NUREG-75/087

U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

SECTION 11.4 SOLID WASTE MANAGEMENT SYSTEMS

REVIEW RESPONSIBILITIES

Primary - Effluent Treatment Systems Branch (ETSB)

Secondary - Structural Engineering Branch (SEB)

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 technical specifications in these areas.

1. a. The design objectives in terms of expected and design volumes of waste to be processed and handled, the types of waste to be processed (e.g., sludges, resins, evaporator bottoms, and dry material such as contaminated tools, equipment, and clothing), the radionuclide content of the waste, equipment design capacities, and the principal parameters employed in the design of the SWS are reviewed. The description of the SWS, the piping and instrumentation diagrams (P&ID's), and the process flow diagrams showing the methods of operation and factors that influence waste treatment are reviewed. The expected chemical content flows 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 are reviewed.

   b. The description of the methods for solidification (i.e., of removal of free water), the solidifying agent used, and the methods to be employed to ensure a solid matrix are reviewed.

   c. 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 to meet applicable federal regulations are reviewed.

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

3. The quality group classifications of piping, and equipment and bases governing the classification chosen are reviewed.

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

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

6. The technical specifications proposed by the applicant for process and effluent control are reviewed at the operating license (OL) stage (FSAR).

SEB will provide an evaluation of the applicant's proposed seismic design classification of structures housing the solid radwaste systems and the required seismic analysis for inclusion in the staff's Safety Evaluation Report.

II. ACCEPTANCE CRITERIA

1. ETSB will accept the solid waste treatment system design if the following conditions are met:

   a. The system design parameters are based on radionuclide concentrations and volumes consistent with reactor operating experience for similar designs and with the source terms of Section 11.1.

   b. All wet solid wastes will be solidified prior to shipment offsite and there are provisions to verify the absence of free liquid in the containers and to reprocess containers in which free liquid is detected in accordance with Branch Technical Position (BTP) ETSB 11-3.

   c. 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 in accordance with applicable Commission and Department of Transportation regulations.

2. ETSB will accept the design capacity of the SWS if the following conditions are met:

   a. Processing equipment is sized to handle the design SWS inputs, e.g., the solid waste generation rates reviewed under I.1 of this plan without the need to ship bulk liquids.

   b. Onsite waste storage facilities provide sufficient storage capacity to allow time for short-lived radionuclides to decay prior to shipping.

The bases for the storage time chosen should be given in the safety analysis report.

3. ETSB will accept SWS components and piping systems, and structures housing SWS components, designed in accordance with the provisions of Branch Technical Position (BTP) ETSB 11-1 (Rev. 1) (Ref. 10).

4. ETSB will accept systems that contain provisions to reduce leakage and facilitate operations and maintenance in accordance with the provisions of Branch Technical Position (BTP), ETSB 11-1 (Rev. 1) (Ref. 10) and Branch Technical Position (BTP), ETSP 11-3 (Ref. 11).

III. REVIEW PROCEDURES

The reviewer will select and emphasize material from this review plan, as may be appropriate for a particular case.

1. a. ETSB reviews the P&ID's 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, radionuclides, and waste categories.

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

   b. ETSB compares the methods to be used to solidify liquids 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 method is capable of solidifying the range of constituents expected to be present in the wastes. ETSB reviews the methods proposed to verify that all liquids have been immobilized or combined during solidification operations and will determine its acceptability considering (1) the ability of the technique to detect free, mobile, or uncombined liquids, (2) the procedure to be employed to solidify free liquids if detected, and (3) the effect of the method on operator exposures.

   c. 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.

2. 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 is compared to the guidelines of (BTB) 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.

3. ETSB compares the quality group and seismic design classifications of the solid waste system and of the structures housing the system to the guidelines of BTP ETSB 11-1 (Rev. 1). The consequences of failures of tanks containing radioactive liquids are evaluated under SRP 15.7.3.

4. ETSB compares equipment layout, design features, and mode of operation of the solid waste system to the guidelines of (BTP) ETSB 11-1 (Rev. 1) and (BTB) ETSB 11-3.

5. At the OL stage ETSB reviews the technical specifications proposed by the applicant for process and effluent control. The reviewer will determine that the content and intent of the technical specifications prepared by 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.

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 solid waste system (SWS) includes the equipment and instrumentation used for the solidification, 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&ID's), 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 and seismic design classification relative to BTP ETSB 11-1, have also been reviewed. 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. REFERENCES

1. 10 CFR Part 20, "Standards for Protection Against Radiation," and Appendix B, "Concentrations in Air and Water Above Natural Background."

2. 10 CFR §50.34a, "Design Objectives for Equipment to Control Releases of Radioactive Materials in Effluents - Nuclear Power Reactors."

3. 10 CFR §50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors."

4. 10 CFR Part 50, Appendix A, "General Design Criteria for Nuclear Power Plants."

5. 10 CFR Part 51, "Licensing and Regulatory Policy and Procedures for Environmental Protection."

6. 10 CFR Part 71, "Packaging of Radioactive Material for Transport and Transportation of Radioactive Materials Under Certain Conditions."

7. Regulatory Guide 1.21, "Measuring, Evaluating, and Reporting Radioactivity in Solid Wastes and Releases of Radioactive Materials in Liquid and Gaseous Effluents from Light-Water-Cooled Nuclear Power Plants," Revision 1.

8. Regulatory Guide 1.BB, "Calculations of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Pressurized Water Reactors (PWR's)."

9. Regulatory Guide 1.CC, "Calculation of Releases of Radioactive Materials in Liquid and Gaseous Effluents from Boiling Water Reactors (BWR's)."

10. Branch Technical Position ETSB 11-1 (Rev. 1), "Design Guidance for Radioactive Waste Management Systems Installed in Light-Water-Cooled Nuclear Reactor Power Plants," attached to Standard Review Plan 11.2.

11. 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 Standard Review Plan 11.4.

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

Solid wastes may be generated as a byproduct of nuclear power either directly, as with spent air filtration media (dry wastes), or indirectly, as with concentrated evaporator bottoms which undergo a solidification process prior to shipping (wet wastes). Solidification processes may be additionally used to render wastes already in a solid form, e.g., spent demineralizer resins, into a less mobile form, thereby mitigating the consequences of potential ruptures to shipping containers.

Dry wastes 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.

Although there are a number of processes available which are capable of solidifying liquid 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 and

2) assure systems are operated within the established process parameters, or

3) have provisions to detect free liquid in containers prior to shipment offsite.

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 storage capacity to accommodate wastes during periods when shipments offsite are not possible, e.g., during labor strikes.

Until a more definitive guide is published, the criteria in Section B, below, provides adequate and acceptable design solutions for the concerns outlined above.

---

[1] For the purpose of this position paper, free water is defined as uncombined water not bound by the solid matrix.

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 herein.

B. Branch Technical Position

I. Dry Solid Waste Compaction

a. Solid waste compaction devices should include a ventilated shroud around the waste container to control the release of airborne dusts generated during the compaction process.

II. Waste Forms Acceptable for Shipment Offsite

a. All wastes should be in a solid immobile form prior to shipment offsite.

b. Spent resins and filter sludges should be combined with a suitable binding agent (e.g., cement, urea formaldehyde) and formed into a solid matrix.

c. For normal operation, shipment of liquids offsite is unacceptable. Means should be provided to effect the complete solidification of all wastes which can be reasonably expected to be generated during normal operation including anticipated operational occurrences.

d. Adsorbants, such as vermiculite, are not acceptable substitutes for solidification.

III. Assurance of Complete Solidification

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

a. Process Control Program

1. Solidification agents and potential waste constituents should be tested and a set of process parameters established which provide boundary conditions within which reasonable assurance can be given that solidification will be complete.

2. The plant operator should provide assurance that the process is run within the parameters established under 1 above. Appropriate records should be maintained for individual batches showing conformance with the established parameters.

b. Free Liquid Detection

Each container filled with solidified wet wastes should be checked by suitable methods to verify the absence of free liquids. 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.

IV. Waste Storage

a. Tanks accumulating spent resins from reactor 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.

b. Storage areas for solidified wastes should be capable of accommodating at least 30 days' waste generation at normal generation rates.

c. Storage areas for dry wastes should be capable of accommodating at least one full offsite waste shipment.

V. Additional Design Features

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

a. Evaporator concentrate piping and tanks have heat tracing.

b. Components and piping which contain radioactive slurries have flushing connections.

c. Solidification agents are stored in low radiation areas generally less than 2.5 mr/hr with provisions for sampling.

d. Tanks or equipment which use compressed gases for transport or drying of resins or filter sludges should be directly exhausted to the plant ventilation exhaust system through HEPA filters as a minimum.

SRP 11.5