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

SECTION 6.2.1.1.A PWR DRY CONTAINMENTS, INCLUDING SUBATMOSPHERIC CONTAINMENTS

REVIEW RESPONSIBILITIES

Primary - Containment Systems Branch (CSB)

Secondary - Core Performance Branch (CPB)
Electrical, Instrumentation and Control Systems Branch (EICSB)
Structural Eningeering Branch (SEB)

I. AREAS OF REVIEW

For pressurized water reactor (PWR) plants with dry containments, the CSB review covers the following areas:

1. The temperature and pressure conditions in the containment due to a spectrum (including break size and location) of postulated loss-of-coolant accidents (i.e., reactor coolant system pipe breaks) and secondary system steam line and feedwater line breaks.

2. The maximum expected external pressure to which the containment may be subjected.

3. The minimum containment pressure used in analyses of emergency core cooling system capability.

4. The effectiveness of static and active heat removal mechanisms.

5. The pressure conditions within subcompartments and acting on system components and supports due to high energy line breaks.

6. The instrumentation provided to monitor and record containment atmosphere pressure and temperature and sump water temperature under post-accident conditions.

7. The proposed technical specifications at the operating license stage of review pertaining to the surveillance requirements for spring or weight loaded check valves used in subatmospheric containments, and vacuum relief devices.

The CSB will also review analyses of anticipated transients without scram (ATWS) which discharge fluid to the containment to assure that containment pressure and temperature design conditions are not exceeded.

Future applications for boiling water reactor (BWR) plants may include a dry containment design. When such a proposal is made, the CSB will review the containment design on the basis of the review plan described herein.

II. ACCEPTANCE CRITERIA

The following acceptance criteria complement General Design Criterion 50 and apply to the design and functional capability of PWR dry containments:

1. For plants at the construction permit (CP) stage of review, the containment design pressure should provide at least a 10% margin above the accepted peak calculated containment pressure following a loss-of-coolant accident, or a steam or feedwater line break.

2. For plants at the operating license (OL) stage of review, the peak calculated containment pressure following a loss-of-coolant accident, or a steam or feedwater line break, should be less than the containment design pressure. In general, the peak calculated containment pressure should be approximately the same as at the construction permit stage of review. However, revised or upgraded analytical models or minor changes in the as-built design of the plant may result in a decrease in the margin.

3. The containment pressure should be reduced to less than 50% of the containment design pressure within 24 hours after the postulated accident, as recommended by Regulatory Guide 1.4.

4. For subatmospheric containments, the containment pressure should be reduced to below atmospheric pressure within one hour after the postulated accident, and the subatmospheric condition maintained for at least 30 days.

5. Containment response analyses should be based on the assumption of loss of offsite power and the most severe single active failure in the emergency power system (e.g., a diesel generator failure), the containment heat removal systems (e.g., a fan, pump, or valve failure), or the core cooling systems (e.g., a pump or valve failure). The selection made should result in the highest calculated containment pressure.

6. The minimum calculated containment pressure should not be less than that used in the analysis of the emergency core cooling system capability (See Standard Review Plan 6.2.1.5, "Minimum Containment Pressure Analysis for Emergency Core Cooling System Performance Capability Studies").

7. Provisions should be made to protect the containment structure against possible damage from external pressure conditions that may result, for example, from inadvertent operation of containment heat removal systems. The provisions made should include conservative structural design to assure that the containment structure is capable of withstanding the maximum expected external pressure; or interlocks in the plant protection system and administrative controls to preclude inadvertent operation of the systems; or for steel containment vessels, vacuum relief devices provided in accordance with the requirements of the ASME Boiler and Pressure Vessel Code, Section III, Division 1, Subsection NE (Ref. 3), and applicable requirements of General Design Criteria 54 and 56.

8. If the primary containment is designed to withstand the maximum expected external pressure, the external design pressure of the containment should provide an adequate margin above the maximum expected external pressure to account for uncertainties in the analysis of the postulated event.

9. Containment internal structures and system components (e.g., reactor vessel, pressurizer, steam generators) and supports should be designed to withstand the differential pressure loadings that may be imposed as a result of pipe breaks within the containment subcompartments (See Standard Review Plan 6.2.1.2, "Subcompartment Analysis").

10. Instrumentation capable of operating in the post-accident environment should be provided to monitor the containment atmosphere pressure and temperature and the sump water temperature following an accident. The instrumentation should have adequate range, accuracy, and response to assure that the above parameters can be tracked throughout the course of an accident. Recording equipment capable of following the transient should be provided.

III. REVIEW PROCEDURES

The procedures described below are followed for the review of PWR dry containments. The reviewer selects and emphasizes material from these procedures as may be appropriate for a particular case. Portions of the review may be carried out on a generic basis for aspects of functional design common to a class of dry containments or by adopting the results of previous reviews of plants with essentially the same containment functional design.

The CSB reviews the containment response analyses to determine the acceptability of the calculated containment design pressure and temperature, and in addition, the containment depressurization time for subatmospheric type containments. The CSB reviews the assumptions made in the analyses to maximize the calcualted containment pressure. The CSB determines the conservatism of the respective containment response analyses by comparing the analytical models, and the assumptions made, with the acceptance criteria in Section II, and by performing appropriate confirmatory analyses. It is not necessary to perform accident pressure calculations for every plant. The CSB will ascertain, however, that the adequacy of the applicant's calculational model has been demonstrated. The CSB determines that the pipe break resulting in the highest containment pressure has been identified. Hot leg, cold leg (pump suction), and cold leg (pump discharge) pipe breaks of the reactor coolant system, and secondary system steam and feedwater line breaks, should be analyzed by the applicant. The CSB reviews the assumptions used to determine that the analyses are acceptably conservative.

The CSB performs confirmatory containment response analyses when necessary using the CONTEMPT-LT computer code (See References 7, 8, and 9 for a description of this code). If the conservatism of certain input data is in question, such as the mass and energy release rate data for the core reflood and post-reflood phases of a loss-of-coolant accident, the CSB uses data calculated using its own analytical models or obtains corrected data from the applicant. This part of the review may include coordination between the CPB and CSB (See Standard Review Plans 6.2.1.3, "Mass and Energy Release Analysis for Postulated Loss-of-Coolant Accidents," and 6.2.1.4, "Mass and Energy Release Analysis for Postulated

Secondary System Pipe Ruptures"). The purpose of these analyses is to confirm the applicant's predictions of the response of the containment to loss-of-coolant accidents and main steam and feedwater line breaks. In general, only the limiting pipe breaks, i.e., the pipe breaks which establish the containment design pressure and containment depressurization time, are analyzed. However, if in the judgment of the CSB the worst break has not been identified, other pipe breaks will be analyzed.

The CSB reviews analyses of the external pressure that the containment structure may be subjected to as a result of pressure and temperature changes inside the containment due to inadvertent operation of containment heat removal systems. The CSB determines whether the most severe condition has been identified, and whether the analysis was done in a conservative manner. The CSB evaluates the acceptability of the provisions made in the plant design to mitigate or withstand the consequences of the above postulated events, and the administrative controls and instrumentation and control provisions to preclude these events.

The CSB determines whether instrumentation capable of withstanding the post-accident environment, and recording equipment, has been provided to monitor and record the course of an accident within the containment. The CSB also determines whether the instrumentation and recording equipment can accomplish the objectives stated in Section II. This review is coordinated with the EICSB. The EICSB, under Standard Review Plan 7.3, has review responsibility for the acceptability of, and the qualification test program for the sensing and actuation instrumentation of the plant protection system and the post-accident monitoring instrumentation and recording equipment.

IV. EVALUATION FINDINGS

The conclusions reached on completion of the review of this section are presented in Standard Review Plan 6.2.1.

V. REFERENCES

The references for this plan are listed in Standard Review Plan 6.2.1.

SRP 6.2.1.1.B