SAFETY EVALUATION REPORT
FOR THE
IDAHO SPENT FUEL FACILITY

Docket No. 72-25

Materials License No. SNM-2512

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

Section Page

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Continued)

TABLES

ACRONYMS

ACI	American Concrete Institute
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
ALARA	As Low As Is Reasonably Achievable
ANS	American Nuclear Society
ANSI	American National Standards Institute
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air-Conditioning Engineers
ASME	American Society of Mechanical Engineers International
ASTM	American Society for Testing and Materials
AWS	American Welding Society
BCVs	Bench Containment Vessels
CCA	Canister Closure Area
CCTV	Closed-Circuit Television
CHM	Canister Handling Machine
CMAA	Crane Manufacturers Association of America
CoC	Certificate of Compliance
CRA	Cask Receipt Area
DBE	Design Basis Earthquake
DE	Design Earthquake
DOE-ID	U.S. Department of Energy—Idaho Operations Office
EP	Emergency Plan
ERDA	Energy Research and Development Administration
FAA	Federal Aviation Administration
FHM	Fuel Handling Machine
FPA	Fuel Packaging Area
HEPA	High-Efficiency Particulate Air
HVAC	Heating, Ventilation, and Air Conditioning
IDCS	Integrated Data Collection System
INEEL	Idaho National Engineering and Environmental Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ISF	Idaho Spent Fuel
ISFSI	Independent Spent Fuel Storage Installation
I&C	Instrumentation and Controls
LCO	Limiting Conditions for Operation
MPU	Mobile Pump Unit
MRS	Monitored Retrievable Storage
Ms	Surface Wave Magnitude
MSMs	Master/Slave Manipulators
MTU	Metric Tons of Uranium
Mw	Moment Magnitude
NFPA	National Fire Protection Association
PGA	Peak Ground Acceleration
PLC	Programmable Logic Controller
PMS	Power Manipulator System

ACRONYMS (Continued)

PSHA	Probabilistic Seismic Hazards Analysis
PWR	Pressurized Water Reactor
RWMC	Radioactive Waste Management Complex
SAR	Safety Analysis Report
SCBA	Self-Contained Breathing Apparatus
SER	Safety Evaluation Report
SMACNA	Sheet Metal and Air-Conditioning Contractors' National Association
SNF	Spent Nuclear Fuel
SR	Surveillance Requirements
SWPA	Solid Waste Processing Area
TEDE	Total Effective Dose Equivalent
TMI	Three Mile Island
TRIGA	Training, Research, and Isotope reactors built by General Atomics
UPS	Uninterruptible Power Supply

EXECUTIVE SUMMARY

On November 19, 2001, the Foster Wheeler Environmental Corporation (FWENC) submitted a license application to the U.S. Nuclear Regulatory Commission (NRC), in accordance with 10 CFR Part 72, to construct and operate an independent spent fuel storage installation, called the Idaho Spent Fuel (ISF) Facility. The application consists of the following documents:

(1) A **License Application**, in which the applicant provides general information and includes as appendices
- — A request for exemption from the seismic design requirement
- — An operator training and certification plan
- — A proposed decommissioning plan
- — Proposed technical specifications;

(2) A **Safety Analysis Report** (SAR), in which the applicant describes plans for building, operating, and maintaining the proposed ISF Facility, and an evaluation of the U.S. Department of Energy (DOE) transfer casks to be used to transfer the spent nuclear fuel (SNF) to the ISF Facility;

(3) An **Emergency Plan**, in which the applicant describes plans for resolving any emergencies that may happen during ISF Facility operation;

(4) A **Safeguards and Physical Security Plan** (this document will not be released to the public), in which the applicant describes plans for ensuring the ISF Facility and nuclear material are appropriately protected; and

(5) An **Environmental Report**, in which the applicant provides information to the NRC staff to use to perform an environmental review of the proposed ISF Facility.

The U.S. Nuclear Regulatory Commission staff has documented its review and conclusions about the safety-related aspects of the license application in this Safety Evaluation Report (SER). This SER provides the NRC staff's evaluation concerning the first three documents of the application for the ISF Facility, as revised and supplemented. This executive summary provides a brief overview and summary of this SER. The NRC staff's approval of the ISF Physical Protection Plan, including the Safeguards Contingency plan and the Security Training and Qualification Plan was previously documented in a letter dated September 15, 2004. The NRC staff's environmental review is documented in NUREG-1773, "Environmental Impact Statement for the Proposed Idaho Spent Fuel Facility," dated January 2004. The Quality Program Plan (QPP) for the ISF Facility was initially submitted to the NRC on March 31, 2001, and subsequently revised through Revision 6, dated May 28, 2004. The staff approved the QPP through Revision 6 in a letter dated August 5, 2004.

The proposed ISF Facility will store three types of SNF: (i) spent fuel elements from the Peach Bottom Unit 1 high temperature gas-cooled reactor, (ii) spent fuel elements from the Training, Research, and Isotope reactors built by General Atomics (TRIGA) from TRIGA research reactors worldwide, and (iii) the reactor reflector modules and loose reflector fuel rods from the Shippingport light water breeder reactor. The bulk of this spent fuel is currently in storage at

the Idaho National Engineering and Environmental Laboratory (INEEL) site. After the ISF Facility is operational, DOE will transfer the SNF from its current storage locations to the ISF Facility, also on the INEEL site. The SNF transfer will occur completely within the boundaries of the INEEL site. Once received at the ISF Facility, FWENC will repackage the SNF and place it in interim storage. The loaded and sealed ISF canisters are to be stored in individual metal storage tubes located in a passively cooled concrete vault (housing 246 metal storage tubes).

The INEEL site consists of 2,305 km^2 [890 mi^2] of land located in southeast Idaho. The INEEL is a DOE-controlled site, and it consists of eight primary facility areas, typically less than a few square miles in size and separated from each other by miles of mostly undeveloped land. The proposed ISF Facility will occupy approximately 32,375 m^2 [8 acres] adjacent to the Idaho Nuclear Technology and Engineering Center. The proposed ISF Facility includes three principal areas

Description of the Proposed ISF Facility

The ISF Facility is a fully enclosed building complex consisting of three principal areas: (i) the cask receipt area (CRA), (ii) the transfer area, and (iii) the storage area. The Transfer Tunnel will provide connections between these three areas of the ISF Facility. The SNF will be transported to the ISF Facility using transfer casks provided by the DOE. Following receipt at the CRA, the SNF will be moved to the transfer area for unloading and repackaging into specially designed canisters (called ISF canisters). After the SNF transfer is completed, the ISF canisters will be sealed and moved to the storage area for interim dry storage.

The proposed ISF storage system consists of three parts: ISF canisters, which will contain the SNF; metal storage tubes, which will contain the ISF canisters during storage; and the concrete vault, which will house the 246 metal storage tubes. After an ISF canister is placed vertically into a metal storage tube, a shield plug is installed and the metal storage tube is sealed with a cover plate with dual metallic seal rings. The storage tubes are filled with an inert gas to reduce potential corrosion of the ISF canisters during storage.

The ISF canisters are made of stainless steel and provide the confinement system for the SNF. The metal storage tubes with cover plates provide the redundant, outer confinement barrier. The transfer casks provided by the DOE also provide radiation shielding and structural protection of the SNF during transfer operations from the CRA to the fuel packaging area.

The U.S. Department of Energy–Idaho Operations Office (DOE-ID) is responsible for transporting the SNF from the current storage facilities on the INEEL site to the ISF Facility. The SNF will be transferred using two existing Peach Bottom transfer casks (PB-1 and PB-2). Both transfer casks were previously certified by the U.S. Atomic Energy Commission in accordance with the provisions of 10 CFR Part 71 for transportation, but those certifications expired in 1982. The casks have continued to be used by DOE under its own authority for a variety of shipments since that time. In order to demonstrate the acceptability of the PB-1 and PB-2 transfer casks for the limited movement of SNF to the ISF Facility, the DOE-ID evaluated the design and performance of both transfer casks, and this evaluation was incorporated by the FWENC as Appendix A in its ISF SAR.

Safety of the Facility

In its evaluation of the application, the NRC staff has determined that FWENC has adequately demonstrated that the proposed ISF Facility, the storage system design, and the DOE transfer casks to be used are structurally sound, and will perform their intended design functions for all normal operating conditions.

FWENC, in its exemption request, proposed to use a probabilistic seismic hazards analysis (PSHA), rather than a deterministic method required by 10 CFR Part 72 regulations, to determine the design earthquake (DE), based on the 2,500-year return period ground motions and considering site-response effects at the ISF Facility site. After review of the applicant's exemption request, the staff agrees that the use of the PSHA methodology with a 2,500-year return period is acceptable and that there are sufficient technical and regulatory bases to grant an exemption to 10 CFR §72.102(f). The staff further concludes that the ISF Facility has been designed to withstand a 2,500-year return period ground motion.

The NRC staff also determined that FWENC has demonstrated that the SNF within the ISF canisters will remain subcritical (i.e., unable to sustain a nuclear chain reaction) during all phases of operation for both normal and credible accident conditions. FWENC provided radiation dose estimates for the surrounding public and personnel at the ISF Facility. The ISF canisters will be welded closed to prevent leakage of radioactive material. The ISF canisters will be placed in metal storage tubes housed in a concrete vault to shield the area outside the ISF canisters from direct radiation during storage.

The rate at which a person is exposed to radiation is called a dose rate. FWENC estimated that members of the public near the proposed ISF Facility would receive doses below the NRC regulatory requirements, which for normal conditions of operation is 0.25 mSv/yr [25 mrem/yr], and for credible accidents is 0.05 Sv/yr [5 rem/yr]. FWENC also calculated radiation dose rates within the vicinity of the stored canisters and transfer casks to demonstrate that personnel at the proposed ISF Facility will not receive doses that exceed 0.05-Sv/yr [5 rem/yr], the NRC annual regulatory limits for personnel at nuclear facilities. These radiation dose limits have been established by the NRC to prevent undue risk and to ensure the safety of all members of the public and personnel at a nuclear facility. FWENC also described its radiation protection program, which employs an "as low as is reasonably achievable" (ALARA) radiation protection principle. The operating ISF Facility staff will monitor radiation doses received by personnel and dose rates within the vicinity of the ISF Facility to verify radiation dose limits are not exceeded. The NRC staff reviewed the FWENC analyses and concludes that the ISF Facility and storage system design are radiologically safe and will meet regulatory requirements.

FWENC was required to demonstrate that all important parts of its proposed ISF Facility will continue to perform their design functions during normal conditions and during any accident that might reasonably be expected to occur. The staff concluded that, as required by 10 CFR Part 72, FWENC has provided acceptable analyses of the design and performance of these structures, systems, and components important to safety during credible off-normal and accident scenarios. Based on evaluations of these events, the staff concludes that these events do not pose a credible hazard to the ISF Facility. The staff further concludes that the FWENC analyses of off-normal and accident events demonstrate that the proposed ISF Facility will be sited, designed, constructed, and operated such that during all credible off-normal and

accident events, public health and safety will be adequately protected, and the capability to retrieve fuel from the ISF Facility will be preserved.

Other Requirements

To demonstrate its financial qualifications, FWENC identified anticipated sources of funds to construct the ISF Facility. Appropriate license conditions have been developed and stated in this SER to provide reasonable assurance of the applicant's financial qualifications.

The staff finds the ISF emergency plan and the safeguards and physical protection plans acceptable. The emergency plan appropriately describes the applicant's program for responding to onsite emergencies. It also describes plans for seeking offsite assistance if needed. In addition, the safeguards and physical protection plan meets applicable NRC requirements, as documented in the NRC staff's approval letter dated September 15, 2004.

REFERENCES

U.S. Atomic Energy Commission. *Certificate of Compliance, Peach Bottom 1 Cask*. CoC USA/6375/B()F. Docket No. 71-6375. Washington, DC: U.S. Atomic Energy Commission. September 1974.

INTRODUCTION

On November 19, 2001, FWENC submitted a license application to the NRC in accordance with 10 CFR Part 72, to construct and operate an independent spent fuel storage installation, called the Idaho Spent Fuel (ISF) Facility. The ISF Facility will store three types of spent nuclear fuel (SNF): (i) Peach Bottom Unit 1 reactor fuel elements, (ii) fuel elements from the Training, Research, and Isotope reactors built by General Atomics from research reactors worldwide, and (iii) the Shippingport reactor reflector modules and fuel rods. To store the SNF, the proposed ISF Facility will use ISF canisters designed specifically for the proposed operation. The loaded and sealed ISF canisters are to be stored in individual metal storage tubes housed in passively cooled concrete vaults. Each metal storage tube will contain one ISF canister. The ISF canister is placed vertically in the metal storage tube.

In support of its application, FWENC submitted the following documents, which contain the information specified in 10 CFR Part 72, Subpart B, License Application, Form, and Contents:

(1) A **License Application** (Foster Wheeler Environmental Corporation, 2001) which contains
- — General information required by 10 CFR §72.22
- — Applicant's technical qualifications required by 10 CFR §72.28
- — A request for exemption from the seismic design requirement
- — An operator training and certification plan required by 10 CFR §72.194
- — A proposed decommissioning plan required by 10 CFR §72.30
- — Proposed technical specifications required by 10 CFR §72.26

(2) A **Safety Analysis Report** (SAR) (Foster Wheeler Environmental Corporation, 2003) for the ISF Facility required by 10 CFR §72.24

(3) An **Emergency Plan** for the ISF Facility required by 10 CFR §72.32

(4) A **Safeguards and Physical Security Plan** for the ISF Facility, which includes the safeguards contingency plan, as required by 10 CFR §72.180 and §72.184

(5) An **Environmental Report** for the ISF Facility required by 10 CFR §72.34

This report documents the results of the safety evaluation review conducted by the staff. Documents reviewed by staff include (i) the ISF Facility SAR and License Application, (ii) supporting calculation packages, (iii) responses to staff requests for additional information, and (iv) other supporting documentation. The technical review was performed according to the applicable regulations in 10 CFR Parts 20 and 72 and supported by NUREG–1567, NUREG–1536, NUREG–0800, and Regulatory Guide 3.48 (U.S. Nuclear Regulatory Commission, 2000, 1997, 1987, 1989).

This Safety Evaluation Report (SER) documents the staff review of the design, operation, and other safety aspects of the proposed ISF Facility described in the preceding submittals, except for the Environmental Report, the safeguards and physical protection plan, and the Quality Program Plan. The Environmental Report is the subject of a separate Environmental Impact Statement, issued by the NRC staff in January 2004. The staff's safeguards review is

documented in the staff's security evaluation dated September 15, 2004. The Quality Program Plan through Revision 6 was approved by the staff in a letter dated August 5, 2004.

The staff's assessment in this SER is based on the regulatory requirements of 10 CFR Part 72. In its review, the staff evaluated: (i) the characteristics of the site; (ii) ISF Facility operations and operating systems; (iii) the design and design criteria for the ISF Facility and its structures, systems, and components important to safety; (iv) programs that support protection of public health and safety and worker health and safety; (v) the impact of potential off-normal and accident events on structures, systems, and components important to safety; (vi) the financial qualifications of the applicant; (vii) the proposed technical specifications; (viii) the emergency plan; and (ix) the seismic design exemption request.

To store the SNF, the applicant proposes to use ISF canisters designed specifically for the ISF Facility. The proposed ISF storage system consists of three distinct components: ISF canisters, metal storage tubes, and the concrete vault. The concrete vault houses 246 metal storage tubes. The ISF storage system is passive and does not rely on any active cooling systems to remove the SNF decay heat. The ISF canisters provide the primary confinement system for the SNF. The metal storage tubes provide an additional confinement barrier.

The Department of Energy-Idaho Operations Office (DOE-ID) is responsible for transporting the SNF from the current storage facilities at the Idaho National Engineering and Environmental Laboratory site to the ISF Facility. Two existing Peach Bottom transfer casks provided by the DOE-ID will be used for SNF transfer to the ISF Facility. The DOE-ID conducted an evaluation of these two casks, and the evaluation results were provided to FWENC and included as Appendix A of the ISF Facility SAR (Foster Wheeler Environmental Corporation, 2003). The staff reviewed Appendix A to confirm that the two Peach Bottom transfer casks are structurally sound and radiologically safe for transporting SNF to the ISF Facility. The staff also reviewed the SAR to verify that the ISF storage system design is radiologically safe and meets the radiological limits of 10 CFR §72.104.

REFERENCES

Foster Wheeler Environmental Corporation. *Idaho Spent Fuel Facility Safety Analysis Report*. ISF–FW–RPT–0033. Docket 72-25. Amendment 3. Morris Plains, NJ: Foster Wheeler Environmental Corporation. November 2003.

Foster Wheeler Environmental Corporation. *License Application, Idaho Spent Fuel Facility.* Docket No. 72-25. ISF–FW–RPT–0127. Rev. 0. Morris Plains, NJ: Foster Wheeler Environmental Corporation. November 2001.

U.S. Nuclear Regulatory Commission. NUREG–1567, *Standard Review Plan for Spent Fuel Dry Storage Facilities*. Final Report. Washington, DC: U.S. Nuclear Regulatory Commission. 2000.

U.S. Nuclear Regulatory Commission. NUREG–1536, *Standard Review Plan for Dry Cask Storage Systems*. Final Report. Washington, DC: U.S. Nuclear Regulatory Commission. 1997.

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 or Monitored Retrievable Storage Installation (Dry Storage)*. Washington, DC: U.S. Nuclear Regulatory Commission. 1989.

U.S. Nuclear Regulatory Commission. NUREG–0800, *Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants*. Washington, DC: U.S. Nuclear Regulatory Commission. 1987.