U.S. NUCLEAR REGULATORY COMMISSION

# STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

## 9.4.4 TURBINE AREA VENTILATION SYSTEM

REVIEW RESPONSIBILITIES

Primary - Auxiliary Systems Branch (ASB)

Secondary - None

## I. AREAS OF REVIEW

The ASB reviews the turbine area ventilation system (TAVS) from air intake to the point of discharge to assure conformance with the requirements of General Design Criteria 2, 5, and 60. 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 ASB 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 SRP section. 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 ASB 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. Failures of nonseismic Category I equipment or components will not result in an unacceptable release of radioactive contaminants.



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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

2. The ASB also reviews safety-related portions of the TAVS with respect to the following:

   a. The capability of the system to direct ventilation air from areas of low radioactivity to areas of higher radioactivity levels.

   b. The capability to detect the need for isolation and to isolate safety-related portions of the system in the event of failures or malfunctions, and the capability of the isolated system to function under such conditions.

3. The 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.

The ASB will coordinate evaluations performed by other branches that interface with the overall evaluation of the system as follows: The Instrumentation and Control Systems Branch (ICSB) and Power Systems Branch (PSB) determine the adequacy of the design, installation, inspection, and testing of all electrical components (sensing, control, and power) required for proper operation as part of their primary review responsibility for SRP Sections 7.7 and 8.3.1 respectively. The Structural Engineering Branch (SEB) determines 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 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 that the components, piping, and structures are designed in accordance with applicable codes and standards as part of its primary review responsibility for SRP Sections 3.9.1 through 3.9.3. The MEB also 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 MEB also reviews the adequacy of the inservice testing program of pumps and valves as part of its primary review responsibility for SRP Section 3.9.6. The Materials Engineering Branch (MTEB) verifies that inservice inspection requirements are met for system components as part of its primary review responsibility for SRP Section 6.6. The review for fire protection, technical specifications, and quality assurance are 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. The Effluent Treatment Systems Branch (ETSB) evaluates the system functional performance to assure that the system meets acceptable limits for radioactive releases during normal operations and evaluates the capability of the system to detect and control leakage of radioactive contamination from the system as

part of its primary review responsibility for SRP Sections 11.3 and 11.5, respectively. The Radiological Assessment Branch (RAB) evaluates the capability of the system to meet radiation protection criteria as part of its primary review responsibility for SRP Section 12.3.

For those areas of review identified above as being 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 sections of the corresponding primary branches.

## 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. 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, "Design Basis for Protection Against Natural Phenomena," 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 for safety-related portions, and Position C.2 for nonsafety-related portions.

2. General Design Criterion 5, "Sharing of Structures, Systems, and Components," as related to shared systems and components important to safety.

3. General Design Criterion 60, "Control of Release of Radioactive Materials to the Environment," as related to the capability of the system to suitably control release of gaseous radioactive effluents to the environment. Acceptance is based on meeting the guidance of Regulatory Guide 1.140, as related to design, testing, and maintenance criteria for normal ventilation, exhaust system, air filtration, and adsorption units of light-water-cooled nuclear power plants, Positions C.1 and C.2.

## 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 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.

The primary reviewer will coordinate this review with the other branches for their particular areas of responsibility as stated in subsection I. The primary reviewer obtains and uses such inputs as required to assure that this review procedure is complete.

As a result of various TAVS designs proposed by applicants, there will be variations in system requirements. For the purpose of this SRP section, 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 would adjust the review procedures given below. However, the system design would be required to meet the acceptance criteria given in subsection II. The reviewer selects and emphasizes material from this SRP section as may be appropriate for a particular case.

1. The SAR is reviewed to verify that the system description and piping and instrumentation diagrams (P&IDs) show the TAVS equipment used for normal operation, and the ambient temperature limits for the areas serviced. 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:

   a. Essential portions of the TAVS are correctly identified and are isolable from nonessential portions of the system. The P&IDs are reviewed to verify that they clearly indicate the physical divisions between each portion and indicate changes in design classification. System drawings are also reviewed to verify that 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 nonessential portions and components from the essential portions.

   b. Essential portions of the TAVS, including the isolation dampers separating essential from nonessential portions, are classified 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 an earthquake 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 nonessential 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 nonseismic 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. Components and subsystems necessary for preventing unacceptable releases of radioactive contaminants can function as required in the event of loss of offsite 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 the 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 the 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. All portions of the system whose failure may result in release of radioactivity which causes an offsite dose of more than 0.5 rem to the whole body or its equivalent to any part of the body shall be classified seismic Category I and safety related. Based on the review of the applicant's proposed design criteria, the design bases and safety classification 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, the staff concludes that the design of the turbine area ventilation system and auxiliary supporting systems is in conformance with the Commission's regulations as set forth in General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena," General Design Criterion 5, "Sharing of Structures, Systems, and Components," and General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."

This conclusion is based on the following:

1. The applicant has met the requirements of GDC 2, "Design Bases for Protection Against Natural Phenomena," with respect to the system being capable of withstanding the effects of earthquakes by meeting the guidelines of Regulatory Guide 1.29, "Seismic Design Classification," Position C.1 for safety-related portions of the system and Position C.2 for nonsafety-related portions of the system.

2. The applicant has met the requirements of GDC 5, "Sharing of Structures, Systems, and Components Important to Safety to Perform Required Safety Functions," with respect to capability of shared systems and components important to safety to perform required safety functions.

3. The applicant has met the requirements of GDC 60, "Control of Releases of Radioactive Materials to the Environment," with respect to the capability of the system to suitably control release of gaseous radioactive effluents to the environment by meeting the guidelines of Regulatory Guide 1.140 "Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants," Positions C.1 and C.2.

The staff concludes that the design of the TAVS conforms to all applicable GDCs and positions of the regulatory guides cited and is, therefore, 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. 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 60, "Control of Releases of Radioactive Materials to the Environment."

4. Regulatory Guide 1.29, "Seismic Design Classification."

5. Regulatory Guide 1.140, "Design, Testing, and Maintenance Criteria for Normal Ventilation Exhaust System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."