U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD FOR NuScale SMR DESIGN

11.4 SOLID WASTE MANAGEMENT SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of the effectiveness of radwaste systems and health physics.

Secondary - Organizations responsible for the review of (1) radwaste system design and performance, and (2) solid waste materials.

I. AREAS OF REVIEW

The integral pressurized water reactor (iPWR) solid waste management system (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 of 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).

This 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 iPWR SWMS has been categorized as nonsafety-related and nonrisk-significant. Failure of the system 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 liquid effluent and gaseous releases and in complying with U.S. Nuclear Regulatory Commission (NRC) regulations on the characterization and classification for the disposal of low-level radioactive wastes. The applicant's final safety analysis report (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), gaseous waste management system (GWMS) for treatment. 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.

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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 Design-Specific Review Standard (DSRS) includes 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), including 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. The inventories of radioactive wastes should also address materials and equipment expected to be generated infrequently, such as large components, and describe the plans for the management and disposition of such wastes. Provisions 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 Title 10 of the Code of Federal Regulations (CFR) Part 60 or 10 CFR Part 63.

2. 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 for the development of the process control program (PCP).

3. 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 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). 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, 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.

4. 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.

5. 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.

6. Types and characteristics of filtration systems, ion-exchange resins, and adsorbent media to treat liquid and wet wastes, including expected removal efficiencies and decontamination factors, grouped by the physical and chemical properties of specific waste streams. The information describing types of proposed filtration and adsorption media should include details from suppliers, as generic or plant-specific information.

7. If neutron activation products are expected in reactor pool water and secondary coolant, the applicant should document the basis for the presence of additional radionuclides contained in related process waste streams and provide sufficient information for the staff to conduct an independent evaluation to address these neutron activation products. This information should characterize the presence and concentrations of neutron activation products in solid wastes, sludge, spent resins, spent filter cartridges, various types of bulk filtration and adsorption media, spent HEPA and charcoal filters, contaminated tools and equipment, among other wastes, as generated during plant operations and outages and maintenance activities.

8. Description of the methods used for volume reduction of dry compactibles 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).

9. 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.

10. 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.

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

12. 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.

13. 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.

14. Quality group and safety classifications of piping and equipment and the bases (safety classifications and applicable codes and standards) governing the classifications assigned in accordance with Regulatory Guide (RG) 1.143 for wastes produced during normal operation and AOOs , and RG 1.143 natural phenomena and man-induced hazards in assigning safety classifications of SSCs for the SWMS.

15. 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.

16. Quality assurance (QA) provisions for radioactive waste management systems, structures and components in support of design criteria in accordance with the guidance of RG 1.143 for liquids, wet and solid wastes produced during normal operation and AOOs.

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

18. 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 of DSRS Sections 9.4, 11.3, and 11.5 and RG 1.140 and 1.143.

19. Designs features of structure and component 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.

20. For processing systems equipped with automatic control features, justification for the placement of isolation or diversion 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.

21. Design provisions incorporated in equipment and facility to facilitate operation and maintenance in accordance with RG 1.143 or as referenced in topical reports, and previous experience with similar equipment and methods referenced in the FSAR or other supporting documents (e.g., FSAR of operating plants) in support of the design basis.

22. 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 of RG 4.21 and NUREG/CR-3587, given the requirements of 10 CFR 20.1406.

23. 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 inflammable materials (dry wastes, spent resins, HEPA filters, and activated charcoals) containing radioactivity, using the guidance of RG 1.143 and 1.189 as they relate to the conduct of fire hazards analysis involving the presence of combustible gases and inflammable materials.

24. 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.

25. 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 and/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 in accordance with RG 1.143 for wastes produced during normal operation and AOOs.

26. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed ITAAC associated with the structures, systems, and components (SSCs) related to this DSRS section in accordance with Standard Review Plan (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 this portion of the application has been reviewed against acceptance criteria contained in this DSRS section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3 and RG 1.215.

27. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items and requirements and restrictions (e.g., system interfaces and site parameters). 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 conduct its evaluation of the associated SSCs, assess the adequacy of system interfaces 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 would be met by a COL applicant under the requirements of 10 CFR 52.47(a) 24) to 52.47(a)(26), 10 CFR 52.79(d)(2), and 10 CFR 52.80(a).

28. For a COL application referencing a DC. When referencing a DC, a COL applicant 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 Part 52 process for seeking exemptions, changes, and departures is observed in changing Tier 1, Tier 2, and Tier 2* information.

29. 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. The staff also reviews the FSAR to ensure that the PCP aspect of the Process and Effluent Monitoring and Sampling Program and associated milestones are included. Alternatively, a COL applicant can endorse by reference Nuclear Energy Institute (NEI) Template 07-10A, "Generic FSAR Template Guidance for PCP," (ADAMS Accession No. ML091050233) as the basis of the PCP until a plant specific PCP is developed before fuel load in accordance with SRP Section 13.4.

Review Interfaces

Systems described in the technical submittal may differ from those outlined in the DSRS or SRP. The staff should use the following recommended DSRS or SRP section interfaces as the basis for reviewing supplemental or complementary information provided in the FSAR for a specific plant design. Other DSRS or SRP sections interface with this section are as follows:

1. Review of the SWMS and waste storage facilities given the use or presence of inflammable or combustible materials (as spent resins, charcoal media, and HEPA filters and dry wastes) is performed under SRP Section 9.5.1 using RG 1.189 as it relates to the conduct of fire hazards analysis involving the presence of combustible gases and inflammable materials.

2. The reviews of interfaces with certified standard designs, COL information items, and conformance with regulatory guidance (RG, SECY, regulatory issue summary (RIS), bulletins, notices, and generic letters) are performed under SRP Sections 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 in SRP Section 2.1.2 and DSRS Section 11.5, unless already integrated in the information presented in DSRS Sections 11.2 and 11.3 for the LWMS and GWMS, respectively.

4. 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 under DSRS Sections 3.3.1, 3.3.2, 3.4.2, 3.5.3, 3.7.1 through 3.7.3, 3.8.4, 3.8.5 and SRP Section 3.7.4 and natural phenomena and man-induced hazards listed in RG 1.143 in assigning safety classifications to SSCs for the SWMS.

5. Review of the acceptability of the seismic and quality, safety and group classifications for structures and system components is performed under DSRS Sections 3.2.1 and 3.2.2.

6. The review of the interface of the SWMS with process fluids collected by equipment and floor drains is performed in DSRS Sections 9.3.3, 9.3.4, and 10.4.

7. The review of design features of building exhaust and ventilation systems servicing radiologically controlled areas where SWMS equipment and radioactive materials are located and used to vent tanks and process equipment where radioactive materials are present (e.g., via the use of high efficiency particulate air and activated charcoal filters) is performed under DSRS Sections 9.4.1 and 11.3. DSRS Sections 11.5 and 11.6 provide guidance on the review of for instrumentation used to monitor and control

(terminate and/or divert) liquid and gaseous process streams and associated ventilation systems.

8. The review of interfaces of radiation monitoring instrumentation and controls used by the SWMS, including provisions for automatic control features and interdependence with sensing elements other than radioactivity (e.g., fluid level, valve position, and system pressure, flow rate, and temperature), is performed using the guidance presented in DSRS Sections 11.5, 11.6 and 9.3.2. The review addresses the types and placement of such sensors in plant systems or skid-mounted processing equipment, operational ranges and qualification of sensing elements in supporting the functions of radiation monitoring systems, functional interdependence and logic in alarming and terminating or diverting process or effluent streams in complying with doses for members of the public and effluent concentration limits under 10 CFR Part 20, before exceeding design objectives of Appendix I to 10 CFR Part 50, in preventing the radioactive contamination of otherwise non-radioactive plant systems, and in avoiding unmonitored and uncontrolled releases of radioactive materials in the environment.

9. Review of technical specifications (TS) is performed under DSRS Sections 16.0 and 11.5, as they relate to administrative programs on radioactive effluent controls and monitoring.

10. Review of QA is performed under SRP Chapter 17 and RG 1.143 as they apply to the design, fabrication, procurement, installation, and testing of SWMS systems.

11. Review of a consequence of a liquid or wet waste tank failure with the potential of releasing radioactive materials to outdoor areas and a usable water supply is conducted under DSRS Section 11.2 and BTP 11-6.

12. If not included in the review of DSRS 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 under DSRS Section 9.4 and, for instrumentation used to monitor and control radioactive effluent releases, under DSRS Section 11.5.

13. Review of the SWMS design provisions incorporated to control, sample, and monitor radioactive materials in liquid, wet, and solid waste process and effluent streams is performed under DSRS Section 11.5.

14. 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 under DSRS Chapter 7 and SRP Section 13.3. In this context, the review, using RG 1.97, addresses the performance, design, qualification, display, QA, and selection of monitoring variables of radiation monitoring equipment required for accident monitoring and sampling.

15. The review of the interface of the SWMS with the demineralized water makeup system, as it relates to the supply of seal water to systems and components containing radioactivity and design features to prevent the cross-contamination of non-radioactive systems and avoid unmonitored and uncontrolled releases to the environment via non-radioactive systems.

16. Review of design features for the protection of potable and sanitary water systems is conducted under DSRS Sections 9.2.4 and 11.5, as they relate to system interfaces in avoiding potential bypass routes to non-radioactive systems.

17. Review of the Standard Radiological Effluent Controls (SREC), as they relate to elements of the PCP, is conducted under DSRS Section 11.5.

18. If not included in the review of DSRS 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's requirements set forth in 10 CFR 20.1302 and 10 CFR 20.1301(e), Table 2 effluent concentrations and Note 4 unity criterion of Appendix B to 10 CFR Part 20, and design objectives and "as low as reasonably achievable" (ALARA) provisions of Appendix I to 10 CFR Part 50, based on information in DSRS Section 11.1 using RG 1.112 and NUREG-0017 (PWR-GALE code and GALE86 - see discussion in DSRS Section 11.1 and Interim Staff Guidance (ISG), DC/COL-ISG-5 (July 2008).) (as modified to reflect the design features of iPWRs), and Appendix 11.4-A. The applicant should document the basis of differences, with sufficient supporting information included in the application, to allow the staff to conduct an independent evaluation of the applicant's use of alternate code parameters.

19. 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 DSRS Chapter 12 using RG 8.8 and 8.10.

20. The review of design features of the SWMS attributed for compliance with 10 CFR 20.1406 using RG 4.21 and NEI 08-08A (ADAMS Accession No. ML093220530) is performed in DSRS Section 12.3 – 12.4.

21. For COL reviews of operational programs, the review of the applicant's implementation plan is performed under SRP Section 13.4, "Operational Programs," and 13.5.2 "Operating and Emergency Operating Procedures."

22. 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 in DSRS Sections 14.2, 11.5, and 9.3.2 using RG 1.68 and 1.33.

23. The completeness of the description of the SWMS design and its operational features are reviewed in SRP Section 14.3 to ensure that there is sufficient information for introduction in Tier 1, Tier 2, and Tier 2* in confirming 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 Commission regulations:

1. 10 CFR Part 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 and 10 CFR 20.1302 and Table 2, Columns 1 and 2 and Note 4 unity criterion 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 Part 50.34, as it relates to the kinds and quantities of radioactive materials expected to be produced during operations and the means to control and limit radioactive effluent releases and radiation exposures within the limits of 10 CFR 20.1301 and 20.1302 for members of the public.

5. 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 Part 50.

6. 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.

7. 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.

8. 10 CFR Part 50, Appendix I, Sections II.A, II.B, II.C, and II.D, as they relate to the numerical guides for design objectives, ALARA provisions, and limiting conditions for operation to meet the ALARA criterion. DSRS Sections 11.2 and 11.3 evaluate source terms and doses from liquid and gaseous effluents. In turn, DSRS Section 11.5 addresses the means to demonstrate compliance with all sources of effluents. DSRS Section 12.3 - 12.4 evaluates doses associated with external radiation from buildings and contained sources of radioactivity contained in systems and components.

9. 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 process streams and external radiation from site buildings and facilities (with single or multiple reactor units).

10. Appendix B to 10 CFR Part 50, Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants for SWMS systems and components not covered by the QA guidance of RG 1.143.

11. 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, as it relates to the design bases of structures housing SWMS and its components using the guidance of RG 1.143 in assigning seismic and quality group classifications, and safety classifications for natural phenomena and man-induced hazards in assigning the safety classifications to SSCs of the SWMS for design purposes .

12. GDC 3, as it relates to the design of SWMS systems and components 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.

13. 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 the handling of solid wastes produced during normal plant operation, including AOOs.

14. 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.

15. 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.

16. 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.

17. 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 characteristics, 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.

18. 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).

19. 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.

20. 10 CFR 20.2108, as it relates to the maintenance of waste disposal records until the NRC terminates the pertinent license requirements.

21. 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.

22. 49 CFR 173.443, as it relates to methods and procedures used to monitor 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.

23. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria 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's regulations.

24. 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 COL, the provisions of the AEA, and the NRC's regulations.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are set forth below. The DSRS is not a substitute for the NRC's regulations, and compliance with it is not required. As an alternative, and as described in more detail below, an applicant may identify the differences between a DSRS section and the design features (DC and COL applications only), analytical techniques, and procedural measures proposed in an application and discuss how the proposed alternative provides an acceptable method of complying with the NRC regulations that underlie the DSRS acceptance criteria.

1. The SWMS design parameters are based on expected radionuclide distributions and concentrations consistent with LWR operating experience as evaluated under DSRS Sections 11.1, 11.2, and 11.3.

2. Processing equipment is sized to handle the design SWMS inputs, that is, the types of liquid, wet, and solid wastes; radionuclide distributions and concentrations; radionuclide removal efficiencies and decontamination factors; waste volume reduction and increase factors; waste volumes; and waste generation rates.

3. All liquid and wet wastes will be stabilized in accordance with a 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 criteria of Branch Technical Position (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 in accordance with the criteria of BTP 11-3.

5. PCP and ODCM, under Appendix 11.4-A of this DSRS Section and DSRS 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 and 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 provide sufficient storage capacity to allow time for shorter lived radionuclides to decay before shipping in accordance with the citeria of BTP 11-3 and RIS 2004-17, 2008-32, and 2011-09. The FSAR should give the bases for determining the duration of the storage.

8. SWMS components and piping systems, as well as structures housing SWMS components, are designed in accordance with 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 provide the means to reduce leakage and facilitate operations and maintenance in accordance with the provisions of RG 1.143 and 4.21, BTP 11-3, and industry guidance (NEI 08-08A and 07-07), 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, in accordance with the guidance of DC/COL- Interim Staff Guidance (ISG)-06, 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 to this DSRS section, 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 liquid, wet, and dry solid wastes will be processed and disposed of in accordance with 10 CFR 61.55 and 10 CFR 61.56 requirements for waste classification and characteristics and with the waste acceptance criteria of the chosen licensed radioactive waste disposal site. The PCP should present the process and methods used to meet these 10 CFR Part 61 requirements.

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) values 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 10 CFR Part 61 requirements, with the exclusion of 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 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 and ODCM.

16. Operational Programs. For COL reviews, the description of the operational program and proposed implementation milestone for the PCP aspect of the Process and Effluent Monitoring and Sampling Program are reviewed in accordance with 10 CFR 20.1301 and 20.1302, 10 CFR 50.34a, 10 CFR 50.36a, and 10 CFR 50, Appendix I, Section II and IV. Its implementation is required by a license condition, as described in SRP Sections 13.4 and 13.5.

17. For processing systems equipped with automatic control features, the design 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. Acceptable guidance is presented in DSRS Section 11.5 and American Nuclear Society (ANS) N42.18-2004.

18. 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 of DSRS Sections 9.4, 11.3, and 11.5, RG 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.

19. The seismic design of structures housing SWMS components, the safety and quality group classifications of radwaste treatment equipment, and provisions to prevent and collect spills from indoor and outdoor storage tanks should conform to the guideance of RG 1.143 for liquids, wet wastes, and solid 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 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 DSRS Section 3.8.4 identify applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and discuss differences from the recommendations of RG 1.143.

The relevant RGs, ISGs and BTPs are as follows:

1. 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 DSRS Sections 11.2 and 11.3 for the LWMS and GWMS, respectively.

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

3. 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 dose objectives and ALARA provisions, unless already addressed in DSRS Sections 11.2 and 11.3 for the LWMS and GWMS in processing and treating effluents generated during the operation of the SWMS.

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 and components 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 and the provisions used to control leakages of liquids and liquid wastes produced during normal operation and AOOs, and natural phenomena and man-induced hazards listed in RG 1.143 in assigning the safety classifications to SSCs of the SWMS for design purposes.

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 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 necessary to demonstrate compliance with 10 CFR 20.1406. DC/COL-ISG-06 is incorporated in DSRS 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 the PCP methods and 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, and dry solid and compactable wastes

Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this DSRS 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. 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 unity criterion 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 the 10 CFR 20.1301 dose limits to individual members of the public will not be exceeded. The review in this DSRS section will include an evaluation of whether the above-identified dose requirements are met. Meeting the requirements on 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 in DSRS Sections 11.2 and 11.3 and will be evaluated in those DSRS 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 or exceeds that noted in NRC guidance, standard DCs, and industry standards, or topical reports. The NRC guidance includes NUREG-0017 and RG 1.112 (as modified) as they relate to the use of acceptable methods for calculating radionuclide concentrations in process streams and annual 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 DSRS 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 specifies 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 further or released to the environment. The holdup times are used in the source term calculations employing the methods described in NUREG-0017 and RG 1.112 (as modified). The applicant should document the basis of differences, with sufficient supporting information included in the

application, to allow the staff to conduct an independent evaluation of the applicant's use of alternate code parameters.

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 and Note 4 unity criterion specified in Table 2, Columns 1 and 2, of Appendix B to 10 CFR Part 20. Meeting the requirement of GDC 60 provides reasonable assurance that the resulting 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 Department of Transportation (DOT) shipping regulations under 49 CFR Parts 171–180.

Appendix 11.4-A and BTP 11-3 to this DSRS section 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 systems, structures, and components 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 and Note 4 unity criterion 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 under DSRS Section 12.0.

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 and BTP 11-3 to this DSRS section 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 systems, structures, and components 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 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 DSRS Section 3.8.4 identify applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and discuss differences from the recommendations 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.

The implementation 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 for natural phenomena and man-induced hazards in assigning the safety classifications to SSCs of the SWMS for design purposes.

6. GDC 3 requires that SSCs important to safety be designed and located, consistent with other safety requirements, to minimize the probability and effect of fires and explosions. With respect to the SWMS, GDC 3 relates to 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; and presence of combustible radioactive materials, such as spent resins, charcoal media, HEPA filters, and dry solid and compactable wastes.

   Meeting the requirements of 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. Specific NRC guidance in meeting the requirements of GDC 3 is provided in RG 1.189, 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 addressed under SRP Section 9.5.1 for plant areas identified with the presence of combustible or inflammable radioactive materials.

   RG 1.189 explains the primary objectives of fire protection programs at nuclear power plants, and describes the regulatory framework the NRC has established, including but not limited to GDC 3; 10 CFR 50.48, “Fire Protection”; and the radiological exposure criteria of 10 CFR Part 20. NRC guidance, under 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. The requirements and dose limits for protection against radiation during plant operations appear in Part 20.1201 and Part 20.1202 for plant workers, Part 20.1301 and Part 20.1302 for members of the public, and as effluent concentration limits in Appendix B to 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 for shipment 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 and the classification (as Class A, B, and C), processing, and disposition of solid wastes. The SWMS and PCP should also address the criteria that the different waste classes should satisfy and the various characteristics that the processed liquid wet wastes and Greater-Than-Class C wastes should meet. Item 8 of this DSRS subsection 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 stabilized as required, will not structurally degrade and will be compatible with the disposal site's waste acceptance criteria and the 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. 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. The maximum radionuclide concentrations allowable for land disposal are defined by 10 CFR 61.55 for Class A, B, and C wastes.

10 CFR 20.2108 requires that the records for disposal of licensed materials made under 10 CFR Part 61 must be maintained until the Commission terminates the pertinent license.

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 shipping regulations under 10 CFR Part 71 and 49 CFR Parts 171–180.

Plant TS 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's 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, NUREG-0133, 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," dated January 17, 1995, as revised; "Final Waste Classification and Waste Form Technical Position Papers," dated May 11, 1983; and "Revised Staff Technical Position on Waste Form (SP-91-13)," dated January 30, 1991. Additional information is presented in IE Information Notice No. 86-20, dated 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.

   Meeting the requirements of 10 CFR Part 71 provides reasonable 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 guidance 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. Generic Letter No. 80-009, 81-038, and 81-039, RIS 2004-17, 2008-32, and 2011-09, and industry guidance (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 the necessary equipment, processes, and procedures to satisfactorily process, monitor, store for decay, and provide storage facilities for radioactive wastes before shipment for offsite disposal or further processing by waste processors.

11. Appendix 11.4-A addresses the long-term storage of wet, stabilized, and dry solid wastes and provides guidance for the design of storage facilities.

Appendix 11.4-A provides guidance for applicants when considering onsite low-level radioactive waste 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. Generic Letter No. 80-009, 81-038, and 81-039, and SECY 94-198 and SECY 93-323, RIS 2004-17, 2008-32, and 2011-09, and industry guidance (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's 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 interim storage periods, or minimize the chance of such occurrences, and to preclude or 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/COM-ISG-06, 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 are identified in RG 4.21 Positions C.1 through C.4. DC/COL-ISG-06 is incorporated in DSRS Section 12.3 -12.4.

A. SWMS processing systems (either as permanently installed systems or in combination with mobile equipment) with a potential for leakage shall provide means to control and contain this leakage to prevent contamination of building floors and interconnected systems (e.g., curbing, floor sloping to local drains, floor-to-floor seals over floor expansion joints, wall-to-floor joint seals, 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). As part of the review process, the staff should identify and point out technical and regulatory issues to applicants as they develop the design of specific systems and operational programs in ensuring that prior NRC issues identified in past IN, I&E, circulars, and RIS have been adequately considered in the application.

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 or reuse 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 of RG 1.143 for wastes produced during normal operation and AOOs.

12. 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. DSRS Sections 11.1, 11.2 and 11.3 address sources of radioactivity and doses associated with liquid and gaseous effluents, respectively. DSRS Sections 11.5 and 11.6 the monitoring of all sources of effluents under routine operation and accident conditions. DSRS 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 DSRS 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 DSRS 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 some 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 Part 50, Appendix I. As such, the review of the SWMS requires a more detailed review than other nonsafety-related and nonrisk significant systems given its potential to have direct impact on public health and safety. The staff will evaluate whether the failure of a SWMS system would compromise any safety-related system or component, nor will not prevent the safe shutdown of the plant. The applicant's FSAR will be reviewed to confirm that sufficient information has been provided in the FSAR, including assumptions, results, and conclusions of the failure analysis, in confirming that the failure of essential systems will not result in plant or operating conditions in non-compliance with NRC regulations with respect to radioactive effluent releases, exposures to radiation and radioactive materials, and doses to workers and members of the public.

The NRC staff will review the information describing the design features of the SWMS provided in the FSAR including referenced subsections of DSRS Sections 11.1, 11.2, 11.3, 11.5, and 12.3-12.4, for completeness in accordance with RG1.70 or RG 1.206 , and DC/COL-ISG-06 as incorporated in DSRS Section 12.3 -12.4.

1. Selected Programs and Guidance - In accordance with the guidance in NUREG-0800, "Introduction - Part 2: Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: Integral Pressurized Water Reactor Edition" (NUREG-0800 Intro Part 2) as applied to this DSRS Section, the staff will review the information proposed by the applicant to evaluate whether it meets the acceptance criteria described in Subsection II of this DSRS. As noted in NUREG-0800 Intro Part 2, the NRC requirements that must be met by an SSC do not change under the SMR framework. Using the graded approach described in NUREG-0800 Intro Part 2, the NRC staff may determine that, for certain structures, systems, and components (SSCs), the applicant's basis for compliance with other selected NRC requirements may help demonstrate satisfaction of the applicable acceptance criteria for that SSC in lieu of detailed independent analyses. The design-basis capabilities of specific SSCs would be verified where applicable as part of completion of the applicable ITAAC. The use of the selected programs to augment or replace traditional review procedures is described in Figure 1 of NUREG-0800, Introduction - Part 2. Examples of such programs that may be relevant to the graded approach for these SSCs include:

    - 10 CFR Part 50, Appendix A, General Design Criteria (GDC), Overall Requirements, Criteria 1 through 5
    - 10 CFR Part 50, Appendix B, Quality Assurance (QA) Program
    - 10 CFR 50.49, Environmental Qualification of Electrical Equipment (EQ) Program
    - 10 CFR 50.55a, Code Design, Inservice Inspection and Inservice Testing (ISI/IST) Programs
    - 10 CFR 50.65, Maintenance Rule requirements
    - Reliability Assurance Program (RAP)

- 10 CFR 50.36, Technical Specifications
- Availability Controls for SSCs Subject to Regulatory Treatment of Non-Safety Systems (RTNSS)
- Initial Test Program (ITP)
- Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC)

This list of examples is not intended to be all-inclusive. It is the responsibility of the technical reviewers to determine whether the information in the application, including the degree to which the applicant seeks to rely on such selected programs and guidance, demonstrates that all acceptance criteria have been met to support the safety finding for a particular SSC.

2. In accordance with 10 CFR 52.47(a)(8), (a)(21), and (a)(22), and 10 CFR 52.79(a)(17), (20) and (37), for design certification or combined license applications submitted under Part 52, the applicant is required to (1) address the proposed technical resolution of unresolved safety issues and medium- and high-priority generic safety issues which are identified in the version of NUREG-0933 current on the date up to 6 months before the docket date of the application and which 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 any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v) for a DC application, and except paragraphs (f)(1)(xii), (f)(2)(ix), (f)(2)(xxv), and (f)(3)(v) for a COL application. These cross-cutting review areas should be addressed by the reviewer for each technical subsection and relevant conclusions documented in the corresponding safety evaluation report (SER) section.

3. The P&IDs and the process flow diagrams are reviewed to determine system design, methods of operation, and parameters used in the design (i.e., expected and design flow rates, concentrations of radioactive material, radionuclide distributions, potential bypasses, and waste categories). With respect to potential bypasses, the review considers improper connection to non-radioactive 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 Generic Letter 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, and the reviewer verifies that the applicant makes definite 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 the volumes, radionuclide distributions and concentrations, and radioactive inventories of wastes to be shipped offsite 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 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 inplant storage capacity, for areas designed to accommodate short term 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 availability of system components to handle surge flows, reliance on mobile processing systems, and whether the storage facilities will provide onsite storage duration periods sufficient to permit the decay of shorter lived radionuclides. For specific types of wet wastes, the reviewer will consider characteristics of filtration systems, ion-exchange resins, and adsorbent media (activated charcoal and filter cartridges), electro-deionization and reverse osmosis units, and use of other treatment technologies to treat process and effluent streams or delist specific chemical properties and corresponding removal efficiencies, decontamination factors, and holdup times in meeting the performance criteria of RG 1.112 (and generic guidance of NUREG-0017, as applicable). 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. If neutron activation products are expected in reactor pool water and secondary coolant, the applicant should document the basis for the presence of additional radionuclides contained in related process waste streams (wet and solid) and provide sufficient information for the staff to conduct an independent evaluation to address neutron activation products.. The information should characterize the presence and concentrations of neutron activation products in solid wastes, sludge, spent resins, spent filter cartridges, various types of bulk filtration and adsorption media, spent HEPA and charcoal filters, contaminated tools and equipment, among other wastes, as generated during plant operations and outages and maintenance activities.

8. For longer term onsite storage (e.g., several years, but within the operational life of the plant), the storage facility is compared to the guidance of DSRS Section 11.4 and Appendix 11.4-A. The review should evaluate if existing storage capacity is adequate, and whether 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 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), 20.1201, 20.1301, 20.1302, 20.1406, and 20.2001(a)(2), and Appendix B, Table 2, effluent concentration limits and Note 4 unity criterion; 10 CFR 50.34a(b)(3), 50.36a, 50.59; Part 50, Appendix A, GDC 3, 60, and 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 this DSRS Section and Appendix 11.4-A; GL 80-051, 81-038, 81-039, 80-009, and 85-14; RIS 2004-17 (Rev. 1), 2008-32, and 2011-09; RG 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 onsite low-level radioactive waste (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 DSRS 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 are located, floor surfaces and sumps should be protected with surface coatings that facilitate the decontamination of radioactivity using the guidance of RG 1.54.

D. With respect to the protection of members of the public and environment, the design and operation of an onsite storage facility complies with 10 CFR 20.1101(b), 20.1301, 20.1302, and Appendix B, Table 2, effluent concentration limits and Note 4 unity criterion; 10 CFR Part 50, Appendix I design objectives and ALARA provisions; and EPA's 40 CFR Part 190, as implemented under 10 CFR 20.1301(e).

E. For the protection of plant workers, the design and operation of an onsite LLRW storage facility complies with the requirements of 10 CFR Part 20, Subparts B, C, F, G, H, I and J, and occupational limits of Part 20.1201, Appendix B, Table 1 occupational values, and guidance of RG 8.8 and 8.10.

F. For buildings where contaminated combustible and inflammable radioactive materials are stored, the design includes a fire hazards analysis to identify measures such that fires would not result in unacceptable radiological releases and radiological consequences to the public under the criteria of Part 50, Appendix A, GDC 3, 60, and 64; Part 20.1201 and Part 20.1202; 10 CFR 20.1301 and 20.1302; and Appendix B to Part 20 (Table 2, Columns 1 and 2)

under the guidance of RG 1.189. RG 1.189 explains the primary objectives of fire protection programs at nuclear power plants, and describes the regulatory framework the NRC has established, including but not limited to GDC 3; 10 CFR 50.48 and the radiological exposure criteria of 10 CFR Part 20. NRC guidance, under 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 fire hazards analysis, as described in SRP Section 9.5.1, were used to identify the need for additional fire protection features to mitigate the consequences of a fire.

G. 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 volumes of radioactive wastes beyond that expected during routine plant operations.

1. The quality group and safety classifications of piping and equipment of the SWMS is compared to the guidance of RG 4.21 and 1.143 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, DSRS Sections 3.2.1, 3.2.2, 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.3, 3.8.4, 3.8.5 and SRP Section 3.7.4 will be used to evaluate conformance and exceptions.

2. 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 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 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, using the flow chart, 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 DSRS Section 3.8.4 identify applicable acceptance criteria in evaluating SSCs requiring seismic design considerations and discuss differences from the recommendations of RG 1.143.

3. Review of the PCP and TS (i.e., administrative controls section proposed by the applicant for process and effluent control) is performed for input to the review of DSRS Section 16.0 and this DSRS section. 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 identified as a result of the NRC staff's review. 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.

4. 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 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.

5. 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 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 DSRS section, including a verification of compliance with offsite dose requirements and liquid and gaseous effluent limits associated with the operation of the SWMS; or

   B. With the results of the review incorporated in the evaluation of DSRS 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

6. The SWMS is reviewed to ensure that the design includes provisions to meet the requirements of 10 CFR 20.1406 using 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 features and 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.

E. 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.

F. 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.

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

i. DC/COL-ISG-06, as incorporated in DSRS Section 12.3 - 12.4.

ii. RG 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. DSRS Sections 9.2.4, 9.3.3, 9.3.4, 9.4, 10.4, 11.2, and 11.3.

iv. IE Bulletin No. 79-19 and 80-10; IE Circular Nos. 77-10, 77-14, 79-21, and 81-09; and IE Information Notice Nos. 79-07, 79-09, 84-72, 85-92, 87-07, and 90-31, 2004-05, 2006-13, and 2012-05; and RIS 2008-03. As part of the review process, the staff should identify and point out technical and regulatory issues to applicants as they develop the design of specific systems and operational programs in ensuring that prior NRC issues identified in past IN, I&E, circulars, and RIS have been adequately considered in the application.

v. NRC endorsed ndustry guidance and other industry standards, such as NEI 08-08A (ADAMS Accession No. ML093220530), ANS N42.18-2004, American Nuclear Society (ANSI)/ANS-55.6-1993 (R2007) ANSI/ANS 55.1-1992 (R2009), and ANSI/ANS-40.37-2009

7. The PCP and associated plant TS are reviewed to determine whether they identify all regulatory requirements, follow the NRC's 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 it relates 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, instructions on the use of the NRC's 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, NUREG-0133, 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," dated January 17, 1995, as revised; "Final Waste Classification and Waste Form Technical Position Papers," dated May 11, 1983; and "Revised Staff Technical Position on Waste Form (SP-91-13)," dated January 30, 1991. Additional information is presented in IE Information Notice No. 86-20, dated 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.

8. In determining compliance with the EPA generally applicable environmental radiation standards of 40 CFR Part 190, as implemented 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 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 DSRS or integrated with the evaluation of DSRS Sections 11.2 and 11.3. In turn, DSRS Sections 11.5 and 11.6 address the monitoring of all sources of effluents, under routine operation and accident conditions. DSRS Section 12.3-12.4 evaluates the doses associated with external radiation from buildings and sources of radioactivity contained in systems and components.

   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 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. For COL applicants with site-specific information on the locations of offsite dose receptors, compliance with the EPA standards should provide the justification on the apportionment of doses due to liquid and gaseous effluent releases and external radiation 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.

9. Operational Programs. The reviewer verifies that the PCP aspect 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 FSAR Section 13.4 of the submittal.

   Implementation of this program will be inspected in accordance with NRC Inspection Manual Chapter IMC-2504, "Construction Inspection Program - Non-ITAAC Inspections."

The applicant described the PCP aspect of the Process and Effluent Monitoring and Sampling Program and its implementation which is included in the license condition on operational programs and implementation, in accordance with DSRS Chapter 16, Section 5.6, Reporting Requirements, as described in SRP Sections 13.4 and 13.5.

10. 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., system interfaces and site parameters) set forth in the FSAR meets NRC regulations and 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 the 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, an early site permit (ESP) or other NRC approvals (e.g., manufacturing license, site suitability report or topical report).

    For reviews of both DC and COL applications, SRP Section 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of this section.

    For reviews of a COL application relying on a DC, 10 CFR 52.63 precludes the staff from imposing new requirements on DCs unless it is deemed necessary to bring the certification in compliance with NRC regulations, provide adequate protection of public health and safety, or preserve common defense and security. Accordingly, the reviewer should ensure that plant design features of the certified design are maintained in the COL application and that, if requested, the Part 52 process for seeking exemptions, changes, and departures is observed in changing Tier 1, Tier 2, and Tier 2* information.

    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) to 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, as augmented by the application of programmatic requirements 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.

If acceptable, 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 20.1301 and 20.1302, 10 CFR 20.1301(e), 10 CFR 20.1406, 10 CFR 20.2006, 10 CFR 20.2007, and 10 CFR 20.2108; 10 CFR 50.34a and 10 CFR 50.36a and Part 50, Appendix I design objectives and ALARA provisions; GDC 2, 3, 60, 61, and 63;

10 CFR 61.55 and 61.56; and 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. This conclusion is based on the following:

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 line or flow diagrams of the system, P&IDs, process and effluent radiation monitoring 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, 61, and 63; provisions for the handling of wastes under the requirements of 10 CFR 61.55 and 61.56 and 10 CFR 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 to unrestricted areas within the limits of 10 CFR Part 20, arising from system operations, to be acceptable.

2. The applicant has described the elements of an operational program addressing the requirements of 10 CFR 61.55 and 61.56 in processing Class A, B, and C wastes and has provided estimates of volume and activity inventories, described onsite short and long-term storage needs, has 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 and 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 criteria of BTP 11-3 and Appendix 11.4-A to this DSRS section (as it relates to plants with temporary onsite storage facilities for low-level radioactive waste).

   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 DSRS 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.

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 branch technical positions and industry standards.

4. 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 DSRS Section 12.3 – 12.4. The staff has reviewed the provisions incorporated in the applicant's design to control the release of radioactive materials in wastes 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 RG 4.21 and RG 1.143 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.

5. The applicant has met the requirements of Appendix A to 10 CFR Part 50, GDC 60, 61, and 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 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 DSRS Section 11.5 and SRP Sections 13.4 and 13.5.

6. 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 DSRS Sections 11.2 and 11.3. The staff concludes that the applicant has met the requirements of 10 CFR 20.1301 and 20.1302; effluent concentration limits of Table 2 and Note 4 unity criterion 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.

7. 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. Conformance with 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, and Part 20 requirements.

8. The applicant has met the requirements of GDC 3 and guidance of RG 1.143 and 1.189, 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, in part, is based on the results of a parallel evaluation and fire hazards analysis performed in SRP Section 9.5.1 for plant areas where combustible or inflammable radioactive materials are expected to be present during operation.

9. 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 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 Part 20.1301(e). DSRS Section 12.3-12.4 evaluates the doses associated with external radiation from buildings and sources of radioactivity contained in systems and components.

10. 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 DSRS Section 11.5 and SRP Sections 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," (ADAMS Accession No. ML083530745). The staff has determined the endorsement of NEI ODCM Template 07-09A to be acceptable. The staff finds the commitment to use NEI ODCM Template 07-09A acceptable. The staff's evaluation of the ODCM is presented in DSRS Section 11.5.

11. 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 at a cost of less than $1000 per man-rem or man-thyroid-rem.

12. 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 meet the guidance of RG 1.143 for wastes produced during normal operation and AOOs.

For DC and COL reviews, the findings will also summarize the staff's evaluation of requirements and restrictions (e.g., system interfaces and site parameters) and COL action items relevant to this DSRS 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 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 system interfaces with other SSCs that are included in the DC, and determined the adequacy of the proposed ITAAC and methods used in verifying that all system interfaces have been met by the COL applicant under the requirements of 10 CFR 52.47(a)(24) to 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 regulations in 10 CFR 52.17(a)(1)(xii), 10 CFR 52.47(a)(9), and 10 CFR 52.79(a)(41) establish requirements for applications for ESPs, DCs, and COLs, respectively. These regulations require the application to include an evaluation of the site (ESP), standard plant design (DC), or facility (COL) against the Standard Review Plan (SRP) revision in effect six months before the docket date of the application. While the SRP provides generic guidance, the staff developed the SRP guidance based on the staff's experience in reviewing applications for construction permits and operating licenses for large light-water nuclear power reactors. The proposed small modular reactor (SMR) designs, however, differ significantly from large light-water nuclear reactor power plant designs.

In view of the differences between the designs of SMRs and the designs of large light-water power reactors, the Commission issued SRM- COMGBJ-10-0004/COMGEA-10-0001, "Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews," dated August 31, 2010 (ML102510405) (SRM). In the SRM, the Commission directed the staff to develop risk-informed licensing review plans for each of the SMR design reviews, including plans for the associated pre-application activities. Accordingly, the staff has developed the content of the DSRS as an alternative method for the evaluation of a NuScale-specific application submitted pursuant to 10 CFR Part 52, and the staff has determined that each application may address the DSRS in lieu of addressing the SRP, with specified exceptions. These exceptions include particular review areas in which the DSRS directs reviewers to consult the SRP and others in which the SRP is used for the review. If an applicant chooses to address the DSRS, the application should identify and describe all differences between the design features (DC and COL applications only), analytical techniques, and procedural measures proposed in an application and the guidance of the applicable DSRS section (or SRP section as specified in the DSRS), and discuss how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria.

The staff has accepted the content of the DSRS as an alternative method for evaluating whether an application complies with NRC regulations for NuScale SMR applications, provided that the application does not deviate significantly from the design and siting assumptions made by the NRC staff while preparing the DSRS. If the design or siting assumptions in a NuScale

application deviate significantly from the design and siting assumptions the staff used in preparing the DSRS, the staff will use the more general guidance in the SRP as specified in 10 CFR 52.17(a)(1)(xii), 10 CFR 52.47(a)(9), or 10 CFR 52.79(a)(41), depending on the type of application. Alternatively, the staff may supplement the DSRS section by adding appropriate criteria in order to address new design or siting assumptions.

VI. REFERENCES

1. 10 CFR Part 20, "Standards for Protection Against Radiation."

2. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."

3. 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants."

4. GDC 61, "Fuel Storage and Handling and Radioactivity Control."

5. GDC 19, "Control Room."

6. GDC 4, "Environmental and Dynamic Effects Design Bases."

7. RG 1.7, "Control of Combustible Gas Concentrations in Containment Following a Loss-of-Coolant Accident."

8. RG 1.112, "Calculations of Releases of Radioactive Materials in Gaseous and Liquid Effluents from Light-Water-Cooled Power Reactors."

9. RG 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors."

10. ANSI/ANS Standard 18.1-1999, "Source Term Specification," American National Standards Institute/American Nuclear Society."

11. NUREG-0737, "Clarification of TMI Action Plan Requirements."

12. 40 CFR Part 190, "Environmental Radiation Protection Standards For Nuclear Power Operations."

13. RG 1.89, "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants."

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

15. RG 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants."

16. RG 1.29, "Seismic Design Classification."

17. RG 1.117, "Tornado Design Classification."

18. RG 1.206, “Combined License Applications for Nuclear Power Plants (LWR Edition).”

19. EPRI, “Pressurized Water Reactor Primary Water Chemistry Guidelines.”

20. EPRI, “Pressurized Water Reactor Primary Water Zinc Application Guidelines.”

21. EPRI, “Advanced Light Water Reactor Utility Requirements Document, Volume III, ALWR Passive Plant.”

22. NUREG-1242, “NRC Review of Electric Power Research Institute's Advanced Light Water Reactor Utility Requirements Document, Passive Plant Designs” Volume 3, Part 1 and Volume 3, Part 2 (ADAMS Accession Nos. ML070600372 and ML070600373).

23. EPRI, “Cobalt Reduction Guidelines.”

24. RG 8.8, “Information Relevant to Assuring that Occupational Radiation Exposures at Nuclear Power Stations Will Be as Low as is Reasonably Achievable.”

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 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 needs, 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 greater 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 inventories, 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 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 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 DSRS sections, regulatory guides, and industry standards for the proper management of radioactive waste. Considerations for waste minimization and volume reduction will also need to be part of an overall site waste management plan and chosen onsite storage alternative. 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. For plants currently licensed under 10 CFR Part 50, the facility design 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 (i.e., no more than a few sieverts whole body dose). 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 and bulk quantities and describe the plans for the management and disposition of such wastes. New further guidance is provided in Generic Letter 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 Part 30 license for the storage of waste beyond 5 years has been eliminated. However, the balance of the technical information presented in Generic Letter 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 (Rev. 1), RIS 2008-32, and RIS 2011-09, and EPRI Report 1018644.

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 unity criterion of Appendix B to 10 CFR Part 20; and 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 interim 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 inflammable or explosive conditions. Unless storage containers are equipped with special vent design features that allow depressurization and collection of gases, and do not permit the migration of radioactive materials in ambient areas, resins highly loaded with 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 exposure using RG 8.8 and 8.10. The use of high-integrity containers (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 precautionary 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 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. In considering fire protection, RG 1.189 explains the primary objectives of fire protection programs at nuclear power plants, and describes the regulatory framework the NRC has established, including but not limited to GDC 3; 10 CFR 50.48; and the radiological exposure criteria of 10 CFR Part 20. 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. The requirements and dose limits for protection against radiation during plant operations appear in Part 20.1201 and Part 20.1202 for plant workers, Part 20.1301 and Part 20.1302 for members of the public, and effluent concentration limits of Appendix B to 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 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 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 DSRS 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.

   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, required postings and markings, requirements for controlled access and material security, and safety features or measures being provided (e.g., radiation monitoring).

F. Licensees should maintain inventory records by waste types, waste contents, 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.

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.

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.

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 DSRS Sections 11.2, 11.3 and 12.3-12.4, and 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 RG 4.21, and applicable industry standards.

B. All tanks or containers should be designed to withstand the corrosive nature of the wet waste 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. There should be provisions to remove 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 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.

F. All temporarily stored wet waste will require additional reprocessing before shipment off site; therefore, provisions should be made to integrate the required treatment with the waste processing and stabilization systems. The interface and associated systems should be designed and tested in accordance with the codes and standards described in DSRS Sections 11.2 (LWMS) and 11.3 (GWMS) and RG 1.143 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 gases, vapors, and fission and activation products from within components or in areas where such equipment is located, and process such streams via appropriate exhaust ventilation systems. All such releases must be controlled under the provisions of the ODCM or an equivalent program.

H. Licensees should maintain inventory records by waste types, waste contents, 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.

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 any 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 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) or design basis events (as required).

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 DSRS Sections 11.2, 11.3, and 12.3-12.4 and RG 1.143 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 to contain spills of dewatered resins or sludge.

B. If wastes exist in a corrosive form, licensees should implement proven measures to protect the container (i.e., special 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 the container 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 the container. The PCP should implement steps to assure the above does not occur and provisions should be made to govern container material selection and precoating 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 failure and/or as required by DOT shipping regulations and license disposal facility criteria for final transportation and disposal or long-term storage. Licensees should develop the means to identify and isolate staging areas used for decontamination activities and provide methods and equipment for decontamination. When significant handling and personnel exposure are anticipated, licensees should incorporate ALARA methodology in accordance with 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) under Part 50.48, Part 50, Appendix A, GDC 3, and guidance of RG 1.189. 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 of RG 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.

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.

F. Licensees should maintain inventory records by waste types, waste contents, 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, metals scraps, 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 their 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 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 DSRS Sections 11.2, 11.3, and 12.3-12-4, and 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 for additional reprocessing or repackaging in the event of container failure and/or as required by DOT shipping regulations and license disposal facility criteria for final transportation and disposal or long-term storage. Licensees should develop the means to identify and isolate staging areas used for decontamination activities and provide methods and equipment for decontamination. When significant handling and personnel exposure are anticipated, licensees should incorporate ALARA methodology in accordance with 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) under Part 50.48, Part 50, Appendix A, GDC 3, and guidance of RG 1.189. 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 of RG 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.

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.

E. Licensees should maintain inventory records by waste types, waste contents, 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.

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, 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 shall 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 shall be consistent with all of the requirements of 10 CFR Part 20 for the handling of such wastes and control of personnel exposure 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 DSRS Sections 11.2, 11.3, and 12.3-12.4 and 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 in accordance with 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.

E. Licensees should maintain inventory records by waste types, waste contents, 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.

VIII. REFERENCES

1. 10 CFR Part 20, “Standards for Protection Against Radiation.”

2. 10 CFR Part 20.1101, “Radiation Protection Programs.”

3. 10 CFR 20.1201, “Occupational Dose Limits for Adults.”

4. 10 CFR 20.1202, “Compliance with Requirements for Summation of External and Internal Doses.”

5. 10 CFR 20.1301, “Dose Limits for Individual Members of the Public.”

6. 10 CFR 20.1302, “Compliance with Dose Limits for Individual Members of the Public.”

7. 10 CFR 20.1406, “Minimization of Contamination.”

8. 10 CFR Part 30, “Rules of General Applicability to Domestic Licensing of Byproduct Material.”

9. 10 CFR Part 50.34, “Contents of Applications; Technical Information.”

10. 10 CFR 50.48, “Fire Protection.”

11. 10 CFR Part 50, Appendix A, General Design Criterion 3, “Fire Protection.”

12. 110 CFR Part 50, Appendix A, General Design Criterion 60, “Control of Releases of Radioactive Materials to the Environment.”

13. 10 CFR Part 50, Appendix A, General Design Criterion 64, “Monitoring Radioactivity Releases.”

14. 10 CFR Part 61, “Licensing Requirements for Land Disposal of Radioactive Waste.”

15. 10 CFR 61.55, “Waste Classification.”

16. 10 CFR 61.56, “Waste Characteristics.”

17. 10 CFR Part 71, “Packaging and Transportation of Radioactive Material.”

18. 10 CFR Part 100, “Reactor Site Criteria.”

19. 40 CFR 190, “Environmental Radiation Protection Standards for Nuclear Power Operations,” as implemented under 10 CFR 20.1301(e).

20. 49 CFR Parts 171–180, “Subpart C—Hazardous Materials Regulations.”

21. DC/COL-ISG-5, "Interim Staff Guidance on the use of the GALE86 Code for Calculation of Routine Radioactive Releases in Gaseous and Liquid Effluents from Boiling-Water-Reactors and Pressurized-Water-Reactors to Support Design Certification and Combined License Applications," July 2008.

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

24. Regulatory Guide 1.189, “Fire Protection for Nuclear Power Plants.”

25. Regulatory Guide 4.21 “Minimization of Contamination and Radioactive Waste Generation: Life Cycle Planning.”

26. Regulatory Guide 8.8, “Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable.”

27. Regulatory Guide 8.10, “Operating Philosophy for Maintaining Occupational Radiation Exposures As Low As Is Reasonably Achievable.”

28. Generic Letter 80-009, “Low Level Radioactive Waste Disposal.”

29. Generic Letter 81-038, “Storage of Low Level Radioactive Wastes at Power Reactor Sites.”

30. Generic Letter 81-039, “NRC Volume Reduction Policy.”

31. SECY 93-323, “Withdrawal of Proposed Rulemaking to Establish Procedures and Criteria for On-Site Storage of low-Level Radioactive Waste After January 1, 1996,” Nov. 29, 1993. Issued under SRM, dated February 1, 1994.

32. SECY 94-198, “Review of Existing Guidance Concerning the Extended Storage of Low-Level Radioactive Waste”, August 1, 1994.

33. Regulatory Issue Summary (RIS) 2004-17 (Rev. 1), “Revised Decay-In-Storage Provisions for the Storage of Radioactive Waste Containing Byproduct Material.”

34. Regulatory Issue Summary (RIS) 2008-32, “Interim Low Level Radioactive Waste Storage at Reactor Sites.”

35. Regulatory Issue Summary (RIS) 2011-09, “Available Resources Associated with Extended Storage of Low-Level Radioactive Waste.”

36. EPRI Report No. 1018644, “Guidelines for Operating an Interim On Site Low Level Radioactive Waste Storage Facility, Revision 1,” Electric Power Research Institute, Palo Alto, CA, February 2009.

37. Nuclear Energy Institute (NEI), "Generic FSAR Template Guidance for Offsite Dose Calculation Manual (ODCM) Program Description," NEI 07-09A (Revision 0, March

2009). The template includes the NRC's Safety Evaluation Report and acceptance finding, see ADAMS Accession No. ML083530745.

38. NEI, "Generic FSAR Template Guidance for Life Cycle Minimization of Contamination," NEI 08-08A (Revision 0, October 2009). The template includes the NRC's Safety Evaluation Report and acceptance finding, see ADAMS Accession No. ML093220530.
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