RULEMAKING ISSUE
NOTATION VOTE

March 29, 2005 SECY-05-0052

FOR: The Commissioners

FROM: Luis A. Reyes
Executive Director for Operations

SUBJECT: PROPOSED RULEMAKING FOR "RISK-INFORMED CHANGES TO LOSS-OF-COOLANT ACCIDENT TECHNICAL REQUIREMENTS"

PURPOSE:

To obtain Commission approval to publish the proposed rule for public comment.

SUMMARY:

The staff has prepared a proposed rulemaking to add a new section to 10 CFR Part 50 providing an alternative, risk-informed set of requirements for emergency core cooling systems. These requirements could be voluntarily adopted by current light-water reactor licensees. This paper summarizes the development of the proposed rule and the contents of this rulemaking package.

The staff recommends that the Commission approve publication of the proposed rule in the *Federal Register* for public comment.

BACKGROUND:

In June 1999, the Commission decided to implement risk-informed changes to the technical requirements of Part 50. The first risk-informed revision to the technical requirements of Part 50 consisted of changes to the combustible gas control requirements in 10 CFR 50.44

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(68 FR 54123, September 16, 2003). Another topic that the Nuclear Regulatory Commission (NRC) decided to examine was the requirements for large-break loss of coolant accidents (LOCAs). A number of possible changes were considered. These included changes to General Design Criterion (GDC) 35 and changes to § 50.46 acceptance criteria, evaluation models, and functional reliability requirements. The NRC also proposed to refine previous estimates of LOCA frequency for various sizes of LOCAs to more accurately reflect the current state of knowledge of the mechanisms and likelihood of primary coolant system rupture.

Industry interest in a redefined LOCA was shown by the Nuclear Energy Institute's (NEI's) filing of Petition for Rulemaking (PRM 50-75) in February 2002. Notice of the petition was published in the *Federal Register* for comment on April 8, 2002 (67 FR 16654). The petition requested that the NRC amend § 50.46 and Appendices A and K to allow — as an option to the double-ended rupture of the largest pipe in the reactor system — the maximum LOCA break size to be "up to and including an alternate maximum break size that is approved by the Director of the Office of Nuclear Reactor Regulation." The NRC received 17 sets of comments. Most were from the power reactor industry in favor of the petition. A few other stakeholders were concerned about potential impacts on defense-in-depth or safety margins if significant changes were made to reactor designs based upon use of a smaller break size. The NRC staff considered the technical issues raised by the petitioner and stakeholders in this proposed rulemaking.

During public meetings, industry representatives expressed interest in a number of possible changes to licensed power reactors as a result of redefining the large-break LOCA. These include lengthening diesel generator start times, optimizing containment spray system setpoints, increasing power, improving fuel management, eliminating potentially required actions for postulated sump blockage issues, and changing setpoints, the required number of accumulators, equipment sequencing, or valve stroke times.

The Commission's March 31, 2003, Staff Requirements Memorandum (SRM) on SECY-02-0057, "Update to SECY-01-0133, 'Fourth Status Report on Study of Risk-Informed Changes to the Technical Requirements of 10 CFR Part 50 (Option 3) and Recommendations on Risk-Informed Changes to 10 CFR 50.46 (ECCS Acceptance Criteria)'" approved most of the staff recommendations on possible changes to LOCA requirements and also directed the NRC staff to prepare a proposed rule that would provide a risk-informed alternative maximum break size. After holding several public meetings to discuss the direction of the proposed rule, the NRC staff requested additional guidance from the Commission in SECY-04-0037, "Issues Related to Proposed Rulemaking to Risk-Inform Requirements Related to Large Break Loss-of-Coolant Accident (LOCA) Break Size and Plans for Rulemaking on LOCA with Coincident Loss-of-Offsite Power" dated March 3, 2004. The Commission provided direction in an SRM dated July 1, 2004. The Commission stated that the staff should determine an appropriate risk-informed alternative break size and that breaks larger than this size should be removed from the design basis event category. The proposed rule should be structured to allow operational as well as design changes and should include requirements for licensees to maintain the capability to mitigate the full spectrum of LOCAs up to the double-ended guillotine break of the largest reactor coolant system pipe. To maintain the core in a coolable geometry, the Commission stated that a high-level criterion in the rule should include the requirement for the licensee to provide effective mitigation capabilities, including effective severe accident mitigation strategies directed at break sizes larger than the alternative maximum break size

permitted by the rule. The Commission also stated that the mitigation capabilities for beyond-design-basis events should be controlled by NRC requirements commensurate with the safety significance of these capabilities. Finally, the Commission stated that LOCA frequencies should be periodically reevaluated and if increases in frequency required licensees to restore the facility to its original design basis or make other compensating changes, the backfit rule (10 CFR 50.109) would not apply. Regarding the current requirement to assume a loss-of-offsite power (LOOP) coincident with all LOCAs, the Commission accepted the NRC staff recommendation to first evaluate the Boiling Water Reactor Owners Group pilot exemption request before proceeding with a separate rulemaking on that topic.

DISCUSSION:

Based on the above Commission guidance, the staff has prepared a proposed rule which contains alternative emergency core cooling system (ECCS) evaluation requirements. These alternative requirements would be codified in a new regulation, § 50.46a, and could be used in lieu of the requirements in the current § 50.46. The rule could be adopted by current nuclear power reactor licensees.[1]

Proposed Rule

The proposed rule would divide the current spectrum of LOCA break sizes into two regions. The division between the two regions is determined by a “transition break size” (TBS). The first region includes small breaks up to and including the TBS. The second region includes breaks larger than the TBS up to and including the double-ended guillotine break (DEGB) of the largest reactor coolant system pipe. The term, “break,” in the TBS does not mean a double-ended guillotine break; rather it refers to an equivalent opening in the reactor coolant system boundary.

The staff determined that an appropriate TBS would be the cross-sectional area of the largest pipe attached to the reactor coolant system. Thus, the TBS will vary from plant to plant depending on the specific piping system design. For pressurized water reactors (PWRs), the largest attached pipe will be the pressurizer surge line whose diameter varies from about 8 inches to 14 inches. For boiling water reactors (BWRs), the area of the TBS break is the cross-sectional flow area of the larger of either the feedwater or the residual heat removal piping inside primary containment. The BWR TBS corresponds to a pipe diameter of approximately 20 inches.

Pipe breaks in the smaller break size region are considered much more likely than pipe breaks in the larger break size region. Consequently, each region will be subject to ECCS requirements commensurate with the relative likelihood of breaks in that region. LOCAs in the smaller break size region will continue to be “design basis accidents” and will continue to be analyzed by current methods, assumptions, and criteria. In the design basis accident region, licensees must perform analyses under current ECCS requirements to determine the limiting size and location for breaks up to and including the TBS.

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[1]The rule would not apply to future design approvals or standard design certifications or to any plants whose construction permits are issued after the effective date of the final rule.

Pipe breaks larger than the TBS, because of their lower likelihood, can be analyzed by the more realistic and less stringent analysis methods established in the new § 50.46a. Although LOCAs for break sizes larger than the transition break will become “beyond-design-basis accidents,” the proposed rule includes requirements ensuring that licensees maintain the ability to mitigate all LOCAs up to and including the double-ended guillotine break of the largest reactor coolant system pipe. Although these breaks must be mitigated, the methods and initial and boundary conditions used for the mitigation analysis may be more realistic. The analysis results must show that the core remains amenable to cooling. Licensees would be allowed to take credit for reliable nonsafety-related systems without assuming other independent failures. The specific metrics for demonstrating "coolable core geometry" are not necessarily limited to a peak cladding temperature of 2200 degrees F and less than 17 percent local cladding oxidation, as required for breaks smaller than the TBS. Licensees could use other metrics and acceptance criteria for demonstrating coolable core geometry if an adequate technical basis is provided to support the licensee’s proposal.

Licensees who perform LOCA analyses using the risk-informed alternative requirements may find that their plant designs are no longer limited by certain parameters from previous large-break analyses. The new analyses could enable licensees to propose a wide range of design or operational changes. The intent of the proposed rule is that licensees use the revised § 50.46a to optimize safety system design and setpoints, and that overall implementation will result in a net reduction in risk to public health and safety. Nevertheless, the proposed rule would require that any increases in core damage frequency (CDF) and large early release frequency (LERF) are themselves small and that plant baseline risk remains relatively small.

To allow licensees to optimize their safety systems for the more likely (smaller) breaks, licensees would be permitted to make changes in containment systems as long as structural and leak tight integrity is maintained for the realistically calculated pressures and temperatures resulting from LOCAs larger than the TBS. In addition, as part of the defense-in-depth evaluation, licensees would be required to show that a reasonable balance is provided between accident prevention and mitigation. This evaluation would include an assessment of the impact of proposed changes on the frequency of late containment failure. This assessment would allow licensees (and the NRC) to identify proposed plant changes that have no effect on CDF or LERF, but are nonetheless risk significant because of the magnitude of the increase in likelihood of late containment failure.

The rule would not require assumption of LOOP or a limiting single failure of the ECCS for the analyses performed to show that the acceptance criteria are met for breaks larger than the TBS. Thus, it is possible that a licensee may be crediting that the full complement of ECCS is available. To ensure that the facility will continue to comply with the acceptance criteria under any at-power operating configurations allowed by the license, the staff proposes to include in § 50.46a(f)(7), requirements that the acceptance criteria not be exceeded during any at-power condition that has been analyzed, and that the plant not be placed in any unanalyzed condition.

The rule would establish an “inconsequential risk” threshold for allowing licensees to implement certain plant changes made possible by the alternative ECCS requirements in § 50.46a without specific prior NRC review and approval. After initial NRC review and approval of a licensee’s license amendment request and the associated risk analysis and evaluation methodology, licensees could make subsequent plant changes meeting the inconsequential risk criterion

without further NRC review or approval.[2] The proposed § 50.46a would state that the provisions of § 50.59 are not applicable to inconsequential risk changes under § 50.46a. Other plant changes which comply with the requirements in § 50.59, and which could have been made under existing § 50.46 (i.e., do not require use of the alternative ECCS requirements in § 50.46a), may continue to be made under § 50.59.

Under the provisions of § 50.46a, facility or operational changes (including necessary changes to the facility's license or technical specifications) having risk impacts greater than the inconsequential risk threshold would be reviewed and approved by the NRC via the license amendment process in §§ 50.90, 50.91 and 50.92.

The potential impacts of plant changes on facility security would be evaluated as part of the license amendment review process. The proposed rule does not contain specific requirements for licensees to evaluate the safety-security interface for proposed changes. The NRC staff is currently developing options regarding the interaction between safety and security considerations with respect to facility changes. The staff is examining the merits of a more global approach to establishing regulatory requirements for the safety-security interface, such as potentially amending § 50.59 and similar parts of the regulations, rather than establishing requirements in individual rule changes associated with more narrowly focused aspects of the regulations, such as changes to § 50.46.

The NRC will periodically evaluate LOCA frequency information. If estimated LOCA frequencies significantly increase so that the conservatism used in selecting the TBS is unacceptably reduced, the NRC will undertake rulemaking (or issue orders, if appropriate) to change the TBS. In that case, § 50.46a provides that the backfit rule (§ 50.109) would not apply, consistent with Commission direction. As a result of changing the TBS, some licensees may be required to modify their facilities in order to restore compliance with the § 50.46a requirements. In these cases, the proposed rule also provides that the backfit rule (§ 50.109) would not apply.

The NRC staff also proposes several conforming changes to the GDC in Appendix A to 10 CFR Part 50, to allow the single failure and LOOP assumptions to be eliminated during analysis of breaks larger than the TBS without creating inconsistencies between the GDC and the requirements in § 50.46a.

Regulatory Analysis

By revising the ECCS requirements for breaks larger than the TBS, the proposed rule would facilitate a large variety of possible design changes at various facilities. The cost-beneficial nature of these design changes would be heavily dependent on plant-specific design parameters and individual licensee business strategies. Thus, when preparing the regulatory analysis, the NRC staff had difficulty estimating generic costs and benefits (including safety benefits) that could result from the rule. The cost-beneficial nature of other plant changes, such as lengthening emergency diesel start times and increasing power generation, are more easily estimated. Accordingly, the NRC regulatory analysis estimates the net positive benefit of plant

[2]Provided, of course, that the plant change did not involve a change to the license or technical specifications.

changes to lengthen emergency diesel start times and to increase power. The NRC staff and the nuclear industry are now performing additional analyses of selected design changes that are anticipated to increase plant safety. One safety enhancement plant change that is being analyzed is modifying the containment spray system actuation settings to minimize risk by more effectively mitigating the more likely small break LOCAs. The results of these studies will also be addressed by the NRC in the final regulatory analysis.

Contents of the Proposed Rulemaking Package

This rulemaking package includes the *Federal Register* notice for the proposed rule (Attachment 1). The notice includes the proposed rule language and statement of considerations. The regulatory analysis is provided in Attachment 2. The rule also amends information collection requirements that must be submitted to the Office of Management and Budget no later than the date the proposed rule is forwarded to the *Federal Register* for publication. The staff has prepared its supporting statement for this rulemaking, which will be finalized upon Commission approval to publish the proposed rule.

Regulatory Guidance

The NRC staff is working to complete a regulatory guide to facilitate implementation of the final rule. The guide is expected to be completed at the same time as the final rule. The industry, via the Nuclear Energy Institute, has proposed to develop implementation guidance which, if found acceptable by the NRC staff, could be endorsed in the regulatory guide as an acceptable way to implement the § 50.46a rule.

RESOURCES:

The resources needed to complete the proposed rulemaking (1.0 FTE in FY 2005; 0.5 FTE in FY 2006) and guidance (1.5 FTE in FY 2005; 0.5 FTE in FY 2006) are included in the current FY 2005 and FY 2006 budgets. Plant-specific implementation will be achieved through individual licensing actions. Inspection of licensee implementation will be performed through the normal inspection process.

RECOMMENDATIONS:

That the Commission:

1. *Approve* the notice of proposed rulemaking for publication (Attachment 1).

2. *Certify* that this rule, if promulgated, will not have a negative economic impact on a substantial number of small entities in order to satisfy the requirements of the Regulatory Flexibility Act, 5 U.S.C. 605(b).3.

Note:

1. The proposed rule will be published in the *Federal Register* with a 75-day public comment period.

2. The Chief Counsel for Advocacy of the Small Business Administration will be informed of the certification regarding economic impact on small entities and the basis for it, as required by the Regulatory Flexibility Act.

3. Copies of the *Federal Register* Notice of proposed rulemaking will be distributed to all affected Commission licensees. The notice will be sent to other interested parties upon request. Copies of the documents are also available in the NRC's Agencywide Document Access and Management System (ADAMS), the Public Document Room and on the NRC rulemaking web site.

4. A public announcement will be issued.

5. The appropriate Congressional committees will be informed.

6. The supporting statement concerning changes in information collection requirements will be sent to the Office of Management and Budget.

COORDINATION:

The Office of the General Counsel has no legal objection to this paper.

The Office of the Chief Financial Officer has reviewed this Commission paper for resource implications and has no objections.

The staff met with the Advisory Committee on Reactor Safeguards concerning the rulemaking approach and implementation guidance on a number of occasions, most recently on March 3, 2005. In a letter dated March 14, 2005, the Committee supported the staff's proposal to issue the proposed rule for public comment.

The Committee to Review Generic Requirements has deferred its review of the rule until the final rule stage.

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Attachments: 1. *Federal Register* Notice
2. Regulatory Analysis

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