14 WASTE CONFINEMENT AND MANAGEMENT EVALUATION

14.1 Conduct of Review

This chapter of the Safety Evaluation Report (SER) evaluates the waste management systems of the Idaho Spent Fuel (ISF) Facility. Chapter 6 of the Safety Analysis Report (SAR) (Foster Wheeler Environmental Corporation, 2003a) provides information about the waste confinement and disposal systems that are part of the ISF Facility. The review objectives for this chapter are to establish that the ISF Facility provides safe confinement and management of radioactive waste generated at the ISF Facility, and that the generation of radioactive waste and release of radioactive material to the environment resulting from facility operation meet regulatory standards.

14.1.1 Waste Sources

The staff's review of the sources of radioactive waste described in Section 6.1, "Onsite Waste Sources," of the SAR included consideration of gaseous, liquid and solid low-level radioactive waste produced during operation of the ISF Facility. The review considered how the SAR addresses the following regulatory requirements:

- 10 CFR §72.104(a) requires that, during normal operations and anticipated occurrences, the annual dose equivalent to any real individual beyond the controlled area must not exceed 0.25 mSv [25 mrem] to the whole body, 0.75 mSv [75 mrem] to the thyroid, and 0.25 mSv [25 mrem] to any other organ, from various sources, including planned discharges of radioactive materials to the environment.

- 10 CFR §72.122(b)(4) requires that, for facilities located over an aquifer, measures be taken to preclude transport of radioactive materials to the environment through this pathway.

- 10 CFR §72.128(a)(5) and §72.24(f) require that systems for handling radioactive materials in the ISFSI must be designed to minimize the quantity of radioactive wastes generated.

The SAR describes the radioactive waste sources, which are limited to those produced during the operation of the ISF Facility. The receipt and repackaging activities of the spent nuclear fuel (SNF) are scheduled to be completed during the first 3 years of ISF Facility operation. Subsequent to the initial receipt and repackaging of SNF, the SAR states there will be minimal generation of radioactive waste. Liquid and solid low-level waste will be disposed of in accordance with applicable regulations. The solid waste will be processed in the solid-waste processing system and sent to the Radioactive Waste Management Complex (RWMC) at the Idaho National Engineering and Environmental Laboratory (INEEL). No liquid waste will be generated by routine operations; however, any liquid waste generated through nonroutine operations will be collected and transported offsite and processed by a licensed liquid waste transport vendor. Any radioactive gases released within the ISF Facility are drawn through the facility's heating, ventilation, and air conditioning (HVAC) system that filters the effluents to meet regulatory requirements. The ISF Facility operations will not result in significant amounts of gaseous radioactive effluents because the bulk of the SNF has been in storage for long

periods (since 1974 and 1982), and the gases have decayed. The liquid waste is generated only during nonroutine decontamination activities.

The staff finds that the SAR adequately describes waste sources, and that there are no routine effluents discharged to the environment because of operation of the ISF Facility, including normal and off-normal conditions. Because there are no routine discharges of either liquid or gaseous effluents to the environment, the staff finds that the requirement of 10 CFR §72.122(b)(4) is met regarding precluding transport of radioactivity to an aquifer. The generation of gaseous waste is minimized because of the age of the SNF. Liquid waste is generated only during nonroutine decontamination activities; consequently, the amount generated is minimized. Solid waste handling and packaging may include size reduction, consolidation, and segregation. Solid waste will be shipped to the RWMC, the U.S. Department of Energy onsite disposal facility located on the INEEL site. Therefore, the staff determines that the requirements of 10 CFR §72.128(a)(5) and §72.24(f) are met because the design of the ISF Facility systems will minimize generation of the radioactive waste.

14.1.2 Off-Gas Treatment and Ventilation

The staff's review of Section 6.2, "Off-gas Treatment and Ventilation," of the SAR regarding off-gas treatment and ventilation considered how the SAR addresses the following regulatory requirements:

- 10 CFR §20.2001(a) authorizes a licensee to dispose of radioactive materials only by certain methods, including transfer to an authorized recipient, and by limited release in effluents.

- 10 CFR §72.24(f) requires the features of ISFSI design and operating modes to reduce, to the extent practicable, radioactive waste volumes generated at the installation.

- 10 CFR §72.104(a) requires that, during normal operations and anticipated occurrences, the annual dose equivalent to any real individual beyond the controlled area must not exceed 0.25 mSv [25 mrem] to the whole body, 0.75 mSv [75 mrem] to the thyroid, and 0.25 mSv [25 mrem] to any other organ, from various sources, including planned discharges of radioactive materials to the environment.

- 10 CFR §72.104(b) requires that operational restrictions be established to meet as low as is reasonably achievable (ALARA) objectives for radioactive materials in effluents.

- 10 CFR §72.104(c) requires that operational limits for radioactive materials in effluents be established to ensure that the dose limits in 10 CFR §72.104(a) are met.

- 10 CFR §72.122(h)(3) requires that ventilation systems and off-gas systems must be provided where necessary to ensure confinement of airborne radioactive particles during normal or off-normal conditions.

- 10 CFR §72.126(c)(1) requires that, as appropriate for the handling and storage system, effluent systems must be provided, as well as methods for measuring the amount of radionuclides in the effluents.

- 10 CFR §72.126(d) requires that the ISFSI must be designed to limit effluents to ALARA levels.

- 10 CFR §72.128(a)(5) requires that systems for handling radioactive materials in the ISFSI must be designed to minimize the quantity of radioactive wastes generated.

The SAR included a description of the ventilation and off-gas treatment for radioactive and nonradioactive gaseous waste and a diagram providing details of the ventilation system (Figures 4.3-3 and 4.3-4 in the SAR). The design criteria and the applicable regulatory limits are described in Section 4.3.1 of the SAR. The release of radioactive gases is expected to occur during the receipt and repackaging of SNF during the first 3 years of facility operation. Redundant confinement boundaries are expected to prevent any release of gases after the SNF has been packed and stored. Monitoring of storage tubes and canisters is expected to ensure their integrity during storage. The SAR lists I-129, Kr-85, and H-3 as the primary gaseous radionuclides. The expected dose rate at the controlled area boundary from these radionuclides is $3 \times 10^{!4}$ µSv [$3 \times 10^{!5}$ mrem/yr], which is much less than the allowable limit of 0.1 mSv/yr [10 mrem/yr]. The SAR indicates that small quantities of hydrogen gas may be produced by the radiolytic decomposition of aqueous solutions in the liquid radioactive waste storage tank. Estimated gas generation rates are low enough to allow passive ventilation of the tank to prevent accumulation of hydrogen gas.

The descriptions also address replacement and disposal of items such as filters, as well as any transfers of waste to other waste treatment systems. The SAR indicates the high-efficiency particulate air (HEPA) filters within the Fuel Packaging Area (FPA) can be replaced using remote handling equipment and can be transferred to the solid radioactive waste system for disposal. The description indicates the manual replacement of primary HEPA filters located in the HEPA filter room will be controlled administratively to keep worker radiation exposure ALARA.

The staff finds that the estimated dose caused by release of gaseous effluents is below the permissible limits and meets the requirements of 10 CFR §20.2001(a)(3). The ventilation and off-gas systems described in the SAR satisfy the requirements of 10 CFR §72.122(h)(3) and §72.24(f) by providing a confinement barrier using HEPA filters to prevent the release of radioactivity to the environment during normal and off-normal conditions. The SAR provides the necessary details to describe the flow of gaseous waste in the HVAC system and the locations of the various monitoring systems to measure the amount of radionuclides in the effluents to satisfy the requirements of 10 CFR §72.126(c)(1) and §72.126(d). Only negligible gaseous releases are anticipated during the first 3 years of the handling and packaging operations, resulting in a total effective dose equivalent reported in the SAR of $3 \times 10^{!4}$ µSv/yr [$3 \times 10^{!5}$ mrem/yr]. The staff finds that the proposed design and operation of the ISF Facility meet 10 CFR §72.104(a)–(c) with regard to doses from gaseous effluents and 10 CFR §20.1101(d) with regard to airborne emissions.

14.1.3 Liquid Waste Treatment and Retention

The staff's review of Section 6.3, "Liquid Waste Treatment and Retention," of the SAR regarding liquid waste treatment and retention considered how the SAR addresses the following regulatory requirements:

- 10 CFR §20.2001(a) authorizes a licensee to dispose of radioactive materials only by certain methods, including transfer to an authorized recipient, and by limited release in effluents.

- 10 CFR §20.2003(a) authorizes a licensee to dispose of radioactive materials by discharge into sanitary sewerage, with certain restrictions.

- 10 CFR §72.104(a) requires that, during normal operations and anticipated occurrences, the annual dose equivalent to any real individual beyond the controlled area must not exceed 0.25 mSv [25 mrem] to the whole body, 0.75 mSv [75 mrem] to the thyroid, and 0.25 mSv [25 mrem] to any other organ, from various sources, including planned discharges of radioactive materials to the environment.

- 10 CFR §72.104(b) requires that operational restrictions be established to meet ALARA objectives for radioactive materials in effluents.

- 10 CFR §72.104(c) requires that operational limits for radioactive materials in effluents be established to ensure that the dose limits in 10 CFR §72.104(a) are met.

- 10 CFR §72.122(b)(4) requires that, for facilities located over an aquifer, measures be taken to preclude transport of radioactive materials to the environment through this pathway.

- 10 CFR §72.126(c)(1) requires that, as appropriate for the handling and storage system, effluent systems must be provided, as well as methods for measuring the amount of radionuclides in the effluents.

- 10 CFR §72.126(d) requires that the ISFSI must be designed to limit effluents to ALARA levels.

- 10 CFR §72.128(b) requires that the ISFSI must have radioactive waste treatment facilities and that provisions must be made for packing of site-generated low-level wastes in a form suitable for storage onsite awaiting transfer to disposal sites.

According to the SAR, liquid waste will not be routinely generated at the ISF Facility during normal operations. The liquid waste may be generated during nonroutine decontamination activities or as a result of sprinkling and firefighting water. Liquid waste collects in local sumps in the Transfer Tunnel, canister closure area (CCA), solid waste processing area (SWPA), and liquid waste storage tank area. Liquid waste is transferred to the liquid waste tanks using the mobile pump unit (MPU) and later will be transported to a licensed facility for treatment or disposal. Two tanks {18,925 L [5,000 gal] and 1,893 L [500 gal]} (Foster Wheeler Environmental Corporation, 2003b) were assessed to be adequate to handle the expected liquid waste generated at the facility. Radioactive elements from the waste stream are removed using a cartridge filtration unit included in the MPU. Filter housings are monitored, and filter cartridges are disposed as solid waste. As stated in Section 6.3.1 of the SAR, design of the liquid waste tanks includes considerations of sump, piping, and pumping configurations to minimize holdup of radioactive material and exposure to personnel. These liquid waste tanks are expected to be sufficient based on expected waste generation rates.

The SAR identifies that penetrations into the first floor area of the FPA and into the fuel handling machine (FHM) maintenance area form a part of the confinement boundary and are important to safety. Figures 6.3-1 and 6.3-2 of the SAR include location of the equipment, flow paths, and other physical features. Gravity flow has been used for flow of water from the radioactive decontamination sink, emergency decontamination shower, and FHM maintenance area to the liquid waste storage tanks. The SAR also indicates the various features in the design are incorporated to determine the volume, concentration, and radioactivity of the wastes fed into collection tanks. These features include periodic monitoring of dose rates on the filter media in the MPU. The storage tank is equipped with an electrically operated agitator and a sampling port to ensure representative liquid waste samples can be collected for analyses. Section 6.1.2 of the SAR identifies seven locations where liquid waste from nonroutine activities may be collected within the ISF Facility. Waste in the individual lines from the workshop and the emergency decontamination shower drain directly to the liquid waste storage tanks. Liquid waste from all other sources is transferred to the storage tank using the MPU, thus preventing chemical reactions or introduction of contaminants, such as complexing agents, that can interfere with waste decontamination. The SAR states the liquid waste storage system is protected from the external environment by the roof, floor, and wall of the Liquid Waste Storage Tank area. This area is below grade and is designed to provide effective containment for tank failure or overflow. A sump for the storage area allows collection and return of the spilled waste or decontamination solutions to the tank. The SAR indicates design considerations include sump, piping, and pumping configurations to minimize holdup of radioactive material and exposure to personnel and to provide the ability to flush the system.

The applicant identified and described an appropriate method for treating contaminated liquids, should it be needed. Therefore, the staff finds that the requirements of 10 CFR §72.128(b) are met for contaminated liquids. The SAR indicates liquid radioactive waste collected in the storage tank will be transported offsite and processed by a licensed liquid waste transport vendor in accordance with all relevant regulations. Hence, the requirements of 10 CFR §20.2001 are met. Section 2.5.3 of the SAR states there are no liquid discharges to the environment, and the staff finds that the proposed design and operation of the ISF Facility meet 10 CFR §72.104(a)–(c) with regard to doses from liquid effluents and 10 CFR §72.122 (b)(4) with regard to precluding transport of radioactive material through an aquifer. The staff finds that the design and operation of the liquid waste treatment and retention system as described in the SAR meet the requirements of 10 CFR §72.126(c)(1) and §72.126(d) with regard to providing handling and storage systems and methods of measuring the amount of radionuclides in the effluents.

14.1.4 Solid Wastes

The staff's review of the handling of solid wastes described in Section 6.4, "Solid Waste," of the SAR included the descriptions of collecting, packaging, and storing solid wastes. The review considered how the SAR addresses the following regulatory requirements:

- 10 CFR §72.104(a) requires that, during normal operations and anticipated occurrences, the annual dose equivalent to any real individual beyond the controlled area must not exceed 0.25 mSv [25 mrem] to the whole body, 0.75 mSv [75 mrem] to the thyroid, and 0.25 mSv [25 mrem] to any other organ, from various sources, including planned discharges of radioactive materials to the environment.

- 10 CFR §72.104(b) requires that operational restrictions be established to meet ALARA objectives for radioactive materials in effluents.

- 10 CFR §72.104(c) requires that operational limits for radioactive materials in effluents be established to ensure that the dose limits in 10 CFR §72.104(a) are met.

- 10 CFR §72.122(h)(3) requires that ventilation systems and off-gas systems must be provided where necessary to ensure confinement of airborne radioactive particles during normal or off-normal conditions.

- 10 CFR §72.128(b) requires that the ISFSI must have radioactive waste treatment facilities, and that provisions must be made for packing of site-generated, low-level wastes in a form suitable for storage onsite awaiting transfer to disposal sites.

The SAR included a description of collecting, packaging, and storing solid wastes. The low-level solid waste generated at the ISF Facility is classified into three types: large canister waste, small canister waste, and process-generated waste. Large canister waste consists of carbon steel, aluminum, or stainless steel cylinders ranging from 0.5 to 0.67 m [18 to 25 in] in diameter and up to 4.0 m [158 in] long, support rings, internal runners (flat bars), runner supports, a landing plate, and crush plates. Small canister waste consists of carbon steel, aluminum, or stainless steel cylinders ranging from 0.10 to 0.13 m [4 to 5 in] in diameter and up to 3.6 m [143 in] long, and box sections of stainless steel up to 1.0 m [40 in] long. Process-generated waste consists of paper, rubber, plastic, rags, machinery parts, tools, vacuum cleaner debris, welding materials, and HEPA filters. The design objective of the solid waste processing system is to safely handle, prepare, and package low-level radioactive solid waste for delivery to the INEEL RWMC in accordance with U.S. Department of Energy–Idaho Operations Office–10381 instructions (1999). The components of the solid waste processing system will not be operated during off-normal service or operating conditions. Figure 6.3-2 in the SAR provides a layout of the solid waste processing equipment. Area radiation monitoring equipment is located in the SWPA, and use of handheld monitors also has been described in the handling and processing of waste. The maximum volume of primary waste expected to be produced annually is 138 m^3 [4,870 ft^3]. Solid waste is packaged and delivered to the RWMC using disposal bins for large pieces or drums for small pieces, such as process-generated waste. The SAR describes the movement of packages into and out of the solid waste storage area. Because the waste containers are in the ISF Facility only temporarily, the effect of corrosion on waste containers is not monitored.

The staff agrees that the provisions for handling solid waste are appropriate and meet the requirements of 10 CFR §72.128(b). The method described would not be expected to produce radioactive effluents, and, therefore, meets the requirements of 10 CFR §72.104(a)–(c) with respect to doses from effluents and meets 10 CFR §72.122(h)(3) with respect to release of effluents.

14.1.5 Radiological Impact of Normal Operations

The staff's review of the summary of radiological impacts of normal operations in Section 6.5, "Radiological Impact of Normal Operations—Summary," of the SAR considered how the SAR addresses the following regulatory requirements:

- 10 CFR §20.1101 requires that a licensee, as part of the radiation protection program, establish a constraint for air emissions of radioactive materials to the environment such that a member of the public is not expected to receive a total effective dose equivalent in excess of 0.1 mSv [10 mrem] per year.

- 10 CFR §20.1301(a) establishes dose limits for a member of the public, including a total effective dose equivalent of 1 mSv [0.1 rem] in a year, and a maximum dose in any unrestricted areas of 0.02 mSv [0.002 rem] in an hour from external sources.

- 10 CFR §20.1301(e) requires that the licensee comply with the environmental radiation standards in 40 CFR Part 190.

- 10 CFR §20.1302(b) requires that the licensee show compliance with the limits in 10 CFR §20.1301, by either demonstrating compliance with the dose limit to an individual by calculation or measurement, or by demonstrating that radioactivity in gaseous and liquid effluents do not exceed the values in table 2 of Appendix B to Part 20, and the dose from external sources would not exceed 0.02 mSv [0.002 rem] in an hour and 0.5 mSv [0.05 rem] in a year.

- 10 CFR §72.40(a)(13)(i) states that the Commission will issue a license under 10 CFR Part 72 upon a determination that the application for a license meets the standards and requirements of the Atomic Energy Act of 1954, as amended, and the regulations of the Commission, and upon finding that, among other things, the activities authorized by the license can be conducted without endangering the health and safety of the public.

The SAR included a summary of radiological impact of normal operations. During all normal and off-normal conditions of storage, the welded canisters will remain sealed, and no radioactive material will be released from inside the canister. Additionally, the practices and procedures proposed to limit and control contamination at the ISF Facility during transfer and handling of waste will ensure that radiological impacts are minimized and that ALARA principles are maintained. Only negligible releases of radioactive material to the environment are expected during normal operations. No liquid effluents are anticipated from the ISF Facility, and only negligible gaseous releases are anticipated during the first 3 years, when the handling and packaging operations will be conducted. For this reason, the radiological impacts will be minimal to the environment from the normal operations of the ISF Facility. The staff determines that the radiological impact of the ISF Facility during normal operations has been described adequately and appropriately and that the radiological impacts from releases will be minimal and will not endanger the health and safety of the public. Based on these considerations, the staff determines that the requirements of 10 CFR §20.1101 have been met with respect to potential releases of radioactive materials during normal operations. The requirements of 10 CFR §72.40(a)(13)(i), §20.1301, and §20.1302 have been met with respect to doses to members of the public from potential releases of radioactive materials during normal operations. The dose to members of the public is evaluated in Chapters 7, 9, and 11 of this SER.

14.2 Evaluation Findings

Based on the staff's review of the information in the SAR, the staff makes the following findings regarding the waste confinement and management of the ISF Facility:

- The ISF Facility is designed and will be operated to reduce to the extent practicable the generated radioactive waste volumes in compliance with 10 CFR §72.24(f).

- Design of the ISF Facility provides acceptable means to limit the annual dose equivalent to any real individual beyond the controlled area during normal operations and anticipated occurrences, including planned discharges, and to not exceed 0.25 mSv [25 mrem] to the whole body, 0.75 mSv [75 mrem] to the thyroid, and 0.25 mSv [25 mrem] to any other organ in compliance with 10 CFR §72.104(a). The ISF Facility operations do not involve any discharge of liquid waste to sanitary sewerage system and are in compliance with 10 CFR §20.2003(a).

- The waste confinement and management activities described in the SAR are sufficient to ensure that the radioactive solid, liquid, and gaseous waste treatment facilities and provisions made for packing site-generated waste in a form suitable for onsite storage awaiting transfer to licensed disposal sites are in compliance with 10 CFR §72.128(b).

- The waste confinement and management activities described in the SAR do not include any routine discharge of effluents to the environment during normal and off-normal conditions, precluding transport of radioactivity to an aquifer, in compliance with 10 CFR §72.122(b)(4).

- Design of the ventilation and off-gas systems described in the SAR ensure confinement of airborne radioactive particles during normal and off-normal conditions in compliance with 10 CFR §72.122(h)(3).

- Design of the liquid and gaseous waste confinement and management systems include monitoring systems to measure the amount of radionuclides, in compliance with 10 CFR §72.126(c)(1).

- Design of the ISF Facility provides acceptable means to limit the release of radioactive materials in effluents during normal operation to ALARA levels, and to control the release of radioactive materials during accident conditions, in compliance with 10 CFR §20.1101, §20.1301, §20.1302, 10 CFR §72.126(d), §72.128(a)(5), and §72.104 with respect to radioactive materials released as effluents.

- The waste confinement and management activities described in the SAR support a conclusion that the activities authorized by the license can be conducted without endangering the health and safety of the public, in compliance with 10 CFR §72.40.

14.3 References

Foster Wheeler Environmental Corporation. *Idaho Spent Fuel Facility Safety Analysis Report*. ISF–FW–RPT–0033. Docket 72-25. Amendment 03. Morris Plains, NJ: Foster Wheeler Environmental Corporation. November 2003a.

Foster Wheeler Environmental Corporation. *Response to NRC Second Round Request for Additional Information*. Idaho Spent Fuel Facility License Application. FW–NRC–ISF–03–0198. Richland, WA: Foster Wheeler Environmental Corporation, Idaho Spent Fuel Facility Project. August 28, 2003b.

U.S. Department of Energy–Idaho Operations Office. DOE /ID–10381, *Idaho National Engineering and Environmental Laboratory Reusable Property, Recyclable Materials, and Waste Acceptance Criteria*. Rev. 9. Idaho Falls, ID: Idaho National Engineering and Environmental Laboratory. March 30, 1999.