U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

10.4.1 MAIN CONDENSERS

REVIEW RESPONSIBILITIES

Primary - Power Systems Branch (PSB)

Secondary - None

I. AREAS OF REVIEW

The main condenser (MC) system is designed to condense and deaerate the exhaust steam from the main turbine and provide a heat sink for the turbine bypass system.

1. The PSB reviews the performance requirements of the main condenser for both direct and indirect cycle plants during all operating conditions. Emphasis will be placed on the review of direct cycle facilities with regard to the prevention of loss of vacuum, corrosion and/or erosion, and hydrogen buildup.

2. The PSB reviews the design of the MC system with respect to the following:

   a. The means to detect, control and facilitate correction of the leakage of cooling water into the condensate; to detect radioactive leakage into or out of the system; and to preclude accidental releases of radioactive materials to the environment in amounts in excess of established limits.

   b. Instrumentation and control features that determine and verify that the MC is operating in a correct mode.

   c. The means provided to deal with flooding from a complete failure of the MC and to preclude damage to safety-related equipment from the flooding.

   d. The capability of the MC to withstand the blowdown effects of steam from the turbine bypass system.

In the review of the Main Condenser, the PSB will coordinate other branch evaluations that interface with the overall review of the system as follows. The

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.

Effluent Treatment Systems Branch evaluates the inventory of radioactive contaminants in the MC during power operation and during shutdown as part of its primary review responsibility for SRP Section 11.5. The Materials Engineering Branch, upon request of PSB, evaluates the adequacy of the materials of construction, the methods used to reduce the corrosion and/or erosion of MC tubes and components, the permissible cooling water inleakage, and the allowed time of operation with inleakage without affecting condensate/feedwater quality for safe reactor operation. The Auxiliary Systems Branch determines that safety-related systems and structures are protected from the effects of flooding as part of its primary review responsibility for SRP Section 3.4.1. The procedures and Test Review Branch determines the acceptability of the preoperational and startup tests as part of its primary review responsibility for SRP Section 14.0.

The reviews 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.

For those areas of review identified above as being part of the primary review responsibility of the other branches, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP section of corresponding primary branches.

II. ACCEPTANCE CRITERIA

Acceptability of the design of the main condenser system, as described in the applicant's safety analysis report (SAR), is based on meeting the requirements of General Design Criterion 60 (GDC 60) and on the similarity of the design to that of plants previously reviewed and found acceptable.

The design of the Main Condenser System is acceptable if the integrated design of the system meets the requirements of GDC 60 as related to failures in the design of the system which do not result in excessive releases of radioactivity to the environment. In addition, GDC 60 is satisfied if the system is designed such that failures do not cause unacceptable condensate quality, or flooding of areas housing safety-related equipment.

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 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 reviewer will select and emphasize material from this SRP section as may be appropriate for a particular case.

The primary reviewer will coordinate this review with other branches' areas of review as stated in subsection I. The primary reviewer obtains and uses such input as required to assure that this review procedure is complete.

1. The SAR is reviewed to determine that the system description delineates the main condenser system capabilities including the minimum system heat transfer and system flow requirements for normal plant and turbine bypass operation. Measures provided to prevent loss of vacuum, corrosion and/or erosion of MC tubes and components, and hydrogen buildup in the MC are

reviewed, with particular emphasis on these measures for direct cycle (boiling water reactor) plants. System performance requirements are reviewed to determine that they satisfactorily limit possible system degradation conditions (e.g., leakage, partial loss of vacuum) and describe the procedures that are followed to detect and correct these conditions. The SAR is also reviewed to determine that any allowed MC system degraded operation does not have an adverse effect on the reactor primary system or secondary system in the case of pressurized water reactors.

2. The reviewer evaluates the MC system design to verify that:

   a. Means have been provided for detecting, controlling and correcting condenser cooling water leakage into the condensate.

   b. The permissible cooling water inleakage and time of operation with inleakage are provided to assure that condensate/feedwater quality can be maintained within safe limits.

   c. Measures have been provided to detect radioactive leakage into and out of the MC system and to preclude unacceptable accidental releases of radioactivity to the environment from the system.

   d. The system is provided with instrumentation and control features that determine and verify that the MC is operating in a correct mode.

3. The reviewer uses engineering judgment and the results of failure modes and effects analyses to determine that:

   a. The failure of a main condenser and the resulting flooding will not preclude operation of any essential systems. Reference to sections of the SAR describing plant 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. Statements in the SAR that verify that the above conditions are met are acceptable.

   b. The system, in conjunction with the main steam system, has provisions to detect loss of condenser vacuum and to effect isolation of the steam source. For direct cycle plants, it will be acceptable if the detection system in the MC can actuate the main steam isolation valves to limit the quantity of steam lost from the condenser.

   c. Design provisions have been incorporated into the MC that will preclude component or tube failures due to steam blowdown from the turbine bypass system.

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 main condenser system (MC) includes all components and equipment from the turbine exhaust to the connections and interfaces with the main condensate and other systems. The scope of review of the main condenser system for the _____ plant included layout drawings, piping and instrumentation diagrams, and descriptive information for the main condenser system and supporting systems that are essential to its operation.

The basis for acceptance of the main condenser system in our review was conformance of the design, design criteria, and design bases to the Commission's regulation as set forth in GDC 60. The staff concludes that the main condenser system design is acceptable and meets the requirements of GDC 60 with respect to failures in the design of the system which do not result in excessive releases of radioactivity to the environment. The applicant has met this requirement by providing radioactive monitors in the system to detect leakage into and out of the main condenser.

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.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, "General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."

2. Regulatory Guide 1.68, "Initial Test Programs for Water-Cooled Reactor Power Plants."