U.S. NUCLEAR REGULATORY COMMISSION

# STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

## 11.4 SOLID WASTE MANAGEMENT SYSTEMS

REVIEW RESPONSIBILITIES

Primary - Effluent Treatment Systems Branch (ETSB)

Secondary - None

### I. AREAS OF REVIEW

At the construction permit (CP) stage, ETSB reviews the design objectives, criteria, performance objectives, and description of the solid waste system (SWS) as given in the applicant's preliminary safety analysis report (PSAR). During the operating license (OL) stage of review, ETSB confirms the design accepted at the CP stage and evaluates the applicant's process control program and technical specifications in these areas.

ETSB 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 SWS.

2. The description of the SWS, 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 SWS, 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.

9. 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.

In addition, ETSB will coordinate other branches' evaluations that interface with the overall review of the system as follows: the Structural Engineering Branch (SEB) 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. The Mechanical Engineering Branch (MEB) 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.

For those areas of review identified above as being reviewed as part of the primary review responsibility of other branches, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP section of the corresponding primary branch.

## II. ACCEPTANCE CRITERIA

ETSB acceptance criteria for the solid waste treatment system design are based on meeting the relevant requirements of the following regulations:

A. 10 CFR Part 20, §20.106 as it relates to radioactivity in effluents to unrestricted areas.

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 have been met.

C. General Design Criterion 60 as it relates to the radioactive waste management systems being designed to control releases of radioactive materials to the environment.

D. General Design Criterion 63 and 64 as it relates to the radioactive waste system being designed for monitoring radiation levels and leakage.

E. 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 as it relates to the seismic design and quality group classification of components used in the gaseous waste treatment system and structures housing the systems 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 (Ref. 1).

3. Other wet wastes will be solidified or dewatered (subject to receiving burial site 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 (Ref. 1).

4. Solid waste containers, shipping casks, and methods of packaging meet applicable Federal regulations, e.g., 10 CFR Part 71 (Ref. 7), and wastes are to be shipped to a licensed burial site in accordance with applicable Commission, Department of Transportation, and State regulations.

5. Processing equipment is sized to handle the design SWS 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 (Ref. 1). (The bases for the storage time chosen should be given in the safety analysis report).

7. SWS components and piping systems, and structures housing SWS components, are designed in accordance with the provisions of Regulatory Guide 1.143 (Ref. 2), and Branch Technical Position (BTP) ETSB 11-3 (Ref. 1).

8. The SWS contains provisions to reduce leakage and facilitate operations and maintenance in accordance with the provisions of Regulatory Guide 1.143 (Ref. 2) and Branch Technical Position (BTP) ETSB 11-3 (Ref. 1).

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 (Ref. 3).

## III. REVIEW PROCEDURES

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

1. ETSB 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, radionuclide distribution, and waste categories.

   The system design and design criteria will be compared with the guidelines of Regulatory Guide 1.143 (Ref. 2), Branch Technical Position (BTP) ETSB 11-3 (Ref. 1), and available data from operating plants of similar design.

2. ETSB 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 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 reviews the methods proposed to verify that all wet wastes have been adequately solidified or dewatered and will determine their acceptability considering (1) 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), (2) the procedure to be employed to solidify or dewater free liquids if detected, and (3) the waste form characteristics.

3. ETSB reviews the description of procedures for the packaging and shipment of solid wastes to an approved offsite burial facility, and verifies that the applicant makes definite commitments to following appropriate Federal and State regulations. ETSB 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 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 (Ref. 1). 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 (Ref. 3).

5. If the SWS contains any storage or makes use of flammable materials, ETSB requests the CEB to provide a review under SRP Section 16.0.

6. ETSB compares the quality group classifications of the solid waste system to the guidelines of Regulatory Guide 1.143 (Ref. 2).

7. ETSB compares the seismic design of the structures housing the SWS to the guidelines of Regulatory Guide 1.143 (Ref. 2). Exceptions are transmitted to MEB, which has primary responsibility under SRP Section 3.2.1.

8. ETSB compares equipment layout, design features, and mode of operation of the solid waste system to the guidelines of Regulatory Guide 1.143 (Ref. 2) and (BTP) ETSB 11-3 (Ref. 1).

9. At the OL stage ETSB reviews the technical specifications 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 of the technical specifications 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 are reviewed per the requirements of 10 CFR Part 50, §50.36a (Ref. 4).

## IV. EVALUATION FINDINGS

ETSB 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:

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; 10 CFR Part 50, §50.34a; General Design Criterion 60, 63, and 64; and 10 CFR Part 71. This conclusion is based on the applicant demonstrating that the solid waste system (SWS) includes the equipment and instrumentation used for the processing, packaging, and storage of radioactive wastes prior to shipment offsite for burial. The scope of the review of the SWS includes line diagrams of the system, piping and instrumentation diagrams (P&IDs), and descriptive information for the SWS and for those auxiliary supporting systems that are essential to the operation of the SWS. The applicant's proposed design criteria and design bases for the SWS, 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 and 71 and of applicable DOT regulations, and the applicant's quality group classification and seismic design relative to Regulatory Guide 1.143, have also been reviewed. 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 our review has been conformance of the applicant's designs, design criteria, and design bases for the solid radwaste system to the regulations and the guides referenced above, as well as to staff technical positions and industry standards. Based on the foregoing evaluation, we conclude that the proposed solid radwaste system is acceptable.

## V. IMPLEMENTATION

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

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.

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 On-Site Storage of Low Level Radioactive Waste."

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 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Materials Under Certain Conditions."

8. 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 between waste packaging and shipment offsite, consideration should be given to providing ample

[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.

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. Adsorbents 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 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 2.5 mr/hr, 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 minimal 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 historial 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.