



U.S. NUCLEAR REGULATORY COMMISSION

# STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

## 9.2.6 CONDENSATE STORAGE FACILITIES

### REVIEW RESPONSIBILITIES

Primary - Auxiliary Systems Branch (ASB)

Secondary - None

### I. AREAS OF REVIEW

The condensate storage facility (CSF) is provided to serve as a receiver for excess water generated by other systems such as the main condenser hotwell, the liquid radwaste low activity reprocessed condensate, and the makeup water treatment system, and also to serve as the water supply or makeup source for various auxiliary systems. Depending upon its specific function in the plant under review, the CSF may or may not be safety related. The ASB review covers the CSF from the condensate storage tank up to the connections or interfaces with other systems to assure conformance with the requirements of General Design Criteria 2, 5, 44, 45 and 46.

1. The ASB reviews the capability of the CSF to supply water to various auxiliary systems and to receive return water from other systems.
2. The ASB reviews the CSF to verify that:
  - a. Failures of CSF components connected to the emergency core cooling system (ECCS) or other safety-related systems do not adversely affect the safety function of the ECCS or other safety-related systems.
  - b. The essential portions of the CSF are protected from the effects of natural phenomena, including cold weather protection, so that the event will not adversely affect the safety function of the system.
  - c. Component redundancy necessary to assure CSF safety functions is provided.
  - d. System components meet design code requirements consistent with the component quality group and seismic design classifications.

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### USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

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- e. Provisions for mitigating the environmental effects of system leakage or storage tank failure are provided.
  - f. Provisions for safe handling of storage tank overflow, the associated instrumentation necessary to detect high or low water level, and isolation means are provided.
  - g. Provisions for automatically transferring from a normal water supply that is nonsafety related to an assured seismic Category I source if required.
3. ASB also performs the following reviews under the SRP sections indicated:
- a. Review of flood protection is performed under SRP Section 3.4.1.
  - b. Review of the protection against internally generated missiles is performed under SRP Section 3.5.1.1.
  - c. Review of the structures, systems, and components to be protected against externally generated missiles is performed under SRP Section 3.5.2.
  - d. Review of high- and moderate-energy pipe breaks is performed under SRP Section 3.6.1.

In addition, the ASB will coordinate other branch evaluations that interface with the overall review of the system as follows: The Reactor Systems Branch (RSB) will identify essential portions of the facilities that are required to function during normal operations and accident conditions, and assist in establishing the basis for the minimum condensate storage capacity as part of its primary review responsibility of SRP Section 6.3. The Effluent Treatment Systems Branch (ETSB) will calculate the radioactivity concentrations in the CSF as part of its primary review responsibility in SRP Section 11.1. The Mechanical Engineering Branch (MEB) determines that components, piping, and structures are designed in accordance with applicable codes and standards as part of its primary review responsibility of SRP Sections 3.9.1 through 3.9.3 and MEB also determines the acceptability of the seismic and quality group classifications for system components as part of its primary review responsibility of SRP Sections 3.2.1 and 3.2.2. The MEB also reviews the adequacy of the inservice testing program of pumps and valves as part of its primary review responsibility of SRP Section 3.9.6. The Structural Engineering Branch (SEB) will determine the acceptability of the design analyses, procedures, and criteria used to establish the ability of seismic Category I structures housing the system and supporting systems to withstand the effects of natural phenomena such as the safe shutdown earthquake (SSE), the probable maximum flood (PMF), and the tornado missiles as part of its primary review responsibility of 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 Materials Engineering Branch (MTEB) verifies the inservice inspection requirements are met for system components and the compatibility of the materials of construction with the service conditions as part of its primary review responsibility of SRP Section 6.1.1. The Instrumentation & Control Systems Branch (ICSB) and Power Systems Branch (PSB) will verify the adequacy of the design, installation, inspection, and testing of all electrical systems (sensing, control, and power) required for proper operation as part of its primary review responsibilities of SRP Section 7.1 and Appendix 7-A for ICSB and SRP Section 8.3.1 for PSB. The Radiological Assessment Branch (RAB) reviews the facility design to assure that radiation

levels exposure to personnel will be maintained as low as is reasonably achievable as part of its primary review responsibility for SRP Section 12.1.

The review for fire protection, technical specifications, and quality assurance is coordinated and performed by the Chemical Engineering Branch, Licensing Guidance Branch, and Quality Assurance Branch as part of their primary review responsibility for SRP Sections 9.5.1, 16.0, and 17.0, respectively. For those areas of review identified above as being the responsibility of other branches, the acceptance criteria and their methods of application are contained in the SRP sections corresponding to those branches.

## **II. ACCEPTANCE CRITERIA**

Acceptability of the design of the condensate storage facility, as described in the applicant's Safety Analysis Report (SAR), is based on specific general design criteria and regulatory guides.

1. For reactor systems where the condensate storage facility is an ultimate means of water supply for safe shutdown or accident mitigation the CSF is acceptable if the integrated facility design is in accordance with the following criteria:
  - a. General Design Criterion 2, as related to the system being capable of withstanding the effects of earthquakes. Acceptance is based on meeting the guidance of Regulatory Guide 1.29, Position C-1, if any portion of the system is deemed to be safety related, and Position C-2 for nonsafety-related functions.
  - b. General Design Criterion 5, as related to the capability of shared systems and components to perform required safety functions.
  - c. General Design Criterion 44, to assure:
    - (1) Redundancy of components so that under normal and accident conditions the safety function can be performed assuming a single active component failure coincident with the loss of offsite power.
    - (2) The capability to isolate components, subsystems, or piping if required so that the system safety function will not be compromised.
    - (3) The capability to provide sufficient makeup water to safety-related cooling systems.
  - d. General Design Criterion 45, as related to design provisions made to permit inservice inspection of safety-related components and equipment.
  - e. General Design Criterion 46, as related to design provisions made to permit operational functional testing of safety-related systems and components to assure structural integrity, system leak tightness, operability and performance of active components, and capability of the integrated system to function as intended during normal, shutdown, and accident conditions.

### III. REVIEW PROCEDURES

The procedures below are used during the construction permit (CP) review to determine that the design criteria and bases and the preliminary design as set forth in the preliminary safety analysis report meet the acceptance criteria given in subsection II. For operating license (OL) reviews, the procedures are used to verify that the initial design criteria and bases have been appropriately implemented in the final design as set forth in the final safety analysis report.

The review of OL applications includes a determination that the content and intent of the technical specifications prepared by the applicant are in agreement with the requirements for system testing, minimum performance, and surveillance developed as a result of the staff's review.

Upon request from the primary reviewer, the coordinated review branches will provide input for the areas of review stated in subsection I. The primary reviewer obtains and uses such input as required to assure that this review procedure is complete.

The condensate storage facility (CSF) may be designed either as a safety-related facility or as a nonsafety-related facility, depending on the plant. The safety function performed by the facility is to ensure an adequate supply of water to the auxiliary feedwater system in the event that it is required for the safe shutdown of the reactor. Normal plant system functions performed by the CSF, such as makeup to the condenser hotwells and other auxiliary systems of the plant are reviewed to verify that failure will not have an adverse effect on the safety-related functions of the facility.

The review procedures given below are for a typical CSF system of the safety-related type. For cases where there are variations from this typical arrangement, the reviewer will adjust the review procedures given below. However, the system design will be required to meet the acceptance criteria given in subsection II.

1. The Safety Analysis Report is reviewed to determine that the facility description, and piping and instrumentation diagrams (P&IDs) delineate the CSF equipment that is used for normal operation, abnormal operation, and accident conditions as follows:
  - a. The facility functional requirements and the minimum flow requirements for supplying water to the auxiliary feedwater system and other safety-related systems are described.
  - b. Component allowable operational degradation (e.g., pump leakage) and the procedures that will be followed to detect and correct degraded conditions when they become excessive are described. The reviewer, using failure modes and effects analyses, or independent calculations, determines that the facility is capable of sustaining the loss of any active component and of meeting minimum flow requirements to the safety-related systems.
2. The facility P&IDs, layout drawings, and component descriptions and characteristics are reviewed to determine the following:

- a. Essential portions of the CSF are correctly identified and are isolable from the nonessential portions of the system. The P&IDs are reviewed to verify that they clearly indicate the physical division between each portion. System drawings are also reviewed to see that they show the means for accomplishing isolation, and the facility description is reviewed to identify minimum performance requirements for the isolation valves.
  - b. Essential portions of the CSF, including the isolation valves separating seismic Category I portions from the nonseismic portions, are classified Quality Group C and seismic Category I.
  - c. Design provisions have been incorporated that permit appropriate inservice inspection and functional testing of system components important to safety. It will be acceptable if the SAR delineates a testing and inspection program and if the system drawings show the necessary test recirculation loops around pumps or isolation valves that would be required by this program.
3. The reviewer verifies that the system has been designed so that facility functions are maintained, as required, in the event of adverse natural phenomena such as tornadoes, hurricanes, and floods, and a loss of offsite power. The reviewer evaluates the facility, using engineering judgment and the results of failure modes and effects analyses, to determine the following:
- a. The failure of portions of the facility or of other systems not designed to seismic Category I standards and located close to essential portions of the facility, or nonseismic Category I structures that house, support, or are close to essential portions of the CSF, does not preclude essential functions. Reference to SAR Chapter 2, describing site features and the general arrangement and layout drawings, as well as to the SAR tabulation of seismic design classifications for structures and facilities, will be necessary. Statements in the SAR to the effect that the above conditions are met are acceptable. (CP)
  - b. The essential portions of the CSF are protected from the effects of floods, cold weather conditions, hurricanes, tornadoes, and internally or externally generated missiles. Flood protection and missile protection criteria are discussed and evaluated in detail under the SRP sections for Chapter 3 of the SAR. The location and design of the facility and structures are reviewed to determine that the degree of protection provided is adequate. A statement to the effect that the facility is located in a seismic Category I structure that is tornado, missile, and flood protected, or that components of the facility will be located in individual structures that will withstand the effects of freezing, flooding, and missiles is acceptable.
  - c. The CSF provides sufficient net positive suction head (NPSH) at safety-related pump suction locations considering low condensate storage tank water levels. The SAR should indicate the minimum water level of the condensate storage tank and the elevation of the pump impellers. An independent calculation verifying the applicant's conclusion regarding pump NPSH may be necessary.

- d. The condensate storage tank is equipped with instrumentation to monitor the water level in the tank and alarm when the water level reaches the low-level setpoint which indicates the minimum reserve condensate storage for safety-related system supply.
  - e. The condensate storage tank overflow piping is connected to the radwaste system. The outdoor storage tank has a dike or retention basin capable of preventing runoff in the event of a tank overflow or tank failure; for a nonsafety-related storage facility, the need for a seismic Category I dike or retention basin is reviewed.
  - f. The essential portions of the facility are protected from the effects of high- and moderate-energy line breaks or cracks. Layout drawings are reviewed to assure that no high- or moderate-energy piping systems are close to essential portions of the CSF, or that protection from the effects of failure will be provided. The means of providing such protection will be given in Section 3.6 of the SAR, and the procedures for reviewing this information are given in the corresponding SRP sections.
  - g. Functions of the essential components and subsystems of the CSF (i.e., those necessary for plant safe shutdown) will not be precluded by a loss of offsite power. The CSF design will be acceptable in this regard if minimum system requirements are met with onsite power.
  - h. The condensate storage tank has design provisions that automatically transfer, as required, from a normal nonsafety-related source to a seismic Category I source.
  - i. If a changeover from a nonsafety-related condensate storage source to a safety-related water source is required for safe shutdown or accident mitigation, then the changeover feature (automatic) should meet all the requirements for a safety-related system or component.
4. The descriptive information, P&IDs, system drawings, and failure modes and effects analyses in the SAR are reviewed to assure that essential portions of the CSF will function as needed following design basis accidents, assuming a concurrent single active component failure. The reviewer evaluates the information presented in the SAR to determine the ability of required components to function, traces the availability of these components on system drawings, and checks that the SAR contains verification that system flow requirements are met for each accident situation for the required time spans. For each case, the design will be acceptable if minimum system flow requirements are met.

#### **IV. EVALUATION FINDINGS**

The reviewer verifies that sufficient information has been provided and his review supports conclusions of the following type, to be included in the staff's safety evaluation report:

The condensate storage facility (CSF) includes all components and piping associated with the facility to the points of connection or interfaces with other systems. The review has determined the adequacy

of the applicant's proposed design criteria and bases for the condensate storage facility and the requirements for sufficient water supply to safety-related systems during normal, abnormal, and accident conditions.

Portions of the CSF that are necessary for safe shutdown or necessary to mitigate the consequences of an accident are classified seismic Category I and Quality Group C.

The staff concludes that the design of the condensate storage facility is acceptable and meets the requirements of General Design Criteria 2, 5, 44, 45, and 46. This conclusion is based on the following:

1. The applicant has met the requirement of General Design Criterion 2 with respect to safety-related portions of the system being capable of withstanding the effects of earthquakes. Acceptance is based on meeting the guidance of Regulatory Guide 1.29, Position C-1, if any portion is deemed safety related, and Position C-2, for nonsafety-related portions. Portions of the system are deemed safety related if a failure or malfunction could result in adverse effects on essential systems or components (i.e., necessary for safe shutdown, accident prevention, or accident mitigation.)
2. The applicant has met the requirements of General Design Criterion 5 with respect to sharing of structures, systems, and components by demonstrating that such sharing does not affect the safe shutdown of either unit in the event of an active or passive failure.
3. The applicant has met the requirements of General Design Criterion 44 with respect to the cooling water system by demonstrating sufficient redundancy and capability exists such that a single failure with the loss of offsite power will not result in adverse effect on the ability to shut down safely or mitigate the consequences of an accident in addition to having sufficient capability to provide makeup water to safety-related cooling systems and the capability to isolate components, subsystems or piping without system degradation.
4. The applicant has met the requirements of General Design Criterion 45 with respect to inservice inspection of the safety-related components and equipment by demonstrating the accessibility of the CSF systems for periodic inspections.
5. The applicant has met the requirements of General Design Criterion 46 with respect to periodic pressure and functional testing to assure structural and leak tight integrity, operability, and performance of its active components, and operability of the system as a whole by demonstrating the capability to operate the system at full capacity during normal startup or shutdown procedures or during normal operation without degrading the system to provide for a safe shutdown or to mitigate the consequences of an accident.

## V. IMPLEMENTATION

The following is intended to provide guidance to the 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's regulations.

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

## VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."
3. 10 CFR Part 50, Appendix A, General Design Criterion 44, "Cooling Water."
4. 10 CFR Part 50, Appendix A, General Design Criterion 45, "Inspection of Cooling Water System."
5. 10 CFR Part 50, Appendix A, General Design Criterion 46, "Testing of Cooling Water System."
6. Regulatory Guide 1.29, "Seismic Design Classification."