U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

SECTION 6.2.1.4 MASS AND ENERGY RELEASE ANALYSIS FOR POSTULATED SECONDARY SYSTEM PIPE RUPTURES

REVIEW RESPONSIBILITIES

Primary - Containment Systems Branch (CSB)

Secondary - Core Performance Branch (CPB)

I. AREAS OF REVIEW

The CSB reviews analyses of the mass and energy released to the containment during a steam or feedwater line break accident in conjunction with its review of the functional capability of the containment structure. The CSB review includes the following areas:

1. The energy sources that are available for release to the containment.

2. The mass and energy release rate calculations.

II. ACCEPTANCE CRITERIA

In addition to the provisions of General Design Criterion 50, the following acceptance criteria apply to the mass and energy release analysis for postulated PWR secondary system pipe ruptures:

1. Sources of Energy

The sources of energy that should be considered in analyses of steam and feedwater line break accidents include: the stored energy in the affected steam generator metal, including the vessel tubing, feedwater line, and steam line; the stored energy in the water contained within the affected steam generator; the stored energy in the feedwater transferred to the affected steam generator prior to the closure of the isolation valves in the feedwater line; the stored energy in the steam from the unaffected steam generator(s) prior to the closure of the isolation valves in the steam generator crossover lines; and the energy transferred from the primary coolant to the water in the affected steam generator during blowdown.

The steam line break accident should be analyzed for various plant conditions from hot standby to 102% of full power.

147 234

2. Mass and Energy Release Rate Calculations

In general, calculations of the mass and energy release rates during a steam or feedwater line break accident should be done in a manner that is conservative from a containment response standpoint; i.e., that maximizes the post-accident containment pressure. The following criteria indicate the degree of conservatism that is desired.

Mass release rates should be calculated using the Moody model (Ref. 22), or a model that is demonstrated to be equally conservative.

Calculations of heat transfer to the water in the affected steam generator should be based on nucleate boiling heat transfer.

Calculations of mass release should consider the water in the affected steam generator and feedwater line, the feedwater transferred to the affected steam generator prior to the closure of the isolation valves in the feedwater lines, the steam in the affected steam generator, and the steam coming from the unaffected steam generator(s) as the secondary system is being depressurized prior to the closure of the isolation valves in the steam generator crossover lines.

If liquid entrainment is calculated for steam line breaks, experimental data should support the predictions of the liquid entrainment model. The effect on the entrained liquid of steam separators located upstream from the break should be taken into account. A spectrum of steam line breaks should be analyzed, beginning with the double-ended break and decreasing in area until no entrainment is calculated to occur, to allow selection of the maximum release case. If no liquid entrainment is calculated, a double-ended rupture of the steam line should be assumed.

The single active failure in the steam generator feedwater line isolation provisions or feedwater pumps that optimizes the mass and energy release to the containment, such that the containment peak pressure is maximized, should be assumed to occur in steam and feedwater line break analyses.

III. REVIEW PROCEDURES

The procedures described below are followed for the review of the mass and energy release analysis of secondary coolant system pipe breaks. 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 or by applying the results of previous reviews of similar plants.

The CSB reviews the secondary coolant system pipe break analysis assumptions to determine whether the "worst" pipe break accident case has been identified by the applicant, and whether the analysis was done in a conservative manner from the standpoint of containment pressure. The CPB reviews the acceptability of the analytical models.

This review may involve coordination between members of the CPB and the CSB on the proposed methods and models used for blowdown analyses. The acceptability of the approach used by the applicant is evaluated based on the acceptance criteria in Section II. The CSB also

reviews analyses of postulated single failures of active components in the secondary system, such as steam and feedwater line isolation valves and feedwater pumps, to determine whether the most severe single failure has been selected which allows mass and energy from the unaffected steam generators and the feedwater system to be transferred to the steam generator blowing down.

If liquid entrainment is calculated in the applicant's steam line break model, the CSB and CPB will determine the validity of the experimental data provided to support the entrainment calculation. CSB and CPB will also ascertain that the effect of steam separators located upstream from the postulated steam line break have been taken into account in the analysis. In addition, the CSB reviews the results of a spectrum of steam line breaks, beginning with the double-ended break and decreasing in area until no entrainment occurs, to be sure that the worst steam line break size has been identified.

The CSB performs confirmatory analyses of the containment pressure response to steam and feedwater line breaks inside the containment using the CONTEMPT-LT computer code.

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.

147 236