

13 WASTE MANAGEMENT EVALUATION (SL)

13.1 Review Objective

The objective of the U.S. Nuclear Regulatory Commission's (NRC's) waste management review is to ensure that the design and proposed operation of the independent spent fuel storage installation (ISFSI) or monitored retrievable storage installation (MRS) provide for the safe confinement and management of any radioactive waste generated as a result of facility operations. This review includes an evaluation of the applicant's analysis to ensure that the dose contribution from radioactive wastes generated by the handling and storage of spent nuclear fuel (SNF), reactor-related greater-than-Class-C (GTCC) waste or, for an MRS, high-level radioactive waste (HLW) at the dry storage facility (DSF), when added to other dose contributors at the site will meet, the requirements in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20, "Standards for Protection Against Radiation," and 10 CFR Part 72, "Licensing Requirements for the Independent Storage of Spent Nuclear Fuel, High-Level Radioactive Waste, and Reactor-Related Greater Than Class C Waste."

13.2 Applicability

This chapter applies to the review of applications for specific licenses "(SL)" for an ISFSI or an MRS, categorized as a dry storage facility (DSF).

13.3 Areas of Review

This chapter addresses the following areas of review:

- waste sources and waste management facilities
- off-gas treatment and ventilation
- liquid waste treatment and retention
- solid wastes
- waste stream radiological characteristics and dose analyses

13.4 Regulatory Requirements and Acceptance Criteria

This section summarizes those sections of 10 CFR Part 72 and 10 CFR Part 20 that are relevant to the review areas this chapter addresses. The NRC staff reviewer should refer to the exact language in the regulations. Table 13-1 matches the relevant regulatory requirements to the areas of review covered in this chapter.

Table 13-1 Relationship of Regulations and Areas of Review

Areas of Review	10 CFR Part 20 Regulations ^a				
	20.1101 (b)(d)	20.1301 (a)(b)(d)(e)	20.1302(a)(b)	20.2001 (a)	20.2003 (a)
Waste Sources and Waste Management Facilities					
Off-Gas Treatment and Ventilation				•	
Liquid Waste Treatment and Retention				•	•
Solid Wastes					
Waste Stream Radiological Characteristics and Dose Analyses	•	•	•		

Areas of Review	10 CFR Part 72 Regulations (cont.)						
	72.24	72.40 (a)(13)	72.104	72.106 (b)	72.122 (b)(1) (2)(4), (e) ^A (h)(3)	72.126	72.128
Waste Sources and Waste Management Facilities	(d)(e)(f) (l)		•	•	•	(a)(b)(c) (d)	•
Off-Gas Treatment and Ventilation	(d)(e)(f) (l)		•	•	•	(a)(b)(c) (d)	•
Liquid Wastes, Treatment and Retention	(d)(e)(f) (l)		•	•	•	(a)(b)(c) (d)	•
Solid Wastes and Treatment	(d)(e)(f)		•	•	•	(a)(b)(c) (d)	•
Waste Stream Radiological Characteristics and Dose Analyses	(e)(l)(m)	•	•	•	(b)(4), (h)(3)	(b)(c) (d)	

a Note that the regulations in 10 CFR Part 20, as specified in the scope in 10 CFR 20.1002, "Method for Obtaining Approval of Proposed Disposal Procedures," "...apply to persons licensed by the Commission to receive, possess, use, transfer, or dispose of byproduct, source, or special nuclear material or to operate a production or utilization facility under parts 30 through 36, 39, 40, 50, 52, 60, 61, 63, 70, or 72 of this chapter."

The following are principal acceptance criteria that apply to confinement and management of site-generated waste:

- establishment of operational restrictions and limits that ensure effluents and direct radiation levels from the DSF waste management system(s), in addition to other site dose contributors, will meet the as low as reasonable achievable (ALARA) objectives and not exceed the limits in 10 CFR 72.104(a), in accordance with 10 CFR 72.104(b) and 10 CFR 72.104(c)
- demonstration that the DSF waste storage and management system(s) is (are) designed to limit radioactive materials releases to ALARA conditions under normal and off-normal operation conditions, control releases under accident conditions, and analyses of doses from the system(s) to support evaluation of DSF compliance with regulatory limits for the applicable conditions, in accordance with 10 CFR 72.126(d)
- analyses and identification of maximum doses and concentrations of radioactive materials in effluents from the waste storage and management system(s) to support evaluation of DSF compliance with 10 CFR 20.1301, "Dose Limits for Individual Members of the Public"
- design and operation of the DSF waste storage and management system(s) in such a way to ensure occupational and public doses will meet ALARA objectives for the DSF and DSF air emissions will not exceed the constraint in 10 CFR 20.1101(d), in accordance with 10 CFR 20.1101, "Radiation Protection Programs."
- safe confinement of all radioactive waste materials generated as a result of DSF operations until disposal
- implementation of the waste confinement objectives; equipment; structures systems and components (SSCs); and program necessary for the protection against radiation (as described in Chapter 10A, "Radiation Protection Evaluation For Dry Storage Facilities," of this SRP)

The results of the dose and radioactive materials concentrations in this chapter are integrated into the radiation protection evaluations (see Chapter 10A of this SRP), by which facility compliance with the dose, ALARA, and other radiation protection criteria is demonstrated and determined.

Additional acceptance criteria apply to the descriptions in the safety analysis report (SAR) of waste sources and management systems, waste characteristics, operations, and monitoring. The SAR must describe the design bases for systems and equipment that maintain control over radioactive material in gaseous and liquid effluents and identify the equipment and facilities important to safety (10 CFR 72.24(l)). The SAR must also include the design objectives and the means to be employed to maintain ALARA with respect to the levels of radioactivity in effluents and to minimize the generation of waste (10 CFR 72.24(l)). The SAR should describe waste operations, from generation and collection to final disposal off site, including narrative text and flowcharts.

The following sections address specific requirements related to waste sources, off-gas treatment and ventilation, liquid waste treatment and retention, and solid wastes. Reviewers can also use NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear

Power Plants: LWR Edition” (primarily Chapter 11, “Radioactive Waste Management”), to identify acceptance criteria for these categories.

13.4.1 Waste Sources and Waste Management Facilities

Radioactive wastes that result from a DSF can be separated into two main categories:

- Effluents—radioactive materials that are discharged to the environment in gaseous or liquid form. The activity content of these effluents must comply with appropriate regulatory limits and ALARA criteria (e.g., 10 CFR 72.24(l) and 10 CFR 20.1101(d)).
- Wastes—radioactive materials that are of sufficient hazard or regulatory concern that they require special care before final disposal. The generation of such wastes must be reduced to the extent practicable (10 CFR 72.24(f) and 10 CFR 72.128(a)(5)).

The SAR should identify all actual and potential sources of site-generated radioactive waste. Waste sources described should include activities that give rise to potentially radioactive wastes that would require treatment or special handling. The identification of sources should be comprehensive.

Anticipated radioactive wastes should be described and classified with respect to source; physical, chemical, and radiological characteristics; and method and design for treatment, handling, and storage mode before disposal. Chapters 6, “Shielding Evaluation,” and 9, “Confinement Evaluation,” of this SRP include guidance regarding source characterization that may also be applicable to the sources for this waste management evaluation. These sources may include items such as crud that is removed during SNF handling (in a pool). The SAR descriptions should include sources of radioactive materials that may become airborne in areas accessible to or normally occupied by operating personnel. Descriptions should include gaseous and particulate materials and calculated nuclide concentrations during normal, off-normal, and accident conditions, as well as calculation models and parameters. The SAR should also identify and describe sources of nonradioactive waste, such as combustion products and chemical wastes, to the extent necessary to enable or support determination as to whether site activities can result in radioactive materials being added to such sources.

The SAR should include an estimate of the total volume of liquid waste discharged to the environment to provide the bases for determining concentrations and activities of radionuclides in liquid effluents. An estimate of total sanitary sewer flow may be needed to determine concentrations of radionuclides in waste disposed to the sanitary sewer.

The SAR facility description should include descriptions of the waste management facilities and systems. These would include systems and SSCs used to store, handle, and treat the radioactive wastes generated as a result of DSF operations. The descriptions should identify facilities and systems in scaled layout and include arrangement drawings of the DSF as well as layout and arrangement drawings of the waste management facilities and systems themselves. These drawings should show the locations of all sources identified and described in the waste management evaluation, including storage locations of wastes. The descriptions should be adequate to enable a clear understanding of movements of wastes within the DSF waste management facilities and systems. The descriptions should also be adequate to enable a clear understanding of the connections between systems that could allow movement of radioactive materials from radioactive waste systems to nonradioactive waste systems and areas and the methods and features used to preclude such movement. The descriptions should include the

design criteria for the SSCs for the facilities and systems, the adequacy of those criteria for ensuring safety and regulatory compliance, and demonstrations that these SSCs meet the design criteria.

13.4.2 Off-Gas Treatment and Ventilation

Off-gas treatment and ventilation systems typically are provided for removing radioactive and nonradioactive hazardous materials from the atmosphere within a confinement barrier before releasing to the environment. The SAR should describe the DSF's ventilation and off-gas treatment systems. The descriptions should include the systems' functions and performance objectives and the physical areas of the facility serviced by each unit system, each unit system's design, and interfaces between systems and with process off-gas systems and equipment (e.g., waste treatment, storage container venting). The SAR descriptions should include drawings, flowsheet, and narrative descriptions. The SAR should also describe actual operations of ventilation and off-gas treatment equipment and the minimum expected performance. The SAR should identify design criteria and limits for operations, safety margins, and performance limits that need to be met for safety. General design criteria should be based on site conditions, including normal, off-normal, and accident condition analyses, design function and performance objectives, and projected volumes of gaseous (or airborne) waste.

The SAR should provide design parameters such as those associated with facility stacks and building ventilation exhaust vents, as they relate to their onsite locations, release heights, exhaust flow, velocity rates, and flow temperatures in determining the types of releases and atmospheric dispersion (X/Q) and deposition parameters (D/Q).

The SAR should also indicate those radioactive wastes that will be produced as a result of off-gas treatment. The applicant should show that system capacity is consistent with the confinement system requirements during normal and off-normal conditions.

The SAR should describe the program for evaluating the performance and efficiency of filters and other treatment devices and the criteria for replacing or regenerating them. The descriptions should also address the replacement and disposal or regeneration of items such as filters and scrubber solutions, including the treatment (with any transfers to other waste systems), handling, and disposal of these wastes. The SAR should describe how these activities are to be done and any possible radiological effects of these activities, including potential personnel exposures and contamination that can result from handling operations. The descriptions should also address how conduct of these activities will meet ALARA objectives.

The SAR should also describe the systems and equipment to monitor gas effluents. This description should include the system and equipment features, locations, and release paths to be monitored. The SAR should also describe the expected reliability and sensitivity of each system and justify the selection of each system and instrument. The SAR should also describe the frequency of sampling, limits for action, and plans to be used to maintain continued integrity of analyses. Such systems would include continuous monitoring systems to detect effluent radioactivity and to alarm on effluent activity levels that exceed operations limits. The SAR would describe the bases for these limits. Chapter 10A of this SRP addresses monitoring and monitoring instrumentation.

13.4.3 Liquid Waste Treatment and Retention

The SAR should identify the sources of all liquid wastes generated and their flow into and out of the liquid treatment systems. These wastes may include laboratory wastes, cask washdown, liquid spills, and decontamination and cleanup solutions. The SAR should also describe the expected inventory levels and characteristics of these wastes and identify the waste streams that will be processed to achieve volume reduction or solidification.

The SAR should describe the systems and equipment for the handling, treatment, and retention of liquid wastes generated from DSF operations. The descriptions should include drawings, flowcharts, and narrative descriptions to enable a clear understanding of the system's design and operations, including design criteria and objectives, function, capabilities, and interfaces with other DSF systems and SSCs.

13.4.3.1 *Design Objectives*

Basic liquid waste treatment concepts include volume reduction, immobilization of radioactive elements, change of composition, and removal of radioactive elements from the waste stream. The description of the facility liquid waste treatment and retention systems should identify the design objectives and demonstrate that the system can handle the expected volume of potentially radioactive and nonradioactive hazardous wastes generated during normal and off-normal operations. The SAR should also describe criteria that incorporate backup and special features to ensure safe confinement of wastes and to minimize personnel doses.

In general, engineered features should be emphasized over procedures to meet protective requirements.

13.4.3.2 *Equipment and System Description*

The SAR should describe the equipment and systems to be installed, including, as applicable, backup and special features that may be relied upon as needed. The SAR should describe the features, systems, and special handling techniques that are important to safety and included in the systems to provide for safe operation. Associated drawings should include the location of equipment, flowpaths, piping, valves, instrumentation, and other physical features. Seismic and quality group classification should conform to the guidelines of Regulatory Guide (RG) 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants." Where feasible, the system should use gravity flow to reduce pressure and to avoid or minimize contamination of pumping and pressure system equipment. The SAR should also reflect measurement capability to determine the volume, concentration, and radioactivity of wastes fed into collection tanks.

Each waste stream fed to the central collection system should use individual lines, where necessary, to prevent chemical reactions or introduction of contaminants such as complexing agents that can interfere with waste decontamination. Individual lines outside confinement (and liquid containment) barriers should be designed not to rupture in the event of frost heave, earth or structure settlement, or earth-structure motions during design-basis earthquakes or other accident or natural phenomenon events. A separate confinement barrier (e.g., drained outer pipe or drained tunnel) should be provided for these lines.

A suitable secondary confinement structure (e.g., secondary vessel, elevated threshold, or dike) should collect or retain spills, overflows, or leakage from storage vessels. The SAR should

indicate the capability to transfer liquid from the secondary confinement to a suitable storage location. All transfer lines should have individual identification.

The piping should be designed to minimize entrapment and buildup of solids in the system. The design should not have any bypasses that route waste streams around collection tanks. Provisions should be made for clean out or decontamination of liquid waste piping, as necessary, to clear potential blockages, perform maintenance or repair, or maintain occupational doses to meet ALARA objectives.

Volume reduction or solidification methods may be used to process liquid wastes. Redundancy and other special features may be incorporated to safely confine the wastes. Adequate shielding should be provided for radioactive liquid waste system components, as necessary.

The SAR should describe how influents to radioactive liquid waste systems are controlled (as necessary, depending on the sources) to prevent introduction of material that may adversely affect system performance. Such materials include, but are not limited to, oils, other organics, insoluble solids, solvents, and hazardous wastes.

The SAR should also describe the liquid monitoring systems, including liquid effluent monitoring systems. The descriptions should include information similar to that described for gas effluent monitoring in Section 13.4.2 above. In addition to release paths, the SAR should describe any other parameters or items that the liquid monitoring systems will use to monitor.

13.4.3.3 *Operating Procedures*

The flow sheets and narrative descriptions of operations should describe the design features and procedures that minimize generation of liquid waste and the possibility of spills, and they should provide for control and containment of spills. The procedures described in the SAR should include performance tests, action levels, actions to be taken under normal and off-normal conditions, and methods for testing to ensure functional operation. The SAR should also describe monitoring and controlling of wastes to the system or facility limits.

13.4.3.4 *Characteristics, Concentrations, and Volumes of Solidified Wastes*

The SAR should describe the physical, chemical, and thermal characteristics of solidified (extracted or residue of liquid) wastes and should also provide estimates of waste volumes and radionuclide concentrations, including the bases for the estimates. Those characteristics and estimates should be compatible with the design criteria and capacity of the liquid waste treatment and retention systems.

13.4.3.5 *Packaging for Onsite Storage*

The SAR shall describe the containers for storing solidified liquid wastes (10 CFR 72.24(l)(3)). The container information should show the materials of construction and include welding design information on the critical boundary welds in regard to the minimum allowable weld joint size configuration. It should also show the maximum temperatures for the waste and container at the highest design heat loads, the homogeneity of the waste contents, the corrosive interactions of the waste on materials of construction, the means for preventing over-pressurization of the container, and the confinement provided by the container under normal, off-normal and accident conditions. The description should also address the container's ability to perform functions in

addition to waste confinement (e.g., shielding), as applicable. The applicant should also demonstrate suitability of packaging for holding and storage of wastes on site at the designated location.

The SAR should also describe aspects of the operating quality assurance program that specifically apply to solidified waste container.

13.4.3.6 *Storage Facilities*

The SAR should describe the storage facilities and operations for site-generated liquid or solidified waste. The descriptions should evaluate the damage to containers (e.g., accidental puncture) from off-normal and accident conditions. The descriptions should also, as applicable, address external corrosion of the container from the environment at the site and within the waste storage facility. The SAR should describe the movement of containers into and out of storage and the expected monitoring. Equipment, waste routing, and spare storage volume should be installed and available to transfer the contents of one tank to another. The minimum spare volume should exceed the maximum liquid content of any one tank.

Provisions should be made so that liquids can be analyzed before transfer. The storage vessels should have agitators, when necessary, to promote mixing of the waste to ensure uniform decay heat distribution, minimize settling, or provide representative waste samples.

If liquid wastes are to be held until site decommissioning or for radioactive decay, the SAR should demonstrate (by analyses or relevant operating experience) that the storage capability is appropriate for the duration of the life of the DSF, or for the projected decay holding time, and the chemistry of the contents. The SAR should also show how the wastes will be handled at the time the installation is permanently decommissioned.

13.4.4 Solid Wastes

The SAR should describe the solid wastes produced during DSF operations, identifying the sources of all generated solid wastes and their flows into and out of the solid waste treatment systems. The SAR should list and characterize the wastes (see Section 13.4.4.4 below), and describe the systems used to treat, package, and contain these wastes. The descriptions should include appropriate drawings, flowcharts, and narrative descriptions to enable a clear understanding of the systems' design and operations, including design criteria and objectives, function, capabilities, and interfaces with other DSF systems and SSCs. The descriptions should include waste radionuclide content, container size, and generation rate.

13.4.4.1 *Design Objectives*

The SAR should identify the design objectives for the systems, including methods and equipment, and demonstrate that the systems can handle the expected volume of potentially radioactive solid wastes generated during normal and off-normal operations. The design objectives should reflect waste minimization as well as safe management. If the design basis includes regulatory limits, the SAR should identify these limits.

In general, engineered features should be emphasized over procedures to meet protective requirements.

13.4.4.2 *Equipment and System Description*

The SAR should describe the equipment and systems to be installed. The SAR should describe the features, systems, and special handling techniques that are important to safety and included in the systems to provide for safe operation. Drawings should identify the locations of equipment and associated features that will be used for volume reduction, confinement, packaging, storage, and disposal.

System and equipment descriptions should address the types of waste treatment methods to be used at the DSF. Fundamental solid waste treatment concepts include volume reduction, immobilization of radioactive material, change of composition, and removal of radioactive material from the waste stream. Solid waste management systems should include provisions for shielding, confinement, handling, and decontamination, as necessary, to ensure that occupational doses are maintained to meet ALARA objectives and to minimize doses to the public from these wastes.

The SAR should also describe the solid waste monitoring systems. The descriptions should, as applicable, include information similar to that described for liquid waste monitoring in Section 13.4.3.2 above. The SAR should describe the procedures, equipment, and instrumentation to be used as well as parameters or items that the monitoring systems will monitor (e.g., integrity of waste container confinement).

13.4.4.3 *Operating Procedures*

The SAR should describe the procedures associated with solid waste system or equipment operations. The procedures should identify performance or functional testing, process limits, action levels, and actions to be taken under normal and off-normal conditions. The SAR should also describe the means for monitoring and controlling to the identified process limits.

13.4.4.4 *Characteristics, Concentrations, and Volumes of Solid Wastes*

The SAR should describe the physical, chemical, radiological, and thermal characteristics of the solid wastes and provide estimates of the waste volumes generated. These characteristics include the radionuclides and their estimated concentrations. The SAR should also provide the bases for the estimates. These characteristics and estimates should be compatible with the design criteria and capacity of the solid waste treatment and retention systems.

13.4.4.5 *Packaging for Onsite Storage*

The SAR shall describe the containers for solid wastes (as for solidified liquid waste described in Section 13.4.3.5 above) (10 CFR 72.24(l)(3)). The SAR should also describe aspects of the operating quality assurance program that specifically apply to solid waste containers.

If a laundry is to be used (e.g., to minimize solid-waste generation), the SAR should describe the containers for transferring the used items. If the laundry is off site, it should be identified and should be licensed to possess radioactive material of the type and quantity to be generated at the DSF. (Note: An offsite laundry is not licensed under 10 CFR Part 72, but an onsite laundry capability to support the DSF should be included in the installation license.)

13.4.4.6 *Storage Facilities*

The SAR should describe the solid waste storage facilities and operations and the movement of containers into and out of storage as well as expected monitoring. The SAR should also address the corrosive aspects of the wastes and monitoring of the containers' confinement barrier. The SAR should appropriately address impacts of other conditions, including off-normal and accident conditions.

The SAR should describe planned disposal of the wastes. If solid wastes are to be held until site decommissioning or for radioactive decay, the SAR should demonstrate (by analyses or relevant operating experience) that the storage containers or confinement, as applicable, are appropriate for the duration of the life of the DSF or for the projected decay holding time. The SAR should also show how the wastes will be handled at the time the installation is permanently decommissioned.

13.4.5 Waste Stream Radiological Characteristics and Dose Analyses

The SAR should provide a summary of the radiological impacts of wastes generated during normal site operations, include the following:

- a summary identifying each effluent and waste type
- the amount of each waste type generated per metric ton of SNF, reactor-related GTCC waste, or HLW handled and stored per unit of time (e.g., per year)
- the quantity and concentration of each radionuclide in each waste stream
- identification of locations, both on site and off site, where individuals may be that are potentially affected by radioactive materials in effluents; these locations include those for personnel who would receive an occupational dose and those individuals receiving a dose as members of the public. Considerations of locations should include the different areas associated with the site (e.g., restricted areas, the controlled area, beyond the controlled area) as defined in 10 CFR Part 20 and 10 CFR Part 72 and the regulatory limitations for who may access these areas
- the estimated concentrations of radionuclides, dose rates, and doses, including, as appropriate, collective (person-rem) doses, at the identified locations for normal, off-normal and accident conditions; the dose and dose rate results should identify the contribution of each radionuclide
- sample calculations and a discussion of the reliability of the concentration and dose estimates
- for each effluent, a summary of the constraints imposed on process systems and equipment to ensure safe operation.

The results of the analyses performed for this waste management evaluation should be sufficient to support the evaluation of compliance with the radiological requirements, including dose limits, for occupational personnel and members of the public. Chapter 10A of this SRP describes the evaluation of the SAR with respect to compliance with the radiological requirements. The results of these analyses should include both the direct radiation and effluent contributions to doses from

the wastes. The shielding and confinement chapters of this SRP (Chapters 6 and 9) provide guidance that is useful for the calculation of direct radiation dose and effluent dose, respectively, and the information the SAR should include regarding those calculations. The direct radiation dose analyses should identify and include the contributions from each waste stream and locations of that waste (e.g., solid and liquid wastes in containers and tanks). The SAR should describe the methods used to determine radionuclide concentrations and doses and dose rates, including any computer codes, equations, models, assumptions, and input data used. The SAR should justify the appropriateness and adequacy of the methods and the results. Chapter 10A of this SRP also describes information in the SAR for evaluating effluents and dose analyses applicable to the evaluations in this chapter.

13.5 Review Procedures

This section describes review procedures used to evaluate the wastes generated as a result of DSF operations; the waste management systems used to treat, handle, and store these wastes; and the radiological analyses of these wastes and the management systems. The reviewer should also refer to Chapter 11 of NUREG-0800, which contains guidance that may also be useful for this review.

Figure 13-1 shows the interrelationship between the waste management evaluation and the other areas of review described in this SRP.

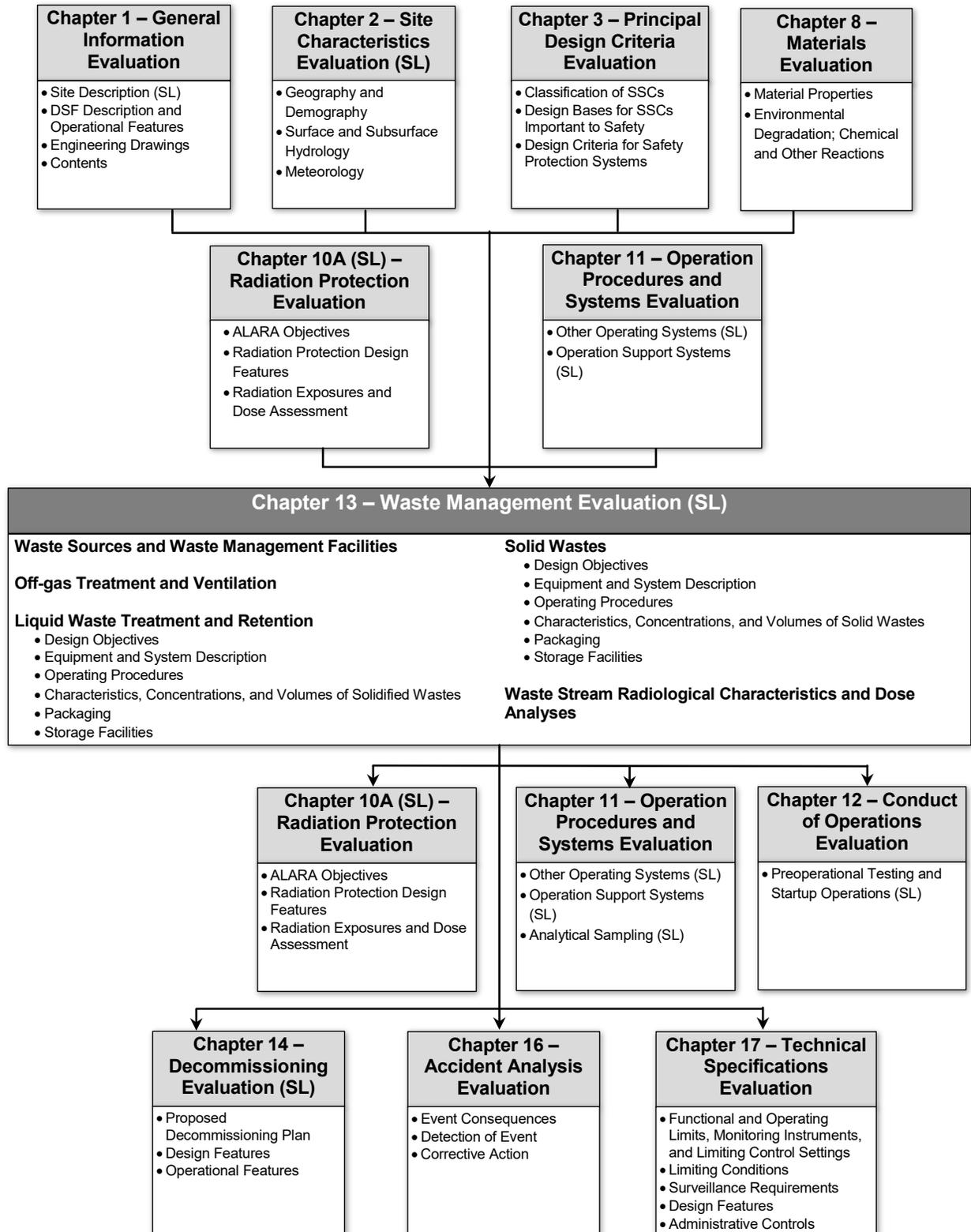


Figure 13-1 Overview of Waste Management Evaluation

13.5.1 Waste Sources and Waste Management Facilities

Determine that the SAR demonstrates that all waste materials generated as a result of facility operations will be safely contained until disposal.

Review the general description and operating features of the facility discussed in the general information chapter of the SAR. Verify that the descriptions include the DSF's waste management facilities and systems and provide the information identified in Section 13.4.1 above. Verify that the features of the facility design and operations reduce, to the extent practicable, the quantity of radioactive waste generated at the installation. Confirm that the waste management systems are adequately designed to handle, treat, and store the wastes generated at the DSF, including having an adequate capacity for the wastes to be generated over the facility lifetime. If applicable, compare flowcharts and facility drawings and diagrams to ensure that the waste confinement and management systems are designed to minimize the quantity of radioactive wastes generated. Verify that the types of waste generated are identified and characterized and that the identification and characterization are consistent with the DSF design and operations. Also verify that the method and design for treatment, handling, and the mode of storage of the wastes before disposal are sufficiently described and are generally accurate and acceptable.

Ensure that the SAR identifies all sources of waste, including on drawings or sketches. Consider the following list (not meant to be all-inclusive) of sources that can exist at a DSF, depending on the facility design and operations:

- wastes associated with normal operations
- filters and membranes (for liquids and from the heating, ventilation, and air conditioning systems of the waste management facilities)
- wipes
- heating, ventilation, and air conditioning duct flushing fluid
- laboratory samples
- decontamination station effluent
- disposable (one-time use) and reusable personal protective clothing and equipment
- laundry effluent (e.g., from washing personal protective clothing, clothing bags)
- contaminated equipment and tools
- radioactive waste containers and bags
- wastes associated with off-normal events and conditions and that, therefore, may be radioactive or handled as possibly radioactive
- confinement area sprinkler runoff
- earth contaminated by spills or from other causes

- pool-related wastes for a DSF with a pool (filters, membranes, materials skimmed or separated from pool water by cleanup systems, piping flushing fluids, coolant seepage and minor leaks, condensate on facility interior surfaces, pool coolant)

Review the waste analysis and check for potential interactions between nonradioactive chemical wastes or combustion products and radioactive materials. If applicable, review the method and design for the treatment, handling, and disposal of chemical wastes or combustion products.

Verify that the SAR describes the means by which waste management facilities and systems and operations will prevent degradation of the wastes and waste systems, including containers and tanks, and will confine the waste materials. Depending upon the design of the waste management SSCs (e.g., types and confinement capabilities of seals), releases to the environment under normal, off-normal, and accident conditions may be possible. Verify that the SAR presents estimates of radionuclides released to the environment for normal conditions, off-normal operations, and accident conditions. The estimates should be based on evaluation of the design and the physical processes of the actual waste management SSCs that will move radionuclides into the environment (e.g., vapor pressure in conjunction with convective flow) or retain them in the storage or holding systems. Have a clear understanding of the components that are designed to reduce the flow of radionuclides into the environment and their performance capabilities (e.g., filtration systems and their nuclide removal efficiencies). Ensure that the release estimates include the contributions from each component of the systems from which releases can occur. These releases should be added to the effluents normally intended to be discharged, or expected to be released, from the facility, if any.

Verify that the SAR estimates waste management facility emissions resulting from off-normal conditions, including possible emissions of radioactive gases from sealed fuel containers that may fail. Verify also that the SAR determines any waste management facility emissions that may result from accident conditions. The NRC accepts that other sources on the site can be assumed to be at normal conditions during such accident conditions unless the same initiating event affects these other sources.

13.5.2 Off-Gas Treatment and Ventilation

Review the design drawings, flowcharts, and narrative descriptions of off-gas treatment and ventilation systems design and operations. Confirm that the information in the SAR is sufficient to understand the design and operations of the systems, identify interfaces between individual systems, and evaluate the performance of the systems. In addition, coordinate with the radiation protection reviewer to evaluate the systems in accordance with the guidance in Section 10A.5.2.1, "Installation Design Features," of this SRP. Confirm that the operations descriptions are consistent with the design and selection of equipment and facilities, general design criteria, and regulatory limits. Ensure that the description of the facility off-gas, waste treatment, and ventilation systems identifies the relevant regulatory requirements, design and performance objectives, and function and general design criteria, including safety margins. The design and design criteria for each unit system should adequately address site conditions and be based on, or include, reasonable estimates of airborne waste generation rates for normal, off-normal, and accident conditions. Ensure design criteria, descriptions, and analyses address the components (e.g., sealed waste containers, ductwork, filters) for all the systems.

Confirm that the systems service the appropriate portions of the facility based upon DSF design and operations descriptions. Verify that the descriptions of the systems design and operations demonstrate that the systems have sufficient capabilities, including capacity, to confine

radioactive materials during projected operations conditions, including normal and off-normal conditions. Ensure that the design of the systems includes sufficient margins such that a single component failure will not result in an uncontrolled release of materials. Ensure that the SAR demonstrates that unit ventilation systems alone and in conjunction with other ventilation systems will be operable. Verify that the design includes satisfactory features for interfacing with other effluent and ventilation systems and with process off-gas equipment. Also ensure that the SAR descriptions demonstrate that the systems design and operations will effectively prevent or limit the spread of radioactive materials, including within the ventilation systems, and control the spread of contamination. In that regard, ensure that the applicant adequately considered potential bypasses, such as improper connections between radioactive systems and nonradioactive systems, and the possibility of uncontrolled and unmonitored effluent releases. In evaluating the proposed design and operations of these systems, consider the design and operations of systems for similar facilities that the NRC has reviewed and approved.

Verify that the design and operations descriptions include provisions to adequately monitor off-gas treatment and ventilation system performance, including such parameters as filter and other treatment device efficiency. Ensure that the design addresses replacement and disposal or regeneration of items such as filters and scrubber solution, including the treatment (with any transfers to other waste systems), handling, and disposal of these wastes. Verify that the design addresses potential personnel exposure and contamination that could result from handling operations.

Ensure that the design and operations of the ventilation and off-gas systems and equipment incorporate adequate consideration of ALARA principles and represent a reasonable effort to minimize releases and exposures (workers and public) to radioactive materials. This includes verifying that the design and operations descriptions of the systems demonstrate that radioactive releases during normal operations and radiation exposure levels will meet ALARA objectives.

Coordinate with the radiation protection and confinement reviewers (Chapters 10A and 9 of this SRP) to evaluate the ventilation and off-gas monitoring systems. Ensure that the SAR addresses the information on monitoring described in Section 13.4.2 above. Ensure that the selected equipment and parameters, locations, and release paths are adequate to ensure that the design criteria and regulatory requirements will be met. Ensure that monitoring processes and equipment are appropriate and reasonable for the expected release paths and materials expected in releases or that should otherwise be monitored for. Ensure that the equipment has adequate detection and alarm capabilities. Section 10A.5.2.5, "Area Monitoring and Effluent Monitoring Instrumentation," of this SRP provides useful guidance and criteria for evaluating effluent monitoring.

13.5.3 Liquid Waste Treatment and Retention

Review the SAR descriptions, including drawings, flow sheets, and narrative descriptions, of liquid waste system design and operations. Confirm the information in the SAR is sufficient to understand the system design and operations, to identify interfaces with other DSF systems, and to evaluate the system's performance. In addition, coordinate with the radiation protection reviewer to evaluate the system in accordance with the guidance in Section 10A.5.2.1 of this SRP. Confirm that the operations descriptions are consistent with the design and selection of equipment and facilities, general design criteria, and regulatory limits. Also ensure, based on the DSF design and operations descriptions, that the SAR adequately identifies and characterizes all liquid wastes, including their sources and expected generation rates and volumes, that may be generated as a result of DSF operations. Determine the reasonableness of the expected inventory levels and that handling, treatment and storage provisions (including any volume

reduction and solidification processes) are sufficient to handle the projected wastes and inventory levels, with some level of margin as appropriate. Ensure that equipment and processes are adequate for the radiation levels of the various wastes.

Verify that the design includes satisfactory features for interfacing with DSF systems, including waste or effluent systems and equipment. Also ensure that the SAR descriptions demonstrate that the systems design and operations will effectively prevent, or limit, the spread of radioactive materials and control the spread of contamination. In that regard, ensure that the applicant adequately considered potential bypasses, such as improper connections between radioactive systems and nonradioactive systems, and the possibility of uncontrolled and unmonitored effluent releases. In evaluating the proposed design and operations of these systems, consider the design and operations of systems for similar facilities that the NRC has reviewed and approved.

13.5.3.1 *Design Objectives*

Review the design objectives and verify that the system can handle the expected volume of potentially radioactive liquid wastes generated during normal and off-normal operations, safely confine the wastes, and minimize personnel doses. Ensure that the design objectives clearly identify which waste streams will be processed to achieve volume reduction or solidification. Verify that all sources of liquid waste have been identified. Assess the applicant's estimates of expected inventories for each stream and determine whether they are reasonable for design purposes.

13.5.3.2 *Equipment and System Description*

Verify that the SAR describes the features, systems, and special handling techniques that are important to safety. Verify that pressure vessels, tanks, and piping systems important to safety will be constructed in accordance with the appropriate quality standard(s). Ensure that the SAR describes any backup or special features that will be used as necessary to ensure design objectives and regulatory requirements are met and adequately justify the selection of these features.

Review the design to ensure that (1) adequate measurement is provided (to determine liquid waste volume and radioactivity concentration and to monitor system performance), (2) the system is not vulnerable to contamination buildup, (3) liquid wastes entering the liquid waste systems do not include materials (e.g., oils, insoluble solids, solvents, hazardous wastes) that may adversely affect system performance, (4) secondary confinement is provided for waste lines outside of the confinement barriers, and (5) provisions are made, as necessary, for component shielding and cleanout or decontamination of piping.

Coordinate with the radiation protection reviewer to ensure that the SAR addresses the information on monitoring described in Section 13.4.3.2 above. Ensure that the selected equipment and parameters, locations, and release paths are adequate to ensure that the design criteria and regulatory requirements will be met. Ensure that the monitoring and equipment are appropriate and reasonable for all release paths and materials. Ensure that the equipment has adequate detection and alarm capabilities. Section 10A.5.2.5 of this SRP provides useful guidance and criteria for evaluating effluent monitoring.

13.5.3.3 *Operating Procedures*

Review the flow sheets and narrative descriptions of operations to verify that proposed design features and procedures will minimize liquid waste generation and the possibility of spills and provide for control and containment of spills. Verify that appropriate provisions are made for ensuring functional operation, including testing procedures, action levels, and associated actions for normal and off-normal conditions as well as means for monitoring and controlling limits.

13.5.3.4 *Characteristics, Concentrations, and Volumes of Solidified Wastes*

Review the applicant's description of the physical, chemical, and thermal characteristics of the solidified wastes and confirm that they are consistent with the applicant's estimates of liquid waste radionuclide concentrations and waste volumes generated. Verify that the solidified wastes are compatible with the design criteria and capacity of the liquid waste treatment and retention systems.

13.5.3.5 *Packaging for Onsite Storage*

Review the descriptions of solidified liquid waste containers and verify that the container specifications are compatible with the forms of waste for which the containers will be used. In making this determination, consider materials of construction (including welding design information on the critical boundary welds in regard to the minimum allowable weld joint size configuration, if appropriate), heat load, potential corrosive interactions of the waste and container materials, prevention of overpressurization, and confinement provided by the container under normal, off-normal, and accident conditions.

13.5.3.6 *Storage Facilities*

Review the description of storage facilities and operations and determine whether the storage capacity is consistent with the estimates of liquid and solidified waste volumes to be generated and stored over the life of the facility or the projected decay holding time (if not held for the entire life of the facility). Review proposed operations to ensure that the movement of containers into and out of storage, monitoring, equipment, waste routing, and spare storage volume (for liquid transfers) have been taken into account, as necessary. Ensure that provisions exist for spills, overflows, or leakage. Confirm that the SAR evaluates and describes damage from off-normal and accident conditions and evaluates the container integrity against corrosion from the environment within the waste storage facility. Verify that long-term storage options are reasonable in light of ultimate disposal plans and availability.

13.5.4 Solid Wastes

Review the SAR descriptions, including drawings, process flow diagrams, and narrative descriptions, of the solid waste system design and operations. Confirm that the information in the SAR is sufficient to understand the system design and operations, identify interfaces with other DSF systems, and evaluate the system's performance. Confirm that the operations descriptions are consistent with the design and selection of equipment and facilities, general design criteria, and regulatory limits. Also ensure, based on the DSF design and operations descriptions, that the SAR adequately identifies and characterizes all solid wastes, including their sources and expected generation rates and volumes, that may be generated as a result of DSF operations. Verify that the design includes satisfactory features for interfacing with DSF systems, including waste or effluent systems and equipment. Also ensure that the SAR descriptions demonstrate that the

systems design and operations will effectively prevent, or limit, the spread of radioactive materials and control the spread of contamination. In evaluating the proposed design and operations of these systems, consider the design and operations of systems for similar facilities that the NRC has reviewed and approved.

13.5.4.1 *Design Objectives*

Verify that the system is capable of handling, treating, and storing the projected wastes (including potentially radioactive and nonradioactive wastes) and waste volumes generated during normal and off-normal operations. Specifically, review waste generated from the use of personal protective clothing and equipment that is to be treated as potentially contaminated because these items typically constitute a large portion of the total volume of waste.

13.5.4.2 *Equipment and System Description*

Review the descriptions of equipment and systems, including drawings, for solid waste collection and treatment to ensure that (1) features, systems, and special handling techniques that are important to safety have been identified; (2) locations of equipment and associated features that are used for volume reduction, confinement, or packaging, storage, and disposal are identified; and (3) provisions exist for shielding, confinement, handling, and decontamination, as necessary, to ensure that occupational doses are maintained to meet ALARA objectives and to minimize doses to the public from these wastes.

Coordinate with the radiation protection reviewer to ensure that the SAR addresses the information on monitoring described in Section 13.4.4.2 above. Ensure that the selected equipment, parameters, and locations are adequate to ensure that the design criteria and regulatory requirements will be met. Ensure that the monitoring and equipment are appropriate and reasonable for the purposes for which they are to be used, including monitoring of system performance. The equipment should have adequate detection and alarm capabilities. Section 10A.5.2.5 of this SRP provides useful guidance and criteria for evaluating monitoring and monitoring instrumentation.

13.5.4.3 *Operating Procedures*

Review the procedures associated with solid waste system, equipment operations, and use of instrumentation and verify that the SAR properly addresses performance testing, process limits, and means for monitoring and controlling identified process limits. Ensure that the SAR provides action levels and associated response actions for normal and off-normal conditions.

13.5.4.4 *Characteristics, Concentrations, and Volumes of Solid Wastes*

Review the applicant's description of the physical, chemical, radiological, and thermal characteristics of the solid wastes and the estimates of waste volumes generated. Verify that the solid wastes are compatible with the design criteria and capacity of the solid waste treatment and retention systems.

13.5.4.5 *Packaging for Onsite Storage*

Review the descriptions of solid waste containers and verify that the container specifications are appropriate for the forms of waste for which the containers will be used. As with solidified wastes (but to a lesser extent), consider materials of construction, heat load, potential corrosive

interactions of the waste and container materials, and confinement provided by the container under off-normal and accident conditions.

If an onsite laundry is to be used, verify that the SAR adequately describes the containers and procedures for the transfer of potentially contaminated items and that such containers and procedures are reasonable. If the laundry is off site, ensure that the SAR describes the appropriate procedures for shipping the containers to the offsite laundry facility and addresses the applicable NRC and Department of Transportation regulatory requirements for offsite transportation.

13.5.4.6 *Storage Facilities*

If solid wastes are to be held until site decommissioning or for radioactive decay, review the description of the storage facilities and operations and determine whether the storage capacity is consistent with the estimates of solid and solidified waste volumes to be generated and stored over the life of the facility or the projected decay holding time (if not held for the entire life of the facility). Also ensure, in coordination with the confinement reviewer, that facility design and operations include appropriate confinement features and monitoring and maintain container integrity against conditions such as corrosion from the environment within the waste storage facility. Review the proposed operations to ensure that the SAR adequately addresses, as necessary, the movement of containers into and out of storage, monitoring, equipment, and impacts of operation conditions (normal, off-normal, and accident conditions). Verify that long-term storage options are reasonable in light of ultimate disposal plans and availability.

13.5.5 Waste Stream Radiological Characteristics and Dose Analyses

Verify that the SAR includes the information, analyses, and results identified in Section 13.4.5 of this SRP. Confirm the completeness and accuracy of the information and analyses based on the DSF design and operations and the characteristics of the proposed DSF site. Verify that the analyses account for each system process and facility activity which could result in the generation of wastes or effluent releases during routine operations and off-normal conditions. Ensure that the results include radionuclide concentrations, doses, and dose rates for each waste stream and waste locations (e.g., storage containers, tanks, and discharge or leak points) and are provided for normal, off-normal, and accident conditions.

Coordinate with the shielding, confinement, and radiation protection reviewers to evaluate the appropriateness and adequacy of the methods used to determine dose rates, doses, and nuclide concentrations as well as the results themselves. Verify that the doses and dose rates include both direct radiation and effluent contributions. For airborne effluent releases, evaluate the proposed short- and long-term atmospheric dispersion (X/Q) and deposition (D/Q) parameters the applicant used and confirm that they are appropriate for calculating gaseous effluent concentrations and doses based on the meteorology information presented in the site characteristics evaluation chapter of the SAR (see SRP Sections 2.4.3, "Meteorology," and 2.5.3, "Meteorology"). Section 13.4.2 above summarizes facility design parameters that should also be accounted for in the review. RG 1.23, "Meteorological Monitoring Programs for Nuclear Power Plants (Safety Guide 23)," and RG 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors," describe acceptable methods to develop the associated atmospheric dispersion and deposition parameters in evaluating the consequences associated with postulated releases of radioactive materials during routine operations and anticipated occurrences, as well as accident conditions.

Confirm that the analyses for airborne effluent releases account for all of the types of system processes or facility activities that could result in routine airborne effluent releases or releases from anticipated occurrences and adequately characterize their radioactive source terms. Ensure that the analyses properly, or conservatively, account for (1) processes by which radioactive materials can, or are assumed to, be released in the environment from the systems; (2) system design features for which credit is applied to mitigate radioactive material releases; (3) the duration of such releases (e.g., continuous or periodic); atmospheric dispersion; and (4) deposition. Confirm that the SAR provides appropriate bases for the selection of downwind sector(s).

Evaluate the analyses of any liquid effluents to confirm that the analyses appropriately and adequately characterize the nuclide concentrations, doses, and dose rates resulting from these effluents. Ensure that the analyses adequately account for the mechanisms for movement of these effluents within the environment, including addressing similar considerations as described above for airborne effluents, as applicable. Section 2.5.4.9, "Environmental Assessment of Effluents," of this SRP provides useful guidance for evaluating the analyses of liquid effluents.

Coordinate with the radiation protection reviewer to ensure that the information and results from the waste management evaluation are sufficient to support the radiation protection evaluation (see Chapter 10A of this SRP). This includes ensuring that the doses and dose rates, and, as applicable, the radionuclide concentrations in effluents are calculated for all locations relevant to the radiation protection evaluation for doses to personnel and the public. The radiation protection reviewer will use the results of the waste management evaluation in combination with the results of the shielding and confinement evaluations to evaluate doses to DSF workers and the public and to evaluate compliance with the radiological requirements in the regulations. Depending on the approach for some analyses, this may include evaluations of radionuclide concentrations in the gaseous and liquid effluents.

13.6 Evaluation Findings

The NRC reviewer should prepare evaluation findings on satisfaction of the regulatory requirements in Section 13.4 of this SRP. If the documentation submitted with the application fully supports positive findings for each of the regulatory requirements, the statements of finding should be similar to the following:

- F13.1 The SAR adequately describes acceptable features of the [DSF designation] design and operating modes that reduce, to the extent practicable, the radioactive waste volumes generated by the installation, in compliance with 10 CFR 72.24(f) and 10 CFR 72.128(a)(5).

- F13.2 The SAR adequately describes acceptable equipment to be installed to maintain control over radioactive materials in gaseous and liquid effluents produced during normal operations and expected operational occurrences; estimated radionuclide releases; and provisions for packaging, storage, and disposal of solid wastes containing radioactive materials resulting from treatment of gaseous and liquid effluents and from other sources, in compliance with 10 CFR 72.24(l).

- F13.3 The SAR provides evaluations of the waste confinement and management activities that are sufficient to demonstrate that the activities to be authorized by the license will not endanger public health and safety, in compliance with 10 CFR 72.40(a)(13).
- F13.4 [If the DSF is located over an aquifer that is a major water resource (which may be interpreted as over any ground water)]: The [DSF designation] design and operations provide acceptable measures to preclude the transport of radioactive materials from the waste management facilities to the environment through the aquifer, in compliance with 10 CFR 72.122(b)(4).
- F13.5 [If appropriate] The SAR evaluations of the waste management activities are sufficient to demonstrate that the effects of operation of the proposed [DSF designation] combined with those of other nuclear facilities at the site will not constitute an unreasonable risk to the health and safety of the public, in compliance with 10 CFR 72.122(e).
- F13.6 [If appropriate] The design of the [DSF designation] provides acceptable ventilation and off-gas systems to ensure the adequate confinement of airborne radioactive particulate materials during normal or off-normal conditions, in compliance with 10 CFR 72.122(h)(3).
- F13.7 [If appropriate] The design of the [DSF designation] provides [an] acceptable effluent system[s], which include[s] means for measuring the amount of radionuclides in effluents during normal operations and under accident conditions, and for measuring the flow of the diluting medium, in compliance with 10 CFR 72.126(c).
- F13.8 The design of the [DSF designation] acceptably provides means to limit the release of radioactive materials in effluents during normal operation and to control the release of radioactive materials under accident conditions, in compliance with 10 CFR 72.126(d).
- F13.9 The design of the [DSF designation] includes radioactive waste treatment facilities that include a capability for packing site-generated, low-level wastes in a form suitable for storage on site while awaiting transfer to disposal sites, in compliance with 10 CFR 72.128(b).
- F13.10 The SAR provides reasonable and appropriate information, including dose rates, to enable performance of the evaluations required in 10 CFR 72.24(e) and 10 CFR 72.24(m) and to allow evaluation of the DSF's compliance with the radiation protection requirements for members of the public in 10 CFR 72.104, 10 CFR 72.106, and 10 CFR Part 20. These evaluations are described in the radiation protection review (SRP Chapter 10A).

The reviewer should provide a summary statement similar to the following:

The proposed waste management system designs and operations provide reasonable assurance that wastes generated as a result of DSF operations will be managed in a manner that supports safe storage of SNF, reactor-related GTCC waste, or HLW at the DSF. This finding is reached on the basis of a review that considered the regulation itself, appropriate regulatory guides, accepted practices, the statements and representations in the application, and the staff's independent, confirmatory evaluations.

13.7 References

10 CFR Part 20, "Standards for Protection against Radiation."

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

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition."

Regulatory Guide 1.23, "Meteorological Monitoring Programs for Nuclear Power Plants (Safety Guide 23)."

Regulatory Guide 1.111, "Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors."

Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants."