Executive Summary of Draft Proposed § 50.46 Rulemaking

The NRC staff is preparing a rule containing 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 those in the current § 50.46. The rule could be voluntarily adopted by nuclear power reactor licensees.[1] The proposed rule would divide the current spectrum of loss of coolant accident (LOCA) break sizes into two regions. The division between the two regions is delineated by a “transition” break size (TBS).[2] 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.

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 each 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 region, licensees must perform analyses under current ECCS requirements to determine the limiting size and location for breaks up to and including the TBS.[3]

Pipe breaks larger than the TBS, based on their lower likelihood, can be analyzed by the more realistic and less stringent methods established in the new § 50.46a. Although LOCAs for break sizes larger than the transition break will become “beyond design-basis accidents,” the NRC will include requirements ensuring that licensees maintain the ability to mitigate all LOCAs up to and including the DEGB of the largest reactor coolant system pipe. Although these breaks would be required to be mitigated, the analysis methods and initial and boundary conditions used may be realistic. Licensees would be allowed to take credit for sufficiently reliable non-safety-related systems without assuming other independent failures and must show that the core remains amenable to cooling. The specific metrics for demonstrating "coolable core geometry" are not necessarily limited to a peak cladding temperature of 2200 degrees F and 17% local cladding oxidation as required for breaks smaller than the TBS. Licensees would be able to propose other criteria for assuring coolable core geometry if an adequate technical basis was also provided to support the proposed criteria.

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 DEGB analyses. Reducing the DEGB limitations could enable licensees to propose a wide scope of design or operational changes. Potential design changes include modifying containment spray

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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.

[2]Different transition break sizes for PWRs and BWRs are being established due to the differences in design between these two types of reactors.

[3]The TBS is defined as a break equivalent in area to a double ended circular opening of a specified diameter.

timing and flow rate, increasing power, modifying core peaking factors, removing some accumulators from service, eliminating fast starting of one or more emergency diesel generators, etc. Some of these design and operational changes could increase plant safety margins. To ensure that other design and operational changes do not unacceptably reduce plant safety margins or increase risk, the rule will require that any potential increase in risk associated with plant modifications be sufficiently small to be consistent with the Commission's Safety Goal Policy Statement. The risk-informed § 50.46a option will establish acceptance criteria for evaluating design changes. These criteria will generally include the criteria for risk-informed license amendments similar to the criteria in Regulatory Guide 1.174 "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Sprcific Changes to the Licensing Basis". The proposed rule includes consideration of late release frequency (LRF) in addition to core damage frequency (CDF) and large early release frequency (LERF). LRF is added because the rule will allow changes to containment capabilities that may increase the likelihood of late containment failure without affecting CDF and LERF. These criteria assure that the risk impact of all changes is acceptable and that sufficient defense-in-depth is maintained.

The staff notes that for breaks larger than the TBS, there is no requirement for assumption of a coincident single failure in the required mitigation analysis. As a result, during the period of time that an ECCS component or train was unavailable (such as for testing or maintenance), certain breaks could cause a loss of coolable core geometry under power uprate conditions. The staff is proposing requirements in § 50.46a (f)(7) that would preclude this situation.

The rule would establish an "inconsequential risk" threshold for allowing licensees to implement plant changes without specific 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.[4] The proposed § 50.46a would state that the provisions of § 50.59 are not applicable to inconsequential risk changes.

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.[5] Potential impacts of the plant changes on facility security would be evaluated as part of the license amendment review process.

The NRC will periodically evaluate LOCA frequency information. If estimated LOCA frequencies significantly increase such that the conservatism used in selecting the TBS is unacceptably reduced, the NRC will undertake rulemaking (or issue orders, if appropriate) to

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

[5]Requirements for license amendments are specified in 10 CFR 50.90. They include public notice of all amendment requests in the *Federal Register*, an opportunity for affected persons to request a public hearing, preparation of an environmental analysis, and a detailed NRC technical evaluation to ensure that the facility will continue to provide adequate protection of public health and safety after the amendment is implemented.

change the transition break size. In that case, § 50.46a provides that the backfit rule (§ 50.109) would not apply. As the result of changing the transition break size, some licensees may be required to take appropriate action to restore compliance with the 50.46a requirements. In these cases, the rule also provides that the backfit rule (10 CFR 50.109) would not apply.

Revised requirements for analyzing breaks larger than the TBS would not only apply to ECCS analyses but would also be reflected in certain other NRC requirements whose implementation is based on LOCA attributes. These include requirements for equipment qualification, containment design pressure, containment spray, valve timing, and others. The staff is also proposing changes to other regulations to permit plant changes (e.g., modifications to actuation of containment spray) that may enhance ECCS performance for smaller breaks but which are now precluded by current requirements.

The new § 50.46a will contain the requirements for the alternative ECCS analyses in both regions, the risk analysis requirements and acceptance criteria, the requirements for making other plant changes in areas that are based on LOCA attributes, and certain limitations on plant changes to ensure adequate defense-in-depth. These include limitations to ensure containment structural integrity and to ensure that plant changes do not significantly change the frequency of pipe breaks in the greater than TBS region. Conforming changes are made in the proposed rule to the General Design Criteria in Appendix A to 10 CFR Part 50 as necessary to eliminate any conflict with the new § 50.46a requirements.

To help establish the TBS, the NRC developed LOCA frequencies as a function of break size using an expert elicitation process for generic BWR and PWR degradation-related LOCAs. A TBS was established using these LOCA event frequencies in consideration with other significant contributing factors that were not explicitly addressed in the expert elicitation process.

The first step was to select break sizes that corresponded to a break frequency of 1.0E-05 per year from the expert elicitation results. The staff chose break sizes associated with the mean frequencies determined by arithmetically aggregating the individual expert elicitation opinions as the starting point. For PWRs this corresponds to 7 inches equivalent diameter, and for BWRs 18 inches equivalent diameter. The staff then considered uncertainty in the elicitation process and other potential mechanisms that could cause pipe failure that were not explicitly considered in the expert elicitation process. Other failure mechanisms included, for example, low-frequency events and transients (e.g., large seismic and rare water hammer loadings), and other consequential LOCAs (e.g., due to heavy-load drop). While considering these factors the staff recognized that the largest pipe connected to the PWR primary coolant system is the pressurizer surge line (approximately 14 inches in diameter), and for BWRs the largest connected pipe to the main recirculation loops is approximately 20 inches in diameter. Increasing the transition break size to 14 inches equivalent diameter for PWRs and 20 inches for BWRs provided a physical threshold for defining the TBS in that the TBS encompassed all auxiliary piping. In addition, these TBS values are within the range supported by the elicitation estimates when considering the uncertainty inherent in processing the results. These values also provide sufficient margin such that any future LOCA frequency reevaluations will not likely require licensees to undo plant modifications made as a result of implementing 10 CFR 50.46a.