inserts the ISF canisters into the storage tubes. As shown in Figure 1.2-4, the CHM consists of a single-failure-proof bridge crane with an integral shielded transfer cask. After an ISF canister is lowered into a storage tube and a shield plug is installed, the storage tube is sealed with a cover plate with dual metallic seal rings to provide the redundant, outer confinement barrier during storage. Storage tubes are filled with an inert atmosphere to reduce potential corrosion of the ISF canisters during storage. Figure 1.2-5 shows a storage tube assembly loaded with an ISF canister, whose internal configuration is presented in Figure 1.2-6.

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## **1.3 GENERAL SYSTEMS DESCRIPTION**

### **1.3.1 Fuel Handling Systems**

#### **1.3.1.1 Transfer Tunnel and Trolleys**

The Transfer Tunnel connects the major areas of the ISF Facility. A rail-mounted cask trolley moves the transfer cask from the Cask Receipt Area to the Transfer Area, where the SNF is unloaded and repackaged into ISF canisters. The cask trolley is also used to move empty Peach Bottom Transfer Casks back to the Cask Receipt Area in preparation for their return to the INL.

A separate canister trolley is used to move the newly loaded ISF canisters within the Transfer Area and to move the sealed and loaded ISF canisters from the Transfer Area to the Storage Area.

#### **1.3.1.2 Cask Receipt Area**

In the Cask Receipt Area, a cask receipt crane transfers incoming SNF shipments, contained in the transfer cask, from the transport vehicle to the cask trolley. The crane, a single-failure-proof, fixed-hoist system, lifts an incoming Peach Bottom Transfer Cask from the transport vehicle. After the transport vehicle leaves the Cask Receipt Area and the cask trolley is moved under the Peach Bottom Transfer Cask, the cask receipt crane lowers the Peach Bottom Transfer Cask onto the cask trolley, where it is secured and prepared for movement to the Transfer Area.

#### **1.3.1.3 Transfer Area**

The Transfer Area includes the following areas:

- FPA, which houses the FHM, where SNF is removed from the incoming Peach Bottom Transfer Cask and repackaged into new ISF canisters
- Canister Closure Area, where ISF canisters are vacuum dried, helium backfilled, and final closure welded
- Solid Waste Processing Area, where solid radioactive waste is prepared for shipment to and disposal on the INL site
- Operating gallery, where operators perform remote SNF handling operations

The FPA is connected to the Transfer Tunnel through ports in the FPA floor. The FHM is a single-failure-proof bridge crane and hoist with multiple, interchangeable lifting fixtures designed for each SNF fuel type and other specific loads. It is used to unload SNF from the Peach Bottom Transfer Cask and place it in the appropriate baskets and then into ISF canisters. Operators also use the FHM to remove and replace plugs from floor ports, remove existing DOE SNF packages from the Peach Bottom Transfer Cask, load SNF into new baskets, and move loaded baskets to new ISF canisters.

In addition to the FHM, the FPA is also equipped with:

- Shielded windows supported by MSMs and a CCTV system that allows operators to view the FPA from the adjacent operating gallery.

- A worktable system for repair or recovery operations. The table provides access to individual SNF assemblies in a horizontal orientation and includes tooling used to repackage damaged SNF.
- Special lifting devices for specific fuel types and non-SNF loads (e.g., port plugs).
- A decanning machine to cut and remove the top portion of existing DOE SNF canisters to allow removal and repackaging of the SNF.
- A PMS mounted on the FHM to perform non-fuel handling operations such as changing FHM lifting fixtures.

This equipment is used in various combinations to remotely handle and repackage the SNF.

#### **1.3.1.4 Storage Area**

In the Storage Area, the CHM transfers the ISF canisters from the canister trolley to a storage tube for interim storage. The CHM is a single-failure-proof bridge crane with an integral shielded transfer cask that provides radiation shielding during ISF canister transfers.

### **1.3.2 Auxiliary Systems**

#### **1.3.2.1 Heating Ventilation and Air Conditioning**

Heating, ventilation, and air conditioning (HVAC) systems make work areas comfortable, provide environmental control for structure and equipment protection, and control radioactive contamination by filtration and by maintaining differential pressures to ensure that air flows from areas of low potential contamination toward areas of higher potential contamination.

The HVAC system is not required to provide cooling or contamination control for the SNF in the Storage Area. Decay heat from the SNF is removed by natural convection cooling.

Potentially contaminated areas are served by a once-through system consisting of a central make-up air-handling unit, final filters, and exhaust fan. Exhaust air is filtered through at least two stages of high efficiency particulate air (HEPA) filtration before discharge to the atmosphere.

#### **1.3.2.2 Power and Distribution System**

The power distribution system provides electrical power to systems and components. The normal power source is the local utility. A standby diesel generator provides backup power to certain systems should the main power source become unavailable.

An uninterruptible power supply (UPS) system conditions selected power supplies and provides power to selected components if the normal and standby power sources fail or are interrupted. In the event of an earthquake, a switch consisting of seismic sensors in conjunction with shunt trip devices automatically isolates the utility/standby source from the UPS source.

Electrical power is not required to ensure cooling of the SNF during storage. SNF handling equipment (e.g., cranes and trolleys) is designed to fail to a safe condition upon loss of electrical power.

### **1.3.2.3 Radiation Monitoring System**

The radiation monitoring and alarm systems:

- warn operating personnel of direct radiation, including criticality, and airborne radioactivity levels above set limits
- provide local and remote alarms for selected monitors
- ensure that the inlet duct to the HEPA filters downstream of the FPA is monitored for airborne radioactivity before reaching the primary filter
- provide for monitoring of Peach Bottom Transfer Cask internal atmosphere
- provide for continuous stack monitoring to detect radioactive particulate in the HVAC air exhaust stream
- provide for stack discharge sampling for gamma radiation

Dedicated criticality monitoring is provided in the second floor operating gallery and CCA. Although engineered features and administrative controls are implemented to preclude an inadvertent criticality event, area criticality monitors are used to trigger an alarm.

Continuous air monitors measure the general level of airborne material in work areas and detect potential breakthrough of the HEPA filters downstream of the FPA. Record sampling is performed at the exhaust stack. Record samplers provide an accurate count of airborne particulate activity over a period of time by drawing ambient air at a known volumetric rate through a small-pore filter, capturing the particulate matter. These filters are periodically removed and sent to a laboratory for analysis.

### **1.3.2.4 CCTV Monitoring System**

CCTV monitoring is installed in areas where remote operations are performed and direct visual inspection is not practical. The CCTV monitoring system may also be used to supplement visual inspection in operations areas where viewing is limited. During repackaging, the CCTV system allows for visual verification of canister and fuel element identification as well as providing a means to maintain a visual record of the verification.

The CCTV monitoring system also provides for general surveillance of the Storage Area.

### **1.3.2.5 Integrated Data Collection System**

The integrated data collection system (IDCS) is a computer-based system capable of monitoring, recording, and reporting data provided by systems throughout the ISF Facility. The IDCS receives data, displays it for use by system operators, and records it to permanent storage media and/or enters it into standardized reports as required by operations. The IDCS has no operational control functions and does not replace the data available locally at points of operation throughout the facility.

### **1.3.2.6 Radioactive Waste Processing Systems**

The ISF Facility includes two radioactive waste systems: a solid waste processing system for processing original DOE SNF canisters and process-generated waste, and a liquid waste processing system for handling and storing liquids generated from decontamination activities.

### **1.3.2.6.1 Solid Waste Processing System**

The solid waste processing system is in the waste area, a sub-area of the Transfer Area. This system provides the necessary equipment for the handling and packaging activities (size reduction, consolidation, and segregation) for radioactive solid wastes. Solid radioactive waste is transferred for disposal to either at the Radioactive Waste Management Complex or an appropriate offsite disposal facility.

Primary waste includes canisters (of carbon steel, aluminum, or stainless steel) used to deliver SNF to the ISF Facility. The solid waste processing system includes the capability to cut these canisters into smaller sections for packaging.

Process-generated waste consists of paper, rubber, plastic, rags, machinery parts, tools, vacuum cleaner debris, welding materials, and HEPA filters.

### **1.3.2.6.2 Liquid Waste Processing System**

Decontamination activities will generate relatively small amounts of liquid radioactive waste. A personnel safety shower may also generate decontamination water. The liquid waste processing system handles and stores liquid waste prior to delivery to an approved disposal facility.

Local sumps collect decontamination water. This liquid is then transferred by either gravity drain or a mobile pump unit to a liquid waste storage tank. Filter cartridges installed in the mobile pump unit will be changed as required and transferred to the Waste Processing Area for disposal as solid radioactive waste. Either DOE or a mobile services contractor will treat the soluble portion of the liquid waste in the liquid waste storage tanks, using mobile equipment as necessary. A pump is provided to transfer liquid waste between the storage tanks or to either DOE or a mobile treatment services contractor. The liquid waste will be treated, if required, and either disposed of by DOE on the INL or transported as low specific activity waste for off-site processing or disposal.

### **1.3.2.7 Fire Protection System**

The fire protection system consists of both active and passive components. Passive components include structural items such as firewalls and fire doors, which provide a physical barrier between fire areas and allow for safe egress from the facility. Active components include:

- fire water supply
- fire hydrants
- sprinkler systems
- fire standpipes and hose stations
- portable fire extinguishers
- fire dampers

The INTEC site provides the fire-water supply to the ISF Facility.

### **1.3.2.8 Potable Water Supply System**

The INTEC site provides potable water for drinking and other domestic needs at the ISF site. It also provides make-up water to the HVAC chilled-water equipment inside the ISF Facility.

### **1.3.2.9 Sanitary Waste Water System**

The sanitary wastewater system encompasses the sanitary drains and sanitary sewer throughout the ISF site. It discharges to the INTEC wastewater system.

### **1.3.2.10 Compressed Air System**

An air compressor provides the compressed air needs for maintenance activities, inflation of port seals, and operation of pneumatic tools inside the ISF Facility. Compressed air connections will be located throughout the ISF Facility where operation and maintenance activities occur.

### **1.3.2.11 Breathing Air System**

A breathing air compressor and associated cascading and cylinder charging equipment provide breathing air to connections throughout the ISF Facility. The system provides breathing air for personnel protection within the radiologically controlled areas and potentially contaminated areas that may contain airborne radioactive contaminants.

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#### **1.4 IDENTIFICATION OF AGENTS AND CONTRACTORS**

DOE has assumed overall responsibility for design, licensing, construction, operation, and decommissioning of the ISF Facility from FWENC. ISF Facility design was performed by FWENC, under contract DE-AC07-00ID13729 to the Department of Energy (modified February 14, 2006), Idaho Operations Office. Subcontractors to FWENC included:

- RWE NUKEM, Ltd., which provides design support associated with the Transfer Area
- ALSTEC Ltd., which supports design activities related to the Storage Area
- Utility Engineering, which supports facility operations and general architectural design
- Tetra Tech FW, Inc., which supports Storage Tube and Canister design

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## 1.5 MATERIAL INCORPORATED BY REFERENCE

The following documents are incorporated in the FSAR by reference:

<b>Document</b>	<b>Document Number</b>
Emergency Plan	PLN-2214
Decommissioning Plan	PLN-2230
Physical Protection Plan	PLN-2215
Environmental Report	ISF-FW-RPT-0032
Technical Specifications	Materials License No. SNM-2512

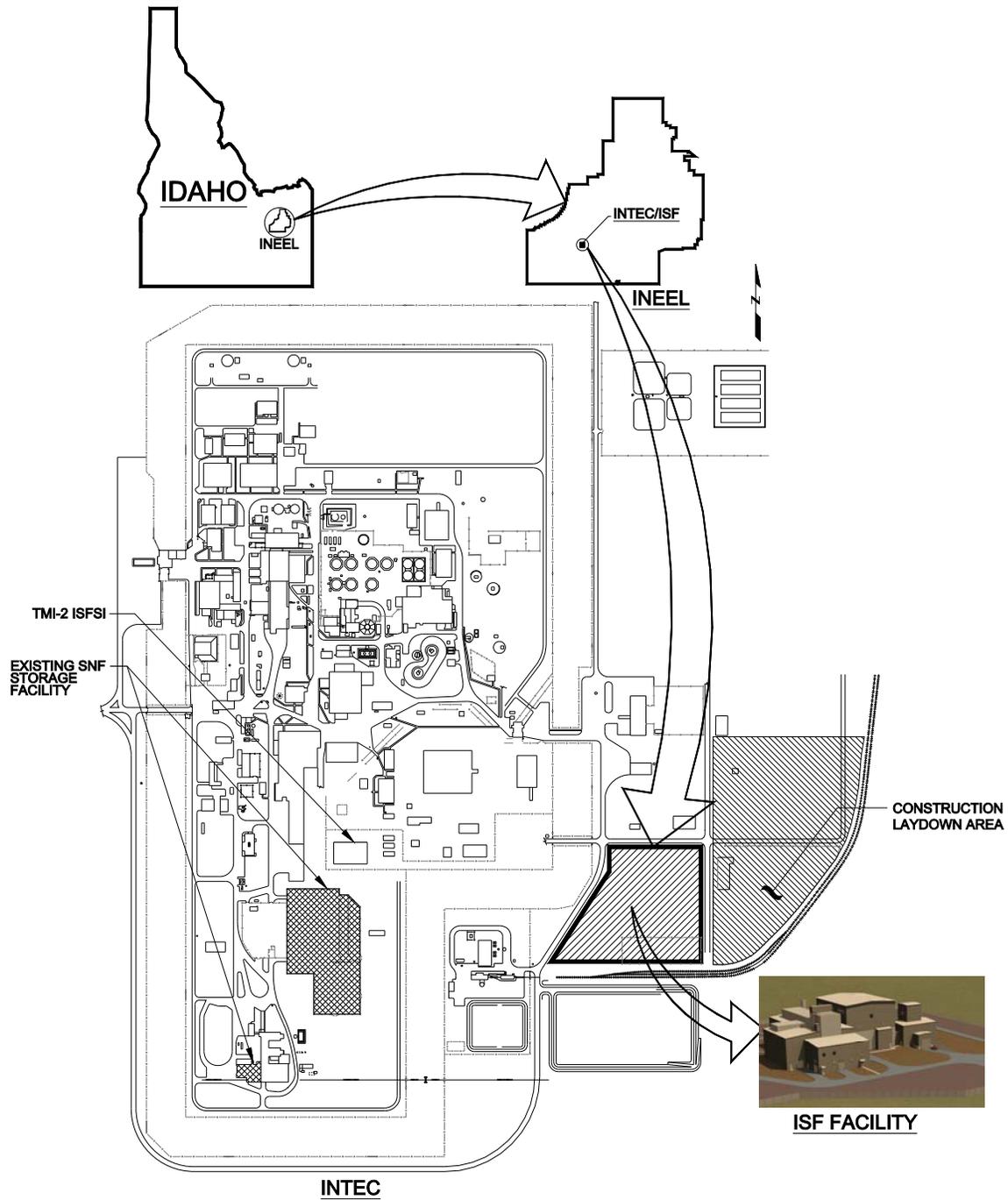
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## 1.6 REFERENCES

- 1-1. U. S. District Court for the District of Idaho, 1995, *Public Service Company of Colorado v. Philip E. Batt*, Civil No. 91-0035-S-EJL (Lead Case), Consent Order, October 17, 1995.
- 1-2. DOE (2000), *Contract Award and Notice to Proceed, Contract No. DE-AC07-00ID13729, Spent Nuclear Fuel Dry Storage Project*, U.S. Department of Energy, Idaho Operations Office, Idaho Falls, Idaho, May.
- 1-3. Title 10, Code of Federal Regulations, Part 72, *Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste*, Office of the Federal Register, Washington, D.C.
- 1-4. U.S. Nuclear Regulatory Commission, Regulatory Guide 3.48, *Standard Format and Content for the Safety Analysis Report for an Independent Spent Fuel Storage Installation (Dry Storage)*, U.S. NRC, 1989.
- 1-5. U.S. Nuclear Regulatory Commission, *Standard Review Plan for Spent Fuel Dry Storage Facilities*, NUREG-1567, U.S. NRC, March 2000.
- 1-6. Title 10, Code of Federal Regulations, Part 71, *Packaging and Transportation of Radioactive Material*, Washington, D.C.
- 1-7. *TMI-2 Independent Spent Fuel Storage Installation*, Docket No. 72-20 (NRC Materials License SNM-2508 issued March 19, 1999).

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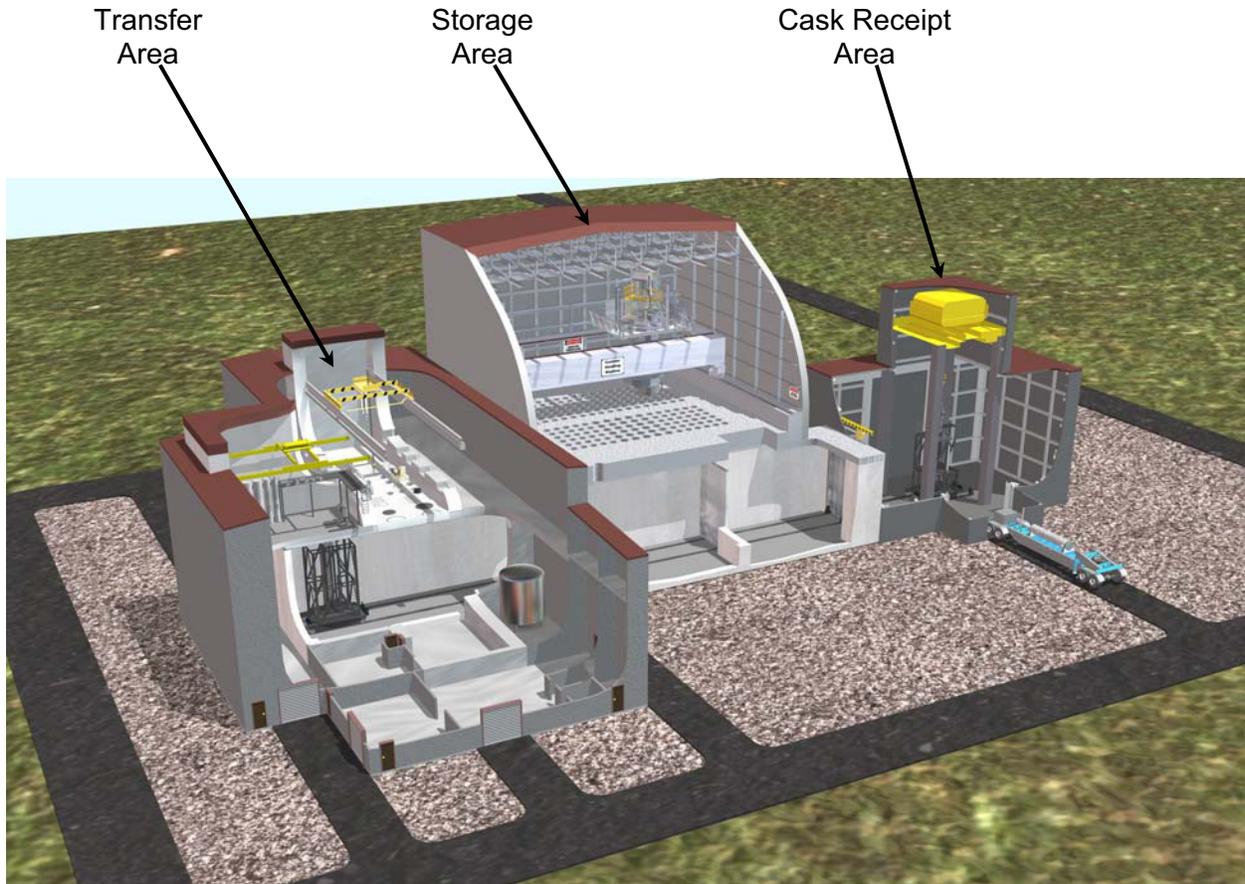
Figure 1.1-1  
Location of the ISF Facility



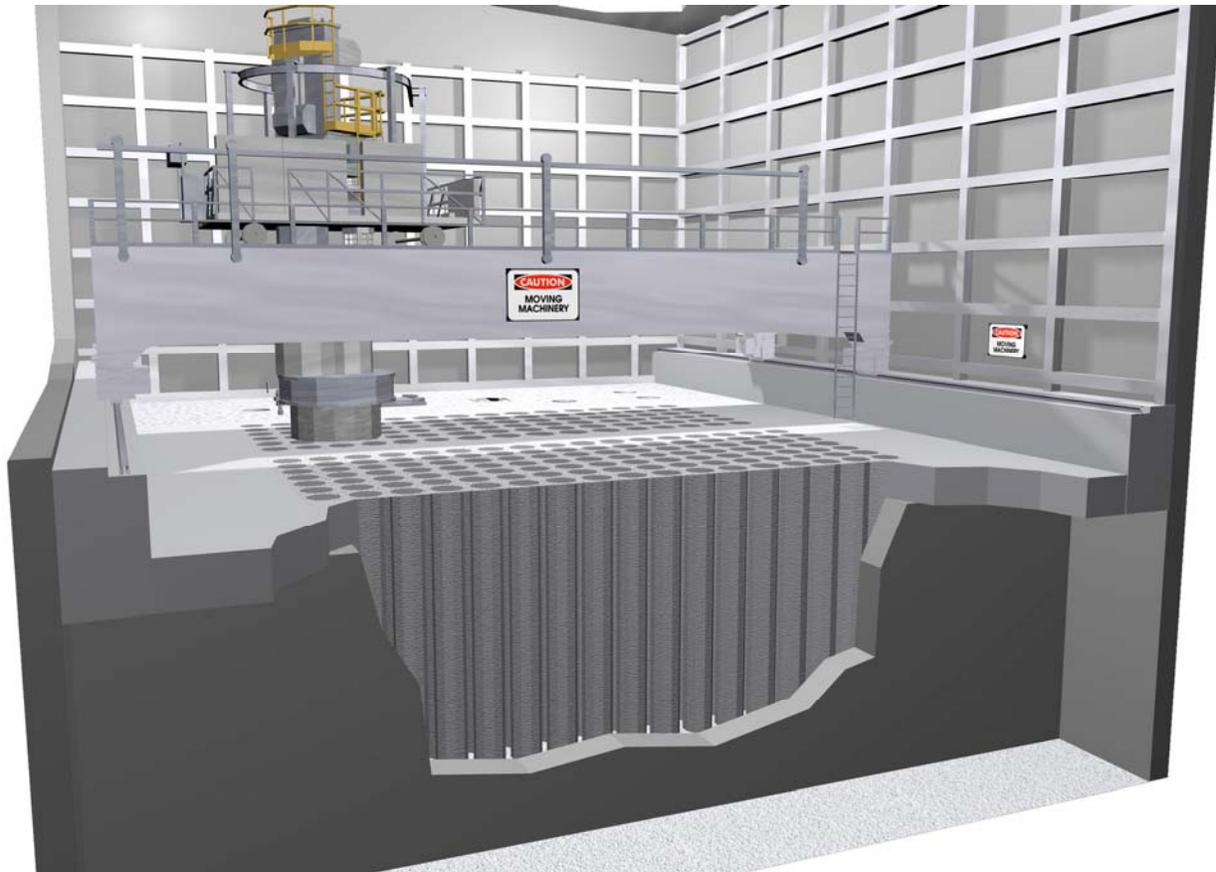
**Figure 1.2-1**  
**External Appearance of the ISF Facility**



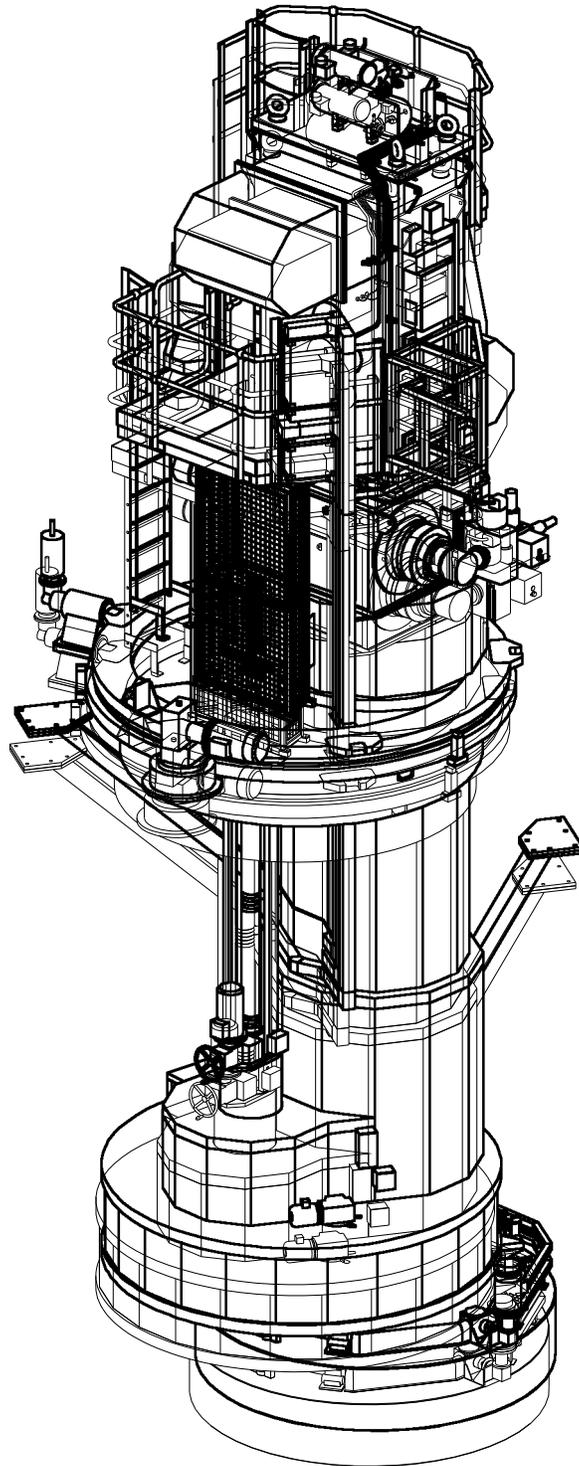
**Figure 1.2-2**  
**General Layout of the Major Areas of the ISF Facility**



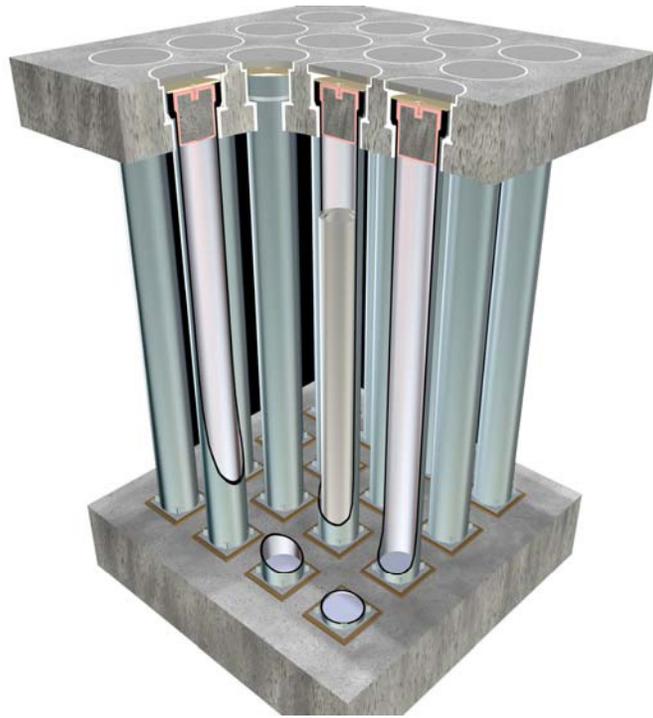
**Figure 1.2-3  
Storage Vault Configuration**



**Figure 1.2-4**  
**Canister Handling Machine Detail**



**Figure 1.2-5**  
**Loaded Storage Tube Assembly**



**Figure 1.2-6**  
**Loaded Canister Assembly**



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