



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

SECTION 9.4.4

TURBINE AREA VENTILATION SYSTEM

REVIEW RESPONSIBILITIES

Primary - Auxiliary and Power Conversion Systems Branch (APCSB)

Secondary - Electrical, Instrumentation and Control Systems Branch (EICSB)
 Mechanical Engineering Branch (MEB)
 Effluent Treatment Systems Branch (ETSB)
 Radiological Assessment Branch (RAB)

I. AREAS OF REVIEW

The APCSB reviews the turbine area ventilation system (TAVS) from air intake to the point of discharge. The review includes components such as air intakes, ducts, cooling units, blowers, isolation dampers, and roof exhaust fans. The review of the TAVS includes systems contained in the turbine building and their relationship, if any, to safety-related equipment areas.

1. The APCSB reviews the functional performance requirements and the methods and equipment provided for air treatment for the TAVS to determine whether the ventilation system or portions of the system have been designed or need to be designed as a safety system. In making this determination, systems provided for heating, ventilating, and air conditioning of the turbine area, designed to normal industrial standards and those systems that provide for control and filtration of small quantities of radioactive gas leakage in the turbine area during normal plant operation, are not considered safety-related for the purpose of this plan. Based on this determination, any safety-related portions of the system are reviewed with respect to functional performance requirements during adverse environmental occurrences, during normal operation, and subsequent to postulated accidents, including the loss of offsite power. The APCSB reviews the safety-related portions of the system to assure that:
 - a. A single active failure cannot result in loss of the system functional performance capability.
 - b. Components and piping have sufficient physical separation or barriers to protect essential portions of the system from missiles and pipe whip.
 - c. Failures of non-seismic Category I equipment or components will not result in an unacceptable release of radioactive contaminants.

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 Revision 2 of 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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2. The APCSb also reviews safety-related portions of the TAVS with respect to the following:
 - a. Provisions to detect and monitor radiation levels.
 - b. The capability of the system to direct ventilation air from areas of low radioactivity to areas of higher radioactivity levels.
 - c. The capability to detect the need for isolation and to isolate safety-related portions of the system in the event of fires, failures, or malfunctions, and the capability of the isolated system to function under these conditions.
3. The applicant's proposed technical specifications are reviewed for operating license applications as they relate to areas covered in this plan.

Secondary reviews are performed by other branches and the results used by the APCSb to complete the overall evaluation of the system. The MEB will, upon request, review the seismic qualification of components and confirm that the components, piping, and structures are designed in accordance with applicable codes and standards. The ETSB will verify that the system functional performance meets acceptable limits for radioactive releases during normal operations. The EICSB will, upon request, determine the adequacy of the design, installation, inspection, and testing of all electrical components required for proper operation. The RAB reviews the system capability to monitor radiation levels. RAB also verifies the system meets the radiation protection criteria.

II. ACCEPTANCE CRITERIA

Acceptability of the TAVS design, as described in the applicant's safety analysis report (SAR), is based on specific general design criteria and regulatory guides. An additional basis for determining the acceptability of the TAVS is the degree of similarity of the design with that for previously reviewed plants with satisfactory operating experience. The design of safety-related portions of the TAVS is acceptable if the integrated design of the system is in accordance with the following criteria:

1. General Design Criterion 2, as related to structures housing the system and the system itself being capable of withstanding the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods, as established in Chapters 2 and 3 of the SAR.
2. General Design Criterion 4, with respect to structures housing the system and the system itself being capable of withstanding the effects of external missiles and internally generated missiles, pipe whip, and jet impingement forces associated with pipe breaks.
3. General Design Criterion 5, as related to shared systems and components important to safety.
4. General Design Criterion 60, as related to the handling of radioactive materials in the TAVS.

5. General Design Criterion 64, as related to the monitoring of gaseous releases through the TAVS.
6. Regulatory Guide 1.26, as related to the quality group classification of systems and components.
7. Regulatory Guide 1.29, as related to seismic design classification of systems and components.
8. Regulatory Guide 1.52, as related to system functional performance requirements.
9. Regulatory Guide 8.8, "Information Relevant to Maintaining Occupational Radiation Exposure As Low As Practicable (Nuclear Reactors)."
10. Branch Technical Positions APCS 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment.

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 Section II of this plan. For the review of operating license (OL) applications, 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 procedures for OL reviews include a determination that the proposed technical specifications are in agreement with the requirements for testing, minimum performance, and surveillance developed by the staff.

As a result of various TAVS designs proposed by applicants, there will be variations in system requirements. For the purpose of this review plan, a typical system is assumed which has fully redundant subsystems, each having an identical essential (safety-related) portion. For cases where there are variations from this typical arrangement, the reviewer adjusts the review procedures given below. However, in such cases, the system design must still meet the acceptance criteria given in Section II. The reviewer selects and emphasizes material from this plan as may be appropriate for a particular case.

1. The SAR is reviewed to verify that the system description section and piping and instrumentation diagrams (P&IDs) show the TAVS equipment used for normal operation, the ambient temperature limits for the areas serviced, and the filtration capacity of the exhaust filters. The system performance requirements are reviewed to determine the allowable component operational degradation (e.g., loss of function, damper leakage) and the procedures that will be followed to detect and correct these conditions. The reviewer, using results from failure modes and effects analyses as appropriate, determines that the system is capable of sustaining the failure of any active component that is required for the prevention of unacceptable releases of radioactive contaminants to the environment.
2. The system P&IDs, layout drawings, and component descriptions and characteristics are then reviewed to determine that:

9.4.4-3

11/24/75

- a. Essential portions of the TAVS are correctly identified and are isolable from non-essential portions of the system. The P&IDs are reviewed to verify that they clearly indicate the physical divisions between each portion and indicate the changes in design classification. System drawings are also reviewed to verify the means provided for accomplishing isolation and to identify minimum performance requirements for the isolation dampers. For the typical system, the drawings and descriptions are reviewed to verify that two automatically operated isolation dampers in series separate non-essential portions and components from the essential portions.
 - b. Essential portions of the TAVS, including the isolation dampers separating essential from non-essential portions, are classified Quality Group C or higher and seismic Category I. Component and system descriptions in the SAR that identify mechanical and performance characteristics are reviewed to verify that the above seismic classifications have been included, and that the P&IDs indicate any points of change in design classification.
3. The reviewer verifies that the safety-related portion of the system has been designed so that system function will be maintained as required, in the event of adverse environmental phenomena or in the event of certain pipe breaks or loss of offsite power. The reviewer evaluates the system, using engineering judgment and the results of failure modes and effects analyses to determine that:
- a. The failure of non-essential portions of the system or of other systems not designed to seismic Category I standards and located close to essential portions of the system, or of non-seismic Category I structures that house, support, or are close to essential portions of the TAVS, will not preclude operation of the essential portions of the TAVS. Reference to SAR sections describing site features and the general arrangement and layout drawings will be necessary, as well as the SAR tabulation of seismic design classifications for structures and systems. A commitment in the SAR confirming that the above conditions are met is acceptable. (CP)
 - b. The essential portions of the TAVS are protected from the effects of floods, hurricanes, tornadoes, and internally and externally generated missiles. Seismic design, flood protection, and missile protection criteria are discussed and evaluated in detail under the standard review plans for Chapter 3 of the SAR. The location and design of the system, structures, and fan rooms (cubicles) are reviewed to determine that the degree of protection provided is adequate. A commitment in the SAR to the effect that the system is located in a seismic Category I structure that is tornado missile and flood protected, or that components of the system will be located in individual cubicles or rooms that will withstand the effects of both flooding and missiles, is acceptable.

- c. The system has the capability to detect and control unacceptable levels of leakage of radioactive contamination from the system. The reviewer verifies that the following conditions are met:
- (1) The system P&ID shows monitors and alarms located in the system discharge.
 - (2) The capability for isolation of the TAVS by two automatically actuated dampers in series is shown on the P&IDs.
 - (3) The system is capable of processing normal releases in a controlled manner.
- d. The essential portions of the system are protected from the effects of high and moderate energy line breaks. Layout drawings are reviewed to assure that no high or moderate energy piping systems are close to essential portions of the TAVS 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 procedures for reviewing this information are given in the corresponding review plans.
- e. Components and subsystems necessary for preventing unacceptable releases of radioactive contaminants can function as required in the event of loss of off-site power. The system design will be acceptable if the TAVS meets minimum system requirements as stated in the SAR assuming a failure of a single active component, within the system itself, or in the auxiliary electric power source which supplies the system. The SAR is reviewed to see that, for each TAVS component or subsystem affected by loss of offsite power, the resulting system flow capacity will not cause the loss of direction of air flow from areas of low potential radioactivity to areas of higher potential radioactivity. Statements in the SAR and the results of failure modes and effects analyses are considered in verifying that the system meets these requirements. This will be an acceptable verification of system functional reliability.
4. The descriptive information, P&IDs, TAVS drawings, and failure modes effects analyses in the SAR are reviewed to assure that essential portions of the system can function following design basis accidents assuming a concurrent single active failure. The reviewer evaluates the analyses presented in the SAR to assure function of required components, traces the availability of these components on system drawings, and checks that the SAR contains verification that minimum system isolation or filtration requirements are met for each accident situation for the required time spans. For each case the design will be acceptable if minimum system 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 turbine area ventilation system (TAVS) includes all components and ducting from air intake to the point of discharge. The scope of review of the TAVS for the _____ plant included layout drawings, piping and instrumentation diagrams and descriptive information for safety-related portions of the system and the auxiliary supporting systems that are essential to its operation. [The review has determined the adequacy of the applicant's proposed design criteria and design bases for the turbine area ventilation system and the requirements (if any) for system performance to preclude any adverse effect on safety-related functions during all conditions of plant operation. (CP)] [The review has determined that the design of the turbine area ventilation system and auxiliary supporting systems is in conformance with the proposed design criteria and bases. (OL)]

"The basis for acceptance in the staff review has been conformance of the applicant's designs and design criteria for the TAVS and necessary auxiliary supporting systems to the Commission's regulations as set forth in the general design criteria, and to applicable regulatory guides, staff technical positions, and industry standards.

"The staff concludes that the design of the TAVS conforms to all applicable regulations, guides, staff positions, and industry standards, and is acceptable."

V. 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 4, "Environmental and Missile Design Bases."
3. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."
4. 10 CFR Part 50, Appendix A, General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."
5. 10 CFR Part 50, Appendix A, General Design Criterion 64, "Monitoring Radioactivity Releases."
6. Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants."

7. Regulatory Guide, 1.29, "Seismic Design Classification."
8. Regulatory Guide, 1.52, "Design, Testing, and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units for Light-Water-Cooled Nuclear Power Plants."
9. Regulatory Guide 8.8, "Information Relevant to Maintaining Occupational Radiation Exposure As Low As Practicable (Nuclear Reactors)."
10. Branch Technical Positions APCS 3-1, "Protection Against Postulated Piping Failures in Fluid Systems Outside Containment," attached to Standard Review Plan 3.6.1, and MEB 3-1, "Postulated Break and Leakage Locations in Fluid System Piping Outside Containment," attached to Standard Review Plan 3.6.2.

11/24/75

SRP 9.4.5