



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

SECTION 10.4.4

TURBINE BYPASS SYSTEM

REVIEW RESPONSIBILITIES

Primary - Auxiliary and Power Conversion Systems Branch (APCSB)

Secondary - Electrical, Instrumentation and Control Systems Branch (EICSB)  
 Reactor Systems Branch (RSB)I. AREAS OF REVIEW

The turbine bypass system (TBS) provides operational flexibility so that the plant may accept certain load changes without disturbing the nuclear steam supply system. The TBS is designed to discharge a stated percentage of rated main steam flow directly to the main condensers, bypassing the turbine. This steam bypass enables the plant to take step load reduction up to the TBS capacity without the reactor or turbine tripping. The system is also used during startup and shutdown to control reactor pressure for a boiling water reactor (BWR) and steam generator pressure for a pressurized water reactor (PWR). The TBS is not required for safe shutdown as the relief and safety valves are operated under emergency conditions. The system is not required to function as a heat sink for the prevention or mitigation of postulated accidents. Failure of the TBS during a load reduction or turbine trip would result in the actuation of the relief valves and possibly the safety valves.

The APCSB reviews the system from the branch connection at the main steam system to the main condensers.

1. APCSB reviews the TBS to determine that it has sufficient capacity and reliability to minimize the necessity for relief and safety valve actuation and that a failure of the system or system components will not have an adverse effect on essential equipment.
2. The APCSB reviews the TBS functional requirements for both normal and abnormal operating conditions, and with respect to the following capabilities: (a) to isolate those portions of the system that could leak or malfunction; (b) to perform adequate operational testing and inservice inspection; and (c) to assure there are no adverse effects of postulated system piping failures on safety-related equipment.
3. The applicant's proposed technical specifications are reviewed at the operating license stage, as they relate to areas covered in this plan.

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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 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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Secondary reviews are performed by other branches and the results are used by the APCS to complete the overall evaluation of the system. The secondary reviews are as follows: the EICSB, upon request, provides information pertaining to controls and instrumentation for the system. The RSB determines that the appropriate seismic and quality group classifications have been established for system components and that the steam bypass capacity is consistent with reactor transient analysis.

## II. ACCEPTANCE CRITERIA

Acceptability of the design of the turbine bypass system, as described in the applicant's safety analysis report (SAR), is based on the criteria below. An additional basis for determining the acceptability of the TBS will be the degree of similarity of the design with that for previously reviewed plants with satisfactory operating experience.

The design of the TBS is acceptable if the integrated design of the system is in accordance with the following criteria:

1. Failure or malfunction of the TBS does not adversely affect essential systems or components (i.e., those necessary for safe shutdown or accident prevention or mitigation).
2. Branch Technical Positions APCS 3-1 and MEB 3-1, as related to breaks in high and moderate energy piping systems outside containment.
3. The system should be capable of providing sufficient steam bypass to the main condenser so that a reactor trip will not occur as a result of load rejections.

## 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 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 applications include 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.

The reviewer selects and emphasizes material from this review plan, as may be appropriate for a particular case.

1. The SAR is reviewed to determine that the system description and piping and instrumentation diagrams (PID's) delineate the system and components.

2. The SAR is reviewed to verify that the system design bases and an evaluation of the system capacity are provided, including the relation between the TBS capacity and relief valve capacity in terms of percentage of rated main steam flow, the maximum reactor power step change the system is designed to accommodate without a reactor or turbine trip, and the maximum electric load step change the reactor is designed to accommodate without reactor control rod motion or steam bypassing.
3. The reviewer verifies that the combined capacity of the TSB and relief valves is sufficient to preclude safety valve actuation in the event of a turbine trip or large electric load rejection.
4. The reviewer uses engineering judgment and the results of failure modes and effects analyses to determine that:
  - a. Failure of the TBS to operate will not preclude operation of any essential systems. Statements in the SAR that confirm the above are acceptable.
  - b. Failure of the TBS high energy piping will not have adverse effects on any safety-related systems or components that may be located close to the system.

#### IV. EVALUATION FINDINGS

The reviewer determines 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 bypass system (TBS) includes all components and piping from the branch connection at the main steam system to the main condensers. The scope of review of the turbine bypass system for the \_\_\_\_\_ plant included layout drawings, piping and instrumentation diagrams, and descriptive information for the TBS and auxiliary supporting systems that are essential to its operation. [The review has determined the adequacy of the applicant's proposed design criteria and bases for the turbine bypass system and the requirements for safe operation of the TBS during normal, abnormal, and accident conditions. (CP)] [The review has determined that the design of the turbine bypass system and auxiliary supporting systems is in conformance with the design criteria and bases. (OL)]

"The basis for acceptance in the staff review has been conformance of the applicant's designs, design criteria, and design bases for the turbine bypass system and its supporting systems to applicable staff technical positions and industry standards.

"The staff concludes that the design of the turbine bypass system conforms to all applicable staff positions and industry standards and is acceptable."

V. REFERENCES

1. 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.

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