U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

11.4 SOLID WASTE MANAGEMENT SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of effectiveness of radwaste systems and health physics in confirming that processed waste products meet regulatory requirements on waste classifications and characteristics for transfers and disposal and shipment.

Secondary - Organizations responsible for the reviews of radwaste system design features, system capacities, and performance in processing and packaging liquid, wet, and solid waste materials.

I. AREAS OF REVIEW

For a review of an application for an early site permit (ESP), a construction permit (CP), standard design certification (DC), or a combined license (COL) that does not reference a DC, the U.S. Nuclear Regulatory Commission (NRC) staff reviews the information in the applicant's Safety Analysis Report (Preliminary Safety Analysis Report (PSAR) or Final Safety Analysis Report (FSAR)) as it relates to the sources of radioactivity that are processed by the solid waste management system (SWMS). At the operating license (OL) or COL stage of review, the staff confirms that the information accepted at the CP or standard DC stage is appropriately incorporated in the relevant sections of OL or COL applications that reference a DC, or that proposed departures are adequately justified and documented.

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This Standard Review Plan (SRP) section addresses the evaluation of plant systems used to manage, treat, process, and store liquid, wet, and solid radioactive wastes generated by pressurized water reactors (PWRs) and boiling water reactors (BWRs). The waste streams include liquid and gaseous effluents generated as byproducts of the operation of waste processing equipment. The staff's evaluation assesses whether an applicant has demonstrated compliance with regulatory requirements on waste classifications and characteristics for the transfer, disposal, and shipment. The evaluation also considers compliance with limits on gaseous and liquid effluent discharges from the operation of waste processing equipment and associated doses to members of the public in ensuring that releases and doses are as low as reasonably achievable (ALARA).

The SWMS manages radioactive wastes, as liquid, wet, and dry solid wastes, produced during normal operation and anticipated operational occurrences (AOOs). Review of the SWMS includes design features that are necessary for collecting, handling, processing, and storing wastes in facilities that are part of the nuclear island (e.g., radioactive waste building) or in other buildings (e.g., as a detached radioactive waste storage only facility). The review encompasses, but is not limited to the design, design objectives, design criteria, treatment methods, and expected releases, including the description of the SWMS, mobile equipment connected to permanently installed systems, piping and instrumentation diagrams (P&IDs), process and effluent radiation monitoring and control instrumentation, and process flow diagrams showing the operational methods and factors that influence waste treatment. The review includes an evaluation of any additional equipment that may be necessary to process liquid, dry, and wet wastes and route them to the point of discharge from the SWMS or to prepare them for shipment to authorized offsite disposal sites or licensed radioactive waste processors.

The SWMS has been categorized as nonsafety-related and nonrisk-significant. Failure of processing systems must not compromise any safety-related system or component, nor may it prevent the safe shutdown of the plant. However, the failure of specific systems or components may have some impacts on the means to control and monitor effluent releases and compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 20 regulations in controlling gaseous and liquid effluent releases to unrestricted areas and doses to members of the public. Radioactive effluent releases are associated with the operation of the SWMS in processing various types of wastes, e.g., solid, liquid, resins, sludge, and filtration media, among others. In addition, the failure of processing equipment may result in waste products that may not comply with NRC regulations on waste classification (10 CFR Part 61.55) and waste characteristics (10 CFR Part 61.56) for disposal at low-level radioactive waste facilities. The applicant's FSAR must provide sufficient information to confirm that any failure of essential systems will not compromise public health and safety under NRC regulations.

The SWMS is relied on to control releases of radioactive materials in liquid and gaseous effluents generated as byproduct effluents during its operation, or instead relies on the design features of the liquid waste management system (LWMS) and gaseous waste management system (GWMS) for the treatment of those effluents and all others generated during the operation of the plant. In either case, such effluents may have a direct impact on public health and safety. As such, the review of the SWMS must be sufficient to assure that the staff has reasonable assurance that public health and safety is adequately protected. The review includes system P&IDs, process flow diagrams showing methods of operation that influence

waste treatment, and any additional equipment necessary to route effluents to the point of discharge, such as plant stacks, building exhaust vents, and discharge tanks of the LWMS.

Accordingly, the staff will adjust its corresponding review depending on which systems (LWMS and GWMS) are used to process and treat liquid and gaseous effluents generated during the operation of the SWMS.

The specific areas of review include the following topics:

1. Design objectives in terms of expected and design volumes of liquid and wet wastes to be handled and processed (e.g., sludge, resins, filters, process concentrates, desiccants, and charcoal) and dry solid wastes and materials (e.g., high-efficiency particulate air (HEPA) filters, contaminated tools, equipment, plastics, glass, metals, rags, paper, and clothing). The review considers information describing expected radionuclide distributions and concentrations, chemicals, and mixed wastes (characterized by the presence of hazardous chemicals and radioactive materials). Expected waste volumes and radioactivity inventories of Class A, B, and C low-level radioactive wastes to be shipped for disposal, shipped to waste processors for treatment and disposal, and returned to the radwaste system for further treatment or reuse.

2. Inventories of radioactive wastes for materials and equipment, such as large components, expected to be generated infrequently and arrangements for their disposition should be described in the waste management plan. The plan should address provisions and methods for onsite short and long-term storage if offsite storage and offsite disposal at licensed facilities are not available; expected waste volumes and radioactivity inventories of Greater-than-Class C radioactive wastes (e.g., neutron-activated components, in-core neutron detectors, but excluding spent fuel); and provisions for long-term onsite storage until disposal at a facility licensed under 10 CFR Part 60 or 10 CFR Part 63.

3. Description of the SWMS; P&IDs; process and effluent radiation monitoring and control instrumentation; and process flow diagrams showing methods of operation, including equipment design capacities, interconnections between plant systems (e.g., ventilation, service water, equipment drains) and mobile processing equipment, alternate processing methods, principal parameters assumed in the SWMS design and operation, and the use of such information in developing a plant-specific process control program (PCP).

4. Special design features and operational procedures to prevent, control, and collect releases of radioactive materials resulting from overflows from tanks containing liquids, sludge, spent resins, charcoal, and other waste concentrates, and measures to prevent the accidental drops or puncturing of waste containers from cranes and forklifts during handling. Corrosion-resistant properties of steel liners (used in rooms and cubicles housing components) and system piping and valves associated with transfer lines to storage tanks and discharge piping buried in soils and concrete, including features designed for the early detection of leaks and spills (e.g., leak detection sumps and wells).

5. Provisions and effectiveness of physical and monitoring precautions taken to minimize spills and leaks (e.g., retention berms and basins around supplemental tanks or portable processing equipment, curbing, level gauges and alarms, component catch

containments or liners, and self-sealing quick-disconnects) and measures to prevent interconnections with nonradioactive systems, such as demineralized water supply, component seal water supply, and instrument air. Provisions for processing radioactive materials associated with the decontamination of leaks and spills and remediation of uncontrolled and unmonitored releases.

6. The means to purge and flush process and sampling lines with nonradioactive fluids (e.g., clean water, air, inert gases) and route purged or flushed fluids to the most appropriate systems (LWMS and GWMS). The review should confirm that the source of nonradioactive purging or flushing fluids is protected from backflow and cross-contamination using appropriate measures, such as check valves, backflow preventers, interlocks, differential pressures, etc.

7. Description of the methods used for dewatering, or to stabilize wet wastes (e.g., removal of free-standing water, encapsulation, solidification, etc.), types of stabilization media or agents, expected waste volume increase factors, and implementation of a PCP to ensure proper waste form characteristics, such as a waste product with a dry and solid matrix, and properly dewatered wet wastes.

8. Availability of standby equipment, alternate processing methods, and interconnections between permanently installed systems and skid-mounted processing equipment in order to evaluate the overall system capability to meet anticipated demands imposed by major processing equipment downtime and waste volume surges resulting from AOOs.

9. Types and characteristics of filtration systems, ion-exchange resins, and absorbent media to treat liquid and wet wastes, including expected removal efficiencies and decontamination factors, and the application of these characteristics by waste streams and treatment methods. The information describing types of proposed filtration and absorption media should include details from the applicant or suppliers, as generic or plant-specific information in characterizing removal efficiencies and decontamination factors.

10. Description of the methods used for volume reduction of dry compactible solid wastes, including sorting methods, technologies (e.g., shredders, crushers, and compactors), system components and their design parameters, and expected waste volume reduction factors and containerization used for shipment and storage (e.g., drums, boxes, etc.).

11. For plants using offgas treatment systems relying on charcoal decay tanks and storage delay tanks or beds, description of the process for regenerating spent charcoals for reuse and facilities used for storing spent charcoals before shipment for disposal or regeneration via third parties. Radiological and physical properties of spent charcoals, such as nuclear grade, bulk density, and mesh size. Provisions to manage and ship spent charcoals for disposal and estimates of the projected annual or periodic amounts of spent charcoals that will be disposed of and stored as radioactive waste.

12. Fraction, if any, of all liquid, wet, and dry solid waste processing projected to be contracted out to waste brokers or specialized facilities. Disposition methods of wastes generated from such processing and whether processed wastes will be returned to the plant for later disposal or shipped directly by the processor to an authorized low-level radioactive waste disposal facility on behalf of the applicant.

13. Description of waste container types and sizes (e.g., drums, boxes, and high-integrity containers (HICs)); filling and handling methods; spill and leak prevention features; procedures for monitoring for removable radioactive contamination and external radiation; and provisions for decontamination, packaging, and storage of containers.

14. Provisions for onsite waste storage before shipping, including expected design volumes; expected radionuclide concentrations and radioactivity inventories and the design bases for these estimates; layout of the packaging, storage, and shipping areas; use of cranes, forklifts, monorails, and similar equipment; storage capacity; fire protection; building ventilation; shielding provisions; and expected onsite storage durations.

15. Design considerations for the use of shielding around waste processing equipment expected to exhibit elevated levels of external radiation, placement of such equipment in shielded cubicles, and the use of temporary or permanent shielding mounted on or in the immediate vicinity of mobile equipment.

16. Quality group and safety classifications of piping and equipment and the bases (safety classifications and applicable codes and standards) governing the classifications using the guidance in Regulatory Guide (RG) 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants," for wastes produced during normal operation and AOOs, and RG 1.143 on natural phenomena and man-induced hazards in assigning safety classifications of systems, structures, and components (SSCs) for the SWMS.

17. Design, expected temperatures and pressures, and construction materials for permanently installed systems and mobile processing equipment, and provisions to protect temperature sensitive filtration and adsorption media from thermal damage and resulting degradation in decontamination factors or removal efficiencies.

18. Quality assurance (QA) provisions for radioactive waste management SSCs in support of design criteria using the guidance in RG 1.143 for liquid, wet, and solid wastes produced during normal operation and AOOs.

19. Design features and applications of surface protective coatings on concrete floor surfaces in areas where process equipment is located and exposed surfaces in sumps and drain channels using the guidance of RG 1.54 in facilitating the decontamination of radioactivity.

20. To the extent not reviewed in SRP Sections 11.2, "Liquid Waste Management System," and 11.3, "Gaseous Waste Management System"; design features used to collect and vent radioactive gases and vapors from tanks, vessels, and processing equipment to appropriate radioactive exhaust ventilation and filtration systems, using the guidance in SRP Sections 9.3, 9.4, 11.2, 11.3, and 11.5, "Process and Effluent Radiological Monitoring Instrumentation and Sampling Systems"; and RG 1.140, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Normal Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants"; and RG 1.143.

21. Design features of containment systems, such as steel liners and concrete enclosures, used in equipment rooms and cubicles where tanks are located that would be capable of

containing the entire expected inventory of one or more tanks in the event of spills, leaks, and component failures.

22. For processing systems equipped with automatic control features, justification for the placement of isolation valves and radiation detectors on process piping in ensuring the timely closure of such valves upon the detection of elevated radioactivity levels, and, if part of the design, controls in monitoring deviations of process flow rates and internal pressures for the purpose of terminating or isolating process flows when deviations exceed preset limits.

23. Design provisions incorporated in equipment to facilitate operation and maintenance using the guidance in RG 1.143 and referenced topical reports, as well as previous experience with similar equipment and methods referenced in the FSAR of other operating plants.

24. To the extent not reviewed in SRP Section 12.3-12.4, “Radiation Protection Design Features,” design features to reduce volumes of liquid, wet, and dry wastes processed by the SWMS; reduce radioactivity levels in wastes; minimize, to the extent practicable, contamination of the facility and environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste using the guidance in RG 4.21, “Minimization of Contamination and Radioactive Waste Generation: Life Cycle Planning,” and NUREG/CR-3587, “Identification and Evaluation of Facility Techniques for Decommissioning of Light Water Reactors,” given the requirements of 10 CFR 20.1406.

25. Design features and operational safeguards to prevent the introduction and mixing of chemical additives with ion-exchange resins in avoiding the generation of exothermic reactions and explosive gas mixtures (e.g., hydrogen and methane) in SWMS components, and fires from combustible and flammable materials (dry wastes, spent resins, HEPA filters, and activated charcoals) containing radioactivity, using the guidance in RG 1.143 and RG 1.189, “Fire Protection for Nuclear Power Plants,” as they relate to the conduct of fire hazards analysis involving the presence of combustible gases and flammable materials.

26. For multi-unit reactor stations, descriptions and design features of equipment and components (as permanently installed systems or in combination with mobile processing equipment) normally shared between interconnected processing and treatment systems.

27. Definition of the boundary of the SWMS, beginning at the interface from plant systems provided for the collection of process streams and radioactive wastes to the point of controlled discharges to the environment, as defined in the PCP or Offsite Dose Calculation Manual (ODCM) at the point of recycling to primary or secondary water system storage tanks, or to within plant facilities used for the storage of radioactive wastes and mixed wastes using the guidance in RG 1.143 for wastes produced during normal operation and AOOs.

28. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For DC and COL reviews, the staff reviews the applicant's proposed ITAAC associated with the SSCs related to this SRP section using the guidance in SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC

cannot be completed until after the rest of the related sections of the application have been reviewed against acceptance criteria contained in this SRP section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate using the guidance in SRP Section 14.3 and RG 1.215, "Guidance for ITAAC Closure under 10 CFR Part 52."

29. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will address COL action items and requirements and restrictions (e.g., interface requirements and site parameters) and note instances where an applicant has submitted conceptual design information for portions of the plant for which the application does not seek certification, given under the requirements of 10 CFR 52.47(a)(24) through 10 CFR 52.47(a)(26), 10 CFR 52.79(d)(2), and 10 CFR 52.80(a).

30. COL application referencing a DC. For a COL applicant, the application must address COL action items, requirements, and restrictions included in the referenced DC. The review should ensure that plant design features of the certified design are maintained in the COL application and that, if requested, the 10 CFR Part 52 process for seeking exemptions, changes, and departures is observed in changing Tier 1, Tier 2, and Tier 2* information. Additionally, the review should confirm that the applicant has addressed the requirements and restrictions (e.g., system interfaces and site parameters) included in the referenced DC and how they are being incorporated under plant- and site-specific conditions.

31. Operational Program Description and Implementation. For a COL application, the staff reviews the PCP aspect of the process and effluent monitoring and sampling program description and the proposed implementation milestones. Alternatively, a COL applicant may incorporate by reference Nuclear Energy Institute (NEI) PCP Template 07-10A, "Generic FSAR Template Guidance for PCP," as the basis of the PCP until a plant-specific PCP is developed before fuel load in accordance with SRP Section 13.4, "Operational Programs."

Review Interfaces

Systems described in the technical submittal may differ from those outlined in the SRP. The staff should use the following SRP section interfaces as the basis for reviewing supplemental or complementary information provided in the FSAR for a specific plant design. The reviewer of this SRP section should verify specific information, as needed to complete the evaluation, and coordinate this review with that of primary reviewers of the sections listed below.

The specific areas of review include the following topics:

1. Review of the SWMS and waste storage facilities given the use or presence of flammable or combustible materials (as spent resins, charcoal media, and HEPA filters and dry wastes) is performed using the guidance in SRP Section 9.5.1.1, "Fire Protection Program" using the guidance in RG 1.189, as they relate to the conduct of fire hazards analysis involving the presence of combustible gases and flammable materials.

2. The reviews of certified standard designs, COL information items, and conformance with regulatory guidance (e.g., RGs, Secretary of the Commission Papers (SECY), regulatory

issue summaries (RISs), bulletins, notices, and generic letters (GLs)) are performed using the guidance in SRP Chapter 1, "Introduction and Interfaces," Items 1.8 and 1.9.

3. The review of the definition of the exclusion area boundary (EAB) and administrative controls in managing liquid and gaseous effluent releases from the SWMS is performed using the guidance in SRP Sections 2.1.2, "Exclusion Area Authority and Control," and 11.5, unless already integrated in the information presented in SRP Sections 11.2 and 11.3 for the LWMS and GWMS, respectively.

4. The review of the design of building ventilation exhaust vents servicing SWMS process equipment and exhaust connections to mobile equipment, as they relate to their locations and release points in determining the type of release and atmospheric dispersion (X/Q) and deposition (D/Q) parameters, is performed using the guidance in SRP Section 2.3.

5. Review of the acceptability of the design analyses, procedures, and criteria used to establish the ability of seismic Category I structures housing the system and supporting systems to withstand the effects of natural phenomena, such as the safe-shutdown earthquake, the probable maximum flood, and tornadoes and tornado missiles, is performed using the guidance in SRP Sections 3.3.1, "Wind Loadings"; 3.3.2, "Tornado Loadings"; 3.4.2, Analysis Procedures"; 3.5.3, "Barrier Design Procedures"; 3.7.1, "Seismic Design Parameters"; through 3.7.4, "Seismic Instrumentation"; 3.8.4, "Other Seismic Category I Structures"; and 3.8.5, "Foundations"; and RG 1.143 with respect to natural phenomena and man-induced hazards used in assigning safety classifications to SSCs for the SWMS.

6. Review of the acceptability of the seismic and quality, safety and group classifications for structures and system components is performed using the guidance in SRP Sections 3.2.1," Seismic Classification," and 3.2.2, "System Quality Group Classification."

7. The review of the collection of SWMS process fluids by equipment and floor drains is performed using the guidance in SRP Sections 9.3.3, "Equipment and Floor Drainage System," 10.4, and 11.2.

8. If not included in the review of SRP Sections 11.2 and 11.3, an evaluation of the design features of building exhaust and ventilation systems servicing areas where liquid, wet, and solid wastes are processed and stored (e.g., use of HEPA and charcoal filters) is conducted using the guidance in SRP Section 9.4 and SRP Section 11.5 for instrumentation used to monitor, control, and sample radioactive effluent releases. The review also addresses design features of ventilation systems used to vent tanks and process equipment (e.g., via the use of high efficiency particulate air and activated charcoal filters).

9. The review of radiation monitoring instrumentation and controls used by the SWMS, including provisions for automatic control features and interdependence with parameters other than radioactivity (e.g., fluid level, valve position, and system pressure, flow rate, and temperature), is performed using the guidance in SRP Sections 11.5 and 9.3.2, "Process and Post-accident Sampling Systems." The review addresses the types and placement of such sensors in plant systems, basis of operational ranges and

qualification of sensing elements in supporting the functions of radiation monitoring systems. The review considers functional interdependence and logic in alarming, terminating and/or diverting process or effluent streams to comply with doses and effluent concentration limits under 10 CFR Part 20 and design objectives of Appendix I to 10 CFR Part 50. The review also addresses design features to prevent radioactive contamination of otherwise nonradioactive plant systems in avoiding unmonitored and uncontrolled releases of radioactive materials to the environment using the guidance in RGs 1.143 and 4.21 and IE Bulletin 80-10, "Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment."

10. Review of technical specifications (TSs) is performed using the guidance in SRP Chapter 16, and Section 11.5, as they relate to administrative controls and programs on radioactive effluent controls and monitoring and implementation of the PCP. Under SRP Section 16, the TS address the elements of administrative controls and programs on radioactive effluent releases and monitoring. Information on their implementation is presented in standard technical specifications, including NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433, and NUREG-1434.

11. Review of QA is performed using the guidance in SRP Chapter 17 for any portion of the SWMS that may be covered by 10 CFR Part 50, Appendix B requirements, depending on design features. The guidance of RG 1.143 applies to the balance of the SWMS since it is not a safety-related system.

12. Review of a consequence analysis of a SWMS liquid or wet waste tank failure (as a component of a permanently installed or skid-mounted mobile treatment system) with the potential of releasing radioactive materials to outdoor areas and impact on a potable water supply is conducted using the guidance in SRP Section 11.2 and Branch Technical Position (BTP) 11-6.

13. For any portion of the SWMS post-accident systems (as identified by the applicant as permanently installed components) that supports safety-related functions, the review of these design features is performed using the guidance in SRP Chapter 7 and SRP Section 13.3. In this context, the review, using the guidance in RG 1.97, "Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants," addresses the performance, design, qualification, display, QA, and selection of monitoring variables of radiation monitoring equipment required for accident monitoring and sampling. For portions of the systems that may impact public health and safety under 10 CFR Part 20, the review of instrumentation and components, with respect to capability, reliability, and conformance to acceptable criteria is performed using the guidance in SRP Sections 7.1, "Instrumentation and Controls – Introduction," 7.5, "Information Systems Important to Safety," 7.6, "Interlock Systems Important to Safety," and 7.7, " Control Systems," and related BTPs in SRP Chapter 7, as mandated by design and operational considerations.

14. The review of the demineralized water make up system, if used as a supply for the water seal system, as described in the FSAR, as it relates to the supply of seal water to systems and components containing radioactivity and design features to prevent the cross-contamination of nonradioactive systems and avoid unmonitored and uncontrolled releases to the environment via nonradioactive systems.

15. Review of design features for the protection of potable and sanitary water systems is conducted using the guidance in SRP Sections 9.2.4 and 11.5, as they relate to system interfaces in avoiding potential bypass routes to nonradioactive systems.

16. Review of the standard radiological effluent controls (SREC), as they relate to operational elements of the PCP, is conducted using the guidance in SRP Section 11.5.

17. If not included in the review of SRP Sections 11.2 and 11.3, an evaluation of source terms and dose calculations is conducted to assess the performance of the SWMS against the NRC requirements set forth in 10 CFR 20.1302 and 10 CFR 20.1301(e), Table 2, Columns 1 and 2 effluent concentrations and Note 4 of Appendix B to 10 CFR Part 20, and design objectives and ALARA provisions of Appendix I to 10 CFR Part 50, based on information given in SRP Section 11.1 using the guidance in RG 1.112, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors"; NUREG-0016, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Boiling Water Reactors (BWRs)"; or NUREG-0017, "Calculation of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Pressurized Water Reactors (PWRs)," and American National Standards Institute/American Nuclear Society (ANSI/ANS) 18.1-1999, as modified to reflect specific design features. Certain design provisions of facilities and equipment described in Appendix 11.4-A, are applicable if design features include releases of airborne radioactivity and discharges of liquid effluents separately from those of the GWMS and LWMS.

18. Review of the ALARA provisions in system design credited for radiation protection and operation to assure compliance with the occupational dose limits of 10 CFR 20.1201 and 10 CFR 20.1202 and Table 1 of Appendix B to 10 CFR Part 20 is conducted under SRP Chapter 12 using the guidance in RG 8.8, "Information Relevant to Ensuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as Is Reasonably Achievable," and RG 8.10, "Operating Philosophy for Maintaining Occupational Radiation Exposures as Low as Is Reasonably Achievable."

19. The review of design features of the SWMS attributed for compliance with 10 CFR 20.1406 using RG 4.21 is performed using the guidance in SRP Sections 12.3-12.4.

20. For COL reviews of operational programs, the review of the applicant's implementation plan is performed using the guidance in SRP Sections 13.4 and 13.5.2.

21. The review of design features of SWMS systems and components associated with the plant's initial testing plan, description of tests, and testing acceptance criteria is performed using the guidance in SRP Sections 14.2, "Initial Plant Test Program - Design Certification and New License Applicants," 11.5, and 9.3.2 using the guidance in RG 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," and RG 1.33, "Quality Assurance Program Requirements (Operation)."

22. The completeness of the description of the SWMS design and its operational features are reviewed using the guidance in SRP Section 14.3 and RG 1.215 to ensure that there is sufficient information in Tier 2 to confirm that ITAAC are inspectable and compliance can be demonstrated with no ambiguity.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following regulations of the NRC:

1. 10 CFR 20.1101(b), as it relates to the use of procedures and engineering controls in maintaining doses to members of the public ALARA.

2. 10 CFR 20.1301, 10 CFR 20.1302, and Table 2, Columns 1 and 2 and Note 4 of Appendix B to 10 CFR Part 20, as they relate to radioactive materials released in gaseous and liquid effluents to unrestricted areas. These criteria apply to releases resulting from SWMS operation during normal plant operations and AOOs.

3. 10 CFR 20.1406, as it relates to the design and operational procedures to minimize contamination, facilitate eventual decommissioning, and minimize the generation of radioactive waste.

4. 10 CFR 20.1501, as it relates to the conduct of radiation surveys in monitoring ambient external radiation levels and airborne concentrations in areas and rooms where wastes are being processed, held, stored, and readied for shipment.

5. 10 CFR 50.34, as it relates to the kinds and quantities of radioactive materials expected to be produced during operations, including AOOs, and the means to control and limit radioactive effluent releases and radiation exposures within the limits of 10 CFR 20.1301 and 10 CFR 20.1302 for members of the public.

6. 10 CFR 50.34(f), as it relates to additional TMI-related requirements and TMI action plan items and generic safety issues (GSIs) identified in NUREG-0933, “Resolution of Generic Safety Issues (Formerly entitled "A Prioritization of Generic Safety Issues”)."

7. 10 CFR 50.34a, as it relates to the availability of sufficient design information to demonstrate that design objectives for equipment necessary to control releases of radioactive effluents to the environment have been met, given the requirements of Appendix I to 10 CFR Part 50.

8. 10 CFR 50.36a(b), as it relates to experience with the design, construction, and operations of nuclear power reactors in complying with 10 CFR 20.1301 and in maintaining doses to members of the public ALARA.

9. 10 CFR 50.48, as it relates to the conduct of fire hazards analyses in minimizing the potential for radioactive releases in plant areas and to the environment in the event of a fire involving radioactive materials.

10. 10 CFR 50.59, “Changes, Tests, and Experiments,” implemented using the guidance in RG 1.187, “Guidance for Implementation of 10 CFR 50.59, Changes, Tests, and Experiments,” as it relates to design changes and differences in treatment performance characteristics of SWMS components in demonstrating compliance with effluent

concentration limits of 10 CFR Part 20, Appendix B, Table 2 for effluents generated as byproduct wastes during the operation of the SWMS.

11. 40 CFR Part 190 (the U.S. Environmental Protection Agency's (EPA) generally applicable environmental radiation standards), as implemented under 10 CFR 20.1301(e), as it relates to limits on total annual doses from all sources of radioactivity contained in effluent streams and external radiation from site buildings and facilities (with single or multiple reactor units).

12. Appendix A to 10 CFR Part 50, General Design Criterion (GDC) 2, as it relates to the design bases of structures housing SWMS and its components using the guidance in RG 1.143 in assigning seismic, safety, and quality group classifications for natural phenomena and man-induced hazards as defined in RG 1.143 in assigning the safety classifications to SWMS SSCs for design purposes.

13. Appendix A to 10 CFR Part 50, GDC 3, as it relates to the design of SWMS treatment systems and operational safeguards to avoid the generation of explosive gas mixtures and exothermic reactions through the inadvertent introduction and mixing of chemical agents in ion exchange resins, and presence of combustible radioactive materials, such as spent resins, charcoal media, HEPA filters, and dry solid and compactable wastes using the guidance in RG 1.189 and RG 1.205, "Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants."

14. Appendix A to 10 CFR Part 50, GDC 60, as it relates to the design of the SWMS to control the release of radioactive materials in liquid and gaseous effluents from the SWMS and to handle solid wastes produced during normal plant operation, including AOOs.

15. Appendix A to 10 CFR Part 50, GDC 61, as it relates to the ability of systems that may contain radioactivity to assure adequate safety under normal and postulated accident conditions in assigning the safety classifications to SSCs of the SWMS for design purposes using the guidance in RG 1.143 to assign the safety classification to SSCs of the SWMS for design purposes.

16. Appendix A to 10 CFR Part 50, GDC 63, as it relates to the ability of the SWMS to detect conditions that may result in excessive radiation levels and to initiate appropriate safety actions.

17. Appendix B to 10 CFR Part 50, as it applies to SWMS systems and components not covered by the QA guidance of RG 1.143.

18. 10 CFR 61.55 and 10 CFR 61.56, as they relate to waste classifications and characteristics, processing, volume and activity inventories, onsite short and long-term storage, offsite storage at licensed facilities, and disposal of dry solid and wet wastes at approved low-level radioactive waste disposal sites, as they relate to Class A, B, and C low-level radioactive wastes.

19. 10 CFR 61.55 and 10 CFR 61.56, for Greater-than-Class C radioactive wastes (e.g., neutron-activated components, in-core neutron detectors, but excluding spent fuel), characterized with concentrations in excess of 10 CFR 61.55 (Table 1) values, as

activated metals, radioactive sources, alpha emitting transuranics, and Pu-241 and Cm-242, as they relate to processing, volume and activity inventories, packaging, and long-term onsite storage until disposal at a facility licensed under 10 CFR Part 60 or 10 CFR Part 63.

20. 10 CFR 20.2006 and Appendix G to 10 CFR Part 20, as they relate to the requirements for transferring and manifesting radioactive materials shipments to authorized facilities (e.g., disposal sites, waste processors).

21. 10 CFR 20.2007, as it relates to compliance with other applicable Federal, State, and local regulations governing any other toxic or hazardous properties of radioactive wastes, such as mixed wastes characterized by the presence of hazardous chemicals and radioactive materials, that may be disposed under 10 CFR Part 20, with these provisions addressed in the development of a plant-specific PCP.

22. 10 CFR 20.2108, as it relates to the maintenance of waste disposal records until the NRC terminates the pertinent license requirements.

23. 10 CFR Part 71 and 49 CFR Parts 171–180, as they relate to the use of approved containers and packaging methods for the shipment of radioactive materials.

24. 49 CFR 173.443, as it relates to methods and procedures used to monitor for the presence of removable contamination on shipping containers; and 49 CFR 173.441, as it relates to methods and procedures used to monitor external radiation levels for shipping containers and vehicles.

25. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed ITAAC that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria are met, a plant that incorporates the DC is built and will operate in accordance with the DC, the provisions of the Atomic Energy Act (AEA), and the NRC regulations.

26. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the AEA, and the NRC regulations.

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC regulations identified above are set forth below. The SRP is not a substitute for the NRC regulations, and compliance with it is not required. However, an applicant is required to identify differences between this SRP section and the design features, analytical techniques, and procedural measures proposed for the facility, and discuss how the proposed alternative provides an acceptable methods of complying with the regulations that underlie SRP acceptance criteria and meeting NRC regulatory requirements under 10 CFR 50.34 and 10 CFR 52.47(a)(9). The same approach may be used to meet the requirements of

10 CFR 50.34(h), 10 CFR 52.17(a)(1)(xii), and 10 CFR 52.79(a)(41) for ESP, CP, DC, OL or COL applications.

1. The SWMS design parameters are based on expected radionuclide distributions and concentrations consistent with light-water reactor (LWR) operating experience, as evaluated using the guidance in SRP Sections 11.1, 11.2, and 11.3.

2. Processing equipment is sized to handle expected SWMS waste throughputs, as types of liquid, wet, and solid wastes; radionuclide distributions and concentrations among waste forms; radionuclide removal efficiencies and decontamination factors of process equipment; resulting waste volume reduction and increase factors; and estimates of yearly waste generation rates and volumes.

3. All liquid and wet wastes will be stabilized using a plant-specific PCP before offsite shipment, or provisions will be made to verify the absence of free liquid in each container using procedures to reprocess containers in which free liquid is detected in accordance with the guidance of BTP 11-3.

4. Other forms of wet wastes will be stabilized or dewatered (subject to the licensed disposal facility's waste acceptance criteria) in accordance with a PCP, or provisions will be made to verify the absence of free liquid in each container using procedures to reprocess containers in which excess water is detected using the guidance in BTP 11-3.

5. The PCP or ODCM, under Appendix 11.4-A of this SRP section and SRP Section 11.5, will be used to address the implementation of SWMS design objectives, design criteria, treatment methods, expected effluent releases, process and effluent radiation monitoring and control instrumentation, and methods for establishing process and effluent instrumentation control set points, as they relate to the regulatory requirements identified in the PCP or ODCM.

6. Waste containers, shipping casks, and methods of packaging wastes meet all applicable Federal regulations (e.g., 10 CFR Part 71, addressing the packaging and transportation of radioactive materials; 10 CFR 20.2006 and Appendix G to 10 CFR Part 20, addressing the transfer and manifesting of radioactive waste shipments; 49 CFR Parts 171-180, addressing U.S. Department of Transportation (DOT) regulations for the shipment of radioactive materials); and 10 CFR Part 61 or corresponding State regulations addressing applicable waste acceptance criteria of the disposal facility or waste processors.

7. Onsite waste storage facilities are sized to provide sufficient storage capacity and allow sufficient time for the decay of shorter-lived radionuclides before shipping using the guidance in BTP 11-3 and RIS 2004-17, 2008-32, and 2011-09. The safety analysis report should give the bases for determining the duration of the storage.

8. The SWMS components and piping systems, as well as structures housing SWMS components, are designed using the provisions of RG 1.143, as it relates to the seismic design, safety, and quality group classifications of components, and BTP 11-3 for wastes produced during normal operation and AOOs.

9. The SWMS contains provisions to reduce leakage and facilitate operations and maintenance using the provisions of RGs 1.143 and 4.21, BTP 11-3, and industry guidance (NEI 08-08A (ADAMS Accession No ML093220530) and NEI 07-07, "Industry Ground Water Protection Initiative – Final Guidance Document"), as they relate to wastes produced during normal operation and AOOs.

10. The SWMS should be designed to implement the requirements of 10 CFR 20.1406. System designs should describe features that will minimize, to the extent practicable, contamination of the facility and environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste, using the guidance in DC/COL- Interim Staff Guidance (ISG)-06, "Final Interim Staff Guidance Evaluation and Acceptance Criteria for 10 CFR 20.1406 to Support Design Certification and Combined License Applications," RG 4.21 and NEI 08-08A, for waste products processed during normal operation and AOOs.

11. For long-term onsite storage (e.g., for several years, but within the operational life of the plant), the storage facility should be designed to the guidance of Appendix 11.4-A, including updated guidance from SECY 93-323 and SECY 94-198, RIS 2004-17, 2008-32, and 2011-09, and industry guidance Electric Power Research Institute (EPRI) Report 1018644.

12. Class A, B, and C wastes, as liquid, wet, dry solid wastes, and activated components, will be processed and disposed of in accordance with 10 CFR 61.55 and 10 CFR 61.56 requirements for waste classification and characteristics taking into considerations the waste acceptance criteria of the chosen licensed radioactive waste disposal facility. The PCP should present the process and methods used to meet these 10 CFR Part 61 requirements and those of the disposal facility.

13. Greater-than-Class C wastes will be processed and placed in long-term onsite storage in accordance with 10 CFR 61.55 and 10 CFR 61.56 requirements for wastes with concentrations in excess of 10 CFR 61.55 (Table 1) limits as activated metals, radioactive sources, alpha emitting transuranics, and Pu-241 and Cm-242 until disposal access is gained at a facility licensed under 10 CFR Part 60 or 10 CFR Part 63. The PCP should present the process and methods used to meet these requirements, excluding spent-fuel.

14. Mixed wastes (characterized by the presence of hazardous chemicals and radioactive materials) will be processed and disposed in accordance with 10 CFR 20.2007, as it relates to compliance with other applicable Federal, State, and local regulations governing any other toxic or hazardous properties of radioactive wastes.

15. All effluent releases (gaseous and liquid) associated with the operation (normal and AOOs) of the SWMS will comply with 10 CFR Part 20 and guidance of RG 1.143, as they relate to the definition of the boundary of the SWMS beginning at the interface from plant systems, including multiunit reactor stations, to the points of controlled liquid and gaseous effluent discharges to the environment or designated onsite storage locations, as defined in the PCP or ODCM.

16. For processing systems equipped with automatic control features, the application should provide the justification for the placement of isolation valves and radiation detectors on

process piping to ensure the timely closure of such valves upon the detection of elevated radioactivity levels. Other considerations may include determining whether system logic demands that a valve or damper should fail in the closed position in protecting the system from further contamination, terminating releases to the environment, or diverting process streams or effluents to appropriate treatment systems. Acceptable guidance is presented in SRP Section 11.5 and ANS N42.18-2004.

17. The design of exhaust ventilation systems used to collect and vent radioactive gases and vapors from tanks, vessels, and processing equipment should use the guidance in SRP Sections 9.3, 9.4, 10.4, 11.3, and 11.5 using the guidance in RGs 1.140 and 1.143 and industry standards. The guidance addresses the design, testing, maintenance, and monitoring of HEPA filters and charcoal absorbers installed in ventilation exhaust systems. If removal efficiencies assigned to radioiodine filtration systems differ from those given in RG 1.140, they should be supported by test data or industry standards under operating or simulated operating conditions. Operating data should address design temperatures and pressure, humidity levels, expected iodine concentrations, flow rates, and types of charcoal (grade, mesh size and bulk density). The test data should also support the effects of aging and poisoning by airborne contaminants.

18. The seismic design of structures housing SWMS components, the safety and quality group classifications of liquid radwaste treatment equipment, and provisions to prevent and collect spills from indoor and outdoor storage tanks should conform to the guidance of RG 1.143 for liquids, wet wastes, and solid wastes produced during normal operation and AOOs.

    The RG 1.143 describes design guidance acceptable to the NRC staff related to seismic, safety, and quality group classifications and QA provisions for the systems and skid-mounted processing equipment, structures, and components of the SWMS for liquid, wet and solid wastes produced during normal operation and AOOs. The RG 1.143 provides guidance in assigning safety classifications to structures and radioactive waste management systems in protecting SSCs against natural phenomena and man-induced hazards. For unmitigated releases of radioactive materials, the acceptance criterion of RG 1.143 is 1 mSv (100 mrem) for members of the public assumed to be located at or beyond the restricted area or in unrestricted areas (whichever is most limiting). For unmitigated radiation exposures to site personnel, the acceptance criterion is 5 rem (50 mSv) for a plant worker assumed to be located in the restricted area. In classifying system components, the radioactivity inventories of components are compared to the acceptance criteria in determining the appropriate safety classification. In addition, RG 1.206, Part I, C.I.3, Sections 3.2.1 and 3.2.2 and SRP Section 3.8.4 identify applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and discuss differences from the guidance of RG 1.143.

19. Operational Programs. For COL reviews, the description of the operational program and proposed implementation milestone for the PCP, as part of the process and effluent monitoring and sampling program, are reviewed in accordance with 10 CFR 20.1301, 10 CFR 20.1302, 10 CFR 50.34a, 10 CFR 50.36a, and 10 CFR Part 50, Appendix I, Sections II and IV. Its implementation is required by a license condition, as described in SRP Sections 13.4 and 13.5.

The relevant RGs, ISG and BTP are as follows:

1. RG 1.109, as it relates to the use of acceptable methods for calculating annual doses to the maximally exposed individual in demonstrating compliance with 10 CFR Part 50, Appendix I design objectives and ALARA provisions, unless already addressed in SRP Sections 11.2 and 11.3 for the LWMS and GWMS in processing and treating effluents generated during the operation of the SWMS.

2. RG 1.110, as it relates to performing a cost-benefit analysis for reducing cumulative dose to the population by using available technology, unless already addressed in SRP Sections 11.2 and 11.3 for the LWMS and GWMS, respectively

3. RG 1.112, as it relates to the use of acceptable methods for calculating annual average radioactivity inventories in liquid, wet, and solid wastes.

4. RG 1.143, as it relates to QA provisions for radioactive waste management systems, structures and components in so far as it applies to SWMS systems not covered by the QA requirements of Appendix B to 10 CFR Part 50.

5. RG 1.143, as it relates to the seismic design, safety, and quality group classifications of components used in the SWMS and structures housing the systems against natural phenomena and man-induced hazards in assigning safety classifications to SSCs for design purposes, and to provisions used to control leakages of liquids and liquid wastes produced during normal operation and AOOs.

6. RG 1.143, as it relates to the definition of the boundary of the SWMS beginning at the interface from plant systems to the point of controlled discharge to the environment, as defined in the ODCM at the point of recycling in designated plant systems for liquid and gaseous wastes, or to designated onsite storage facilities for subsequent offsite shipments or for short and long-term storage as packaged wet wastes, stabilized wastes, and dry solid and compactable wastes.

7. DC/COL-ISG-06, NEI 08-08A and RG 4.21, as they relate to acceptable levels of detail and content needed to demonstrate compliance with 10 CFR 20.1406. The guidance of DC/COL-ISG-06 has been incorporated in SRP Section 12.3-12.4.

8. BTP 11-3, as it relates to design guidance of installed radioactive waste management systems with respect to the processing of dry and wet wastes, use of PCP procedures to dewater and stabilize wet wastes, radioactive waste storage, use of portable or skid mounted systems in supplementing the capacity of permanently installed SWMS, and general consideration for specific design features.

9. Appendix 11.4-A, as it relates to design features and guidance applied to facilities and systems used for the storage of radioactive materials, as wet wastes, stabilized wastes, dry solid and compactable wastes, and Greater-Than-Class-C wastes.

10. NUREG-1430, as it relates to Standard Technical Specifications - Babcock and Wilcox Plants.

11. NUREG-1431, as it relates to Standard Technical Specifications - Westinghouse Plants.

12. NUREG-1432, as it relates to Standard Technical Specifications - Combustion Engineering Plants.

13. NUREG-1433, as it relates to Standard Technical Specifications - General Electric Plants (BWR/4).

14. NUREG-1434, as it relates to Standard Technical Specifications - General Electric Plants (BWR/6).

Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. 10 CFR 20.1302 requires that surveys of radiation levels in unrestricted areas be performed to demonstrate system compliance with the 10 CFR 20.1301 dose limits to individual members of the public. 10 CFR 20.1302 identifies two approaches, either of which can demonstrate compliance with the 10 CFR 20.1301 dose limits. Each one of these approaches requires the following:

   A. Demonstrate that the annual average concentrations of radioactive material released in gaseous and liquid effluents at the boundary of the unrestricted area do not exceed the limits and Note 4 specified in Table 2 of Appendix B to 10 CFR Part 20; and

   B. Demonstrate that the annual and hourly doses from external sources to an individual continuously present in an unrestricted area will not exceed 0.5 millisievert (mSv) (0.05 rem) and 0.02 mSv (0.002 rem), respectively.

   Meeting the above requirements provides reasonable assurance that 10 CFR 20.1301 dose limits to individual members of the public will not be exceeded. The review will include an evaluation of whether the above dose requirements are met. Meeting the requirements of gaseous and liquid effluent concentration limits in unrestricted areas from all plant sources of radioactivity (including that associated with the operation of the SWMS is identified as an acceptance criterion using the guidance in SRP Sections 11.2 and 11.3 and will be evaluated in those SRP sections as well.

2. Meeting the requirements of 10 CFR 50.34a, as it relates to adequate design information on the SWMS, provides reasonable assurance that the SWMS will have the necessary equipment and design features to control and monitor radioactive effluent releases to the environment resulting from its operation, in accordance with the requirements of 10 CFR 20.1302, Appendix I to 10 CFR Part 50, and GDC 60, 61 and 64.

   The review should evaluate the types and characteristics of filtration systems, ion-exchange resins, and adsorbent and stabilization media proposed to treat liquid and wet wastes. This includes removal efficiencies, decontamination factors, waste volume increase factors for stabilized wastes, and volume decrease factors for compacted wastes, taking into account the expected physical, chemical, and radiological properties of process waste and effluent streams. The review should determine whether performance meets that noted in NRC guidance, standard DCs, and industry standards,

or topical reports. The NRC guidance includes NUREG-0016 or NUREG-0017 and RG 1.112 (as revised as of six months before the docket date of the application), as they relate to the use of acceptable methods in calculating radionuclide concentrations in process streams and effluent releases; and RG 1.110, as it relates to performing cost-benefit analysis in reducing cumulative population doses by using available technology, unless already addressed in SRP Sections 11.2 and 11.3.

3. Compliance with GDC 60 requires that each nuclear power plant design shall include means to handle radioactive wastes produced during normal reactor operation, including AOOs. GDC 60 requires that the SWMS must provide for a holdup capacity sufficient to retain radioactive wastes, particularly where unfavorable site environmental conditions may impose unusual operational limitations on the release of effluents. Waste processing holdup times and long-term storage capacity also provide decay time for shorter-lived radionuclides before they are processed or released to the environment.

   Meeting the requirement of GDC 60 provides reasonable assurance that releases of radioactive materials in liquid and gaseous effluents to unrestricted areas during normal operation of the SWMS and AOOs will not result in offsite radiation doses exceeding the dose objectives specified in Appendix I to 10 CFR Part 50, or concentrations of radioactive materials in liquid effluents in any unrestricted area exceeding the limits of Table 2, Columns 1 and 2, and Note 4 of Appendix B to 10 CFR Part 20.

   Meeting the requirements of GDC 60 also provides reasonable assurance that wastes produced from the SWMS will meet the requirements of 10 CFR 61.55 and 10 CFR 61.56 for waste classification and characteristics and shipping regulations under 10 CFR Part 71 and DOT 49 CFR Parts 171-180.

   As noted herein, Appendix 11.4-A, BTP 11-3 and RG 1.143 provide guidance on the use of design codes and standards related to seismic, safety, and quality group classifications and QA provisions for the SSCs of the SWMS for liquids, wet wastes, and solid wastes produced during normal operation and AOOs.

4. Compliance with GDC 63 requires that radioactive waste systems be able to detect conditions that may result in excessive radiation levels in waste storage locations and to initiate appropriate safety actions.

   Meeting the requirements of GDC 63 will provide reasonable assurance that the SWMS will be equipped with monitoring and detection capabilities to facilitate the initiation of timely corrective actions. It will also ensure that effluent concentrations in unrestricted areas arising from SWMS operation do not exceed the limits for effluents specified in Table 2, Columns 1and 2, and Note 4 of Appendix B to 10 CFR Part 20 and that radiation exposures to occupational workers do not exceed the occupational dose limits of 10 CFR 20.1201 and 10 CFR 20.1202 and Table 1 of Appendix B to 10 CFR Part 20. The review on occupational exposures is conducted using the guidance in SRP Chapter 12.

5. Compliance with GDC 61 requires that the SWMS and other systems (as permanently installed systems or in combination with mobile systems) that may contain radioactivity shall be designed to ensure adequate safety under normal and postulated accident conditions. This criterion specifies that such facilities shall be designed with a capability

to permit inspection and testing of components important to safety and with suitable shielding for radiation protection. Appendix 11.4-A, BTP 11-3, and RG 1.143 describe design guidance acceptable to the NRC staff related to seismic, safety, and quality group classifications and QA provisions for the SSCs of the SWMS for wastes produced during normal operation and AOOs.

RG 1.143 describes design guidance acceptable to the NRC staff related to seismic, safety, and quality group classifications and QA provisions for the systems and skid-mounted processing equipment, structures, and components of the SWMS for liquid, wet, and solid wastes produced during normal operation and AOOs. RG 1.143 provides guidance in assigning safety classifications to structures and radioactive waste management systems in protecting SSCs against natural phenomena and man-induced hazards. For unmitigated releases of radioactive materials, the acceptance criterion of RG 1.143 is 1 mSv (100 mrem) for members of the public assumed to be located at or beyond the restricted area or in unrestricted areas (whichever is most limiting). For unmitigated radiation exposures to site personnel, the acceptance criterion is 5 rem (50 mSv) for a plant worker assumed to be located in the restricted area. In classifying system components, the radioactivity inventories of components are compared to the criteria in determining the appropriate safety classification. In addition, RG 1.206, Part I, C.I.3, Sections 3.2.1 and 3.2.2, and SRP Section 3.8.4 identify applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and discuss differences from the guidance of RG 1.143.

Meeting the requirements of GDC 61 provides reasonable assurance that releases of radioactive materials during normal operation and AOOs, including adverse conditions on system components, will not result in radioactive material concentrations and radiation doses that exceed the limits specified in 10 CFR Part 20. In addition, meeting this requirement will help ensure that the SWMS will continue to perform its functions under postulated accident conditions.

Using the guidance in RG 1.143 provides reasonable assurance that the assigned safety classifications for structures housing the SWMS and its components comply with the requirements of GDC 2 and 61 for natural phenomena and man-induced hazards in assigning the safety classifications to SSCs of the SWMS for design purposes.

6. Radioactive materials should be processed, handled, and stored using equipment, methods, and procedures that avoid or minimize potential releases of radioactivity in the event of a fire. GDC 3 relates to fire protection features for SSCs important to safety and can be used to address SWMS design features and operational safeguards to prevent, for example, the generation of exothermic reactions and explosive gas mixtures through the introduction and mixing of chemical additives with ion-exchange resins, and fires of contaminated charcoal adsorption media and HEPA filters used in ventilation systems. Such considerations should also address the bulk storage of spent-activated carbon, storage methods and procedures to avoid the potential for spontaneous heating and auto-ignition of activated carbon, which may be due to radioactive decay heat and adsorption of various vapors and gases, including oxygen.

   Using GDC 3 provides reasonable assurance that the SWMS is protected from the effects of the detonation of explosive mixtures, exothermic reactions, and combustion of

radioactive wastes, and that the functions of its systems will not be compromised in meeting radiation protection dose standards for workers and effluent concentration limits of 10 CFR Part 20 associated with releases of contaminated fire protection water and combustion gases and smoke. Specific NRC guidance in meeting the requirements of GDC 3 is provided in RG 1.189 and 1.205, IE Information Notices 83-14, 84-72, 88-08, and 90-50, and in NUREG/CR-4601. This evaluation is performed in parallel with the fire protection analysis (FPA) addressed using the guidance in SRP Section 9.5.1.1 for plant areas identified with the presence of combustible or flammable radioactive materials.

The RGs 1.189 and 1.205 explain the primary objectives of fire protection programs at nuclear power plants, and describe the regulatory framework the NRC has established, including but not limited to GDC 3, and the radiological exposure criteria of 10 CFR Part 20. NRC guidance, using the guidance in RGs 1.189 and 1.205, explains that in order to meet NRC regulations, a fire hazards analysis should demonstrate that the plant will maintain the ability to minimize the potential for radioactive releases in plant areas and to the environment in the event of a fire. Such events are treated as AOOs, which should not result in unacceptable radiological consequences under the criteria of 10 CFR Part 20. The requirements and dose limits for protection against radiation during plant operations are in 10 CFR 20.1201 and 10 CFR 20.1202 for plant workers, 10 CFR 20.1301 and 10 CFR 20.1302 for members of the public, and effluent concentration limits are listed in Appendix B to 10 CFR Part 20 (Table 2, Columns 1 and 2).

7. 10 CFR Part 61 establishes, for land disposal of radioactive waste, the procedures, criteria, and terms and conditions for the disposal of radioactive wastes containing byproduct, source, and other special nuclear material. State and local regulations also apply to the licensing of land disposal facilities.

   The SWMS processes liquid, wet, and dry solid wastes shipped to a licensed disposal facility. For the SWMS, 10 CFR 61.55 and 10 CFR 61.56 require the inclusion of provisions in the system design and PCP that describe the dewatering and stabilization processes, waste classification (as Class A, B, and C), and processing and disposition of solid wastes. The SWMS and PCP should also address the criteria that the different waste classes should satisfy and various characteristics that the processed liquid wet wastes should meet. Item 8, below, outlines the technical and procedural elements that the PCP should address and identifies related NRC guidance.

   Meeting the requirements of 10 CFR 61.55 and 10 CFR 61.56 provides reasonable assurance that radioactive wastes processed by the SWMS have been properly classified, such that controls and resulting waste forms are stable and that the processed waste, when stabilization is required, will not structurally degrade and will be compatible with the disposal site's waste acceptance criteria and 10 CFR Part 61 requirements. In addition to the estimates of the amounts of liquid, wet, and dry solid wastes, such inventories should also address materials and equipment expected to be generated infrequently, such as large components, and describe the plans for their management and disposition. The maximum radionuclide concentrations allowable for land disposal are defined by 10 CFR 61.55 for Class A, B, and C wastes. For Greater-than-Class C wastes (e.g., neutron-activated components, in-core neutron

detectors, but excluding spent fuel) characterized with concentrations in excess of 10 CFR 61.55 (Table 1) values, as activated metals, radioactive sources, alpha emitting transuranics, and Pu-241 and Cm-242, the PCP should present the process used to meet these requirements and identify long-term storage needs until disposal becomes available at a facility licensed under 10 CFR Part 60 or 10 CFR Part 63.

8. In the context of 10 CFR Part 61, radioactive wastes shipped to disposal facilities must comply with the requirements addressing waste classifications and characteristics and the shipping regulations under 10 CFR Part 71 and 49 CFR Parts 171-180.

   Plant TS (Administrative Controls) require that a PCP be established to provide reasonable assurance of the complete stabilization of process wastes and the absence of free water in processed wastes. The PCP and operational procedures should describe, given specific waste processing technologies and methods, a set of process parameters that are used to process wastes. Among others, the parameters include pH, water content, oil content, presence of hazardous materials, content of chelating agents, and ratio of stabilization agent to chemical additives by types of wastes. The types of wastes may include filter sludge, spent resins, boric acid solutions, process concentrates, and filter media. The PCP should describe the bases in developing waste mixture formulas, sampling, analysis, tests, radionuclide scaling factors, encapsulation and concentration averaging, controls on radiolytic hydrogen gas generation, and methods to demonstrate that the processing of actual or simulated waste samples can be successfully accomplished and ensure compliance with the requirements of 10 CFR 61.55 and 10 CFR 61.56 for waste classification and characteristics. The PCP should describe provisions for onsite long-term storage for Greater-than-Class C wastes at concentrations in excess of 10 CFR 61.55 (Table 1) values, excluding spent fuel. The PCP also addresses descriptions and characterization of wastes in shipping manifests in accordance with 10 CFR 20.2006; compliance with 10 CFR 20.2007, as it relates to other applicable Federal, State, and local regulations governing the presence of any other toxic or hazardous materials in waste; conformance with NRC and DOT shipping regulations under 10 CFR Part 71 and 49 CFR Parts 171-180; and compliance with waste acceptance criteria of authorized disposal facilities or waste processors. The PCP should identify surveillance requirements consistent with the plant's TS, administrative procedures, operational procedures, operation of the process and effluent radiation monitoring and control instrumentation and procedures for setting instrumentation alarm set points, QA and quality control, radiological controls and monitoring, information to be contained in annual radiological effluent release reports, reporting requirements to the NRC, instructions on the use of the NRC uniform radioactive shipping waste manifest, and the process for initiating and documenting changes to the PCP and its supporting procedures.

   Related guidance may be found in NUREG-1301 (PWRs) or NUREG-1302 (BWRs) and NUREG-0133 for either type, and NUREG/BR-0204. Specific guidance on waste form, characterization, and classification is listed in Inspection Procedure 84850, "Issuance Final Branch Technical Position on Concentration Averaging and Encapsulation," January 17, 1995; Concentration Averaging and Encapsulation, Branch Technical Position, Rev. 1, Vol. 1 and 2, February 2015 (ML12254B065); ("Final Waste Classification and Waste Form Technical Position Papers," May 11, 1983; and "Revised Staff Technical Position on Waste Form (SP-91-13)," January 30, 1991. Additional

information is presented in IE Information Notice No. 86-20, March 28, 1986, on methodologies used to develop waste-scaling factors. See IE Bulletin No. 79-19 and IE Information Notice No. 84-72, 85-92, 87-07, and 90-31 for illustrative examples.

9. 10 CFR Part 71 establishes requirements for packaging, preparation for shipment, and transportation of licensed material and procedures and standards for packaging and shipping of fissile material or quantities of other licensed materials in excess of Type A quantities, and it defines the applicability of 10 CFR Part 71 to waste generators and common carriers. Regarding allowable external radiation levels and residual surface contamination on external surfaces of shipping containers and packages, 10 CFR Part 71 presents criteria and also refers to DOT shipping regulations under Subpart I (Class 7) of 49 CFR Part 173. Records of the disposals of licensed materials made using 10 CFR Part 61 requirements must be maintained, as stated in 10 CFR 20.2108, until the Commission terminates the pertinent license.

   Meeting the requirements of 10 CFR Part 71 provides assurance that the operation of the SWMS and development of the PCP with regard to packaging, preparation for shipment, qualification of the packaging material, testing of the package, exemptions, quality control and procedures, and transportation of licensed radioactive materials will not result in an undue risk to the public.

10. BTP 11-3 presents guidance on SWMS design and operation, addressing process parameters, waste stabilization or dewatering, waste form properties, free liquid detection, QA, waste storage, and portable solid waste systems.

    The BTP focuses primarily on wet and liquid wastes for the purpose of ensuring complete stabilization and dewatering. For dry wastes, it emphasizes the use of waste volume reduction technologies for minimizing the amounts of wastes shipped to land disposal facilities. GL No. 80-009, 81-038, and 81-039, RIS 2004-17, 2008-32, and 2011-09, and EPRI Report 1018644 provide further guidance.

    Meeting the guidance of BTP 11-3 provides reasonable assurance that the SWMS, as implemented under the PCP, includes necessary equipment, processes, and procedures to satisfactorily process, monitor, store for decay; and addresses storage needs for radioactive wastes before shipment to offsite disposal facilities or waste processors for further processing.

    Appendix 11.4-A addresses the long-term storage of wet, stabilized, and dry solid wastes. Appendix 11.4-A provides guidance for considering onsite low-level radioactive waste (LLRW) storage capabilities for periods that may last several years but significantly less than the life of the plant. The guidance emphasizes safety considerations in the storing, handling, and eventual disposition of radioactive wastes under 10 CFR Part 61 or equivalent State regulations. GL No. 80-009, 81-038, and 81-039, and SECY 94-198 and 93-323, RIS 2004-17, 2008-32, and 2011-09, and EPRI Report 1018644 contain further guidance.

    Meeting the guidance of Appendix 11.4-A provides reasonable assurance that the SWMS, as implemented under the PCP, will meet the associated requirements of NRC regulations (10 CFR Part 20 and 10 CFR Part 71) and DOT shipping regulations (49 CFR Parts 171-180) to ensure that container breaches will not occur during

extended storage periods or minimize the chance of such occurrences, and reduce the likelihood of uncontrolled and unmonitored releases of radioactive wastes and materials from processing, handling, transportation, and storage accidents.

10 CFR 20.1406 requires that applicants describe how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste. DC/COL-ISG-06 (ADAMS Accession No. ML092470100), NEI 08-08A, and RG 4.21 provide guidance for use in implementation of the requirements of 10 CFR 20.1406. Specific guidance to meet 10 CFR 20.1406 is identified in RG 4.21 Positions C.1 through C.4. The guidance of DC/COL-ISG-06 is incorporated in SRP Section 12.3-12.4. The guidance addresses the following aspects:

A. SWMS processing systems (either as permanently installed systems or in combination with mobile equipment) with a potential for leakage should provide means to control and contain such leakage to prevent contamination of building floors and interconnected systems. (Such means include curbing, floor sloping to local drains, floor-to-floor seals over floor expansion joints, wall-to-floor joint seals, steel liners, sheathed hoses, drip pans or containment boxes, backflow preventers, siphon breakers, self-sealing quick-disconnects, and operational interlocks). See guidance given in relevant NRC bulletins and circulars (e.g., IE Bulletin No. 79-19 and 80-10; IE Circular No. 77-10, 77-14, 79-21, and 81-09; and IE Information Notice No. 79-07, 79-09, 84-72, 85-92, 87-07, and 90-31).

B. In facilitating decommissioning, designs should minimize, to the extent practicable, embedding contaminated piping in concrete, consistent with maintaining radiation doses ALARA during operations and decommissioning.

C. In minimizing waste generation, provisions should be in place to clean contaminated materials (e.g., system components and equipment) and regenerate resin beds as applicable (e.g., demineralizer resin beds with some remaining ion-exchange capacity when feasible), as opposed to prompt disposal.

D. Mobile liquid waste processing systems with interconnections to permanently installed plant SWMS systems should include provisions that avoid the contamination of nonradioactive systems, prevent uncontrolled and unmonitored releases of radioactive materials in the environment, and avoid interconnections with potable and sanitary water systems.

E. All temporary and flexible lines (as hoses and connections), system piping embedded in concrete, and effluent discharge lines or piping buried in soils should undergo pressure testing. All system piping and valves associated with transfer lines to storage tanks and discharge piping buried in soils and concrete, including features designed for the early detection of leaks and spills (e.g., leak detection sumps and wells) should have corrosion-resistant properties. See guidance in RG 1.143 for wastes produced during normal operation and AOOs.

11. 10 CFR 20.1301(e) requires that NRC licensed facilities comply with the EPA generally applicable environmental radiation standards of 40 CFR Part 190 for facilities that are

part of the fuel cycle. The EPA annual dose limits are 0.25 mSv (25 millirem (mrem)) to the whole body, 0.75 mSv (75 mrem) to the thyroid, and 0.25 mSv (25 mrem) to any other organ.

Meeting the requirements of 10 CFR 20.1301(e) necessitates the consideration of all potential sources of external radiation and radioactivity, including liquid and gaseous effluents and external radiation exposures from buildings, storage tanks, radioactive waste, and storage areas. The EPA standards apply to the entire site or facility, which may have either single or multiple reactor units. SRP Sections 11.1, 11.2 and 11.3 address sources of radioactivity and doses associated with liquid and gaseous effluents, respectively. In turn, SRP Section 11.5 addresses compliance with all sources of effluents. SRP Section 12.3-12.4 addresses sources of radiation and external radiation exposures from buildings housing the SWMS, radioactive waste storage areas, storage tanks, and other site buildings.

For COL applicants with site-specific information on the locations of offsite dose receptors, compliance with the EPA standards should consider whether doses due to gaseous and liquid effluent releases and external radiation are additive or need to be addressed separately given actual exposure pathways. The location of offsite dose receptors and the determination of actual exposure pathways should be based on the results of a current land use census for the site. If there is no site-specific information, the applicant may assume that all exposures occur at one location or in one sector in bounding dose estimates, where doses from liquid and gaseous effluent releases and external radiation are summed up and compared to the EPA standards. In such instances, the applicant should provide a commitment to reassess compliance with the EPA standards by appropriately assigning doses with actual exposure pathways once site-specific information becomes available on their locations within the vicinity of the site.

III. REVIEW PROCEDURES

These review procedures are based on the identified SRP acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements and guidance identified in Subsection II. The review should confirm that the applicant has submitted sufficient information for the staff to conduct an independent evaluation of any proposed alternative method and demonstration of compliance with NRC regulations and SRP acceptance criteria and supporting regulatory guidance.

While the SWMS has been categorized as nonsafety-related and nonrisk-significant, the failure of specific systems or components may have impacts on the means to control and monitor radioactive wastes and process and effluent streams in complying with NRC regulations under 10 CFR Part 20 and 10 CFR Part 50, Appendix I. As such, the review of the SWMS must be sufficiently detailed to assess whether a failure of any SWMS system may have an impact on demonstrating compliance with the requirements of 10 CFR Part 20, Appendix B, Table 2 Effluent Concentration Limits and dose limits to members of the public and design objectives and ALARA provisions of 10 CFR Part 50, Appendix I. The applicant's description of the failure analysis will be reviewed to confirm that sufficient information has been provided to confirm that the failure of essential systems will not result in plant or operating conditions in noncompliance

with NRC regulations on exposure to workers and members of the public and that the FSAR's failure analysis are consistent with SRP guidance and acceptance criteria.

The NRC staff will review the information describing the design features of the SWMS provided in the FSAR including referenced subsections of SRP Sections 11.1, 11.2, 11.3, 11.4, 11.5, and 12.3-12.4, for completeness using the guidance in RG 1.70 or RG 1.206. While the SRP references RG 1.70 and RG 1.206, not all sections of RG 1.70 have a corresponding review plan section. The SRP sections applicable to a COL application, submitted under 10 CFR Part 52, for a new LWR, are based on RG 1.206.

1. Programmatic requirements. Commission regulations and policy mandate "programs" applicable to SSCs that include:

   A. Technical specifications (Section 5.0, Administrative Controls) as they relate to administrative programs on radioactive material controls and monitoring via the ODCM, SREC, and radiological environmental monitoring program (REMP); and programs and procedures to process wastes for storage, shipment, and disposal via the PCP. The associated TS are presented in NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433, and NUREG-1434. The review of the SREC, ODCM, REMP, and PCP may be conducted as part of the review of SRP Section 11.5, depending on where the applicant has located the procedural details and programmatic controls, given the provisions of GL 89-01 and NUREG-1301 and NUREG-1302.

   B. Startup testing plan, as described in SRP Section 14.2 using the guidance in RGs 1.68 and 1.33.

   C. Implementation of these programs will be inspected in accordance with NRC Inspection Manual Chapter (IMC)-2504, "Construction Inspection Program - Non-ITAAC Inspections."

   D. If applicable, the staff reviews the proposed augmentation of programmatic elements in assessing the adequacy of the SWMS design and resulting effects on the development of the radioactive gaseous and gaseous effluent source terms as byproducts of its operation. The staff's evaluation and conclusion of the acceptability of the augmented programmatic elements is addressed in Safety Evaluation Report (SER) Section 13.4, "Operational Programs," and relevant requirements and guidance identified in this SER section for the systems and components identified in the supplemental or new programmatic elements.

2. For new reactor license applications submitted under 10 CFR 52.47(a)(8), 10 CFR 52.79(a)(17) and 10 CFR 52.79(a)(20), the applicant is required to (1) address the proposed technical resolution of unresolved safety issues (USIs) and medium- and high-priority GSIs that are identified in the version of NUREG-0933 current on the date 6 months before application and that are technically relevant to the design; (2) demonstrate how the operating experience insights have been incorporated into the plant design; and, (3) provide information necessary to demonstrate compliance with technically relevant portions of the TMI requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v), as referenced in 10 CFR 52.47(a)(21), 10 CFR 52.47(a)(22), and 10 CFR 52.47(a)(8), respectively. With respect to

NUREG-0933, TMI Action Plan Items, Task III.D (Radiation Protection) and Task III.D.2 (Public Radiation Protection Improvement), the applicant should describe design features of the SWMS that are used to control and reduce potential exposures to offsite populations following an accident. With respect to GSIs, the applicant should present an evaluation of the issues listed in NUREG-0933 and, depending upon their applicability to the design, present information that demonstrates implementation of acceptance criteria. These cross-cutting review areas should be addressed by the reviewer for each technical subsection and relevant conclusions should be documented in the corresponding SER section.

3. The P&IDs and the process flow diagrams are reviewed to evaluate system design, methods of operation, and parameters used in the design, (i.e., expected and design flow rates, concentrations of radioactive materials, radionuclide distributions, potential bypasses, and waste categories). With respect to potential bypasses, the review considers improper connection to nonradioactive systems and the possibility of uncontrolled and unmonitored effluent releases. The system design and design criteria, including mobile waste processing systems, are compared with RG 1.143, BTP 11-3, and available data from operating LWR plants, as they relate to wastes produced during normal operation and AOOs.

4. The methods to be used for stabilization and/or dewatering are compared with experience gained from previous licensing reviews and with available data from operating plants employing similar methods. The elements of the PCP are reviewed to assure that the proposed stabilization and/or dewatering method is capable of solidifying and/or dewatering the range of constituents expected to be present in wastes. The methods proposed are reviewed, and a determination is made as to their acceptability considering (a) the ability of the technique to detect free, mobile, or uncombined liquids (in the case of encapsulation or solidification) or excess free water (such as in the case of dewatering), (b) the procedures to be employed to solidify or dewater free liquids if detected, (c) the expected final waste form characteristics, and (d) the extent of reliance on mobile processing systems and waste processors. The PCP, including dewatering or stabilization (if performed), is reviewed on a plant specific basis against the 10 CFR Part 61 requirements and guidance given in Appendix 11.4-A and BTP 11-3 and GL No. 80-009, 81-038, and 81-039.

5. The description of procedures for the packaging and shipment of solid wastes to an approved offsite disposal facility or waste processor is reviewed. The reviewer verifies that the applicant describes commitments to follow appropriate NRC and DOT regulations, as well as EPA and State regulations addressing the presence of other toxic and hazardous materials. The values given in the applicant's submittal for waste volumes, radionuclide distributions and concentrations, and yearly radioactive inventories to be shipped off site are compared with data from operating plants of similar design and information from previous license applications.

6. The solid waste system design capacity is compared with the design basis in light of expected waste volumes to determine whether the applicant has provided sufficient reserve capacity for greater than expected waste volumes, which may occur as a result of AOOs. The in-plant storage capacity, for areas designed to accommodate approximately 6 months of waste generation, is compared to the guidance of

Appendix 11.4-A and BTP 11-3. The comparison will be based on the design criteria as stated in the applicant's submittal, the capability of system components to handle surge flows, reliance on mobile processing systems, and whether storage facilities will provide onsite storage sufficient to permit the decay of shorter-lived radionuclides. The reviewer will determine whether design descriptions, assumptions, and parameters are adequately conservative, and consistent with the guidance of BTP 11-3. In instances where the applicant has proposed to supplement the SWMS with portable or skid-mounted processing equipment, the reviewer will extend its review to those systems, and confirm whether their operating characteristics are capable of meeting the acceptance criteria of BTP 11-3.

7. For longer term onsite storage (e.g., several years, but within the operational life of the plant), the design of the waste storage facility should be evaluated against the guidance described in Appendix 11.4-A to this SRP section. The review should evaluate whether existing storage capacity is adequate, and the need to construct an onsite storage facility in the event that access to offsite disposal and storage are not available. The duration of onsite storage should include the means to provide sufficient storage capacity for several years within the operational life of the plant, but exclude wastes generated during decommissioning activities. With respect to decommissioning, NRC requirements are contained in 10 CFR 50.82 and 10 CFR 50.83. If additional storage capacity is necessary, the design and construction of onsite storage must comply with applicable NRC regulatory requirements and guidance of RG 1.143, and industry codes and standards. In its review, the staff should assess and determine that:

   A. A safety review and radiological assessments have been conducted to assure the safety of the public and protection of the environment. The review and assessment should follow the requirements of 10 CFR 20.1101(b), 10 CFR 20.1201, 10 CFR 20.1301, 10 CFR 20.1302, 20.1406, and 10 CFR 20.2001(a)(2), and Appendix B, Table 2, effluent concentration limits and Note 4 for radionuclide mixtures; 10 CFR 50.34a(b)(3), 10 CFR 50.36a, 10 CFR 50.59; 10 CFR Part 50, Appendix A, GDC 3, GDC 60, and GDC 64; Appendix I design objectives and ALARA provisions; and EPA's 40 CFR Part 190 generally applicable environmental radiation standards, as implemented under 10 CFR 20.1301(e).

   B. The design and operational features have considered NRC guidance and industry standards. The NRC guidance includes SRP Section 11.4 and Appendix 11.4-A; GL 80-051, 81-038, 81-039, 80-009, and 85-14; RIS 2004-17 (Revision 1), 2008-32, and 2011-09; RGs 1.206, 1.189, 1.54, and 4.21; IE Circular 80-18; Information Notice 89-13; IE Bulletin 80-10; and NUREG/CR-2731, -4601, and -4062. Industry guidance includes EPRI Report 1018644 on interim LLRW storage, EPRI Report 1011730 guidance on groundwater monitoring, NEI 08-08A guidance on minimizing contamination, and NEI 07-07 guidance on groundwater protection.

   C. If the design of the onsite storage facility includes systems and equipment to further process and treat liquid, wet, or dry solid wastes, such as by filtration, adsorption, dewatering, stabilization, compaction, venting, sorting, repackaging, and storage for decay, the design of the equipment should follow NRC

requirements and guidance identified in SRP Sections 11 and 12 and others as mandated by specific design considerations. All equipment, tanks, overflows, drains, and sample lines should be routed to liquid drains and collection tanks. For systems and processes generating radioactive gases and aerosols, the equipment should include vents exhausted to proper filtration systems, such as HEPA and charcoal filters. In areas where equipment is located, wall and floor surfaces and sumps should be protected with surface coatings and steel liners in facilitating the decontamination of radioactivity. See RGs 1.54, 1.143, and 4.21 for details.

D. For the protection of plant workers, the design and operation of an onsite low level waste repository complies with the requirements of 10 CFR Part 20, Subparts B, C, F, G, H, I and J, and occupational limits of 10 CFR 20.1201 and 10 CFR 20.1501, Appendix B, Table 1 occupational values, and guidance of RG 8.8 and 8.10, as confirmed using the review described in SRP Chapter 12.

E. For buildings where contaminated combustible and flammable radioactive materials are stored, the design includes a FPA to identify measures ensuring that fires will not result in unacceptable radiological releases and radiological consequences to the public under the criteria of 10 CFR Part 50, Appendix A, GDC 3, GDC 60, and GDC 64; 10 CFR 20.1201 and 10 CFR 20.1202; 10 CFR 20.1301 and 10 CFR 20.1302; and Appendix B to 10 CFR Part 20 (Table 2, Columns 1 and 2) using the guidance in RG 1.189. The RG 1.189 explains the primary objectives of fire protection programs at nuclear power plants, and describes the regulatory framework, including but not limited to GDC 3, and the radiological exposure criteria of 10 CFR Part 20. NRC guidance, using the guidance in RG 1.189, explains that in order to meet NRC regulations, a fire hazards analysis should demonstrate that the plant will maintain the ability to minimize the potential for radioactive releases in plant areas and to the environment in the event of a fire. Such events are treated as AOOs, which should not result in unacceptable radiological consequences under the criteria of 10 CFR Part 20. Radioactive materials that may be involved in fires include dry active wastes, spent ion-exchange resins, spent HEPA filters, and spent charcoals. The results of the FPA, as described in SRP Section 9.5.1.1, were used to identify the need for additional fire protection features to mitigate the consequences of a fire.

F. Provisions were identified to manage the long-term storage and disposition of large components (e.g., contaminated steam generators, coolant pumps, and activated piping and reactor internals), and bulk quantities of radioactive wastes (e.g., spent activated charcoals, resins, etc.). The review should confirm that the waste management program and PCP have identified methods and procedures in dealing with the infrequent generation of large amounts of radioactive wastes and activated components beyond that expected during routine plant operations.

8. The quality group and safety classifications of piping and equipment of the SWMS is compared to the guidance of RG 1.143 and 4.21 for wastes produced during normal operation and AOOs. The seismic design criteria of equipment and structures housing the SWMS are also compared to the design guidance identified in RG 1.143. When

applicable, SRP Sections 3.2.1, 3.2.2, 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5 will be used to evaluate exceptions.

9. The equipment layout, design features, and mode of operation of the solid waste system, as permanently installed systems or in combination with mobile processing equipment, are compared to the guidance of RG 1.143 and BTP 11-3, as they relate to wastes produced during normal operation and AOOs.

   The applicant's design is compared to RG 1.143, as acceptable guidance, related to seismic, safety, and quality group classifications and QA provisions for the systems and skid-mounted processing equipment, structures, and components of the SWMS for liquid, wet and solid wastes and effluents produced during normal operation and AOOs. RG 1.143 provides guidance for assigning safety classifications to structures and radioactive waste management systems in protecting SSCs against natural phenomena and man-induced hazards. For unmitigated releases of radioactive materials, the acceptance criterion is 1 mSv (100 mrem) for members of the public assumed to be located at or beyond the restricted area or in unrestricted areas (whichever is most limiting). For unmitigated radiation exposures to site personnel, the acceptance criterion is 5 rem (50 mSv) for a plant worker assumed to be located in the restricted area. In classifying system components, the radioactivity inventories of components are compared to the criteria in determining the appropriate safety classification. In addition, RG 1.206, Part I, C.I.3, Sections 3.2.1, 3.2.2 and SRP Section 3.8.4 identify applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and discuss differences from the guidance of RG 1.143.

10. Review of the PCP and TS (i.e., administrative controls section proposed by the applicant for process and effluent control) is performed with the review of SRP Chapter 16.0 and this SRP section, as adopted from standard technical specifications (NUREG-1430, NUREG-1431, NUREG-1432, NUREG-1433, and NUREG-1434). The reviewer will determine that the content and scope of the programs identified in the administrative controls section of the TS prepared by the applicant are in agreement with requirements. The review will include the evaluation or development of appropriate limiting conditions for operation or controls and their bases, consistent with the plant design. The programs identified in the administrative controls section of the TS are reviewed according to the requirements of 10 CFR 50.36a.

11. The classification and characterization of wastes are compared to the requirements of 10 CFR 61.55 and 10 CFR 61.56. The requirements address the classification and characteristics of wastes, and they define maximum radionuclide concentrations allowable for land disposal as Class A, B, and C wastes. The information should address the processing, volume and activity inventories, onsite short and long-term storage, offsite storage at licensed facilities, and disposal of dry solid and wet wastes at approved low-level radioactive waste disposal sites. For Greater-than-Class C wastes (e.g., neutron-activated components, in-core neutron detectors, but excluding spent fuel), characterized with concentrations in excess of 10 CFR 61.55 (Table 1) values, characterized as activated metals, radioactive sources, alpha emitting transuranics, and Pu-241 and Cm-242, the information should present the process used to meet these requirements and identify long-term onsite storage needs until disposal becomes available at a facility licensed under 10 CFR Part 60 or 10 CFR Part 63.

12. Meeting the requirements of 10 CFR 50.34a, as it relates to the SWMS, provides reasonable assurance that each nuclear power reactor will have necessary design features and equipment to control releases of radioactive liquid and gaseous effluents to the environment in accordance with the requirements of 10 CFR 20.1302 and 10 CFR 20.1301(e); Appendix I to 10 CFR Part 50; and Appendix A to 10 CFR Part 50, GDC 60 and GDC 61. These requirements may be evaluated using the following two approaches:

    A. As part of the review of this SRP section, including a verification of compliance with offsite dose requirements and liquid and gaseous effluent limits associated with the operation of the SWMS and waste storage; or

    B. With the results of the review incorporated in the evaluation of SRP Sections 11.2 and 11.3, addressing compliance with offsite dose requirements, effluent concentrations limits, and all liquid and gaseous effluents from all sources, including those generated by the operation of the SWMS

13. The SWMS is reviewed to ensure that the design includes provisions to meet the requirements of 10 CFR 20.1406 using the guidance in RG 4.21. The review will confirm that:

    A. Adequate design features exist, supplemented with operating programs, processes and procedures (as necessary), as these will provide reasonable assurance that spills, leaks, and inadvertent discharges of radioactive effluents will be prevented or minimized to the extent practicable.

    B. In the event that a spill, leak, or inadvertent discharge does occur, the staff should verify that there is reasonable assurance that it will be detected in a timely manner. For those SSCs that are typically inaccessible for routine inspection or observation, leak detection capability, to the extent practical, should allow for the identification and measurement of relatively small leak rates, depending on the concentrations of radioactive materials (e.g., several gallons per week).

    C. Design features should be supplemented, as necessary, by operating programs, processes, and procedures to monitor spills and leaks and evaluate their impact to the environment.

    D. Justification for automatic control to features and placement of isolation or diversion valves and radiation detectors on process piping to ensure the timely closure of such valves upon the detection of elevated radioactivity levels. Other considerations may include determining whether system logic demands that a valve or damper should fail in the closed position in protecting the system from further contamination, terminating releases to the environment, or diverting process streams or effluents to appropriate treatment systems.

    E. The site and facilities have been designed and will be operated to minimize the generation and volume of radioactive waste, both during operation and during decommissioning. Design features that facilitate decommissioning should be described, and their role in the decommissioning process should be discussed. These should include both design features (such as modular components and

adequate space for equipment removal) and operating procedures to minimize the amount of residual radioactivity that will require remediation at the time of decommissioning.

In addressing the above, the NRC guidance includes the following:

i. DC/COL-ISG-06, as incorporated in SRP Sections 12.3-12.4.

ii. RGs 4.21 and 1.143 for wastes produced during normal operation and AOOs; for system process streams, wastes, waste products, and liquid and gaseous effluents; and NUREG/CR-3587, as it relates to techniques used in decommissioning light water reactors.

iii. SRP Sections 9.1, 9.2, 9.3, 9.4, 10.4, 11.2, and 11.3.

iv. IE Bulletin No. 79-19 and 80-10; IE Circular No. 77-10, 77-14, 79-21, and 81-09; and IE Information Notice No. 79-07, 79-09, 84-72, 85-92, 87-07, and 90-31, 2004-05, 2006-13, and 2012-05; and RIS 2008-03.

v. Industry guidance and standards NEI 08-08A, ANS N42.18-2004, ANSI/ANS-55.6-1993 (R2007) ANSI/ANS 55.1-1992 (R2009), ANSI/ANS-40.37-2009, and ANSI/ANS-18.1-1999.

14. The PCP and associated plant TS are reviewed to determine whether they identify all regulatory requirements, follow NRC guidance, and contain all appropriate operational elements. The regulatory requirements are associated with 10 CFR 61.55 and 10 CFR 61.56 for waste classification and characteristics; 10 CFR 20.2006 for the characterizations of waste in shipping manifests; 10 CFR 20.2007 as to other applicable Federal, State, and local regulations governing the presence of any other toxic or hazardous materials; NRC and DOT shipping regulations under 10 CFR Part 71 and 49 CFR Parts 171-180; and waste acceptance criteria of authorized disposal facilities or waste processors. The PCP should describe, given specific waste processing technologies and methods, a set of parameters used to process wastes. The PCP should identify surveillance requirements consistent with the plant's TS, administrative procedures, operational procedures, QA and quality control program, radiological controls and monitoring, information to be contained in annual radiological effluent release reports, reporting requirements to the NRC, record keeping, instructions on the use of the NRC uniform radioactive shipping waste manifest, and the process for initiating and documenting changes to the PCP and its supporting procedures.

Related guidance may be found in NUREG-1301 (PWRs) or NUREG-1302 (BWRs) and NUREG-0133 for either, NUREG/BR-0204, and RG 1.21. Specific guidance on waste form, characterization, and classification is listed in Inspection Procedure 84850; "Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation," January 17, 1995; Concentration Averaging and Encapsulation, Branch Technical Position, Rev. 1, Vol. 1 and 2, February 2015 (ML12254B065); "Final Waste Classification and Waste Form Technical Position Papers," May 11, 1983; and "Revised Staff Technical Position on Waste Form (SP-91-13)," January 30, 1991. Additional information is presented in IE Information Notice No. 86-20, March 28, 1986, on

methodologies used to develop waste scaling factors. See IE Bulletin No. 79-19 and IE Information Notice No. 84-72, 85-92, 87-07, and 90-31 for illustrative examples.

15. In determining compliance with the EPA generally applicable environmental radiation standards of 40 CFR Part 190, as required under 10 CFR 20.1301(e), the review considers all sources of radiation and radioactivity as potential contributors to total doses to members of the public from the site, whether from single or multiple units. The review focuses on sources of radioactivity released via effluent discharges and external radiation exposures from waste processing buildings, waste storage buildings, waste storage tanks, and temporary waste storage or staging areas. The source terms and associated doses from liquid and gaseous effluents associated with the operation of the SWMS may be evaluated in this section of the SRP or integrated with the evaluation of SRP Sections 11.2, 11.3, and additional guidance. SRP Section 11.5 addresses the means of demonstrating compliance with all sources of effluents. SRP Section 12.3-12.4 provides guidance in evaluating the doses associated with external radiation from buildings and sources of radioactivity contained in systems and components.

    For OL and COL applicants with site-specific information on the locations of offsite dose receptors, compliance with the EPA standards requires consideration of whether doses due to gaseous and liquid effluent releases and external radiation are additive or need to be addressed separately given actual exposure pathways. The location of offsite dose receptors and the determination of actual exposure pathways should be based on the results of a current land use census for the site. The reviewer should determine whether the applicant has applied site-specific information in assigning doses for all identified exposure pathways, or instead has assumed that all exposures occur at one location in bounding dose estimates, where doses from gaseous and liquid effluent releases and external radiation are summed up and compared to the EPA standards. In such instances, the applicant should provide a commitment to reassess compliance with the EPA standards, as implemented under 10 CFR 20.1301(e), by appropriately assigning doses with actual exposure pathways once site-specific information becomes available on their locations within the vicinity of the site.

16. Operational Programs. The reviewer verifies that the PCP, as part of the process and effluent monitoring and sampling program, is fully described and that implementation milestones have been identified. The reviewer verifies that the program and implementation milestones are included in the application, as described in SRP Section 13.4.

    Implementation of this program will be inspected in accordance with NRC IMC-2504, "Construction Inspection Program - Non-ITAAC Inspections." The applicant should describe the PCP and its implementation, which is included in the license condition on operational programs and implementation, using the guidance in SRP Chapter 16, Section 5.6, Reporting Requirements, as described in SRP Sections 13.4 and 13.5.

17. For the review of a DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), set forth in the FSAR meets NRC regulations, guidance and acceptance criteria. The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional

COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to FSAR Sections 1.8 and 1.9.

For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, ESP, other NRC approvals (e.g., manufacturing license, site suitability report or topical report), or proposes other reactor technology. The staff will confirm that the applicant has properly incorporated the relevant information from the DC or that of another design into the COL application, addressed all COL action items associated with specific design aspects of SSCs (e.g., balance of plant topics not covered in the design) left to the COL applicant, and considerations driven by site-specific features.

For reviews of both DC and COL applications, the guidance of SRP Section 14.3 should be followed to conduct the review of ITAAC. The review of ITAAC cannot be completed until after the completion of the review conducted using the guidance in this section and related others, as warranted by design features.

For reviews of a COL application relying on a DC, 10 CFR 52.63 precludes the staff from imposing new requirements on the DC unless it is deemed necessary to bring the certification in compliance with NRC regulations applicable and in effect at the time the certification was issued, provide adequate protection of public health and safety, or preserve common defense and security. A DC has finality for issues resolved at the DC stage, and the staff can only make changes to this information if it meets one of the standards in 10 CFR 52.63. If a COL applicant seeks to make changes to information within the scope of a DC (as Tier 1, 2, or Tier 2* information), then it must also follow the appropriate change process in Section VIII of the DC. Accordingly, the reviewer should ensure that plant design features of the certified design are maintained in the COL application and that, if requested, the 10 CFR Part 52 process for seeking exemptions, changes, and departures is observed in changing Tier 1, Tier 2, and Tier 2* information. These provisions apply only to those portions of the DC that are incorporated by reference in the COL and do not apply to site-specific design features that are within the scope of the COL.

In instances where an applicant has submitted conceptual design information for portions of the plant for which the application does not seek certification, the review should confirm that the applicant has submitted sufficient details for the staff to conduct its evaluation of the associated SSCs, assess the adequacy of interface requirements with other SSCs that are included in the DC, and confirm the adequacy of proposed ITAAC and methods used in verifying that all interface requirements have been met by a COL applicant under the requirements of 10 CFR 52.47(a)(24) through 10 CFR 52.47(a)(26), 10 CFR 52.79(d)(2), and 10 CFR 52.80(a).

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the staff's safety review and analysis, conducted in accordance with the staff's review approach described in the SRP Introduction, support conclusions of the following types to be included in the staff's SER. The reviewer also states the bases for those conclusions. When programmatic elements are used to assess design adequacy and effects on the development of new or modifications of existing operational programs, the reviewer confirms that the applicant has properly identified

those elements of the program in DC and COL FSAR Section 13.4 (Table 13.4-x), as supplemental elements to an existing program or as the addition of a new program.

The staff concludes that the design of the SWMS (either as a permanently installed system or in combination with mobile systems), which includes the equipment necessary to process liquid, wet, and dry solid wastes and to control releases of radioactive materials associated with the operation of the SWMS, is acceptable and meets the requirements of 10 CFR 20.1301and 10 CFR 20.1302, 10 CFR 20.1406, 10 CFR 20.2006, 10 CFR 20.2007, and 10 CFR 20.2108; 10 CFR 50.34a, 10 CFR 50.34(f), 10 CFR 50.36a and 10 CFR Part 50, Appendix I dose objectives and ALARA provisions; GDC 2, GDC 3, GDC 60, GDC 61, and DC 63; 10 CFR 61.55 and 10 CFR 61.56; 10 CFR Part 71 and 49 CFR Parts 171–180 for the proper classification, characterization, packaging, shipment, and disposal of radioactive wastes; and applicable NRC BTPs and RGs.

The reviewer states the bases for those conclusions, as listed below:

1. The applicant has demonstrated that the SWMS, either as a permanently installed system or in combination with mobile systems, includes the equipment and instrumentation used for the processing, packaging, and storage of radioactive wastes before shipment to an offsite licensed land disposal facility or waste processors. The scope of the review of the SWMS includes flow diagrams of the system, P&IDs, process and effluent radiation monitoring, sampling, and control instrumentation, and descriptive information for the SWMS and for those auxiliary supporting systems that are essential to the operation of the SWMS. The staff has reviewed the applicant's proposed design criteria and design bases for the SWMS, as well as the applicant's analysis of those criteria and bases. The ability of the proposed system to process the types and volumes of wastes, including radionuclides and radioactivity levels expected during normal operation and AOOs, are in accordance with GDC 60, GDC 61, and GDC 63; provisions for the handling of wastes under the requirements of 10 CFR 61.55, 10 CFR 61.56, 10 CFR Part 71; and applicable DOT regulations under 49 CFR Parts 171-180. The staff found the design features built into the SWMS to control effluent releases, arising from system operation, to unrestricted areas within the limits of 10 CFR Part 20 to be acceptable.

2. The applicant has described the elements of an operational program addressing the requirements of 10 CFR 61.55 and 10 CFR 61.56 in processing Class A, B, and C wastes and has provided estimates of yearly volume and activity inventories, described onsite short and long-term storage needs, and identified offsite storage at licensed facilities and disposal at approved low-level radioactive waste disposal sites. In addition to the estimates of the amounts of liquid, wet, and dry solid wastes, the inventories address materials and equipment expected to be generated infrequently, such as large components, and describe the plans for their management and disposition. For Greater-than-Class C wastes (e.g., neutron-activated components, in-core neutron detectors, but excluding spent fuel), characterized with concentrations in excess of 10 CFR 61.55 (Table 1) values, the information summarizes the process used to meet these requirements and identify long-term onsite storage needs until disposal becomes available at a facility licensed under 10 CFR Part 60 or 10 CFR Part 63.

3. Based on the staff's review, the applicant's proposed PCP, operating procedures, and TS, as they relate to classifying, processing, and disposing of wastes, meet the requirements of 10 CFR Part 61, 10 CFR 20.2006, 10 CFR 20.2007, and 10 CFR 20.2108. The applicant's proposed methods of assuring complete stabilization, encapsulation, and/or dewatering are acceptable, and the processing, design features, and waste storage also meet the provisions of BTP 11-3 and Appendix 11.4-A to this SRP (as it relates to plants with temporary onsite storage facilities for low-level radioactive waste). The basis for acceptance in the staff's review is conformance of the applicant's design, design criteria, design bases, and proposed PCP and TS for the SWMS, including the associated use of mobile processing equipment, to the regulations and regulatory guidance, as referenced above, as well as to BTPs and industry standards.

   The PCP describes, given the proposed waste processing technologies and methods, a set of parameters that are used to process wastes. The PCP identifies surveillance requirements consistent with the plant's TS, administrative procedures, operational procedures, QA and quality control program, radiological controls and monitoring program, information to be contained in annual radiological effluent release reports, reporting requirements to the NRC, instructions on using the NRC's uniform radioactive shipping waste manifest, and the process for initiating and documenting changes to the PCP and its supporting procedures. The applicant has committed in SRP Sections 13.4 and 13.5 to develop a plant-specific PCP before fuel load, based on NEI PCP Template 07-10A, "Generic FSAR Template Guidance for Process Control Program (PCP)." The staff has determined that the applicant's use of NEI PCP Template 07-10A is acceptable. The staff finds the commitment to use NEI PCP Template 07-10A acceptable.

4. If applicable, the staff has reviewed the proposed augmentation of programmatic elements in assessing the adequacy of the SWMS design and resulting effects on the development of the radioactive liquid and gaseous effluent source terms as byproducts of its operation. The staff's evaluation and conclusion of the acceptability of the augmented programmatic elements is addressed in SER Section 13.4 and relevant requirements and guidance identified in SER sections for the systems and components identified in the supplemental or new programmatic elements. The staff concludes that the proposed augmentation of programmatic elements (Note: Staff to provide a summary description and identify other SER sections presenting the staff's evaluation findings) is acceptable and consistent with the ALARA principle described in 10 CFR 20.1101(b) and 10 CFR Part 50, Appendix I design objectives.

5. The applicant has met the requirements of 10 CFR 20.1406 with respect to providing a description of how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of radioactive waste, with supplemental information presented in FSAR Section 12.3-12.4. The staff has reviewed the provisions incorporated in the applicant's design to control the release of radioactive materials resulting from spills, leaks, and inadvertent tank overflows; avoid the contamination of nonradioactive systems; prevent uncontrolled and unmonitored releases of radioactive materials to the environment; and avoid interconnections with potable and sanitary water systems. The staff concludes that the measures proposed by

the applicant are consistent with the requirements of GDC 60 and 61 to 10 CFR Part 50, Appendix A, and 10 CFR 20.1406, and the guidance of RGs 1.143 and 4.21 for wastes produced during normal operation and AOOs. The staff concludes that the proposed design features and operational programs and procedures are consistent with NRC guidance and the requirements of 10 CFR 20.1406.

6. The applicant has met the requirements of Appendix A to 10 CFR Part 50, GDC 60, GDC 61, and GDC 63, with respect to controlling releases of radioactive materials to the environment using available technology. The staff has considered the ability of the proposed SWMS and mobile processing equipment to meet the operational demands of the plant and AOOs and has concluded that the system capacity and design flexibility are adequate to meet the plant's anticipated needs. With respect to 10 CFR Part 50, GDC 64 on radioactive effluent monitoring, the applicant has presented information on the development of a plant and site-specific ODCM, as described in SRP Sections 11.5, 13.4, and 13.5.

7. Compliance with gaseous and liquid effluent concentration limits in unrestricted areas and associated doses to members of the public due to the operation of the SWMS is addressed in SRP Sections 11.2 and 11.3. The staff concludes that the applicant has met the requirements of 10 CFR 20.1301 and 10 CFR 20.1302; effluent concentration limits of Table 2, and Note 4 of Appendix B to 10 CFR Part 20; and design objectives and ALARA provisions of Sections II.A, II.B, and II.C of Appendix I to 10 CFR Part 50.

8. The applicant has fulfilled the requirements of Section II.D of Appendix I to 10 CFR Part 50 with respect to meeting the ALARA criterion. The staff has considered the potential effectiveness of augmenting the proposed SWMS using items of reasonably demonstrated technology and has determined that further waste treatment will not effect reductions in cumulative population doses reasonably expected within an 80 kilometer (50 mile) radius of the reactor and comply with the cost-benefit ratio of Section II.D of Appendix I.

9. The staff has reviewed the applicant's QA provisions for the SWMS, the quality group and safety classifications used for system components, and the seismic design applied to structures housing these systems. The design of the systems and structures housing these systems meets the guidance of RG 1.143, for wastes produced during normal operation and AOOs. The use of RG 1.143 provides reasonable assurance that the assigned safety classifications for structures housing the SWMS and its components comply with the requirements of GDC 2 and GDC 61, guidance of RG 1.143 for natural phenomena and man-induced hazards, and 10 CFR Part 20 requirements.

10. The applicant has met the requirements of GDC 3 and guidance of RGs 1.143, 1.189, 1.205 and Appendix 11.4-A in protecting the SWMS and plant areas where radioactive wastes are processed and stored from the effects of the detonation of explosive mixtures, exothermic reactions, and fires and combustion of radioactive wastes. The operation of the SWMS and plant facilities, where systems are located, will not be compromised in meeting radiation protection

dose standards for workers and effluent concentration limits and doses for members of the public under the requirements of 10 CFR Part 20. This conclusion is based, in part, on the results of a parallel evaluation and fire protection analysis performed in SRP Section 9.5.1.1 for plant areas where combustible or flammable radioactive materials are expected to be present during operation. The staff finds the scope of the fire protection program and operational safeguards adequate as it they relates to system design features and commitment to conduct fire hazards analyses involving the presence of combustible or flammable radioactive materials.

11. The staff has reviewed the sources of radiation and radioactivity and associated doses to members of the public and concludes that annual doses from the SWMS and other sources of radioactivity released via effluent discharges and radiation from the site (which may have either single or multiple reactor units), including liquid and gaseous effluents and external radiation exposures from buildings and storage tanks, as a source of external radiation, will not exceed the EPA generally applicable environmental radiation standards of 40 CFR Part 190, as implemented under 10 CFR 20.1301(e). SRP Section 12.3-12.4 evaluates the doses associated with external radiation from buildings and sources of radioactivity contained in systems and components.

12. All liquid and gaseous effluent releases associated with the operation of the SWMS are controlled by the ODCM, as it relates to the PCP's aspect with process and effluent monitoring and sampling. The applicant has committed in SRP Sections 11.5, 13.4, and 13.5 to develop a plant and site-specific ODCM before fuel load, based on NEI ODCM Template 07-09A, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description." The staff's evaluation of the ODCM and acceptability of NEI ODCM Template 07-09A are presented in SRP Section 11.5.

13. For DC and COL reviews, the findings will also summarize the staff's evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this SRP section and confirm that the applicant has met NRC requirements and guidance described in the application. If requested by the COL applicant, the findings will confirm whether the 10 CFR Part 52 licensing process for seeking exemptions, changes, and departures in the COL application was observed in changing specific features of the DC in Tier 1, Tier 2, and Tier 2* information, and that resulting changes in plant design features and operations will ensure compliance with NRC regulations and guidance once the facility is constructed and operating in conformity with the COL.

    In instances where an applicant has submitted conceptual design information for portions of the plant for which the application does not seek certification, the findings will summarize the staff's evaluation in confirming that the applicant has submitted supplemental design details for the associated SSCs, adequately addressed interface requirements with other SSCs that are included in the DC, and determined the adequacy of the proposed ITAAC and methods used in verifying that all interface requirements have been met by the COL applicant under the requirements of 10 CFR 52.47(a)(24) through 10 CFR 52.47(a)(26), 10 CFR 52.79(d)(2), and 10 CFR 52.80(a).

In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of ESP, CP, DC, OL or COL applications submitted by applicants pursuant to 10 CFR Part 50 and 10 CFR Part 52. The staff will use the method described herein to evaluate conformance with Commission regulations as noted below. With respect to demonstrating conformance with the SRP, NRC regulations state, in part, that the application must contain "an evaluation of the standard plant design against the SRP revision in effect 6 months before the docket date of the application." However, an applicant is required to identify differences between this SRP section and design features, analytical techniques, and procedural measures proposed for the facility, and discuss how the proposed alternatives to the SRP acceptance criteria provide acceptable methods in complying with regulations that underlie SRP acceptance criteria and meet NRC regulatory requirements under 10 CFR 50.34(h), 10 CFR 52.17(a)(1)(xii), 10 CFR 52.47(a)(9), and 10 CFR 52.79(a)(41) for ESP, CP, DC, OL and COL applications.

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APPENDIX 11.4-A

DESIGN GUIDANCE FOR TEMPORARY STORAGE OF LOW-LEVEL RADIOACTIVE WASTE

I. INTRODUCTION

The objective of this technical position is to provide guidance to licensees considering additional onsite low-level radioactive waste (LLRW) storage capabilities. While it may be prudent and/or necessary to establish additional onsite storage capability, waste should not be placed in contingency storage if it can be disposed readily at a licensed disposal site. Shipping waste at the earliest practicable time minimizes the need for eventual waste reprocessing caused by potential changes in a disposal facility's requirements, reduces occupational and non-occupational exposures and potential accident consequences, and, in the event of burial ground closure, maximizes the amount of storage space available for use.

The duration of the intended storage, the type and form of waste, and the amount of radioactive material present will dictate the safeguards and the level of complexity required to assure public health and safety and minimal risk to operating personnel. For longer intended storage periods, a higher degree of controls will be required for radiation protection and accident prevention. The duration of the onsite storage safety hazard is predicated on the type of waste being stored, radionuclide distributions, concentrations and total inventories, physical and chemical stability and potential corrosive interactions with waste containers over the expected duration of storage, and how readily radioactivity might be transported into the environment in the event of spills and leaks. In general, it is preferable to store radioactive material in solid form. Under some circumstances, however, temporary storage in a liquid or wet form may be desirable or required, but the associated storage methods and conditions must be thoroughly understood for implementation purposes. The specific design and operation of any storage facility will be significantly influenced by the various waste forms; consequently, this document addresses wet waste, stabilized wet waste, and dry low-level radioactive waste regulated under 10 CFR Part 61 and equivalent Agreement State regulations.

II. GENERAL INFORMATION

Before implementing any additional onsite storage capacity, licensees should conduct a comprehensive safety review and environmental assessments to assure adequate public health and safety protections and minimal environmental impact. The acceptance criteria and performance objectives of any proposed storage facility or area will need to meet minimal requirements in design, operations, safety considerations, policy considerations, and compliance with other applicable Federal, State, and local regulations governing any other toxic or hazardous properties of radioactive wastes (such as mixed wastes characterized by the presence of hazardous chemicals and radioactive materials). For purposes of this technical position, the major emphasis will be on safety considerations for storing, handling, and eventual disposition of radioactive wastes. Design and operational acceptability will be based on specific requirements, which are defined in existing SRP sections, regulatory guides, and industry standards for the proper management of radioactive wastes. Considerations for waste minimization and volume reduction will also need to be part of an overall site waste management plan and evaluation of various onsite storage alternatives. Licensees and applicants should implement additional waste management considerations for ALARA, decontamination, and decommissioning of the temporary storage facility, including disposal, as

early as possible, because future requirements for waste forms and packaging may make wastes stored under current requirements unacceptable for final disposition.

Facility design and operation should assure that radiological consequences of postulated accidents or AOO events (e.g., fire, tornado, seismic occurrence, and flood) do not exceed acceptance criteria, as defined in RG 1.143 given the requirements of GDC 2 and GDC 61. For plants currently licensed under 10 CFR Part 50, the facility design and operation should assure that radiological consequences of design basis events (e.g., fire, tornado, seismic occurrence, and flood) do not exceed a small fraction (10 percent) of 10 CFR Part 100 dose limits (i.e., no more than a few Sieverts whole body dose).

Further guidance is provided in GL No. 80-009, 81-038, and 81-039, and in SECY-94-198 and SECY-93-323. It should be noted that under SECY-94-198 and SECY-93-323, the provision requiring a 10 CFR Part 30 license for the storage of waste beyond 5 years has been eliminated. However, the balance of the technical information presented in GL No. 81-038 on the storage of low-level waste remains applicable for the purpose of this guidance. NRC and industry guidance provide further information on waste storage, including RIS 2004-17 (Revision 1), RIS 2008-32, and RIS 2011-09, and EPRI Report 1018644.

The added storage capacity should typically consider the anticipated low-level waste volumes generated over the operational life of the plant, with wastes generated during decommissioning being addressed under separate NRC regulatory requirements and guidance. Licensees should determine the design storage capacity (volume and radioactive material inventories) from historical and projected waste generation rates for all units, considering both volume minimization/reduction programs and the need for surge capacity due to operations which may generate infrequent or unusually large amounts of waste, e.g., plant components (e.g., steam generators) and bulk quantities (e.g., spent charcoal) and describe the plans for the management and disposition of such wastes.

In considering expanded storage capacity, licensees should consider the design and construction of additional volume reduction facilities (e.g., trash compactors, shredders, incinerators, etc.), as necessary, and then process wastes that may have been stored during their construction. Regional or State low-level waste compacts and unaffiliated States may establish new or additional low-level waste disposal sites in the future under 10 CFR Part 61 or equivalent Agreement State regulations.

III. GENERALLY APPLICABLE GUIDANCE

1. The quantity of radioactive material allowed and the shielding configurations will be dictated by the dose rate criteria for both the site boundary and unrestricted areas or site. The EPA limits, under 40 CFR Part 190, will restrict the annual doses from direct radiation and effluent releases from all sources within the uranium fuel cycle, and 10 CFR 20.1302 limits the exposure rates in unrestricted areas. Offsite doses from onsite storage must be sufficiently low to account for other uranium fuel cycle sources (e.g., an additional dose of less than or equal to 0.01 mSv (1 mrem) per year is not likely to exceed the dose limits of 10 CFR 20.1301 and 20.1302; effluent concentration limits of Table 2 and Note 4 of Appendix B to 10 CFR Part 20; or 40 CFR Part 190 dose limits, as implemented under 10 CFR 20.1301(e). Onsite dose limits associated with temporary storage will be controlled per 10 CFR Part 20, including the ALARA principle of 10 CFR 20.1101.

2. Compatibility of the container materials with waste forms and with environmental conditions external to the containers is necessary to prevent significant container corrosion. Container selection should be based on data that demonstrate minimal corrosion from the anticipated internal and external environment for a period well in excess of the planned storage duration. Container integrity after the period of storage should be sufficient to allow handling during transportation and disposal without container breach due to the effects of internal corrosion and interactions of waste materials.

   Gas generation from organic materials in waste containers can also lead to container breach and potentially inflammable or explosive conditions. To minimize the number of potential problems, licensees should evaluate the potential for gas generation, gas generation rates, results of radiolysis, biodegradation, or chemical reaction with respect to container breach and the creation of flammable or explosive conditions. Unless storage containers are equipped with special vent design features that allow depressurization and collection of gases (in preventing the migration of radioactive and combustible gases into ambient areas), spent resins loaded with significant inventories of radioactive materials should not be stored for longer than approximately one year.

   Licensees should implement a program providing for at least periodic (quarterly) visual inspections of container integrity (e.g., for indication of swelling, bulging, generation of corrosion products, leaks, or breach). Inspections can be accomplished by the use of television monitors; by walkthroughs if storage facility layout, shielding, and container storage array permit; or by selecting waste containers that are representative of the types of waste and containers stored in the facility and placing them in a location specifically designed for inspection purposes. All inspection procedures developed should minimize radiation occupational exposures using the guidance in RGs 8.8 and 8.10. The use of HICs (300-year lifetime design) would permit an inspection program of reduced scope, while recognizing that because of likely elevated external radiation levels, inspection procedures may require additional cautionary instructions.

3. If possible, the preferred location of the additional storage facility is inside the plant's protected area. If adequate space in the protected area is not available, the licensee should place the storage facility on the plant site and establish both a physical security program (fence, locked and alarmed gates and doors, and periodic security patrols) and include a restricted area for radiation protection purposes, consistent with 10 CFR Part 20 requirements and ALARA guidance of RGs 8.8 and 8.10. The facility should not be in a location that requires transportation of wastes over public roads unless no other feasible alternatives exist. Licensees must conduct any transportation over public roads in accordance with the NRC and DOT regulations (10 CFR Part 71 and 49 CFR Parts 171-180).

4. Licensees should implement operational safety features to prevent the accidental dropping of containers from cranes and forklifts or the puncturing of containers from forklifts during the movement and transportation of radioactive waste containers. Personnel should receive training in the proper operation of such equipment and instruction on the use of methods to securely hold containers on such equipment (e.g., tie-downs, gates, cages). The corresponding safety program should be based on the

results of a failure analysis, given the type of equipment and operations planned to be conducted.

5. The facility should include design features, in accordance with 10 CFR 20.1406 and guidance of RG 4.21, that would minimize, to the extent practicable, contamination of the waste facility and environment; facilitate eventual decommissioning; and minimize, to the extent practicable, the generation of extraneous radioactive waste. This requirement applies to storage facilities used to process and store liquid, wet, dry solid, and stabilized wastes, and large components (e.g., steam generators, activated components, etc.) and bulk wastes (e.g., spent charcoals removed from gas delay tanks or beds).

6. Radioactive materials should be processed, handled, and stored using equipment, methods, and procedures that avoid or minimize potential releases of radioactivity in the event of a fire. The GDC 3 relates to fire protection features for SSCs important to safety and can be used to provide guidance for SWMS design features and operational safeguards to prevent, for example, introduction and mixing of chemical additives with ion-exchange resins in avoiding the generation of exothermic reactions and explosive gas mixtures. When spent-activated carbon is stored in bulk quantities, storage methods and procedures should consider the potential for spontaneous heating and auto-ignition of activated carbon, which may be due to radioactive decay heat and adsorption of various vapors and gases, including oxygen. Using GDC 3 provides reasonable assurance that radioactive materials are protected from the effects of fires and that the function of plant systems and components will not be compromised in meeting effluent discharge concentration limits of 10 CFR Part 20 associated with releases of contaminated fire protection water and combustion gases and smoke. In considering fire protection, RGs 1.189 and 1.205 explains the primary objectives of fire protection programs at nuclear power plants, and describes the NRC regulatory framework. RG 1.189 and 1.205 explain that in order to meet NRC regulations, a fire hazards analysis should demonstrate that the plant will maintain the ability to minimize the potential for radioactive releases in plant areas and to the environment in the event of a fire. Such events are treated as AOOs, which should not result in unacceptable radiological consequences under the criteria of 10 CFR Part 20. The requirements and dose limits for protection against radiation during plant operations appear in 10 CFR 20.1201 and 10 CFR 20.1202 for plant workers, 10 CFR 20.1301 and 10 CFR 20.1302 for members of the public, and effluent concentration limits of Appendix B to 10 CFR Part 20 (Table 2, Columns 1 and 2).

7. Licensees shall describe the elements of an operational program addressing the requirements of 10 CFR 61.55 and 10 CFR 61.56 in processing Class A, B, and C wastes and provide estimates of volume and activity inventories, describe onsite short and long-term storage needs, identify offsite storage at licensed facilities and disposal at approved low-level radioactive waste disposal sites. For Greater-than-Class C wastes (e.g., neutron-activated components, in-core neutron detectors, but excluding spent fuel), characterized with concentrations in excess of 10 CFR 61.55 (Table 1) values and as activated metals, radioactive sources, alpha emitting transuranics, and Pu-241 and Cm-242, the information should present the process used to meet these requirements and identify long-term onsite storage needs until disposal becomes available at a facility licensed under 10 CFR Part 60 or 10 CFR Part 63.

8. For low-level dry waste and stabilized waste storage, the following criteria apply:

   A. Licensees shall monitor potential releases and release pathways of all radionuclides present in stabilized waste forms as described in Section VI, Appendix A to 10 CFR Part 50. Surveillance programs shall incorporate adequate methods for detecting failure of container integrity and measuring and controlling releases to the environment. For outside storage, licensees shall conduct periodic direct radiation and surface contamination monitoring to ensure that levels are below limits specified in 10 CFR 20.1301 and 10 CFR 20.1302, 10 CFR Part 71, and Subpart I (Class 7) of 49 CFR Part 173. All containers should be decontaminated to these or lower levels before storage.

   B. Structures housing dry and stabilized wastes should be designed to seismic criteria as defined in this SRP section and in SRP Sections 11.2, 11.3, and 12.3-12.4 and RG 1.143 for wastes produced during normal operation and AOOs. Licensees should incorporate provisions for collecting liquid drainage, including provisions for sampling all collected liquids. Routing of the collected liquids should be to radwaste systems if contamination is detected or to normal discharge pathways if the water ingress is from external sources and remains uncontaminated by plant-generated radioactivity. All such releases must be controlled under the provisions of the ODCM or an equivalent program for standalone storage facilities.

   C. Waste stored in outside areas should be held securely by installed holddown systems. The holddown system should secure all containers during severe environmental conditions, up to and including a range of postulated accidents or design-basis event (as required) for the waste storage facility. Long-term waste storage in outdoor conditions should be justified in terms of its necessity and duration.

   D. Licensees should assure container integrity against corrosion from the external environment, including external weather protection where necessary and practical. Storage containers should be raised off storage pads where water and snow/ice accumulations can be expected to cause external corrosion and possible degradation of container integrity resulting in premature failures and leaks.

   E. Licensees should establish maximum radioactive material inventory limits (in becquerels and curies) for all expected waste forms, based on the design of the storage area, dose limits for members of the public, radiation monitoring, required postings and markings, requirements for controlled access and material security, and safety features or protective measures described in the plant's radiation protection program.

   F. Licensees should maintain inventory records by waste forms, radionuclides and types of radioactive materials, dates of storage, shipment, and other relevant data. Inventory records should be maintained and updated periodically as wastes are being accumulated, and be readily accessible in the event of an emergency in guiding first responders and for assessing potential radiological impacts.

G. The facility design should incorporate provisions for a ventilation exhaust system (for storage areas) and an airborne radioactivity monitoring system (building exhaust vents) where there is a potential for airborne radioactivity to be generated or to accumulate. All such releases must be controlled under the provisions of the ODCM or an equivalent program for standalone storage facilities.

IV. WET RADIOACTIVE WASTE STORAGE

1. Wet radioactive waste is defined as any liquid, liquid/solid slurry, sludge, resins, or other process concentrates. For storage considerations, wet waste is further defined as any waste that contains free liquid in amounts exceeding the requirements for burial as established by the NRC or a burial ground licensing authority.

2. The design of the facility's supporting structure and tanks should prevent uncontrolled and unmonitored releases of radioactive materials resulting from spillage or accident conditions. Steel liners covering floors and lower portions of walls should be considered in rooms and cubicles where significant volumes of liquid and wet wastes are stored to ensure containment in the event of a major container failure or leak.

3. The following design objectives and criteria apply to wet radioactive waste storage facilities:

   A. Structures that house liquid radwaste storage tanks should be designed to seismic criteria as defined in this SRP section and SRP Sections 11.2, 11.3 and 12.3-12.4, and guidance of RG 1.143 for wastes produced during normal operation and AOOs. Foundations and walls shall also be designed and fabricated to contain the liquid inventory that might be released during a container/tank failure and include provisions to pump liquids to appropriate systems for storage or processing. The design should be reviewed and evaluated against the requirements of 10 CFR 20.1406 and guidance of RG 4.21, and applicable industry standards.

   B. All tanks or containers should be designed to withstand the corrosive nature of the types of wet wastes being stored. The design shall also consider the duration of storage under which the corrosive conditions exist.

   C. All storage structures should have curbs or elevated thresholds with floor drains and sumps to safely collect wet waste in the event of the failure of all tanks or containers. Steel liners, covering floors and lower portions of walls, should be considered in rooms and cubicles where significant volumes of liquid and wet wastes are stored to ensure containment in the event of a major container failure or leak. There should be provisions to remove or pump spilled wet waste to the radwaste treatment systems.

   D. All tanks and containers shall have provisions to monitor liquid levels and to sound an alarm (local and control room) in the event of potential overflow conditions.

E. All potential releases and release pathways of radioactivity (e.g., evolved gases, breach of container) shall be controlled and monitored in accordance with Appendix A to 10 CFR Part 50, under GDC 60 and GDC 64. Surveillance programs should incorporate appropriate methods for monitoring breach of container integrity or accidental releases. All such releases must be controlled under the provisions of the ODCM or an equivalent program for standalone storage facilities.

F. All temporarily stored wet waste will require additional reprocessing before shipment off site; therefore, provisions should be made to integrate the required treatment using waste processing and stabilization systems. The interface and associated systems should be designed and tested in accordance with the codes and standards described in this SRP section and SRP Sections 11.2 (LWMS) and 11.3 (GWMS) and RGs 1.143 and 4.21 for wastes produced during normal operation and AOOs

G. The facility design should include provisions for a ventilation exhaust system (for storage areas) and an airborne radioactivity monitoring system (building exhaust vents) where there is a potential for airborne radioactivity to be generated or to accumulate, with provisions to collect off gases/vapors/particulates from within components or in areas where such equipment is located, and process gases/vapors/particulates via appropriate exhaust ventilation systems. All such releases must be controlled under the provisions of the ODCM or an equivalent program for standalone storage facilities.

H. Licensees should maintain inventory records by waste types, waste contents, radionuclides and types of radioactive materials, dates of storage, shipment, and other relevant data. Inventory records should be maintained and updated periodically as wastes are being accumulated, and be readily accessible in the event of an emergency in guiding first responders and for assessing potential radiological impacts.

V. STABILIZED RADIOACTIVE WASTE STORAGE

1. Stabilized radwaste for storage purposes is defined as waste that meets stabilized waste criteria for licensed storage or disposal facilities. For purposes of this document, spent resins, activated charcoals, or filter sludge dewatered to the above criteria are included in this waste categorization and criteria.

2. Any storage plans should address container protection and reprocessing requirements for eventual shipment and burial.

3. Casks, tanks, and liners containing stabilized radioactive waste should be designed with good engineering judgment to preclude or reduce the probability of uncontrolled releases of radioactive materials during handling, transportation, or storage. Licensees and applicants must evaluate the accident mitigation and control procedures and their ability to protect the facility from postulated accidents or AOO events (e.g., fire, flooding, tornadoes) as defined in RG 1.143, or under 10 CFR Part 100 (i.e., small fraction of the dose limit) consistent with the licensing basis of the plant.

4. The following design objectives and criteria are applicable to stabilized waste storage containers and facilities:

   A. Structures that house stabilized radwaste should be designed to seismic criteria as defined in this SRP section and SRP Sections 11.2, 11.3, and 12.3-12.4 and guidance of RG 1.143 or current licensing basis for wastes produced during normal operation and AOOs. All stabilized radwaste should be located in restricted areas where effective material control and accountability can be maintained. While structures may be required to meet specific seismic criteria, licensees should employ good engineering judgment to ensure that radioactive materials are contained safely, such as by the use of curbs and drains, and steel liners to contain spills of dewatered resins or sludge.

   B. If liquid wastes exist in a corrosive form, applicants and licensees should implement proven measures to protect containers (i.e., special internal liners or coatings) and/or neutralize all excess liquids. If deemed appropriate and necessary, non-corrosive materials (e.g., stainless steel) should be used. Potential corrosion between solid waste forms and containers should also be considered and minimized during planning and design stages. In the case of dewatered resins, highly corrosive acids and bases can be generated, which will significantly reduce the longevity of containers. The PCP should implement steps to assure the above does not occur and provisions should be made to govern container material selection and pre-coating to ensure that container breach does not occur during temporary or protracted storage periods.

   C. There should be provisions for additional reprocessing or repackaging in the event of container failures, as required by DOT shipping regulations and license disposal facility criteria for final transportation and disposal or long-term storage. Licensees should designate isolated staging areas used for decontamination activities and provide methods and equipment for decontamination. When significant handling and personnel exposures are anticipated, licensees should incorporate ALARA methodology using the guidance in RGs 8.8 and 8.10.

   D. Licensees should develop and implement procedures for early detection, prevention, and mitigation of accidents (e.g., fires from combustible materials and explosive gas mixtures). Storage areas and facility designs should incorporate good engineering features and capabilities for handling accidents and provide safeguard systems, such as fire detection and suppression systems (e.g., smoke detectors and sprinklers) using the guidance in RG 1.189 and 1.205, as described earlier. If water sprinkler systems are used, floors should be sloped to drain into local floor sumps or curbed to prevent water runoff to uncontrolled areas and avoid unmonitored releases using the guidance in RGs 1.143 and 4.21. Licensees should establish personnel training and administrative procedures to ensure both control of radioactive materials and minimize personnel exposures. Fire suppression devices may not be necessary if combustible materials in the area are minimal, based on the results of a fire hazards and protection analysis. The guidance provides reasonable assurance that radioactive materials are protected from the effects of fires and that the function of plant systems and components will not be compromised in meeting

effluent discharge concentration limits of 10 CFR Part 20 associated with releases of contaminated fire protection water and combustion gases and smoke.

E. The facility design should incorporate provisions for a ventilation exhaust system (for storage areas and venting of equipment) and an airborne radioactivity monitoring system (building exhaust vents) where there is a potential for airborne radioactivity to be generated or to accumulate. All such releases must be controlled under the provisions of the ODCM or an equivalent program for standalone storage facilities.

F. Licensees should maintain inventory records by waste forms, radionuclides and radioactive material, dates of storage, shipment, and other relevant data. Inventory records should be maintained and updated periodically as wastes are being accumulated, and be readily accessible in the event of an emergency in guiding first responders and for assessing potential radiological impacts.

VI. LOW-LEVEL DRY WASTE STORAGE

1. Low-level dry waste is classified as contaminated material (e.g., paper, trash, rags, clothing, plastics, glass, metal scraps, wood, air filters, and spent charcoal media) that contains radioactive materials dispersed randomly in relatively small concentrations throughout large volumes of inert material and contains no free water. Generally, this category also includes items and material that cannot be readily decontaminated, such as tools and instruments, trash, etc. Depending on their physical properties, some types of dry wastes can be compacted and processed to reduce their bulk shipping volumes.

2. Licensees should implement controls to segregate and minimize the generation of low-level dry waste to lessen the impact on waste storage capacity. Licensees should consider the integration of volume reduction equipment to minimize the need for additional waste storage facilities. The design should be reviewed and evaluated against the requirements of 10 CFR 20.1406 and guidance of RG 4.21, and applicable industry standards.

3. The following design objectives and criteria are applicable for low-level dry waste storage containers and facilities:

   A. Structures that house dry waste should be designed to seismic criteria as defined in this SRP section and SRP Sections 11.2, 11.3, and 12.3-12-4, and guidance of RG 1.143 for wastes produced during normal operation and AOOs. All dry or compacted radwaste should be located in restricted areas where effective material control and accountability can be maintained. While structures may be required to meet specific seismic criteria, licensees should use good engineering judgment to ensure the radioactive material is contained safely.

   B. There should be provisions made for additional reprocessing or repackaging in the event of container failures and as required by DOT shipping regulations and license disposal facility criteria for final transportation and disposal or long-term storage. Licensees should designate isolated staging areas used for decontamination activities and provide methods and equipment for decontamination. When significant handling and personnel exposures are

anticipated, licensees should incorporate ALARA methodology described in RGs 8.8 and 8.10.

C. Licensees should develop and implement procedures for early detection, prevention, and mitigation of accidents (e.g., fires from combustible materials). Storage areas and facility designs should incorporate good engineering features and capabilities for handling accidents and provide safeguard systems, such as fire detection and suppression systems (e.g., smoke detectors and sprinklers) using the guidance of RGs 1.189 and 1.205, as described earlier. If water sprinkler systems are used, floors should be sloped to drain into local floor sumps or curbed, and steel liners should be used to prevent water runoff to uncontrolled areas and avoid unmonitored releases using the guidance in RGs 1.143 and 4.21. Licensees should establish personnel training and administrative procedures to ensure both control of radioactive materials and minimize personnel exposures. Fire suppression devices may not be necessary if combustible materials in the area are minimal, based on the results of a fire hazards and protection analysis. The guidance provides reasonable assurance that radioactive materials are protected from the effects of fires and that the function of plant systems and components will not be compromised in meeting effluent discharge concentration limits of 10 CFR Part 20 associated with releases of contaminated fire protection water and combustion gases and smoke.

D. The facility design should incorporate provisions for a ventilation exhaust system (for storage areas and venting of equipment) and an airborne radioactivity monitoring system (building exhaust vents) where there is a potential for airborne radioactivity to be generated or to accumulate. All such releases must be controlled under the provisions of the ODCM or an equivalent program for standalone storage facilities.

E. Licensees should maintain inventory records by waste forms, radionuclides and types of radioactive materials, dates of storage, shipment, and other relevant data. Inventory records should be maintained and updated periodically as wastes are being accumulated, and be readily accessible in the event of an emergency in guiding first responders and for assessing potential radiological impacts.

VII. GREATER-THAN-CLASS C WASTE STORAGE

For Greater-than-Class C wastes, characterized with concentrations in excess of 10 CFR 61.55 (Table 1) values and, characterized as activated metals, radioactive sources, alpha emitting transuranics, and Pu-241 and Cm-242, the information should present the process used to meet these requirements and identify long-term onsite storage needs until disposal becomes available at a facility licensed under 10 CFR Part 60 or 10 CFR Part 63. This provision does not address the management and storage of spent fuel.

Licensees should describe the elements of an operational program addressing the processing, packaging, storage, inspection, radiation monitoring of such wastes and adjacent areas, posting and marking requirements, and access controls. The operational program should be consistent with all of the requirements of 10 CFR Part 20 for the handling of such wastes and control of personnel exposures in conformance with generally applicable guidance, as described earlier.

A. Structures that house Greater-Than-Class C wastes should be designed to seismic criteria as defined in this SRP section and SRP Sections 11.2, 11.3, and 12.3-12.4 and guidance of RG 1.143 for wastes produced during normal operation and AOOs. The design of waste containers should ensure integrity and durable containment of the radioactivity during normal and a range of expected abnormal conditions. The waste container materials should not support combustion, e.g., containers made of wood, fiberboard, or plasticized cardboard materials are not acceptable. The packaged material should not cause fires through spontaneous chemical exothermic reactions, retained heat, or generation of explosive gas mixtures.

B. Containers should comply with the applicable criteria of 10 CFR Part 71 and 49 CFR Parts 171-180 to minimize the need for repackaging for future shipments.

C. Increased container handling and personnel exposure should be anticipated; consequently, licensees should incorporate all applicable ALARA provisions described in RGs 8.8 and 8.10.

D. Facility design should provide for a ventilation exhaust system (for storage areas) and an airborne radioactivity monitoring system (building exhaust vents) where there is a potential for airborne radioactivity to be generated or to accumulate. All such releases must be controlled under the provisions of the ODCM or an equivalent program for standalone storage facilities.

E. Licensees should maintain inventory records by waste forms, radionuclides and types of radioactive materials is, dates of storage, shipment, and other relevant data. Inventory records should be maintained and updated periodically as wastes are being accumulated, and be readily accessible in the event of an emergency in guiding first responders and for assessing potential radiological impacts.

VIII. REFERENCES

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3. U.S. Code of Federal Regulations, "Radiation Protection Programs," § 20.1101, Chapter 1, Title 10, "Energy.”

4. U.S. Code of Federal Regulations, "Occupational Dose Limits for Adults," § 20.1201, Chapter 1, Title 10, "Energy.”

5. U.S. Code of Federal Regulations, "Compliance with Requirements for Summation of External and Internal Doses," § 20.1202, Chapter 1, Title 10, "Energy.”

6. U.S. Code of Federal Regulations, "Dose Limits for Individual Members of the Public," § 20.1301, Chapter 1, Title 10, "Energy."

7. U.S. Code of Federal Regulations, "Compliance with Dose Limits for Individual Members of the Public," § 20.1302, Chapter 1, Title 10, "Energy."

8. U.S. Code of Federal Regulations, "Minimization of Contamination," § 20.1406, Chapter 1, Title 10, "Energy."

9. U.S. Code of Federal Regulations, "Rules of General Applicability to Domestic Licensing of Byproduct Material," Part 30, Chapter 1, Title 10, "Energy."

10. U.S. Code of Federal Regulations, "Contents of Applications; Technical Information," § 50.34, Chapter 1, Title 10, "Energy."

11. U.S. Code of Federal Regulations, "Fire Protection," § 50.48, Chapter 1, Title 10, "Energy."

12. U.S. Code of Federal Regulations, "Domestic Licensing of Production and Utilization," Part 50, Chapter 1, Title 10, "Energy," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

13. U.S. Code of Federal Regulations, "Domestic Licensing of Production and Utilization," Part 50, Chapter 1, Title 10, "Energy," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion 3, "Fire Protection."

14. U.S. Code of Federal Regulations, "Domestic Licensing of Production and Utilization," Part 50, Chapter 1, Title 10, "Energy," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."

15. U.S. Code of Federal Regulations, "Domestic Licensing of Production and Utilization," Part 50, Chapter 1, Title 10, "Energy," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control."

16. U.S. Code of Federal Regulations, "Domestic Licensing of Production and Utilization," Part 50, Chapter 1, Title 10, "Energy," Appendix A, "General Design Criteria for Nuclear Power Plants," General Design Criterion 64, "Monitoring Radioactivity Releases."

17. U.S. Code of Federal Regulations, "Licensing Requirements for Land Disposal of Radioactive Waste," Part 61, Chapter 1, Title 10, "Energy."

18. U.S. Code of Federal Regulations, "Waste Classification," § 61.55, Chapter 1, Title 10, "Energy."

19. U.S. Code of Federal Regulations, "Waste Characteristics," § 61.56, Chapter 1, Title 10, "Energy."

20. U.S. Code of Federal Regulations, “Packaging and Transportation of Radioactive Material,” Part 71, Chapter 1, Title 10, “Energy.”

21. U.S. Code of Federal Regulations, “Reactor Site Criteria,” Part 100, Chapter 1, Title 10, “Energy.”

22. U.S. Code of Federal Regulations, Title 40, Chapter 1, Part 190 - "Environmental Radiation Protection Standards for Nuclear Power Operations," Subpart B, Environmental Standards for the Uranium Fuel Cycle. (as implemented under 10 CFR § 20.1301(e).)

23. U.S. Code of Federal Regulations, Subchapter C, Hazardous Materials Regulations," Parts 171–180, Chapter 1, Title 49, "Transportation.”

24. U.S. Nuclear Regulatory Commission, Generic Letter 80-009, “Low Level Radioactive Waste Disposal,” January 29, 1980.

25. U.S. Nuclear Regulatory Commission, Generic Letter 81-038, “Storage of Low Level Radioactive Wastes at Power Reactor Sites,” November 10, 1981.

26. U.S. Nuclear Regulatory Commission, Generic Letter 81-039, “NRC Volume Reduction Policy,” November 1981.

27. U.S. Nuclear Regulatory Commission, “Design Guidance for Radioactive Waste Management Systems, Structures, and Components Installed in Light-Water-Cooled Nuclear Power Plants,” Revision 2. Regulatory Guide 1.143, ADAMS Accession No. ML013100305.

28. U.S. Nuclear Regulatory Commission, “Fire Protection for Nuclear Power Plants,” Regulatory Guide 1.189. ADAMS Accession No. ML092580550.

29. U.S. Nuclear Regulatory Commission, “Risk-Informed, Performance-Based Fire Protection for Existing Light-Water Nuclear Power Plants,” Regulatory Guide 1.205. ADAMS Accession No. ML092730314.

30. U.S. Nuclear Regulatory Commission, “Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning,” Regulatory Guide 4.21. June 2008. ADAMS Accession No. ML082120212.

31. U.S. Nuclear Regulatory Commission, “Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable,” Regulatory Guide 8.8. ADAMS Accession No. ML003739549.

32. U.S. Nuclear Regulatory Commission, “Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable,” Regulatory Guide 8.10. ADAMS Accession No. ML13350A207.

33. U.S. Nuclear Regulatory Commission, RIS 2004-17, “Revised Decay-In-Storage Provisions for the Storage of Radioactive Waste Containing Byproduct Material, Revision 1.” September 27, 2004.

34. U.S. Nuclear Regulatory Commission, RIS 2008-32, “Interim Low Level Radioactive Waste Storage at Reactor Sites.” December 30, 2008 (ADAMS Accession No. ML082190768).

35. U.S. Nuclear Regulatory Commission, RIS 2011-09, “Available Resources Associated with Extended Storage of Low-Level Radioactive Waste.” August 16, 2011 (ADAMS Accession No. ML111520042).

36. U.S. Nuclear Regulatory Commission, “Withdrawal of Proposed Rulemaking to Establish Procedures and Criteria for On-Site Storage of low-Level Radioactive Waste After January 1, 1996,” SECY-93-323. ADAMS Accession No. ML080720113.

37. U.S. Nuclear Regulatory Commission, “Review of Existing Guidance Concerning the Extended Storage of Low-Level Radioactive Waste,” SECY-94-198. ADAMS Accession No. ML071640462.

SRP Section 11.4
Description of Changes

Section 11.4 "Solid Waste Management System"

This SRP section affirms the technical accuracy and adequacy of the guidance previously provided in Section 11.4, Revision 3, dated March 2007, of this SRP (ADAMS Accession No. ML070710397).

Editorial changes included adding new abbreviations in several places throughout this section and correcting grammatical errors. Other changes reflect the removal of redundant information.

Technical changes incorporated in this revision include:

I. AREAS OF REVIEW

The areas of review section was revised by identifying additional technical areas that warrant staff evaluation in assessing the design and performance characteristics of the SWMS in recognition of existing guidance and regulatory requirements. In part, the additional technical topics identified here also support the expanded topics listed in review interfaces. The additional areas of review address:

1. Quality assurance provisions given the guidance of RG 1.143 for SWMS systems not covered by the requirements of 10 CFR Part 50, Appendix B.

2. Expanded discussions on design features to prevent, control, and collect radioactive materials from building ventilation systems and ductwork, and gases vented from SWMS components and mobile processing equipment. The discussions now also refer to RGs 1.54 and 4.21 and industry guidance under NEI 08-08A in meeting the requirements of 10 CFR 20.1406.

3. For processing systems equipped with automatic control features, justification for the placement of isolation or diversion dampers/valves and radiation detectors on process piping, ductwork, and effluent discharge lines to ensure the timely closure of valves and dampers upon the detection of elevated radioactivity levels, and, if part of the design, controls in monitoring deviations of process and discharge flow rates and terminating releases or isolating process flows when deviations exceed preset limits.

4. Design features and operational safeguards to prevent the introduction and mixing of chemical additives with adsorption media to avoid the generation of exothermic reactions and explosive gas mixtures in SWMS components.

5. With respect to the management of all expected forms of radioactive wastes, the guidance addresses inventories of radioactive wastes that will be generated infrequently, such as large components, activated components, and Greater-than-Class C wastes (e.g., neutron-activated components, in-core neutron detectors, etc., but excluding spent fuel). The guidance considers planning and the management of such wastes onsite over short and long-term storage duration if offsite storage and offsite disposal at licensed facilities are not available during the operational life of the plant.

6. The listing of plant systems identified in review interfaces has been expanded to ensure that the staff's review of radiological considerations is properly integrated with parallel and complementary evaluations conducted by other technical disciplines. For systems that contribute potential liquid and gaseous wastes to process streams and effluents managed by the LWMS and GWMS, the following SRP sections were identified with technical and regulatory interfaces. The SRP Sections are 1.8, 1.9, 2.1.2, 2.3, 7.1, 7.5, 7.6, 7.7, 9.2.3, 9.5.1.1, 12.3-12.4, 13.3, 13.5, 14.2, and 14.3 and associated BTPs as noted in each SRP section.

II. ACCEPTANCE CRITERIA

The acceptance criteria section and Appendix 11.4-A of this SRP section were revised by including citations of existing regulatory requirements not cited in the prior SRP and providing clarification on methods in used calculating radioactive source terms and doses to members of the public in demonstrating compliance with 10 CFR Part 20 and 10 CFR Part 50, Appendix I. The major additions include:

1. Addition of a discussion on 10 CFR 20.1101(b), as it relates to the use of procedures and engineering controls in maintaining doses to members of the public ALARA.

2. Addition of a discussion on 10 CFR 50.36a(b), as it relates to experience with the design, construction, and operations of nuclear power reactors in complying with 10 CFR 20.1301 and in maintaining doses to members of the public ALARA.

3. Addition of a discussion on 10 CFR 20.1501, as it relates to the conduct of radiation surveys in monitoring ambient external radiation levels and airborne concentrations in areas and rooms where wastes are being processed, held, stored, and readied for shipment.

4. Addition of a discussion on 10 CFR 50.48, as it relates to the conduct of fire hazards analyses in minimizing the potential for radioactive releases in plant areas and to the environment in the event of a fire involving radioactive materials.

5. Addition of a discussion on 10 CFR Part 50, Appendix A, GDC 2, as it relates to the design bases of structures housing SWMS and its components using the guidance in RG 1.143 in assigning seismic and quality group classifications, and safety classifications for natural phenomena and man-induced hazards as defined in RG 1.143 in assigning safety classifications to SWMS SSCs for design purposes.

6. Addition of a discussion on 10 CFR Part 50, Appendix A, GDC 3, as it relates to the design of SWMS systems and operational safeguards to avoid the generation of explosive gas mixtures and exothermic reactions through the inadvertent introduction and mixing of chemical agents with adsorption media using the guidance in RGs 1.189 and 1.205 in conducting fire hazards analyses involving the presence of radioactivity in combustible or flammable materials. Using GDC 3 provides reasonable assurance that radioactive materials are protected from the effects of fires and that the function of its plant systems and components will not be compromised in meeting effluent discharge concentration limits of 10 CFR Part 20 associated with releases of contaminated fire protection water and combustion gases and smoke.

7. Addition of a discussion on 10 CFR Part 50, Appendix B, QA Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, insofar as it applies to SWMS systems and components not covered by the QA guidance of RG 1.143.

8. Addition of a discussion on 40 CFR Part 190 (EPA generally applicable environmental radiation standards), as implemented under 10 CFR 20.1301(e), as it relates to limits on annual doses from all sources of radioactivity released via effluent discharges and external radiation from site buildings and facilities (with single or multiple reactor units). The SRP guidance has been expanded in evaluating the implementation of standards for sites that have site-specific information on the locations of offsite dose receptors, and those that do not.

9. Clarification on the application of RG 1.143 acceptance criteria related to seismic, safety, and quality group classifications and QA provisions for SSCs of the SWMS produced during normal operation and AOOs. RG 1.143 provides guidance in assigning safety classifications to structures and waste management systems in protecting SSCs against natural phenomena and man-induced hazards. The acceptance criteria are revised to conform to 10 CFR Part 20 dose limits for members of the public and plant workers and their assumed locations in restricted areas for workers and unrestricted areas for members of the public. Also, the revised guidance refers to RG 1.206, Part I, C.I.3, Sections 3.2.1 and 3.2.2 and SRP Section 3.8.4 in identifying applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and differences using the guidance in RG 1.143.

10. Additional clarification is provided on the use of automatic control features and placement of isolation dampers/valves and radiation detectors on process piping, ductwork, and effluents to ensure the timely closure of valves and dampers upon the detection of elevated radioactivity levels, and, if part of the design, controls in monitoring deviations in exhaust flow rates in terminating releases or isolating process flows when deviations exceed preset limits. Other considerations include determining whether system logic demands that a valve or damper should fail in the closed position in protecting the system from further contamination, terminating releases to the environment, or diverting process streams or effluents to appropriate treatment systems.

11. The revision provides guidance on the review of the proposed technical resolution of and medium- and high-priority GSIs identified in the version of NUREG-0933 current on the date 6 months before application and that are technically relevant to the design; how operating experience insights have been incorporated into the plant design; and information necessary to demonstrate compliance with technically relevant portions of the TMI requirements.

12. Updated listing of NRC and industry guidance reflecting operating experience – see updated reference list below.

13. The SRP guidance endorses NEI 08-08A, “Generic FSAR Template Guidance for Life Cycle Minimization of Contamination,” (Revision 0, October 2009) in describing acceptable methods in complying with 10 CFR 20.1406 and guidance of RG 4.21.

14. The SRP guidance endorses NEI PCP Template 07-10A (March 2009) as an acceptable commitment in developing a plant-specific PCP before fuel load, as specified in SRP Section 11.4 and 13.4.

III. REVIEW PROCEDURES

The review procedures section was updated in recognition of the revisions identified in the areas of review and acceptance criteria sections, as noted in explanations above.

IV. EVALUATION FINDINGS

The evaluation findings section was revised by expanding the discussions on the results of the staff's evaluation and conclusion of acceptability against cited regulations and guidance. The revisions address:

1. Using the guidance in RG 1.143, compliance with 10 CFR Part 50, Appendix A, GDC 2 and GDC 61, as they relate to acceptance criteria related to seismic, safety, and quality group classifications and QA provisions for SSCs of the SWMS for liquid and gaseous wastes produced during normal operation and AOOs. The acceptance criteria are revised to conform to 10 CFR Part 20 dose limits for members of the public and plant workers, given assumed locations in restricted areas for workers and unrestricted areas for members of the public.

2. Compliance with 10 CFR Part 50, Appendix A, GDC 3, as it relates to the design of waste handling and treatment media to minimize the generation of explosive gas mixtures and exothermic reactions in systems and components using the guidance in RG 1.189 in conducting of hazards analysis involving the presence of combustible gases and flammable materials.

3. If applicable, proposed augmentation of programmatic elements in assessing the adequacy of the design and resulting effects on the development of associated radioactive gaseous effluent source terms and compliance with 10 CFR Part 20 effluent concentration and dose limits and 10 CFR Part 50, Appendix I design objectives and ALARA provisions.

4. Confirmation that the applicant has committed, given SRP Sections 11.4, 13.4, and 13.5, to develop a plant-specific PCP before fuel load, based on NEI PCP Template 07-10A, "Generic FSAR Template Guidance for Process Control Program (PCP)," March 2009.

V. IMPLEMENTATION

The implementation section was revised by expanding the discussions on the evaluation of DC and COL applications. The expanded discussion address differences between standard plant design features, COL applications, and SRP acceptance criteria, and provide guidance on the acceptability of alternative methods in complying with cited regulations and SRP acceptance criteria.

VI. REFERENCES

The following references were added, with parallel revisions made to Appendix 11.4-A of this SRP section, in supporting the expanded discussions presented in areas of review, acceptance criteria, and review procedures. The added references are:

1. American National Standards Institute, ANSI N42.18-2004, "Specification and Performance of On Site Instrumentation for Continuously Monitoring Radioactivity in Effluents," 2004. Standards are available at http://www.ANSI.org.

2. American National Standards Institute/American Nuclear Society, ANSI/ANS-18.1-1999, "American National Standard Radioactive Source Term for Normal Operation of Light Water Reactors," 1999. Standards are available at http://www.ANSI.org.

3. American National Standards Institute/American Nuclear Society, ANSI/ANS-55.6-1993 (R2007), "Liquid Radioactive Waste Processing System for Light Water Reactor Plants," Reaffirmed in 2007. Standards are available at http://www.ANSI.org.

4. American National Standards Institute/American Nuclear Society, ANSI/ANS 55.1-1992 (R2009), "Solid Radioactive Waste Processing System for Light-Water-Cooled Reactor Plants," 2009. Standards are available at http://www.ANSI.org.

5. American National Standards Institute/American Nuclear Society, ANSI/ANS-40.37-2009, "American National Standard, Mobile Low-Level Radioactive Waste Processing Systems," 2009. Superseded ANSI/ANS-40.37-1993 in 2009. Standards are available at http://www.ANSI.org.

6. American National Standards Institute/Health Physics Society, ANSI/HPS N13.1-2011, "Sampling and Monitoring Releases of Airborne Radioactive Substances from the Stacks and Ducts of Nuclear Facilities." Approved March 30, 2011. Standards are available at http://www.ANSI.org.

7. Electric Power Research Institute, EPRI Report No. 1011730, "Groundwater Monitoring Guidance for Nuclear Power Plants," September 2005. EPRI reports are available at http://www.EPRI.com.

8. Electric Power Research Institute, EPRI Report No. 1018644, "Guidelines for Operating an Interim On Site Low Level Radioactive Waste Storage Facility, Revision 1," February 2009. EPRI reports are available at http://www.EPRI.com.

9. Nuclear Energy Institute, NEI 07-07, "Industry Ground Water Protection Initiative – Final Guidance Document," August 2007. NEI reports are available at http://www.NEI.org.

10. Nuclear Energy Institute, NEI 07-09A, "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description," Revision 0, March 2009. ADAMS Accession No. ML083530745.

11. Nuclear Energy Institute, NEI 07-10A, "Generic FSAR Template Guidance for Process Control Program (PCP)," March 2009. ADAMS Accession No. ML091460627.

12. Nuclear Energy Institute, NEI 08-08A, “Generic FSAR Template Guidance for Life Cycle Minimization of Contamination,” Revision 0, October 2009. ADAMS Accession No. ML093220530.

13. U.S. Code of Federal Regulations, "Radiation Protection Programs," § 20.1101, Chapter 1, Title 10, "Energy.”

14. U.S. Code of Federal Regulations, "Occupational Dose Limits for Adults," § 20.1201, Chapter 1, Title 10, "Energy.”

15. U.S. Code of Federal Regulations, "Compliance with Requirements for Summation of External and Internal Doses," § 20.1202, Chapter 1, Title 10, "Energy.”

16. U.S. Code of Federal Regulations, "General Requirements," § 20.2001, Chapter 1, Title 10, "Energy.”

17. U.S. Code of Federal Regulations, "Transfer for Disposal and Manifests," § 20.2006, Chapter 1, Title 10, "Energy.”

18. U.S. Code of Federal Regulations, "Compliance with Environmental and Health Protection Regulations," § 20.2007, Chapter 1, Title 10, "Energy.”

19. U.S. Code of Federal Regulations, "Records of Waste Disposal," § 20.2108, Chapter 1, Title 10, "Energy.”

20. U.S. Code of Federal Regulations, “Standards for Protection Against Radiation,” Part 20, Chapter 1, Title 10, “Energy,” Appendix B, "Annual Limits on Intake and Derived Air Concentrations of Radionuclides for Occupational Exposure; Effluent Concentrations; Concentrations for Release to Sewerage."

21. U.S. Code of Federal Regulations, “Standards for Protection Against Radiation,” Part 20, Chapter 1, Title 10, “Energy,” Appendix G, “Requirements for Transfers of Low-Level Radioactive Waste Intended for Disposal at Licensed Land Disposal Facilities and Manifests.”

22. U.S. Code of Federal Regulations, "Additional TMI-Related Requirements," § 50.34(f), Chapter 1, Title 10, "Energy.”

23. U.S. Code of Federal Regulations, “Contents of Applications; Technical Information,” § 50.34, Chapter 1, Title 10, “Energy.”

24. U.S. Code of Federal Regulations, “Design Objectives for Equipment to Control Releases of Radioactive Material in Effluents in Nuclear Power Reactors,” § 50.34a, Chapter 1, Title 10, “Energy.”

25. U.S. Code of Federal Regulations, "Technical Specifications on Effluents from Nuclear Power Reactors," § 50.36a, Chapter 1, Title 10, "Energy.”

26. U.S. Code of Federal Regulations, "Fire Protection," § 50.48, Chapter 1, Title 10, "Energy.”

27. U.S. Code of Federal Regulations, "Changes, Tests, and Experiments," § 50.59, Chapter 1, Title 10, "Energy."

28. U.S. Code of Federal Regulations, “Domestic Licensing of Production and Utilization,” Part 50, Chapter 1, Title 10, “Energy,” Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion 2, “Design Bases For Protection Against Natural Phenomena.”

29. U.S. Code of Federal Regulations, “Domestic Licensing of Production and Utilization,” Part 50, Chapter 1, Title 10, “Energy,” Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion 3, “Fire Protection.”

30. U.S. Code of Federal Regulations, “Domestic Licensing of Production and Utilization,” Part 50, Chapter 1, Title 10, “Energy,” Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion 60, “Control of Releases of Radioactive Materials to the Environment.”

31. U.S. Code of Federal Regulations, “Domestic Licensing of Production and Utilization,” Part 50, Chapter 1, Title 10, “Energy,” Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion 61, “Fuel Storage and Handling and Radioactivity Control.”

32. U.S. Code of Federal Regulations, “Domestic Licensing of Production and Utilization,” Part 50, Chapter 1, Title 10, “Energy,” Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion 63, “Monitoring Fuel and Waste Storage.”

33. U.S. Code of Federal Regulations, “Domestic Licensing of Production and Utilization,” Part 50, Chapter 1, Title 10, “Energy,” Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion 64, “Monitoring Radioactivity Releases.”

34. U.S. Code of Federal Regulations, “Domestic Licensing of Production and Utilization,” Part 50, Chapter 1, Title 10, “Energy,” Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants.”

35. U.S. Code of Federal Regulations, “Domestic Licensing of Production and Utilization,” Part 50, Chapter 1, Title 10, “Energy,” Appendix I, “Numerical Guides for Design Objectives and Limiting Conditions for Operation to Meet the Criterion ‘As Low As Is Reasonably Achievable’ for Radioactive Material in Light-Water-Cooled Nuclear Power Reactor Effluents.”

36. U.S. Code of Federal Regulations, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” Part 52, Chapter 1, Title 10, “Energy.”

37. U.S. Code of Federal Regulations, Subpart A, Early Site Permits, "Finality of Early Site Permit Determinations," § 52.39, Chapter 1, Title 10, "Energy."

38. U.S. Code of Federal Regulations, Subpart B, Standard Design Certifications, “Contents of Applications; Technical Information.” § 52.47, Chapter 1, Title 10, “Energy.”

39. U.S. Code of Federal Regulations, Subpart B, Standard Design Certifications, "Finality of Standard Design Certifications," § 52.63, Chapter 1, Title 10, "Energy."

40. U.S. Code of Federal Regulations, Subpart C, Combined Licenses, "Contents of Applications; Additional Technical Information," § 52.80, Chapter 1, Title 10, "Energy."

41. U.S. Code of Federal Regulations, "Waste Classification," § 61.55, Chapter 1, Title 10, "Energy."

42. U.S. Code of Federal Regulations, "Waste Characteristics," § 61.56, Chapter 1, Title 10, "Energy."

43. U.S. Code of Federal Regulations, "Packaging and Transportation of Radioactive Material," Part 71, Chapter 1, Title 10, "Energy."

44. U.S. Code of Federal Regulations, "Packaging and Transportation of Radioactive Material," Part 71, Chapter 1, Title 10, "Energy," Appendix A, "Table A-1, A1 and A2 Values for Radionuclides."

45. U.S. Code of Federal Regulations, Title 40, Chapter 1, Part 190 - "Environmental Radiation Protection Standards for Nuclear Power Operations." Subpart B, Environmental Standards for the Uranium Fuel Cycle. (as implemented under 10 CFR § 20.1301(e).)

46. U.S. Nuclear Regulatory Commission, "Final Waste Classification and Waste Form Technical Position Papers," May 11, 1983.

47. U.S. Nuclear Regulatory Commission, "Issuance of Final Branch Technical Position on Concentration Averaging and Encapsulation," January 17, 1995, ~~as revised,~~ draft Revision 1, August 2011.

48. U.S. Nuclear Regulatory Commission, "Concentration Averaging and Encapsulation, Branch Technical Position," Rev. 1, Vol. 1 and 2, February 2015 (ADAMS Accession No. ML12254B065).

49. U.S. Nuclear Regulatory Commission, DC/COL-ISG-06, "Final Interim Staff Guidance Evaluation and Acceptance Criteria for 10 CFR 20.1406 to Support Design Certification and Combined License Applications," (as incorporated in SRP Section 12.3-12.4). September 9, 2008.

50. U.S. Nuclear Regulatory Commission, "Revised Staff Technical Position on Waste Form (SP-91-13)," January 30, 1991.

51. U.S. Nuclear Regulatory Commission, Generic Letter 80-051, "Letter to Licensees Concerning On-Site Storage of Low-Level Waste," January 5, 1981.

52. U.S. Nuclear Regulatory Commission, Generic Letter 85-14, "Commercial Storage at Power Reactor Sites of Low-Level Radioactive Waste not Generated by the Utility," August 1, 1985.

53. U.S. Nuclear Regulatory Commission, Generic Letter 89-01, “Implementation of Programmatic Controls for Radiological Effluent Technical Specifications in the Administrative Controls Section of the Technical Specifications and the Relocation of Procedural Details of RETS to the Offsite Dose Calculation Manual or to the Process Control Program,” January 31, 1989.

54. U.S. Nuclear Regulatory Commission, Information Notice No. 2006-13, “Ground-Water Contamination Due to Undetected Leakage of Radioactive,” July 10, 2006 (ADAMS Accession No. ML060540038).

55. U.S. Nuclear Regulatory Commission, Information Notice No. 2012-05, “Abnormal Releases of Radioactive Water Potentially Resulting in Groundwater Contamination,” April 25, 2012 (ADAMS Accession No. ML120410213).

56. U.S. Nuclear Regulatory Commission, Information Notice No. 79-07, “Rupture of Radwaste Tanks,” March 23, 1979.

57. U.S. Nuclear Regulatory Commission, Information Notice No. 79-09, “Spill of Radioactively Contaminated Resin,” March 30, 1979.

58. U.S. Nuclear Regulatory Commission, Information Notice No. 83-14, “Dewatered Spent Ion Exchange Resin Susceptibility to Exothermic Chemical Reaction,” March 21, 1983.

59. U.S. Nuclear Regulatory Commission, Information Notice No. 84-72, “Clarification of Conditions for Waste Shipments Subject to Hydrogen Gas Generation,” September 10, 1984.

60. U.S. Nuclear Regulatory Commission, Information Notice No. 85-92, “Surveys of Wastes Before Disposal from Nuclear Reactor Facilities,” December 2, 1985.

61. U.S. Nuclear Regulatory Commission, Information Notice No. 86-20, “Low-Level Radioactive Waste Scaling Factors, 10 CFR Part 61," March 28, 1986.

62. U.S. Nuclear Regulatory Commission, Information Notice No. 87-07, “Quality Control of Onsite Dewatering/Solidification Operations by Outside Contractors,” February 3, 1987.

63. U.S. Nuclear Regulatory Commission, Information Notice No. 88-08, “Chemical Reactions with Radioactive Waste Solidification Agents,” March 14, 1988.

64. U.S. Nuclear Regulatory Commission, Information Notice No. 89-13, “Alternate Waste Management Procedures in Case of Denial of Access to Low-Level Waste Disposal Sites,” February 8, 1989.

65. U.S. Nuclear Regulatory Commission, Information Notice No. 90-31, “Update on Waste Form and High Integrity Container Topical Report Review Status, Identification of Problems with Cement Solidification and Reporting of Waste Mishaps,” May 4, 1990.

66. U.S. Nuclear Regulatory Commission, Information Notice No. 90-50, “Minimization of Methane in Plant Systems and Radwaste Shipping Containers,” August 8, 1990.

67. U.S. Nuclear Regulatory Commission, Bulletin No. 79-19, “Packaging of Low-Level Radioactive Waste for Transportation and Burial,” August 10, 1979.

68. U.S. Nuclear Regulatory Commission, Bulletin No. 80-10, “Contamination of Nonradioactive System and Resulting Potential for Unmonitored, Uncontrolled Release of Radioactivity to Environment,” May 6, 1980.

69. U.S. Nuclear Regulatory Commission, Circular No. 77-10, “Vacuum Conditions Resulting in Damage to Liquid Process Tanks,” July 15, 1977.

70. U.S. Nuclear Regulatory Commission, Circular No. 77-14, “Separation of Contaminated Water Systems from Uncontaminated Plant Systems,” November 22, 1977.

71. U.S. Nuclear Regulatory Commission, Circular No. 79-21, “Prevention of Unplanned Releases of Radioactivity,” October 19, 1979.

72. U.S. Nuclear Regulatory Commission, Circular No. 80-18, “10 CFR 50.59 Safety Evaluations for Changes to Radioactive Waste Treatment Systems,” August 22, 1980, implemented using RG 1.187.

73. U.S. Nuclear Regulatory Commission, Circular No. 81-09, “Containment Effluent Water That Bypasses Radioactivity Monitor,” July 10, 1981.

74. U.S. Nuclear Regulatory Commission, Inspection Manual Chapter IMC-2504, “Construction Inspection Program - Non ITAAC Inspections,” issued April 25, 2006 (ADAMS Accession No. ML12298A017).

75. U.S. Nuclear Regulatory Commission, Inspection Procedure 84850, “Radioactive Waste Management-Inspection of Waste Generator Requirements of 10 CFR Part 20 and 10 CFR Part 61,” December 22, 2008 (ADAMS Accession No. ML083510736).

76. U.S. Nuclear Regulatory Commission, NUREG/BR-0204, “Instructions for Completing NRC’s Uniform Low-Level Radioactive Waste Manifest.” July 1998 (ADAMS Accession No. ML071870172).

77. U.S. Nuclear Regulatory Commission, NUREG/CR-2731, “An Evaluation of the Safety Aspects of the Design and Operation of Temporary/Mobile Radioactive Waste Solidification Systems,” May 1982.

78. U.S. Nuclear Regulatory Commission, NUREG/CR-3587, “Identification and Evaluation of Facility Techniques for Decommissioning of Light Water Reactors.” June 1986 (ADAMS Accession No. ML081360413).

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