U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

11.4 SOLID WASTE MANAGEMENT SYSTEMS~~S~~[1]

REVIEW RESPONSIBILITIES

Primary - ~~Effluent Treatment~~Plant Systems Branch ~~(ETSB)~~(SPLB)[2]

Secondary - None

I. AREAS OF REVIEW

At the construction permit (CP) or standard design certification[3] stage, ~~ETSB~~SPLB[4] reviews the design objectives, criteria, performance objectives, and description of the solid waste management system (SWMS) as given in the applicant's preliminary safety analysis report (PSAR). During the operating license (OL) or combined license (COL)[5] stage of review, ~~ETSB~~SPLB confirms the design accepted at the CP or standard design certification[6] stage and evaluates the applicant's process control program and technical specifications in these areas.

~~ETSB~~SPLB reviews the following:

1. The design objectives in terms of expected and design volumes of waste to be processed and handled, the wet and dry types of waste to be processed (e.g., sludges, resins, evaporator bottoms, and dry material such as contaminated tools, equipment, rags, paper, and clothing), the activity and expected radionuclide distribution contained in the waste, equipment design capacities, and the principal parameters employed in the design of the SWMS.

2. The description of the SWMS, the piping and instrumentation diagrams (P&IDs), and the process flow diagrams showing the methods of operation, the expected chemical content and radionuclide concentrations of liquid wastes to be processed and handled by the

SWMS, and the expected volumes to be returned to the liquid radwaste system for further treatment.

3. The description of the methods for solidification (i.e., of removal of free water), the description of the methods for dewatering, the solidifying agent used, and the implementation of a process control program to ensure a solid matrix and proper waste form characteristics and/or complete dewatering.

4. The description of the type and size of solid waste containers; the method of filling, handling, and monitoring for removable radioactive contamination; and provisions for decontamination, packaging and storage.

5. The provisions for the onsite storage of solid wastes, the expected and design volumes, the expected radionuclide contents, and the design bases for these values.

6. The quality group classifications of piping and equipment, and bases governing the classification chosen.

7. Design provisions incorporated in the equipment and facility design to reduce leakage and facilitate operation and maintenance.

8. Special design features, referenced topical reports, and previous experience with similar equipment and methods referenced in the SAR.

Review Interfaces[7]

1. As part of its primary review responsibility under the SRP Section 9.5.1, the SPLB reviews the SWMS for the storage or use of flammable materials.[8]

~~The consequences of a liquid tank failure having the potential to release radioactive materials to a potable water supply as part of its review responsibility under SRP Section 15.7.3.~~[9]

2. In addition, ~~ETSB~~SPLB will coordinate other branches' evaluations that interface with the overall review of the system as follows:

   a. The ~~Structural Engineering~~Civil Engineering and Geosciences Branch (~~SEB~~ECGB[10]) determines the acceptability of the design analyses, procedures, and criteria used to establish the ability of seismic Category 1 structures housing the system and supporting systems to withstand the effects of natural phenomena such as the safe shutdown earthquake (SSE), probable maximum flood (PMF), and tornado missiles as part of its primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4 and 3.8.5.

   b. The Mechanical Engineering Branch (EMEB) determines the acceptability of the seismic and quality group classifications for system components as part of its primary review responsibility for SRP Sections 3.2.1 and 3.2.2.

~~The reviews for Technical Specifications and Quality Assurance are coordinated and performed by the Licensing Guidance Branch and the Quality Assurance Branch (QAB) as part of their primary review responsibility for SRP Sections 16.0 and 17.0, respectively.~~[11]

c. The Technical Specifications Branch (TSB) coordinates and performs reviews of the proposed technical specifications as part of its primary review responsibility for SRP Section 16.0.[12]

d. The Quality Assurance and Maintenance Branch (HQMB) coordinates and performs reviews of quality assurance programs as part of its primary review responsibility for SRP Chapter 17.[13]

For those areas of review identified as part of the primary review responsibility of other branches, the acceptance criteria and methods of application are contained in the referenced SRP section.

II. ACCEPTANCE CRITERIA

~~ETSB~~SPLB acceptance criteria for the ~~solid waste treatment system~~SWMS[14] design are based on meeting the relevant requirements of the following regulations:

A. 10 CFR Part 20, ~~§ 20.106~~§ 20.1302[15] as it relates to ~~radioactivity~~ 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 anticipated operational occurrences.[16]

B. 10 CFR Part 50, 50.34a as it relates to sufficient design information being provided to demonstrate that design objectives for equipment necessary to control releases of radioactive effluents to the environment resulting from SWMS operation[17] have been met.

C. General Design Criterion 60 (GDC 60)[18] as it relates to the ~~radioactive waste management systems~~ SWMS[19] being designed with means to ~~control releases of radioactive materials to the environment.~~handle solid wastes produced during normal plant operation, including operational occurrences.[20]

D. General Design Criteria 63 and 64 as they relate to the radioactive waste system being designed for monitoring radiation levels and leakage.

E. 10 CFR Part 61 as it relates to classifying, processing, and disposing solid wastes.[21]

F. 10 CFR Part 71 as it relates to radioactive material packaging.

The relevant requirements of the Commission regulations identified above are met by using the regulatory positions contained in Regulatory Guide 1.143[22] as it relates to the seismic design and quality group classification of components used in the ~~gaseous waste treatment system~~SWMS[23] and structures housing the system~~s~~ and the provisions used to control leakages.

Specific criteria necessary to meet the relevant requirements of the Commission's regulations are as follows:

1. The system design parameters are based on radionuclide concentrations and volumes consistent with reactor operating experience for similar designs.

2. All liquid wet wastes will be solidified in accordance with a process control program prior to shipment offsite or there will be provisions to verify the absence of free liquid in each container and to reprocess containers in which free liquid is detected in accordance with Branch Technical Position (BTP) ETSB 11-3.

3. Other wet wastes will be solidified or dewatered (subject to ~~receiving burial site~~licensed disposal facility's[24] acceptance) in accordance with a process control program or there will be provisions to verify the absence of free liquid in each container and to reprocess containers in which excess water is detected, in accordance with Branch Technical Position (BTP) ETSB 11-3.

4. Solid waste containers, shipping casks, and methods of packaging meet applicable Federal regulations, e.g., 10 CFR Part 71, and wastes are to be shipped to a licensed ~~burial site~~disposal facility[25] in accordance with applicable Commission, Department of Transportation, and State regulations.

5. Processing equipment is sized to handle the design SWMS inputs, i.e., the solid waste generation rates reviewed under item I.1 of this SRP section.

6. Onsite waste storage facilities provide sufficient storage capacity to allow time for short-lived radionuclides to decay prior to shipping in accordance with Branch Technical Position (BTP) ETSB 11-3. (The bases for the storage time chosen should be given in the safety analysis report (SAR)).

7. SWMS components and piping systems, and structures housing SWMS components, are designed in accordance with the provisions of Regulatory Guide 1.143, and Branch Technical Position (BTP) ETSB 11-3.

8. The SWMS contains provisions to reduce leakage and facilitate operations and maintenance in accordance with the provisions of Regulatory Guide 1.143 and Branch Technical Position (BTP) ETSB 11-3.

9. For longer term onsite storage (several years, but significantly less than the life of the plant) the storage facility should be designed to the guidelines of Appendix A to this SRP section.

10. The wet solid wastes will be processed and disposed in accordance with 10 CFR Part 61, §§ 61.55 and 61.56, requirements with regard to waste classification and characteristics.[26]

Technical Rationale[27]

The technical rationale for application of the above acceptance criteria to the SWMS is discussed in the following paragraphs.[28]

1. 10 CFR 20.1302 requires that surveys of radiation levels in unrestricted areas be performed to demonstrate system compliance with the dose limits to individual members of the public contained in 10 CFR 20.1301.

   10 CFR 20.1302 identifies two approaches either of which can demonstrate compliance with the dose limits of 10 CFR 20.1301. The requirements for one of these approaches are 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 effluent concentration limits 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 mSv (0.05 rem) and 0.02 mSv (0.002 rem) respectively.

   Meeting the requirements on gaseous and liquid effluent concentrations in unrestricted areas resulting from SWMS operation is identified as an acceptance criterion in this SRP section. Compliance with the offsite dose requirements identified above will be verified by PERB as part of its primary review responsibility for SRP Section 12.1. Meeting both requirements provides assurance that the dose limits specified in 10 CFR 20.1301, for individual members of the public will not be exceeded.[29]

2. Acceptance Criterion II.B gives the technical rationale for 10 CFR Part 50, § 50.34a, requirement. Meeting the requirements of 10 CFR Part 50, § 50.34a, as it relates to adequate design information on SWMS provides a level of assurance that the SWMS will have necessary equipment and design features to control releases of radioactive effluents to the environment resulting from its operation, in accordance with the requirements of 10 CFR 20.1302 and GDC 61.[30]

3. 10 CFR Part 50, Appendix A, GDC 60, requires that provisions be included in the nuclear power unit design to handle suitably radioactive solid wastes produced during normal reactor operation, including anticipated operational occurrences.

   Meeting the requirement of GDC 60 provides a level of assurance that releases of radioactive materials via liquid and gaseous effluents arising from SWMS operation during normal plant operation, including anticipated operational occurrences, will not result in effluent concentrations in unrestricted areas exceeding the limits specified in 10 CFR Part 20, Appendix B, Table 2, and the solid wastes produced during the SWMs operation will be handled in accordance with the requirements of 10 CFR Part 61, §§ 61.55 and 51.56 and DOT regulations.[31]

4. 10 CFR Part 50, Appendix A, General Design Criterion 63 (GDC 63), "Monitoring Fuel and Waste Storage," requires that radioactive waste systems be provided with systems to detect conditions that may result in excessive radiation levels in the waste storage locations and to initiate appropriate safety actions.

SRP Section 11.4 describes staff positions related to the design of the SWMS, including provisions for radioactive monitoring and detection systems and the capability of such systems to maintain any liquid or gaseous effluents in unrestricted areas, arising from SWMS operation, below the limits specified in 10 CFR Part 20, Appendix B, Table 2.

Meeting the requirements of GDC 63 will provide a level of assurance that the SWMS will be provided with monitoring and detection capabilities to facilitate initiation of timely corrective actions and to ensure that effluent concentrations in unrestricted areas arising from SWMS operation do not exceed the 10 CFR Part 20, Appendix B, Table 2 limits and radiation exposures to occupational workers do not exceed the 10 CFR Part 20 limits.[32]

5. 10 CFR Part 50, Appendix A, General Design Criterion 64 (GDC 64), "Monitoring Radioactivity Releases," requires that provisions be provided for monitoring the effluent discharge paths and the plant environs for radioactive material that may be released from normal operations, including anticipated operational occurrences and from postulated accidents.

SRP Section 11.4 describes staff positions related to the design of the SWMS including provisions for equipment to be used to prevent spillage while filling, pouring and from overfilling the containers. In addition, provisions are made to contain the contents of the resin storage tanks in the event of a failure.

Meeting the requirements of GDC 64 will provide a level of assurance that the SWMS will be provided with the capabilities to monitor and detect leakages to ensure that the effluent concentrations in unrestricted areas arising from SWMS operation do not exceed the limits specified in 10 CFR Part 20, Appendix B, Table 2, Columns 1 and 2.[33]

6. 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," establish, 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.

The SWMS processes both wet solid wastes and dry active wastes for shipment to a licensed disposal facility. With regard to the SWMS, 10 CFR Part 61, §§ 61.55 and 61.56, require that provisions be included in the system design that describe the dewatering process and solidification process and the classifying, processing, and the disposing of solid wastes. The system should also address the criteria which the different waste classes should satisfy and the various characteristics that the processed wet wastes should satisfy.

Meeting the requirements of 10 CFR Part 61, §§ 61.55 and 61.56, provide a level of assurance that the radioactive waste processed by the SWMS has been properly classified such that controls, waste form and disposal methods are effective and that the processed waste when stabilized, if required, will not structurally degrade.[34]

7. 10 CFR Part 71 establishes requirements for packaging, preparation for shipment, transportation of licensed material, and procedures and standards for packaging and shipping of fissile material or a quantity of other licensed material in excess of a Type A quantity as defined by 10 CFR Part 61.55.

With regard to the SWMS, 10 CFR Part 71 defines the manner in which the solid waste byproduct is packaged, the qualifications of the packaging material, testing of the package, and the quality control governing the overall activity.

Meeting the requirements of 10 CFR Part 71 provide a level of assurance that the operation of the solid waste systems with regard to packaging, preparation for shipment, and transportation of licensed material will not result in an undue risk to the public.[35]

8. Branch Technical Position (BTP) ETSB 11-3 contains system design guidelines addressing process parameters, waste solidification or dewatering, waste form properties, free liquid detection, waste storage, and portable solid waste systems.

With regard to the SWMS, the system receives radioactive materials generated in the form of "wet" and "dry" wastes. These wastes are collected and processed by the solid waste system using the guidelines contained in BTP ETSB 11-3.

Meeting the guidelines of BTP ETSB 11-3 provide a level of assurance that the solid waste system include the necessary equipment, processes and procedures to satisfactorily process, monitor and store radioactive wastes prior to being shipped offsite.[36]

9. Appendix 11.4-A to SRP Section 11.4 addresses the long term storage of wet waste, solidified wet waste and dry low level waste.

The objective of Appendix 11.4-A is to provide guidance to applicants considering onsite low level radioactive waste storage capabilities for several years, but for a storage period significantly less than the life of the plant. The guidance places emphasis on safety considerations in the storing, handling, and eventual disposition of the radioactive waste.

Meeting the guidelines of Appendix 11.4-A provide a level of assurance that the solid waste system will meet the requirements to minimize or ensure that container breach will not occur during temporary storage periods and to preclude or reduce the occurrence of uncontrolled releases of radioactive materials due to handling, transporting, or storage.[37]

III. REVIEW PROCEDURES

The ~~ETSB~~SPLB reviewer will select and emphasize material from this SRP section as may be appropriate for a particular case.

1. ~~ETSB~~SPLB reviews the P&IDs and the process flow diagrams to determine system design, methods of operation, and parameters used in the design, i.e., expected and design flow rates, ~~radioactivity~~ concentrations of radioactive material,[38] radionuclide distribution, and waste categories. The system design and design criteria will be compared with the guidelines of Regulatory Guide 1.143, Branch Technical Position (BTP) ETSB 11-3, and available data from operating plants of similar design.

2. ~~ETSB~~SPLB compares the methods to be used for solidification and/or dewatering with experience gained from previous licensing reviews and with available data from operating plants employing similar methods. ~~ETSB~~SPLB will review the process control programs to assure that the proposed solidification and/or dewatering method is capable of solidifying and/or dewatering the range of constituents expected to be present in the wastes. ~~ETSB~~SPLB reviews the methods proposed to verify that all wet wastes have been adequately solidified or dewatered and will determine their acceptability considering (a) the ability of the technique to detect free, mobile, or uncombined liquids (in the case of solidification) or excess free water (in the case of dewatering), (b) the procedure to be employed to solidify or dewater free liquids if detected, and (c) the waste form characteristics. SPLB will review the process control programs, including dewatering or solidification (if performed), on a plant-specific basis against 10 CFR Part 61 requirements.[39]

3. ~~ETSB~~SPLB reviews the description of procedures for the packaging and shipment of solid wastes to an approved offsite ~~burial~~disposal[40] facility, and verifies that the applicant makes definite commitments to following appropriate Federal and State regulations. ~~ETSB~~SPLB compares the values given in the SAR for the volumes and radionuclide content of solid wastes to be shipped offsite with data from operating plants of similar design and information from previous license applications.

4. ~~ETSB~~SPLB compares the solid waste system design capacity with the design basis input 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 anticipated operational occurrences. The inplant storage capacity, for areas designed to accommodate approximately six months' waste generation, is compared to the guidelines of BTP ETSB 11-3. The comparison will be based on the design criteria as stated in the SAR, on the availability of system components to handle surge flows, and on whether the storage facilities will provide onsite storage periods sufficient to permit the decay of short-lived radionuclides. For longer term onsite storage (several years, but significantly less than life of the plant) the storage facility is compared to the guidelines of Appendix A to this SRP section.

5. The SPLB reviews~~If~~ the SWMS ~~contains any~~for the storage or ~~makes~~ use of flammable materials~~, ETSB requests the CEB to provide a review under SRP Section 16.0~~.[41]

6. ~~ETSB~~SPLB compares the quality group classifications of the solid waste system to the guidelines of Regulatory Guide 1.143.

7. ~~ETSB~~SPLB compares the seismic design of the structures housing the SWMS to the guidelines of Regulatory Guide 1.143. Exceptions are transmitted to EMEB, which has primary responsibility under SRP Section 3.2.1.

8. ~~ETSB~~SPLB compares equipment layout, design features, and mode of operation of the solid waste system to the guidelines of Regulatory Guide 1.143 and BTP ETSB 11-3.

9. At the OL or COL[42] stage ~~ETSB~~TSB[43] reviews the technical specifications, i.e., administrative controls section, proposed by the applicant for process and effluent control for input to the review of SRP Section 16.0. The reviewer will determine that the content, ~~and~~ intent, and scope of the ~~technical specifications~~programs identified in the administrative controls section of the TS prepared by the applicant are in agreement with the requirement developed as a result of the staff's review. The review will include the evaluation or development of appropriate limiting conditions for operation and their bases consistent with the plant design. The ~~technical specifications~~programs identified in the administrative controls section of the TS are reviewed per the requirements of 10 CFR Part 50, 50.36a.[44]

10. SPLB compares the waste classification and the waste characteristics to the requirements of 10 CFR Part 61, §§ 61.55 and 61.56.[45]

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.[46]

IV. EVALUATION FINDINGS

~~ETSB~~SPLB verifies that sufficient information has been provided and that the review is adequate to support conclusions of the following type, to be included in the staff's safety evaluation report (SER):

> The staff concludes that the design of the solid waste management systems is acceptable and meets the requirements of 10 CFR Part 20, ~~§ 20.106~~§ 20.1302;[47] 10 CFR Part 50, 50.34a; General Design Criterion 60, 63, and 64; 10 CFR Part 61;[48] and 10 CFR Part 71.
>
> This conclusion is based on the applicant demonstrating that the solid waste system (SWMS) includes the equipment and instrumentation used for the processing, packaging, and storage of radioactive wastes prior to shipment to an offsite licensed disposal facility~~for burial~~.[49] The scope of the review of the SWMS includes line diagrams of the system, piping and instrumentation diagrams (P&IDs), and descriptive information for the SWMS and for those auxiliary supporting systems that are essential to the operation of the SWMS. The applicant's proposed design criteria and design bases for the SWMS, and the applicant's analysis of those criteria and bases have been reviewed. The

capability of the proposed system to process the types and volumes of wastes expected during normal operation and anticipated operational occurrences in accordance with General Design Criterion 60, provisions for the handling of wastes relative to the requirements of 10 CFR Parts ~~20~~61 and 71 and of applicable DOT regulations, the design features built into the system to limit effluent releases to unrestricted areas arising from system operation within the limits of 10 CFR Part 20,[50] and the applicant's quality group classification and seismic design relative to Regulatory Guide 1.143, have also been reviewed. The applicant's proposed operating procedures as they relate to classifying, processing, and disposing solid wastes have been reviewed and meet the requirements of 10 CFR Part 61.[51] The applicant's proposed methods of assuring complete solidification and/or dewatering have been reviewed and the processing, design features and waste storage meet Branch Technical Position ETSB 11-3 and SRP Section 11.4 - Appendix A (applicable to plants with temporary onsite storage of low level radioactive waste).

The basis for acceptance in the staff's review has been conformance of the applicant's designs, design criteria, and design bases for the ~~solid radwaste system~~ SWMS[52] to the regulations and the guides referenced above, as well as to staff technical positions and industry standards. Based on the foregoing evaluation, the staff concludes that the proposed solid radwaste system is acceptable.

For design certification reviews, the findings will also summarize, to the extent that the review is not discussed in other safety evaluation report sections, the staff's evaluation of inspections, tests, analyses, and acceptance criteria (ITACC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.[53]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.[54] Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section.[55]

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides.

VI. REFERENCES

1. Branch Technical Position ETSB 11-3, "Design Guidance for Solid Radioactive Waste Management Systems Installed in Light-Water-Cooled Nuclear Power Reactor Plants," attached to SRP Section 11.4.

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

3. Standard Review Plan Section 11.4, Appendix A, "~~Design Guidance for Temporary OnSite Storage of Low Level Radioactive Waste~~ Radiological Safety Guidance for Onsite Contingency Storage Capacity.[56]"

4. 10 CFR Part 50, § 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."

5. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants," Criterion 60, "Control of Releases of Radioactive Material to the Environment;" Criterion 63, "Monitoring Fuel and Waste Storage;" and Criterion 64, "Monitoring Radioactive Release."

6. 10 CFR Part 20, "Standards for Protection Against Radiation," and Appendix B, "Concentrations in Air and Water Above Natural Background."

7. 10 CFR Part 61, "Licensed Requirements for Land Disposal of Radioactive Waste."[57]

~~7~~8. 10 CFR Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Materials Under Certain Conditions."

~~8~~9. 10 CFR Part 50, § 50.34a, "Design Objectives for Equipment to Control Releases of Radioactive Materials in Effluents - Nuclear Power Reactors."

Branch Technical Position - ETSB 11-3

Design Guidance for Solid Radioactive Waste Management Systems
Installed in Light-Water-Cooled Nuclear Power Reactor Plants

A. BACKGROUND

During normal operation of a nuclear power plant, radioactive materials are generated in the form of "wet" and "dry" wastes. Wet wastes, including spent bed resins, filter sludge, spent powdered resins, evaporator and reverse osmosis concentrates, and spent cartridge filter elements, normally result as byproducts from liquid processing systems. Dry wastes, including activated charcoal, HEPA filters, rags, paper, and clothing, normally result as byproducts from ventilation air and gaseous waste processing systems and maintenance and refueling operations. Wet and dry wastes will require processing in appropriate portions of the solid waste management system prior to shipment offsite for disposal.

Compressible dry wastes such as contaminated rags, paper and clothing normally undergo a compaction process to reduce the volume of waste shipped offsite. Special provisions are needed to assure that contaminated airborne dusts are not released to the process area during compaction.

Liquid wet wastes such as evaporator and reverse osmosis concentrates are solidified (i.e., combined with a suitable binder) prior to shipping, to render the waste immobile and thereby mitigate the consequences of potential ruptures to shipping containers. Other wet wastes such as spent bead and powdered resins, and filter sludges, are either solidified or dewatered prior to shipping. Spent cartridge filter elements are packaged with suitable absorbers in shielded containers, or solidified, prior to shipping.

Although there are a number of processes available which are capable of solidifying wet wastes under controlled conditions, there is a potential for free[1] liquids to remain in containers following solidification with the widely varying chemical species encountered during power plant operations. Based on the NRC staff's judgment, it is necessary that vendors and operators implement certain measures to (1) establish process parameters within which systems must be operated to obtain complete solidification, (2) assure proper waste form properties are achieved, and (3) assure systems are operated within the established process parameters, or (4) have provisions to detect free liquid in containers prior to shipment offsite. Similar restrictions apply to dewatered products to provide greater assurance that these products meet the receiving burial site free liquid restrictions at the time of receipt at the burial site.

Following packaging, wastes are normally stored for decay of short-lived radionuclides and to accumulate sufficient wastes for a shipment offsite. Insofar as the continuous operation of the solid waste system is contingent upon storage space being available for the interim period

[1] For the purpose of this position paper, free liquid is defined as liquid which is still visible after solidification or dewatering is complete, or is drainable from the low point of a punctured container.

between waste packaging and shipment offsite, consideration should be given to providing ample storage capacity to accommodate wastes during periods when shipments offsite are not possible, e.g., during labor strikes. Furthermore, in view of the reduced availability of burial site disposal capacity, it may be desirable to provide additional onsite short term storage capacity to accommodate surges in solid waste volume due to interruption or limitations in offsite disposal services. Upon resumption of the disposal services, the stored wastes could then be shipped in an orderly fashion.

The criteria in Section B, below, provide adequate and acceptable design solutions for the concerns outlined above.

This position paper sets forth minimum branch requirements and is not intended to prohibit the implementation of more rigorous design codes, standards, or quality assurance measures than those indicated.

B. BRANCH TECHNICAL POSITION

I. PROCESSING REQUIREMENTS

1. Dry Wastes

a. Compaction devices for compressible dry wastes (rags, paper, and clothing) should include a ventilated shroud around the waste container to control the release of airborne dusts generated during the compaction process.

b. Activated charcoal, HEPA filters, and other dry wastes which do not normally require solidification processing should be treated as radioactively contaminated solids and packaged for disposal in accordance with applicable Federal regulations.

2. Wet Wastes

a. Liquid wet wastes such as evaporator and reverse osmosis concentrates should be rendered immobile by combining with a suitable binding agent (cement, asphalt, etc.) to form a homogeneous solid matrix (absent of free water) prior to offsite shipment. Adsorbent such as vermiculite are not acceptable substitutes for binding agents.

b. Spent resins and filter sludges may, if acceptable to the receiving burial site, be shipped dewatered. These dewatered wastes are subject to (1) items B.II.1.b. and B.II.2. below, (2) to the receiving burial site maximum free liquid criteria (upon receipt at the burial site), and (3) applicable DOT regulations. Furthermore, the activity level of the dewatered wastes may, subject to receiving burial site requirements, dictate the type of container to be used. Solidification of spent resins and filter sludges in a suitable binder is also an acceptable alternative.

c. Spent cartridge filter elements may be packaged in a shielded container with a suitable absorber such as vermiculite, although it would be desirable to solidify the elements in a suitable binder.

II. ASSURANCE OF COMPLETE SOLIDIFICATION OR DEWATERING

Complete solidification or dewatering of wet wastes should be assured by the implementation of a process control program or by methods to detect free liquids within container contents prior to shipment.

1. Process Control Program

a. Solidification (binding) agents and potential waste constituents should be tested and a set of process parameters (pH, ratio of waste to agent, etc.) established which provide boundary conditions within which reasonable assurance can be given that solidification will be complete, with essentially zero free liquid, and appropriate waste form characteristics.

b. Dewatering procedures, equipment, and potential waste constituents should be tested and a set of process parameters (settling time, drain time, drying time, etc.) be established which provide boundary conditions within which reasonable assurance can be given that dewatering will be complete, with essentially zero free liquid.

c. The solid waste processing system (or liquid waste processing system, as appropriate) should include appropriate instrumentation and wet waste sampling capability necessary to successfully implement and/or verify the process control program described in items B.II.1.a and/or B.II.1.b, above.

d. The plant operator should provide assurance that the process is run within the parameters established under items B.II.1.a and/or B.II.1.b, above. Appropriate records should be maintained for individual batches showing conformance with the established parameters.

2. Free Liquid Detection

Each container filled with solidified or dewatered wet wastes should be checked by suitable methods to verify the absence of free liquids if a process control program is not followed or an off-normal condition exists during processing. Visual inspection of the upper surface of the waste in the container is not alone sufficient to ensure that free water is not present in the container. Provisions to be used to verify the absence of free liquids should consider actual solidification procedures which may create a thin layer of solidification agent on top without affecting the lower portion of the container.

III. WASTE STORAGE

1. Tanks accumulating spent resins from reactor water purification systems should be capable of accommodating at least 60 days waste generation at normal generation rates. Tanks accumulating spent resins from other sources and tanks accumulating filter sludges should be capable of accommodating at least 30 days waste generation at normal generation rates.

2. Storage areas for ~~solidified wastes~~ processed wet wastes (i.e., solidified or dewatered wastes)[58] should be capable of accommodating at least 30 days waste generation at normal generation rates. These storage areas should be located indoors.

3. Storage areas for dry wastes and packaged contaminated equipment should be capable of accommodating at least one full offsite waste shipment.

IV. PORTABLE SOLID WASTE SYSTEMS

The following supplementary guidance should be incorporated into the design and use of portable (mobile) solidification and/or dewatering systems:

1. Tanks containing wet wastes are limited to inplant installation, they should not be part of the portable system.

2. The use of flexible piping should be limited to necessary interfaces with plant systems. Such piping is also subject to the hydrostatic test requirements delineated in Regulatory Guide 1.143.

3. Portable systems should be located, as a minimum, on concrete pads with curbs and drainage provisions for containing radioactive spills. Provisions should be available for interfacing the drains with the plant's liquid radwaste system. Portable systems should have integral ventilation systems with either self-contained filters, or interface with the plant's ventilation exhaust system.

4. Regulatory Guide 1.143 seismic criteria for structures housing solid waste systems are not applicable.

V. ADDITIONAL DESIGN FEATURES

The following additional design features should be incorporated into the design of the solid waste system.

1. Evaporator concentrate piping and tanks should have heat tracing if the concentrates are likely to solidify at ambient temperatures.

2. Components and piping which contain radioactive slurries should have flushing connections.

3. Solidification agents should be stored in low radiation areas, generally less than 0.025 mSv/hr (2.5 mr/hr)[59], with provisions for sampling.

4. Tanks or equipment which use compressed gases for transport or drying of resins or filter sludges should be vented directly to the plant ventilation exhaust system which includes HEPA filters as a minimum. The vent design should prevent liquids and solids from entering the plant ventilation system.

APPENDIX 11.4-A DESIGN GUIDANCE FOR TEMPORARY ONSITE STORAGE OF LOW LEVEL RADIOACTIVE WASTE

A. BACKGROUND

Restrictions and reduced allocations at commercial burial sites have caused a need to actively consider increased onsite storage capacity in excess of that necessary to allow for decay of short-lived radionuclides and to allow for the possibility of shipping delays due to labor strikes. If such storage capability is planned, the applicant must assure that the design and operation of the proposed facility is adequate to maintain public health and safety, minimize risk to operating personnel, and present a minimal environmental impact.

The objective of this appendix is to provide guidance to applicants considering onsite low level radioactive waste storage capabilities for several years, but for a period significantly less than the life of the plant.

The duration of the intended storage, the type and form of waste, and the magnitude of radionuclides present will dictate the safeguards and the level of complexity (waste form, container material, building design, surveillance, etc.) required to assure public health and safety, and informal risk to operating personnel. The magnitude of the onsite storage hazard is predicated on the type of waste being stored, the quantity of radionuclides present, and how readily they might be transported into the environment. In general, it is preferable to store radioactive material in solid form. Under some circumstances, however, temporary storage in liquid form may be desirable or required. The specific design and operation of any storage facility will be significantly Influenced by the various waste forms, consequently, this Appendix addresses wet waste, solidified wet waste and dry low level waste.

Prior to acceptance of such an on-site storage facility, substantial safety review and environmental analysis must be conducted to assure adequate public health and safety, and minimal environmental impact. The acceptance criteria and performance objectives of any proposed storage facility, or area, will need to meet minimal requirements in areas of design considerations, operational considerations, and safety considerations. For purposes of this appendix, the major emphasis will be on safety considerations in the storing, handling, and eventual disposition of the radioactive waste. Additional considerations for decontamination and decommissioning of the temporary storage facility also need to be integrated into the design and operation of the proposed storage facility.

B. STORAGE FACILITY REQUIREMENTS

1. General Requirements

(a) The following design objectives and criteria are applicable for wet, solidified (or dewatered), and low level dry radioactive waste storage facilities:

(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 onsite. The 40 CFR Part 190 limits will restrict the annual dose from direct radiation and effluent release to the

public (individual to less than 25 mrem per year to the whole body from all sources of the uranium fuel cycle; therefore, offsite doses from onsite storage must be sufficiently low to account for other sources (e.g., < 1 mrem/year. Onsite dose limits associated with temporary storage will be controlled per 10 CFR Part 20 including the ALARA principle of 10 CFR Part 20, Section 20.1.

(2) All potential release pathways of radionuclides (e.g., evolved gases, breach of container, etc.) shall be controlled and monitored as per 10 CFR Part 50 Appendix A (General Design Criteria 60 and 64). Surveillance programs should incorporate adequate methods for detecting failure of container integrity and measuring releases to the environment.

(b) In addition, the following design objectives and criteria are applicable to solidified (or dewatered) and low level dry radioactive waste storage facilities:

(1) For outside storage, periodic direct radiation and surface contamination monitoring shall be conducted to insure that levels are below limits specified in 10 CFR Part 20, Section 20.202, 20.205, and 49 CFR Part 173, Section 173.397. All containers should be decontaminated to these levels or below before storage.

(2) Procedures should be developed and implemented for early detection, prevention and mitigation of accidents (e.g., fires). Storage areas and facility designs should incorporate good engineering features and contingencies so as to handle accidents and provide safeguard systems such as fire detectors and suppression systems (e.g., smoke detector and sprinklers), personnel training and administrative procedures to insure both control of radioactive materials and minimum personnel exposures. Fire suppression devices may not be necessary if combustible materials are minimal in the area.

(3) Provisions should be incorporated 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 (e.g., rain water or moisture) and remains uncontaminated.

(4) Low level solidified waste stored in outside areas should be held securely by installed hold down systems. The hold down system should secure all containers during severe environmental conditions up to and including the design basis event for this waste storage facility.

(5) Increased container handling and personnel exposure can be anticipated, consequently, all ALARA methodology should be incorporated per Regulatory Guides 8.8 and 8.10.

(6) Container integrity should be assured against corrosion from the external environment; external weather protection should be included where necessary and practical. Storage containers should be raised off storage pads where water accumulation can be expected to cause external corrosion and possible degradation of container integrity.

(7) Total curie and storage capacity limits should be established based on the design of the storage area and the safety features provided. The design capacity (ft^3, Ci) should be based on historical waste generation rates for the specific facility, considering both volume minimization/reduction programs and the need for surge capacity due to operations which may generate unusually large amounts of waste.

(8) Inventory records of waste types, contents, dates of storage, shipment, etc., should be maintained.

2. Wet Radioactive Waste Storage

(a) Wet radioactive waste will be defined as any liquid or liquid/solid slurry. For storage considerations, wet waste is further defined as any waste which does not meet receiving burial site free liquid requirements for solidified or dewatered waste.

(b) The facility, supporting structure and tanks should be designed to prevent uncontrolled releases of radioactive materials due to spillage or accident conditions.

(c) The following design objectives and criteria are applicable for wet radioactive waste storage facilities.

(1) Structures that house liquid radwaste storage tanks should be designed to seismic criteria as defined in Regulatory Guide 1.143, Section 5.0. Foundations and walls shall also be designed and fabricated to contain the liquid inventory which might be released during a container/tank failure.

(2) All tanks or containers should be designed to withstand the corrosive nature of the wet waste storage. The duration of storage under which the corrosive conditions exist shall also be considered in the design.

(3) All storage structures should have curbs or elevated thresholds with floor drains and sumps to safely collect wet waste assuming the failure of all tanks or containers. Provisions should be incorporated to route spilled wet waste to the radwaste treatment systems.

(4) All tanks and containers shall have provisions to monitor liquid levels and to alarm potential overflow conditions.

(5) All temporarily stored wet waste will require additional reprocessing prior to shipment offsite; therefore, provision should be established to integrate the required treatment with the waste processing and solidification systems. The interface and associated systems should be designed and tested in accordance with the codes and standards described in Regulatory Guide 1.143.

3. Solidified Radioactive Waste Storage

(a) Solidified radwaste shall be defined as wet waste (e.g., evaporator bottoms, resins, and sludge) which is solidified, meets the free liquid criteria of Branch Technical Position ETSB 11-3, and satisfies applicable transportation and disposal site requirements. For purposes of this appendix, dewatered resins or filter sludges satisfying the two latter criteria shall also be defined under this waste classification.

(b) Dewatered resins and sludges should be stored in containers that satisfy receiving burial site criteria, in addition to applicable transportation regulations. Any storage plans should address container protection as well as any reprocessing requirements for eventual shipment and burial.

(c) Casks, tanks, and liners containing solidified radioactive waste should be designed with good engineering judgement to preclude or reduce the occurrence of uncontrolled releases of radioactive materials due to handling, transporting, or storage. Accident mitigation and control for design basis events (e.g., fire, flooding, tornadoes, etc.) must be evaluated and protected against unless otherwise justified.

(d) The following design objectives and criteria are applicable for solidified waste storage containers and facilities:

(1) All solidified radwaste should be located in restricted areas where effective material control accountability can be maintained. While structures are not required to meet seismic criteria, protection should be afforded to insure the radioactivity is contained safely by use of good engineering judgment, such as the use of curbs and drains to contain spills of dewatered resins or sludges.

(2) If the waste product is potentially corrosive, proven provisions should be made to protect the container (i.e., special liners or coatings) and, or neutralize the waste. If deemed appropriate and necessary, highly noncorrosive materials (e.g., stainless steel) should be used. Potential corrosion between the solid waste forms and the container should also be considered. In the case of dewatered resins, highly corrosive acids and bases can be generated which will significantly reduce the longevity of the container. The Process Control Program (PCP), should implement steps to assure the above does not occur, and provisions on container material

selection and precoating should be made to insure that container breach does not occur during temporary storage periods.

(3) Provisions should be made for additional reprocessing or repackaging due to container failure and/or, as required for final transporting and burial, as per DOT and burial site criteria. Contamination isolation and decontamination capabilities should be developed. Whereby significant handling and personnel exposure can be anticipated, ALARA methodology should be incorporated as per Regulatory Guides 8.8 and 8.10.

4. Low Level Dry Waste Storage

(a) Low level dry waste is classified as contaminated material which contains sources of radioactive material that is dispersed in small concentrations throughout large volumes of inert material which contain no free water. Generally, this consists of dry contaminated material such as rags, clothing, paper, air filters and small equipment (i.e., tools and instruments) which cannot be easily decontaminated.

(b) Licensees should implement controls to segregate and minimize the generation of Low Level Dry Waste to lessen the impact on waste storage.

(c) The following design objectives and criteria are applicable for low level dry waste storage containers and facilities:

(1) All dry or compacted radwaste should be located in restricted areas where effective material control and accountability can be maintained. While structures are not required to meet seismic criteria, protection should be afforded to insure the radioactivity is contained safely by use of good engineering judgement.

(2) The waste container should be designed to insure radioactive material containment during normal and abnormal occurrences. The waste container materials should not support combustion. The packaged material should not cause fires through, spontaneous chemical reactions, retained heat, etc.

(3) Containers should generally comply with the criteria of 10 CFR Part 71 and 49 CFR Part 170 to minimize the need for repackaging for shipment.[60]

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 the ability to dispose of waste at a licensed disposal site exists. The shipping of waste at the earliest practicable time minimizes the need for eventual waste reprocessing due to possibly changing disposal facility requirements, reduces occupational and non-occupational exposures and potential accident consequences, and in the event of burial ground closure, maximizes the amount of storage space available for use.

The duration of the intended storage, the type and form of waste, and the amount of radioactive material present will dictate the safeguards and the level of complexity required to assure public health and safety, and minimal risk to operating personnel. The longer the intended storage period, the greater the degree of controls that will be required for radiation protection and accident prevention. For purposes of this document, the duration of temporary waste storage is to be up to five (5) years. The magnitude of the onsite storage safety hazard is predicated on the type of waste being stored, the amount of radionuclides present, and how readily they might be transported into the environment. 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. The specific design and operation of any storage facility will be significantly influenced by the various waste forms, consequently, this document addresses wet waste, solidified wet waste and dry low level radioactive waste.

II. General Information

Prior to any implementation of additional onsite storage, substantial safety review and environmental assessments should be conducted to assure adequate public health and safety and minimal environmental impact. The acceptance criteria and performance objectives of any proposed storage facility, or area, will need to meet minimal requirements in areas of design, operations, safety considerations and policy considerations. For purposes of this technical position, the major emphasis will be on safety considerations in the storing, handling and eventual disposition of the radioactive waste. Design and operational acceptability will be based on minimal requirements which are defined in existing SRP, Regulatory Guides, and industry standards for proper management of radioactive waste. Considerations for waste minimization and volume reduction will also have to be incorporated into an overall site waste management plan and the onsite storage alternative. Additional waste management considerations for ALARA, decontamination, and decommissioning of the temporary storage facility, including disposal, should be performed as early as possible because future requirements for waste forms may make stored wastes unacceptable for final disposition.

Facility design and operation should assure that radiological consequences of design basis events (fire, tornado, seismic event, flood) should not exceed a small fraction (10%) of 10 CFR Part 100, i.e., no more than a few Sv (rem) whole body dose. The added capacity would typically extend storage to accommodate no more than an amount of waste generated during a nominal five-year period. In addition, waste should not be stored for a duration that exceeds five years. Storage of waste in excess of the quantities and duration described herein requires Part 30 licensing approval. The design capacity (m, MBq) should be determined from historical waste generation rates for the station, considering both volume minimization/reduction programs and

the need for surge capacity due to operations which may generate unusually large amounts of waste.

The five-year period is sufficient to allow licensees to design and construct additional volume reduction facilities (incinerators, etc.), as necessary, and then process wastes that may have been stored during construction. Regional state compacts to create additional low-level waste disposal sites should also be established within the next five years.

III. Generally Applicable Guidance

(a) 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 40 CFR 190 limits will restrict the annual dose from direct radiation and effluent releases from all sources of uranium fuel cycle and 10 CFR Part 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 $\leq$ 0.01 mSv [1 mrem/year] is not likely to cause the limits of 40 CFR 190 to be exceeded). Onsite dose limits associated with temporary storage will be controlled per 10 CFR Part 20 including the ALARA principal of 10 CFR 20.1003.

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

Gas generation from organic materials in waste containers can also lead to container breach and potentially flammable/explosive conditions. To minimize the number of potential problems, the waste form gas generation rates from radiolysis, biodegradation, or chemical reaction should be evaluated with respect to container breach and the creation of flammable or explosive conditions. Unless storage containers are equipped with special vent designs which allow depressurization and do not permit the migration of radioactive materials, resins highly loaded with radioactive material, such as BWR reactor water cleanup system resins, should not be stored for a period in excess of approximately one year.

A program of at least periodic (quarterly) visual inspection of container integrity (swelling, corrosion products, breach) should be performed. Inspection can be accomplished by use of TV monitors; by walkthroughs if storage facility layout, shielding, and the 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 occupational exposure. The use of high integrity containers (300 year lifetime design) would permit an inspection program of reduced scope.

(c) If possible, the preferred location of the additional storage facility is inside the plant protected area. If adequate space in the protected area is not available, the storage facility should be placed on the plant site and both a physical security program (fence, locked and alarmed gates and doors, periodic patrols) and a restricted area for radiation protection purposes should be established. The facility should not be placed in a location that requires transportation of the waste over public roads unless no other feasible alternatives exist. Any transportation over public roads must be conducted in accordance with NRC and DOT regulations.

(d) For low level dry waste and solidified waste storage:

1. Potential release pathways of all radionuclides present in the solidified waste form shall be monitored as per 10 CFR 50, Appendix A. Surveillance programs shall incorporate adequate methods for detecting failure of container integrity and measuring releases to the environment. For outside storage, periodic direct radiation and surface contamination monitoring shall be conducted to insure that levels are below limits specified in 10 CFR 20.1302, and 49 CFR 173.397. All containers should be decontaminated to these levels or below before storage.

2. Provisions should be incorporated 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.

3. Waste stored in outside areas should be held securely by installed hold down systems. The hold down system should secure all containers during severe environmental conditions up to and including the design basis event for this waste storage facility.

4. Container integrity should be assured against corrosion from the external environment; external weather protection should be included where necessary and practical. Storage containers should be raised off storage pads where water accumulation can be expected to cause external corrosion and possible degradation of container integrity.

5. Total becquerel (curie) limits should be established based on the design of the storage area and the safety features provided.

6. Inventory records of waste types, contents, dates of storage, shipment, etc., should be maintained.

IV. <u>Wet Radioactive Waste Storage</u>

(a) Wet radioactive waste will be defined as any liquid or liquid/solid slurry. For storage considerations, wet waste is further defined as any waste which contains free liquid in

amounts which exceed the requirements for burial as established by the burial ground licensing authority.

(b) The facility supporting structure and tanks should be designed to prevent uncontrolled releases of radioactive materials due to spillage or accident conditions.

(c) The following design objectives and criteria are applicable for wet radioactive waste storage facilities:

1. Structures that house liquid radwaste storage tanks should be designed to seismic criteria as defined in Standard Review Plan (Section 11.2). Foundations and walls shall also be designed and fabricated to contain the liquid inventory which might be released during a container/tank failure.

2. All tanks or containers should be designed to withstand the corrosive nature of the wet waste stored. The duration of storage under which the corrosive conditions exist shall also be considered in the design.

3. All storage structures should have curbs or elevated thresholds with floor drains and sumps to safely collect wet waste assuming the failure of all tanks or containers. Provisions should be incorporated to remove spilled wet waste to the radwaste treatment systems.

4. All tanks and containers shall have provisions to monitor liquid levels and to alarm potential overflow conditions.

5. All potential release pathways of radionuclides (e.g., evolved gases, breach of container, etc.) shall be controlled, if feasible, and monitored as per 10 CFR 50, Appendix A (General Design Criteria 60 and 64). Surveillance programs should incorporate adequate methods for monitoring breach of container integrity or accidental releases.

6. All temporarily stored wet waste will require additional reprocessing prior to shipment offsite; therefore, provisions should be established to integrate the required treatment with the waste processing and solidification systems. The interface and associated systems should be designed and tested in accordance with the codes and standards described in Standard Review Plan Section 11.

V. Solidified Radioactive Waste Storage

(a) Solidified radwaste for storage purposes shall be defined as that waste which meets solidified waste criteria for licensed facilities. For purposes of this document, resins or filter sludges dewatered to the above criteria will be defined under this waste classification/criteria.

(b) Any storage plans should address container protection as well as any reprocessing requirements for eventual shipment and burial.

(c) Casks, tanks, and liners containing solidified radioactive waste should be designed with good engineering judgment to preclude or reduce the probability of occurrence of uncontrolled releases of radioactive materials due to handling, transportation or storage. Accident mitigation and control for design basis events (e.g., fire, flooding, tornadoes, etc.) must be evaluated and protected against unless otherwise justified.

(d) The following design objectives and criteria are applicable for solidified waste storage containers and facilities:

1. All solidified radwaste should be located in restricted areas where effective material control and accountability can be maintained. While structures are not required to meet seismic criteria, protection should be afforded to insure the radioactive material is contained safely by use of good engineering judgment, such as the use of curbs and drains to contain spills of dewatered resins or sludges.

2. If liquids exist which are corrosive, proven provisions should be made to protect the container (i.e., special liners or coatings) and/or neutralize the excess liquids. If deemed appropriate and necessary, highly non-corrosive materials (e.g., stainless steel) should be used. Potential corrosion between the solid waste forms and the container should also be considered. In the case of dewatered resins, highly corrosive acids and bases can be generated which will significantly reduce the longevity of the container. The Process Control Program (PCP) should implement steps to assure the above does not occur; provisions on container material selection and precoating should be made to insure that container breach does not occur during temporary storage periods.

3. Provision should be made for additional reprocessing or repackaging due to container failure and/or, as required for final transportation and disposal as per DOT and licensed disposal facility criteria. Contamination isolation and decontamination capabilities should be developed. When significant handling and personnel exposure can be anticipated, ALARA methodology should be incorporated as per Regulatory Guides 8.8 and 8.10.

4. Procedures should be developed and implemented for early detection, prevention and mitigation of accidents (e.g., fires). Storage areas and facility designs should incorporate good engineering features and capabilities for contingencies so as to handle accidents and provide safeguard systems such as fire detectors and suppression systems, (e.g., smoke detector and sprinklers). Personnel training and administrative procedures should be established to insure both control of radioactive materials and minimum personnel exposures. Fires suppression devices may not be necessary if combustible materials are minimal in the area.

VI. Low Level Dry Waste Storage

(a) Low level dry waste is classified as contaminated material (e.g., paper, trash, air filters) which contains radioactive material dispersed in small concentrations throughout large

volumes of inert material and contains no free water. Generally, this consists of dry material such as rags, clothing, paper and small equipment (i.e., tools and instruments) which cannot be easily decontaminated.

(b) Licensees should implement controls to segregate and minimize the generation of low level dry waste to lessen the impact on waste storage. Integration of Volume Reduction (VR) hardware should be considered to minimize the need for additional waste storage facilities.

(c) The following design objectives and criteria are applicable for low level dry waste storage containers and facilities:

1. All dry or compacted radwaste should be located in restricted areas where effective material control and accountability can be maintained. While structures are not required to meet seismic criteria, protection should be afforded to insure the radioactive material is contained safely by use of good engineering judgment.

2. The waste container should be designed to insure radioactive material containment during normal and abnormal occurrences. The waste container materials should not support combustion. The packaged material should not cause fires through spontaneous chemical reactions, retained heat, etc.

3. Containers should generally comply with the criteria of 10 CFR 71 and 49 CFR 170 to minimize the need for repackaging for shipment.

4. Increased container handling and personnel exposure can be anticipated, consequently, all ALARA methodology should be incorporated per Regulatory Guides 8.8 and 8.10.[61]

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SRP Draft Section 11.4
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	PRB Comment C1	Changed "systems" to system. (Global change for this section where appropriate.)
2.	Current PRB name and acronym	Changed PRB to Plant Systems Branch (SPLB).
3.	SRP-UDP format item	Added reference to standard design certification stage of review.
4.	Current PRB acronym	Changed PRB to SPLB. (Global change for this section.)
5.	SRP-UDP format item	Added reference to combined license (COL) stage of review.
6.	SRP-UDP format item	Added reference to standard design certification stage of review.
7.	SRP-UDP format item	Added "Review Interfaces" to facilitate grouping the coordinating review branches and the other SRP sections which support the review of SRP Section 11.4.
8.	SRP-UDP format item	Changed to indicate the review tasks of the PRB SPLB.
9.	PRB comment C2	Deleted inappropriate sentence that addressed liquid tank failure.
10.	Current review branch name and acronym	Changed for selected sections of SRP Chapter 3.0 Civil Engineering and Geosciences Branch (ECGB).
11.	SRP-UDP format item	Change to delete redundant statement.
12.	SRP-UDP format item and current review branch name and acronym	Current branch for SRP Section 16.0 Technical Specifications Branch (TSB).
13.	SRP-UDP format item and current review branch name and acronym	Current branch for SRP Chapter 17 Quality Assurance and Maintenance Branch (HQMB).
14.	PRB comment C1	Deleted reference to "solid waste treatment system" and substituted "SWMS."
15.	Integrated Impact No. 454	Editorial change to indicate the new Part 20 section number § 20.1302.
16.	PRB comment C3	Revised paragraph for added specificity with respect to the applicability of the acceptance criteria.
17.	PRB comment	Added "resulting from SWMS operation" for added specificity.
18.	Editorial	Added abbreviation for General Design Criterion 60.

Item	Source	Description
19.	PRB comment C1	Deleted reference to "solid waste management system" andsubstituted "SWMS."
20.	PRB comment C3	Modified sentence for added specificity.
21.	Integrated Impact No. 453	Added reference to 10 CFR Part 61 requirements.
22.	SRP-UDP format item	Editorial comment to indicate that RG 1.143 should be updated in accordance with PNL IPD 11.21 and INEL 11.4:IPD01.
23.	PRB comment C3a	Deleted erroneous reference to "gaseous waste treatment system."
24.	PRB comment C4	Replaced "receiving burial site" with "licensed disposal facility."
25.	PRB comment C4	Replaced "burial site" with "disposal facility."
26.	Integrated Impact No. 453	Added reference to 10 CFR Part 61 requirements.
27.	SRP-UDP format item	Paragraph heading "Technical Rationale" added to"ACCEPTANCE CRITERIA" subsection and put in numbered form to incorporate the bases for the acceptance criteria.
28.	SRP-UDP format item	Added the lead in statement for the "Technical Rationale."
29.	SRP-UDP format item and PRB comment C6	Added technical rational for 10 CFR 20.1302 provided by the PRB technical reviewer.
30.	SRP-UDP format item and PRB comment C7	Added the technical rationale for 10 CFR Part 50, § 50.34 a provided by the PRB reviewer.
31.	SRP-UDP format item and PRB comment C8	Added the technical rationale for GDC 60 provided by the PRB reviewer.
32.	SRP-UDP format item and PRB comment C9	Added the technical rationale for GDC 63 provided by the PRB reviewer.
33.	SRP-UDP format item and PRB comment C10	Added the technical rationale for GDC 64 as modified by thePRB reviewer.
34.	SRP-UDP format item and PRB comment C11	Added the technical rationale for 10 CFR Part 61 as modified by the PRB reviewer.
35.	SRP-UDP format item	Added the technical rationale for 10 CFR Part 71.
36.	SRP-UDP format item	Added the technical rationale for BTP ETSB 113.
37.	SRP-UDP format item	Added the technical rationale for Appendix 11.1A to SRP Section 11.4.
38.	Editorial	Substituted "radioactive material" for "radioactivity."
39.	Integrated Impact No. 453	Added reference to 10 CFR Part 61 requirements.

Item	Source	Description
40.	PRB comment C4	Replaced "burial" with "disposal."
41.	SRP-UDP format item	Editorial change to add current PRB acronym and responsibility SPLB.
42.	SRP-UDP format item	Added reference to combined license stage of review.
43.	Current review branch acronym	Editorial change to add current review branch acronym TSB.
44.	PRB comment C12	Revised paragraph as directed by the PRB reviewer.
45.	Integrated Impact No. 453	Added reference to 10 CFR Part 61, §§ 61.55 and 61.56.
46.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
47.	Integrated Impact No. 454	Editorial change to indicate the new Part 20 section number § 20.1302.
48.	Integrated Impact No. 453	Added reference to 10 CFR Part 61.
49.	PRB comment C4	Replaced "for burial" with "licensed disposal facility."
50.	PRB comment C13	Revised sentence in accordance with direction from the PRB reviewer.
51.	Integrated Impact No. 453	Added reference to 10 CFR Part 61
52.	PRB comment C1	Standardized on use of SWMS.
53.	SRP-UDP Format Item, Implement 10 CFR 52 Related Changes	To address design certification reviews a new paragraph was added to the end of the Evaluation Findings. This paragraph addresses design certification specific items including ITAAC, DAC, site interface requirements, and combined license action items.
54.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
55.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
56.	Integrated Impact No. 1415	Added Reference item to reflect name change of Appendix 11.4A.
57.	PRB comment C14	Added 10 CFR Part 61 Reference in accordance with direction from the PRB reviewer and renumbered subsequent references.
58.	PRB comment C16	Revised sentence in accordance with the PRB reviewer directions.
59.	Conversion of 2.5 mr/hr to SI units	Converted 2.5 mr/hr to 0.025 mSv/hr.

Item	Source	Description
60.	Integrated Impact No. 1415	Removed current version of Appendix 11.4A in its entirety.
61.	Integrated Impact No. 1415 and PRB comment C17 and C4	Added new version of Appendix 11.4A as modified by the PRB reviewer.

SRP Draft Section 11.4
Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
453	Consider adding GDC 61 and 10 CFR 61 as ACCEPTANCE CRITERIA and developing appropriate REVIEW PROCEDURES to address the requirements of 10 CFR 61. In addition, consider revising Branch Technical Position (BTP) ETSB 11-3 to address staff positions on waste form.	Incorporated 10 CFR Part 61 into SRP Section 11.4 as recommended by II 453. GDC 61 not added and BTP ETSB 11-3 not incorporated as recommended by II 453.
454	Consider revising the ACCEPTANCE CRITERIA, REVIEW PROCEDURES, and EVALUATION FINDINGS to replace citations of superseded sections in 10 CFR Part 20.	Incorporated into the SRP in Sections II.A.1 and IV, 2nd ¶.
455	Consider revising REVIEW PROCEDURES to identify Reg. Guides 7.3 and 7.4 as available guidance on packaging and shipment of radioactive material.	Do not incorporate Reg. Guides 7.3 and 7.4 into SRP Section 11.4 as review criteria. Guidance on packaging and shipment of radioactive material is incorporated in the SRP in Sections II and III.
456	Consider revising ACCEPTANCE CRITERIA to address the requirements of 10 CFR 50.36a and modify REVIEW PROCEDURES and EVALUATION FINDING to address evaluation of the Process Control Program (PCP).	Not incorporated as SRP Section 11.4 states that the TS will be reviewed in accordance with the requirements of 10 CFR 50.36a and the PCP is a part of the technical specifications.
457	Developing a revision to Reg. Guide 1.143 to provide an alternate method for defining seismic criteria should be considered a candidate for future work.	Not incorporated in the SRP as PNL IPD-7.0 Form No. 11.2-1 needs to be completed.
1414	Consider reviewing the revised standards for applicability as SRP Section 11.4 review criteria and update RG 1.143 to endorse the latest version of the standards.	Not incorporated in the SRP as IPD Form 7.0, INEL 11.4: IPD-01 needs to be completed.
1415	Update Appendix 11.4-A to SRP Section 11.4 to include the appropriate provisions of Generic Letter (GL) 81-38, "Storage of Low-Level Radioactive Wastes at Power Reactor Sites," November 11, 1981.	SRP Section 11.4, Appendix 11.4-A was updated to reflect the provisions of Generic Letter 81-38 by replacing Appendix 11.4-A in its entirety by the Enclosure to Generic Letter 81-38.