March 17, 1992

POLICY ISSUE
(Information)

SECY-92-092

For: The Commissioners

From: James M. Taylor
Executive Director for Operations

Subject: THE CONTAINMENT PERFORMANCE GOAL, EXTERNAL EVENTS SEQUENCES, AND THE DEFINITION OF CONTAINMENT FAILURE FOR ADVANCED LIGHT WATER REACTORS

Purpose: To provide the Commission with information on the containment performance goal, external events sequences, and the definition of containment failure.

Background: On October 12, 1990, the staff submitted to the Commission SECY-90-353, "Licensing Review Basis Document for the Combustion Engineering Inc. System 80+ Evolutionary Light Water Reactor." The Commission responded to SECY-90-353, in a staff requirements memorandum (SRM) of March 5, 1991, stating that

> Final resolution of the containment performance goal, external events sequences, and the definition of containment failure will also depend on the Commission decision on the definition of a large release. The staff's proposed resolution of these issues should be submitted for Commission approval.

Discussion: The staff, in keeping with the Commission's policy expectation that future designs for nuclear power plants achieve a higher standard of severe accident safety performance, believes that severe accidents should be addressed so as to provide an additional level of assurance that the containment function will

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be met. Severe accidents and their impact on the containment design have been addressed in the following documents: (1) by the staff in SECY-90-016, "Evolutionary Light Water Reactor (LWR) Certification Issues and Their Relationship to Current Regulatory Requirements," (2) by the Advisory Committee on Reactor Safeguards (ACRS) in their May 17, 1991 letter to the Commission, "Proposed Criteria to Accommodate Severe Accidents in Containment Design," (3) by the staff for passive LWRs in a Commission paper (the staff provided the Commission and ACRS with an advance information copy of this paper on February 20, 1992) similar in scope to SECY-90-016 and (4) by the staff in SECY-92-070, "Staff Comparison of ACRS-Proposed Criteria to Accomodate Severe Accidents in Advanced Light Water Reactor Containment Designs with Related Criteria Proposed by Industry." Collectively, these efforts reflect the staff's current rationale for assessing the severe accident performance of advanced LWR containment designs. This rationale is intended to ensure robustness of the containment design against severe accident phenomena that could lead to early containment failure.

In SECY-90-016, the staff addressed numerous containment issues including hydrogen control, core concrete interaction, high pressure core melt ejection, containment performance, and dedicated containment vent penetration. In its SRM of June 26, 1990, the Commission approved a majority of the staff's positions and provided further guidance on other positions. The staff is implementing the Commission-approved positions in SECY-90-016 for the evolutionary LWRs. The staff has prepared for Commission approval a paper similar in scope to SECY-90-016 for use in evaluating the passive LWRs. In addition, the staff is continuing its evaluation of the ACRS-proposed criteria (5/17/91 letter) to ensure they are appropriately considered in future containment designs.

In the January 28, 1992 SRM relating to SECY-91-262, "Resolution of Selected Technical and Severe Accident Issues for Evolutionary Light Water Reactor (LWR) Designs," the Commission stated that the staff should proceed with generic rulemaking as quickly as possible where appropriate for evolutionary and passive designs. In any generic rulemaking efforts, the staff will utilize, to the extent possible, the Commission-approved positions from SECY-90-016, and Commission-approved positions developed in the consideration of the ACRS-proposed severe accident containment design criteria and proposed staff positions for the passive LWRS.

The staff is also evaluating the definition of "large release" and will submit findings to the Commission in a separate paper (WITS Item 9000136). The staff is restating here its position on the following issues for all evolutionary reactors: containment performance goal, external events sequences, and the definition of "containment failure." The staff's evaluation of these issues as they relate to the CE System 80+ design and the other evolutionary LWRs, will be documented in the draft safety evaluation reports (DSER) and final safety evaluation reports

(FSER) which will be provided to the Commission for approval. The staff does not anticipate that the current staff approach to the containment performance goal would likely be impacted by the definition of "large release." Nevertheless, upon resolution of the definition of "large release," the staff will re-evaluate its positions.

Containment Performance Goal

The staff developed the containment performance goal to ensure that the containment would perform its function in the face of most credible severe accident challenges. The staff proposed two options for meeting the containment performance goal: a probabilistic approach or a deterministic approach. In SECY-90-016, the staff stated that

> In view of the low probability of accidents that would challenge the integrity of the containment, the staff concludes that the probability of failure of the mitigation systems (those systems which can reduce the consequences of a core damage accident), from the onset of core damage to loss of containment integrity resulting in an uncontrolled leakage substantially greater than the design basis leakage, should not exceed approximately 0.1.

The staff also stated that it would "accept a CCFP of 0.1 or a deterministic containment performance goal that offers comparable protection." The staff recommended that the Commission approve the staff's position to use a conditional containment failure probability (CCFP) of 0.1 or a deterministic containment performance goal that offers comparable protection in evaluating evolutionary LWRs. The following criteria for containment performance was judged to be appropriate in place of CCFP:

> The containment should maintain its role as a reliable leak tight barrier by ensuring that containment stresses do not exceed ASME service level C limits for a minimum period of 24 hours following the onset of core damage and that following this 24 hour period the containment should continue to provide a barrier against the uncontrolled release of fission products.

In its June 26, 1990 SRM, the Commission approved the use of a 0.1 CCFP as a basis for establishing regulatory guidance for the evolutionary LWRs. The Commission directed that the NRC should not impose this objective as a requirement, and that the use of the CCFP should not discourage accident prevention. The Commission directed the staff to review suitable alternative deterministically-established containment performance objectives providing comparable mitigation capability that may be submitted by the applicants. The Commission directed that any such alternatives be submitted to the Commission.

The staff is evaluating the evolutionary LWR designs to determine if they meet the Commission-approved position for the containment performance goal. The staff will forward the results of its evaluations of the evolutionary LWRs to the Commission for approval in the DSER and FSER. The staff has prepared a Commission paper for the passive LWR designs similar in scope to SECY-90-016. An advance information copy was provided to the Commission and ACRS on February 20, 1992. The paper provides the staff's positions and requests the Commission to provide guidance and approval on the staff's positions.

External Event Sequences

The staff provided the Commission with an advance information copy of a paper similar in scope to SECY-90-016 which addresses the following areas for external events sequences at passive and evolutionary LWRs: seismic hazard curves and design parameters, tornado design basis, and site-specific probabilistic risk assessments. The paper provides the staff's positions and requests the Commission's approval where necessary.

Definition of Containment Failure

The definition of containment failure is closely related to the containment performance goal. In SECY-90-016, the staff provided two approaches for meeting the containment performance goal: a probabilistic approach and a deterministic approach.

In SECY-90-016, the staff described in the following manner the containment performance goal requiring a CCFP not exceeding 0.1:

> In view of the low probability of accidents that would challenge the integrity of the containment, the staff concludes that the probability of failure of the mitigation systems (those systems which can reduce the consequences of a core damage accident), from the onset of core damage to loss of containment integrity resulting in an uncontrolled leakage substantially greater than the design basis leakage, should not exceed approximately 0.1.

Therefore, the definition of containment failure would be as follows for the containment performance goal using a probabilistic approach that requires a CCFP of 0.1: the loss of containment integrity resulting in an uncontrollable leakage substantially greater than the design basis leakage. In SECY-90-016, the staff described the containment performance goal using a deterministic approach in the following manner:

> The containment should maintain its role as a reliable leak tight barrier by ensuring that containment stresses do not exceed ASME service level C limits for a minimum period of 24 hours following the onset of core damage and that following this 24 hour period the containment should continue to provide a barrier against the uncontrolled release of fission products.

Therefore, the definition of containment failure for the containment performance goal using a deterministic approach would be as follows: the failure (1) to maintain a reliable leak tight barrier for 24 hours following core damage and (2) to prevent the uncontrolled release of fission products following this 24-hour period. Since Service Level C is applicable only to metal containments, the staff is developing a comparable criterion for the concrete containments.

Conclusions: The staff is evaluating the implementation of the containment performance goal and definition of containment failure as directed by the Commission in response to SECY-90-016 for evolutionary LWRs. The results of the staff's evaluation will be submitted in the safety evaluation reports to the Commission for approval. The staff prepared a Commission paper, similar in scope as SECY-90-016, which addresses containment performance goals for passive LWRs and discusses external events sequences for both evolutionary and passive LWRs. The definition of containment failure for passive LWRs depends on the containment performance goal, as the two are related to one another. The staff expects to have interchanges with the ACRS on these issues within the next several months.

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