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Project No. 694

March 6, 2006

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USNRC

March 8, 2006 (4:27pm)

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

Secretary
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

ATTN: Rulemakings and Adjudications Staff

SUBJECT: *RIN 3150-AH29, Risk-Informed Changes to Loss-of-Coolant Accident Technical Requirements*, Westinghouse Owners Group Comments on Draft Rule Change, (MUHP-3062)

The WOG appreciates the opportunity to provide comments to the NRC regarding the November 7, 2005 draft of the 10 CFR Part 50.46 rule change.

LBLOCA redefinition is a key part of a vision for a consistent, risk-informed, performance-based regulatory structure for the long term. The work presented in this draft of the proposed rule language is a very significant step forward. However, some more work is needed to ensure broad implementation of the revised rule across the industry. An effective and workable rule is critical to successful implementation by the licensees. The revised rule should result in significantly reduced administrative and analytical burden for both licensees and the NRC. The design and operational focus should be shifted to the more safety significant events. Therefore, the requirements for breaks larger than the Transition Break Size (TBS) need to be commensurate with the risk contribution of these larger break sizes.

WOG endorses the specific rule-change alternatives proposed by NEI and their bases. The attached comments address general areas of the proposed rule that are of concern to WOG.

Attachment 1 contains responses to specific topics identified by the NRC for public comment. Attachment 2 contains additional WOG comments. Attachment 3 contains recommended methodologies for analyzing beyond-TBS LOCA for PWRs.

Template = SECY-067

SECY-02

If you have any questions or require additional information, please contact Wayne Harrison at (361) 972-7298 or Bob Jaquith at (860) 731-6447.

Sincerely yours,

Frederick P. "Ted" Schiffley, II, Chairman
Westinghouse Owners Group

FPS:PJH:las

Attachments:

1. WOG Responses to Specific Topics Identified by the NRC for Public Comment on Risk-Informed Changes to Loss-of-Coolant Accident Technical Requirements (Draft Rule for Comment, November 7, 2005)

2. Additional WOG Comments on the Draft Rule

3. WOG-Proposed Methodologies for Analyzing the Beyond Transition Break Size LOCA for PWRs

cc: Licensing Subcommittee
Risk Management Subcommittee
LBLOCA Working Group
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Attachment 1

Westinghouse Owners Group Responses to Specific Topics Identified by the NRC for Public Comment

The NRC requested specific public comments on 16 questions and issues. These specific topics for comment were identified in section III.J of the Federal Register Notice.

Topic 1. In proposed § 50.46a(b), the Commission specifically precluded the application of the § 50.46a alternative requirements to future reactors. However, future light water reactors might benefit from § 50.46a. The Commission requests specific public comments regarding whether § 50.46a should be made available to future light water reactors.

Response 1. Future PWRs and BWRs operating with materials, pressures and temperatures similar to operating LWRs should be able to use § 50.46a. There is no technical reason that new plants should have to meet outdated requirements for which existing plants can opt out.

Topic 2. The Transition Break Size (TBS) specified by the NRC in the proposed rule does not include an adjustment to address the effects of seismically-induced LOCAs. NRC is currently performing work to obtain better estimates of the likelihood of seismically-induced LOCAs larger than the TBS. By limiting the extent of degradation of reactor coolant system piping, the likelihood of seismically-induced LOCAs may not affect the basis for selecting the proposed TBS. However, if the results of the ongoing work indicate that seismic events could have a significant effect on overall LOCA frequencies, the NRC may need to develop a new TBS. To facilitate public comment on this issue, a report from this evaluation will be posted on the NRC rulemaking Web site at http://ruleforum.llnl.gov before the end of the comment period. In December 2005, stakeholders should periodically check the NRC rulemaking web site for this information. The NRC requests specific public comments on the effects of pipe degradation on seismically-induced LOCA frequencies and the potential for affecting the selection of the TBS. The NRC also requests public comments on the results of the NRC evaluation that will be made available during the comment period. (See Section III.B.3 of this supplementary information.)

Response 2. The NRC report "Seismic Considerations for the Transition Break Size," published in December 2005, indicates that seismic loading will only have a small (~10%) effect on the LOCA frequencies estimated by the NRC expert panel (NUREG-1829, June 2005). This small change in LOCA frequency is well within the uncertainty bounds, which were also estimated by the NRC expert panel. The NRC has set the TBS in the proposed rule very conservatively by including a very substantial margin above the break size which would correspond to a LOCA frequency of 1.0E-05/year. Therefore, seismic effects should not change the transition break size.

Topic 3. Depending on the outcome of an ongoing NRC study (see Section III.B.3 of this supplementary information), the final rule could include requirements for licensees to perform plant-specific assessments of seismically-induced pipe breaks. These assessments

would need to consider piping degradation that would not be prejudiced by implementation of the licensee's inspection and repair programs. The assessments would have to demonstrate that reactor coolant system piping will withstand earthquakes such that the seismic contribution to the overall frequency of pipe breaks larger than the TBS is insignificant. The NRC requests specific public comments on this and any other potential options and approaches to address this issue.

Response 3. As discussed in Response 2, above, seismic loading will only have a small (~10%) effect on the LOCA frequencies estimated by the NRC expert panel (NUREG-1829, June 2005). This small change in LOCA frequency is well within the uncertainty bounds, which were also estimated by the NRC expert panel. Since these results are quite favorable, no plant specific seismic evaluations should be required.

Topic 4. The ACRS noted that "a better quantitative understanding of the possible benefits of a smaller break size is needed before finalizing the selection of the transition break size." The TBS to be included in the final rule should be selected to maximize the potential safety improvements. Thus, the NRC is soliciting comments on the relationship between the size of the TBS and potential safety improvements that might be made possible by reducing the maximum design-basis accident break size.

Response 4. The NRC and the industry should take the opportunity of this rule change to determine the appropriate transition break size and not settle for a rule that is needlessly conservative. Since this rulemaking cannot easily be changed in the future as new information becomes available, the TBS should be based on sound technical facts and expert opinions with some margin for uncertainties and unknowns that could show up in the future and erode margins. It is not appropriate to set the TBS on the basis of where the most benefit is, as this may change tomorrow and there will be no easy recourse. The WOG believes that the TBS should be no larger than the attached piping, and the location of the break should be within the RCS piping section where it is attached. For example, for plants with large attached piping to both the hot and cold legs, the TBS for the cold leg should be based on the largest piping attached to the cold leg, and the TBS for the hot leg should be based on the largest piping attached to the hot leg.

The Commissioners have recommended a design basis LOCA cut-off frequency of 1.0E-5/year, which corresponds to a break size of about a three- or four-inch diameter effective break (for PWRs). The WOG believes that selecting a TBS equal to the largest attached piping (8 to 12 inch diameter break) is very conservative. However, the WOG has conducted thermal-hydraulic and risk analyses that show that there are substantial potential benefits for PWR plants even with this larger TBS.

Topic 5. The proposed § 50.46a includes an integrated, risk-informed change process to allow for changes to the facility following reanalysis of beyond design basis LOCAs larger than the TBS. However, the current regulations in 10 CFR Part 50 already have requirements addressing changes to the facility (§ 50.59 and § 50.90). It might be more efficient to include the integrated, risk-informed change (RISP) requirements, for plants that use § 50.46a, under these existing change processes. The Commission solicits specific public comments on

whether to revise existing §§ 50.59 and 50.90 to accommodate the requirements for making plant changes under § 50.46a.

Response 5. In and of itself, the proposed rule involves no significant change to plant design or how the plant is operated. Adoption of the § 50.46a option will have no significant effect on plant risk. There is no reason that the existing requirements of 10 CFR 50.59 and 50.90 need to be revised to accommodate a new or revised change process for plants that adopt the § 50.46a option. The existing 50.59 process and associated guidance have been endorsed by the NRC and have been shown to be an effective process for evaluation of changes to the facility. The WOG believes that the proposed RISP will add little value and much burden. WOG recommends that it be removed from the proposed rule consistent with the NEI recommended changes.

For changes involving Technical Specifications, the risk-informed change process should rely on the guidance of Regulatory Guide 1.174 with no special requirements specific to 50.46.

Topic 6. The proposed § 50.46a rule would rely on risk information. The NRC has included specifically applicable PRA quality and scope requirements in the proposed rule. However, there are other NRC regulations that also rely on risk information (e.g. § 50.65 maintenance rule and § 50.69 alternative special treatment requirements). Consistent with the Commission policy on a phased approach to PRA quality, it might be more efficient and effective to describe PRA requirements (e.g., contents, scope, reporting, changes, etc.), in one location in the regulations so that the PRA requirements would be consistent among all regulations. The NRC is seeking specific public comments on whether it would be better to consolidate all PRA requirements into a single location in the regulations so that they were consistent for all applications or to locate them separately with the specific regulatory applications that they support.

Response 6. "PRA requirements" will vary from application to application. These requirements include: 1) Scope of the PRA, e.g., internal events, seismic, fire, etc., 2) Modes for which the PRA must be applicable, e.g., full power, low power, shutdown, and 3) Degree of technical adequacy required, e.g., ASME PRA Standard capability category 2 for a specific scope as the entire PRA need not necessarily be capability category 2.. The principle drawback from having a set of requirements defined in a single place is that those requirements will have to satisfy the most demanding application, and then all "lesser" applications will need to meet those requirements. Instead, it would be preferable to have some highlight requirements (e.g., scope, modes, technical adequacy) defined in the context of the application, and then rely on Regulatory Guide 1.200, the ASME PRA Standard, other standards, etc. to define the specific technical requirements.

However, WOG recommends that this proposed rule change not be the vehicle to make this decision. The existing regulatory guides and review processes are adequate for the implementation of the proposed rule.

Topic 7. The proposed § 50.46a rule would include the requirement that all allowable at-power operating configurations be included in the analysis of LOCAs larger than the TBS and demonstrated to meet the ECCS acceptance criteria. Historically, operational restrictions have not been contained in § 50.46 but were controlled through other requirements (e.g., technical specifications and maintenance rule requirements). It might be more practical to control the availability of equipment credited in the beyond design-basis LOCA analyses in a manner more consistent with other operational restrictions. As a result, the NRC is soliciting public comments on the most effective means for implementing appropriate operational restrictions and controlling equipment availability to ensure that ECCS acceptance criteria are continually met for beyond design-basis LOCAs.

Response 7. Owing to the very low frequency of beyond the TBS LOCAs, there should be a minimum of associated operational restrictions. The WOG believes that the existing Technical Specifications for the ECCS and Maintenance Rule operating restrictions (§ 50.65(a)(4)) are adequate to protect the public health and safety, and that there should be no need to impose additional operating restrictions for beyond TBS LOCAs. As-written, the proposed requirement could preclude a licensee from performing on-line maintenance on the ECCS. The improvement in the ECCS reliability and availability would be expected to offset the small increase in risk associated with the allowed outage time. Consequently, the effect of the operational restriction is likely to be risk-adverse.

Topic 8. Given the Commission's intent (See SRM for SECY–04–0037) that plant changes made possible by this rule should be constrained in areas where the current design requirements "contribute significantly to the built-in capability of the plant to resist security threats," the Commission seeks examples on either side of this threshold (plant changes allowed vs. changes prohibited), and additionally any examples of changes made possible by § 50.46a that could enhance plant security and defense against radiological sabotage or attack. (See Section III.G.2 of this supplementary information.) The Commission also solicits comments on whether the § 50.46a rule should explicitly include a requirement to maintain plant security when making changes under § 50.46a or otherwise rely on a separate rulemaking now being considered by the NRC to more globally address safety and security requirements when making plant changes under §§ 50.59 and 50.90. Any examples of plant changes that involve Safeguards Information should be marked and submitted using the appropriate procedures.

Response 8. The security-related aspects of plant changes that might be enabled by this rule change should be addressed in the evaluation of those specific changes. The changes to 10 CFR 50.46 should not be tied to security issues. Making a "security connection" to this rule change will introduce needless complications and be counterproductive.

Issues related to preserving "built-in capability" of the plant to resist threats should be addressed centrally in a single location within the regulations. As has been seen in recent years, there is a need to reconsider security measures as the threats change. Maintaining all requirements related to security in one place, be it regulation or Commission policy, is the most appropriate way to avoid conflicting information and enhance the ease of change.

Topic 9. Given the potential impact to the licensee (since the backfit rule would not apply) of the NRC's periodic re-evaluation of estimated LOCA frequencies which could cause the NRC to increase the TBS, should the rule require licensees to maintain the capability to bring the plant into compliance with an increased transition break size (TBS), within a reasonable period of time?

Response 9. Either the backfit rule should be applied to this rule, or a set of criteria that defines how and when the NRC would determine the TBS is no longer acceptable should be created. If there is a need to "bring the plant back into compliance," the licensee should be allowed a great deal of latitude regarding how this would be accomplished, with the principal goal being to make changes such that risk requirements are achieved with a reasonable mix of prevention and mitigation. (Not necessarily specifically undoing the changes that were made). Rulemaking should be re-opened if the NRC wants to change the TBS later. There is no need to include any provisions in the proposed rule to allow this to be done.

Topic 10. Is the proposed rule sufficiently clear as to be "inspectable?" That is, does the rule language lend itself to timely and objective NRC conclusions regarding whether or not a licensee is in compliance with the rule, given all the facts? In particular, are the proposed requirements for PRA quality sufficient in this regard?

Response 10. The risk-informed aspects of the rule, including the PRA quality requirements, should rely on the guidance of RG 1.174 and RG 1.200 and the 50.46 rule change should require no more "inspectability" than any other performance-based risk-informed application.

Topic 11. The proposed § 50.46a rule would impose no limitations on "bundling" of different facility changes together in a single application. Changes which would increase plant risk substantially or create risk outliers could be grouped with other plant changes which would reduce risk so that the net change would meet the risk acceptance criteria. Are the net change in risk acceptance criteria in the proposed rule adequate or should some additional limitations be imposed to avoid allowing facility changes which are known to increase plant risk?

Response 11. No additional criteria are needed to specify what can and cannot be bundled. Applications that can be shown to meet RG 1.174 criteria should be allowed as long as other regulations are met.

Topic 12. Is there an alternative to tracking the cumulative risk increases associated with plant changes made after implementing § 50.46a that is sufficient to provide reasonable assurance of protection to public health and safety and common defense and security? (See Section III.D.1 of this supplementary information.)

Response 12. Tracking cumulative risk is addressed in Regulatory Guide 1.174, and for changes enabled by § 50.46a, compliance with the Reg. Guide should be sufficient to ensure that cumulative risk does not impact the health and safety of the public. Including additional requirements to track cumulative risk for § 50.46a-related changes adds unnecessary complexity to the regulations and is inconsistent with other performance-based risk-informed regulation. Other risk-informed changes (e.g., risk-informed Technical Specifications) will

likely have a more significant risk impact. The measures already in place for monitoring changes in risk associated with TS changes are certainly adequate for the risk increases that might be associated with plant changes enabled by this rule.

Topic 13. The Commission requests specific public comments on the acceptability of applying the change in risk acceptance guidelines in RG 1.174 to the total cumulative change in risk from all changes in the plant after adoption of § 50.46a. Should other risk guidelines be used and, if so, what guidelines should be used? (See Section III.D.1.c of this supplementary information.)

Response 13. Applying quantitative guidance on the acceptability of a risk-informed application to the cumulative risk impact of all risk-informed applications is not appropriate. There is no need to apply existing criteria or to develop new criteria for the risk impact from all changes made to the plant. Changes made to the plant should be done according to existing regulations and regulatory guides (e.g., §§ 50.59, 50.90, and RG 1.174). The choice of method is dictated by the type of the plant change; each has it own criteria. It is unnecessary to try to apply a single set of risk acceptance guidelines across a spectrum of risk-significant and non-risk-significant plant modifications.

Cumulative risk tracking is most appropriately accomplished by monitoring the base PRA results to ensure that the total core damage frequency (CDF) as well as the CDF from specific initiators or classes of accidents is not increasing. Such monitoring would verify that increases in risk resulting from a series of plant changes affecting some class of accidents (e.g., LOCAs) is not being masked by reductions elsewhere.

Topic 14. After approval to implement § 50.46a, the proposed rule would require tracking risk associated with all proposed plant changes but would not require a licensee to include risk increases caused by previous risk-informed changes that were implemented before § 50.46a was adopted. Licensees who adopt § 50.46a before implementing other risk-informed applications will have a smaller risk increase "available" compared to licensees who have already incorporated some risk-informed changes into their overall plant risk before adopting § 50.46a. The Commission does not consider this a safety issue but requests specific public comments on whether this potential inconsistency should be addressed and, if so, how? (See Section III.D.1 of this supplementary information.)

Response 14. Establishing quantitative guidance on the cumulative risk impact of all risk-informed applications is not appropriate. Cumulative risk tracking is most appropriately accomplished by monitoring the base PRA results to ensure that the total CDF as well as the CDF from specific initiators or classes of accidents is not increasing. Even though licensee will move at different speeds in the development and implementation of risk-informed applications, when they invoke § 50.46a their base PRA results will be whatever they will be. It would make no sense to establish a system of risk "credits" or "debits" a licensee may get from proceeding faster or slower in implementing risk-informed applications.

Topic 15. The proposed § 50.46a would require licensees to report every 24 months all "minimal" risk facility changes made under § 50.46a(f)(1) without NRC review. Are there less burdensome or more effective ways of ensuring that the cumulative impact of an unbounded number of "minimal" changes remains inconsequential? (See Section III.E.3 of this supplementary information.)

Response 15. As discussed in responses numbered 12, 13, and 14, above, the WOG believes it is unnecessary to track cumulative impacts of 50.46 related changes. RG 1.174 addresses both the risk from an individual application and total plant risk in the criteria for acceptability of an application. This should be sufficient. Although licensees could submit a biennial report of the overall CDF changes, having the information available for inspection should be acceptable. An exception to this might be made for requiring a report for significant increases in CDF (> 5E-06/yr) and then only if related to LOCA contribution.

Topic 16. Should the § 50.46a rule itself include high-level criteria and requirements for the risk evaluation process and acceptance criteria described in Reg. Guide 1.174, as is currently proposed? If these criteria were included in the regulatory guide only, and not in the rule, how could the NRC take enforcement action for licensees who failed to meet the acceptance criteria?

Response 16. Requirements for the risk evaluation process should not be prescribed in the rule. Standards and processes exist to establish requirements for risk evaluation and PRA technical adequacy (e.g. RG 1.174, RG 1.200, ASME PRA Standard). Commissioners commented that RG 1.174 is an acceptable guideline for determining the acceptability of changes. The risk-informed aspects of the rule, including the PRA quality requirements, should rely on the guidance of RG 1.174 and RG 1.200.

Enforcement should depend on the requirements associated with the individual plant changes that a licensee proposes to implement by application of the proposed 10CFR50.46a.

Attachment 2

Additional WOG Comments on the Draft Rule

This draft rule change represents a very significant milestone in the effort to risk-inform the regulations. LBLOCA redefinition is an important cornerstone in performance-based, risk-informed regulatory change. A well-crafted final rule will provide both safety and operational benefits.

The ultimate success of the revised rule will depend on licensees' ability to implement the rule. We feel that this draft of the rule is an improvement, but is still too burdensome and has too much uncertainty. Some of the draft rule's requirements, including the change control process, would make implementation very difficult and are likely to discourage many plants from implementing § 50.46a. The WOG welcomes the NRC's efforts to risk-inform § 50.46, and offers the following comments.

1.0 Comments Related to TBS break size

Comment 1.1 - LBLOCA redefinition is a key part of a vision for a consistent, stable, risk-informed, performance-based regulatory structure for the long term. Today's design and operational focus should be shifted to the more safety significant events. The existing design basis break size is unnecessarily conservative. Switching to a more safety significant design basis break size is important because the current very improbable design basis break size drives design and operating requirements and is very resource intensive.

Comment 1.2 - The WOG agrees that setting the transition break size (TBS) at the sizes of the piping attached to the RCS loop is reasonable. Although setting the TBS at the size of largest piping attached to the RCS loop piping is conservative compared with the Commissioners' recommended 1E-05/year initiating event frequency, the WOG believes that setting the TBS at the size of the largest attached piping will provide significant benefit while providing substantial margin to account for uncertainties or any new information that may become available on break size vs. frequency. The requirement that plants must still be able to mitigate breaks larger than the TBS provides even more margin.

Comment 1.3 - The TBS in the draft rule may be set too conservatively. For plants with large attached piping to both the hot and cold legs, the transition break size for the hot leg should be based on the largest connecting pipe on the hot leg, and the transition break size for the cold leg should be based on the largest connecting pipe on the cold leg. These are logical break sizes and avoid the arbitrary nature of the size of a connecting pipe on the hot leg also being applied to the cold leg. This should be defensible based on focusing on the high stress locations in the primary loop, and the ruggedness of the main loop piping. For those plants with no large piping connected to the cold legs, it should be acceptable to apply the same transition break size for the cold leg as is applied for the hot legs.

Comment 1.4 – The FRN states that the Backfit Rule will not apply to future changes of the TBS. The WOG recognizes the need react to new information that may become available. However, the size of the TBS has been chosen so conservatively compared with the judgments of the expert panel, it is highly unlikely that the TBS will need to be changed. Since no criteria have been established for what the NRC may deem to be justification for a change in the TBS, this leaves too much uncertainty or instability in the regulation. Therefore the WOG believes the Backfit Rule should apply to TBS changes.

2.0 Comments related to Operational Restrictions

Comment 2.1 - An effective and workable rule is critical to successful implementation by the utilities. Therefore, the requirements for breaks larger than the TBS need to be commensurate with risk contribution of these larger break sizes. The revised rule should result in significantly reduced administrative and analytical burden for both licensees and the NRC. The draft rule, as currently written, is excessively burdensome with respect to change control, operating restrictions and expansion of the plant licensing basis. Existing change control processes including §§ 50.59, 50.90, and 50.65 already impose sufficient control to protect the public health and safety.

Comment 2.2 - Change control requirements are onerous, particularly the requirement for the NRC to review and approve the change control program. Existing change control processes including §§ 50.59, 50.90, and 50.65 already impose sufficient control to protect the public health and safety. The effect of the rule would be for the NRC to be in the business of individually reviewing a myriad of insignificant changes to which they already have access through license amendments, 10 CFR 50.59 reports, and inspection. The RISP approach is not consistent with performance-based regulation.

Existing approaches to risk-informed, performance-based regulation, including RG 1.174, and RG 1.200, provide sufficient controls to ensure that implementation of § 50.46a will not lead to unacceptable consequences.

Comment 2.3 – On one hand, the draft rule says that the Single Failure Criterion is not required for beyond TBS analyses. But, on the other hand, the rule imposes an operating restriction that prohibits ANY operation in a configuration that is not analyzed and shown acceptable. This is more restrictive than the current rule and the impact on maintenance would probably be adverse. This additional restriction is not consistent with risk-informed regulation. The Commission also commented that this provision may not be appropriate.

Existing plant configuration control programs, including implementation of (a)(4) of the Maintenance Rule, provide sufficient controls to ensure that implementation of § 50.46a will not lead to plant operation in high risk configurations.

3.0 Comments Related to Rule Language

Comment 3.1 - Elimination of the requirement to submit beyond TBS analyses for NRC approval is a positive change.

Comment 3.2 - The new reporting requirements include the addition of a 0.4 percent change in oxidation as a threshold for determining if a change, or the sum of changes, is significant. The rationale for selecting 0.4 percent is that it is the same, on a percentage basis, as the existing PCT change reporting requirement. This rationale is only true if one considers the range of interest of PCT as 0-2200°F [(50°F/2200°F)*(17 percent) = 0.4 percent]. If instead, one considers the range of interest of PCT as 1700-2200°F or 1800-2200°F, from the perspective of transient oxide build-up, this same rationale gives a significance threshold of 1.7 or 2.1 percent. On this basis, it is recommended that the significance threshold for changes in oxidation be revised to 2.0 percent.

It should also be noted that changes in oxidation are much more difficult to estimate than changes in peak cladding temperature. This is because oxidation is an integrated parameter based on the temperature transient versus time, whereas PCT is a point value. If the significance threshold for oxidation is not adjusted as recommended above, it is anticipated that the new oxidation reporting requirement will require more frequent re-analyses than the current regulations require, with no commensurate benefit to the public health and safety.

4.0 Comments Related to PRA "Quality" and Associated Burden

Comment 4.1 – The PRA requirements are excessive. Requirements for PRA should not be prescribed in the rule. Standards and processes exist to establish requirements for PRA technical adequacy (e.g., RG 1.174, RG 1.200, ASME PRA Standard). A peer reviewed internal events PRA that meets RG 1.200 should be sufficient for § 50.46a implementation.

Comment 4.2 - Licensees that adopt the draft rule language would be required to use an integrated, risk-informed change control process to demonstrate the acceptability of all future facility changes. Use of this RISP for all future facility changes under § 50.59 and § 50.90 represents a new operational restriction based on beyond design-basis considerations. This represents a very significant expansion of the licensing basis and would be an excessive burden on licensees and regulators. Requiring that all plant changes be processed through the RISP assessment is an unnecessary burden without a commensurate safety benefit. Most modifications have no material safety significance. While these likely would be dispositioned in a RISP with a qualitative assessment, there would still be costs associated with the performance and documentation of the assessment. The existing framework in technical specifications related to ECCS equipment and containment safeguards should be maintained for both <TBS and >TBS breaks (this is not what is being proposed in the draft rule, under "plant operational requirement" and "restrictions on plant operation"). It seems illogical to adopt more restrictive requirements on safeguards for beyond design basis events than exist for design basis events.

In addition, the proposed requirement to periodically submit a summary or listing of these evaluations to the NRC needlessly focuses licensee and NRC resources directly on a large set of information that by its very definition has no safety or risk significance. Development of this information by the licensees is a non-trivial task. This burden is contradictory to the express purpose of the rule to reduce the allocation of resources to events that do not contribute significantly to risk.

Comment 4.3 - The requirement to update the PRA at a frequency no less often than once every two refueling cycles is potentially burdensome. While maintaining the PRA current is important, establishing a legal requirement to update at a specific frequency would remove flexibility in the allocation of PRA resources. This could be an especially acute problem for licensees with multiple sites that implement § 50.46a. This requirement is a likely impediment to licensees adopting the proposed alternative represented by 10 CFR 50.46a. An alternative would be to require that after every second refueling cycle, that the need for a PRA update is assessed and that appropriate action be initiated.

5.0 Potential Applications and Uses

Comment 5.1 - The new RISP elements of § 50.46a may be so burdensome that no licensee is likely choose to implement § 50.46a. This was an unfortunate change from earlier versions of the proposed rule change language.

The risk assessment process requirements seem excessive. There are established practices in the regulations and Regulatory Guides for making changes (both permanent and temporary) in the plant and assessment of their impact. These include §§ 50.59, 50.90, 50.65(a)(4), RG 1.174, RG 1.177 among others. The draft rule language for § 50.46a does not need to "reinvent" these processes. They should be valid and adequate for any changes that are made as a result of invoking § 50.46a.

Comment 5.2 - There is a large margin between the containment design pressure and the ultimate failure pressure. The proposed rule should allow the peak calculated containment pressures exceeding the containment design pressure by a modest amount without challenging the structural integrity of containment. Containment leak rate testing programs would be based on the new design basis TBS break size. We understand details of the containment related acceptance criteria for the beyond TBS break sizes will be contained in the associated regulatory guidance.

Attachment 3

WOG-Proposed Methodologies for Analyzing the Beyond Transition Break Size LOCA for PWRs

Purpose

The Nuclear Regulatory Commission is proposing to amend its regulations to permit current power reactor licensees to implement a voluntary risk-informed alternative to the current requirements for analyzing the performance of emergency core cooling systems during LOCAs. This proposed rule change will include a transition break size (TBS) for which the current regulations of 10 CFR 50.46 and Appendix K will remain applicable for break sizes up to and including the TBS. Break sizes larger than the TBS up to the double-ended break of the largest pipe will be designated as beyond design basis events, and the proposed regulations will require a demonstration of mitigation capability rather than conformance to 50.46. This attachment proposes analytical methodologies to be used by the industry to demonstrate mitigation capability for the beyond design basis LOCAs for PWRs. The purpose of this attachment is to provide the NRC staff with information for consideration in the development of the associated regulatory guide.

Overview of the NRC Position in the Proposed 50.46a Rule and Supplementary Information

The proposed 50.46a rule and the supplementary information includes the NRC staff's position regarding the beyond design basis LOCA analysis requirements for LOCA break sizes larger than the TBS. The following excerpts characterize the staff's position and are used in the development of the industry proposed methodologies:

> *"The analysis method must address the most important phenomena in analyzing the course of the accident. The evaluation must be performed for a number of postulated LOCAs of different sizes and locations sufficient to provide assurance that the most severe postulated LOCAs larger than the TBS up to the double-ended rupture of the largest pipe in the reactor coolant system are analyzed. Sufficient supporting justification, including methodology used, must be available to show that the analytical technique reasonably describes the behavior of the reactor system during a LOCA from the TBS up to the double-ended rupture of the largest reactor coolant system pipe. Comparisons to applicable experimental data must be made. These calculations may take credit for the availability of offsite power and do not require the assumption of a single failure. Realistic initial conditions and availability of equipment may be assumed if supported by plant-specific data or analysis." (Reference 50.46a(e)(2))*
>
> *"(2) Acceptance criteria for LOCAs involving breaks larger than the TBS. The following acceptance criteria must be used in determining the acceptability of ECCS cooling performance.*
>
> *(i) Coolable geometry. Calculated changes in core geometry must be such that the core remains amenable to cooling.*

(ii) Long term cooling. After any calculated successful initial operation of the ECCS, the calculated core temperature must be maintained at an acceptably low value and decay heat must be removed for the extended period of time required by the long-lived radioactivity remaining in the core." (Reference 50.46a(e)(4))

"Criterion 35-Emergency core cooling. A system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts. Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure, except for loss of coolant accidents involving pipe breaks larger than the transition break size under § 50.46a. For those accidents, a single failure need not be assumed and the unavailability of offsite power need not be assumed for onsite electric power system operation." (Reference Criterion 25, p. 117)

"The Commission stated that the mitigation capabilities for beyond design-basis events should be controlled by NRC requirements commensurate with the safety significance of these capabilities." (Reference FR p. 67601)

". . . accidents in the larger break size region will be analyzed by less stringent methods based on their lower likelihood." (Reference FR p. 67602)

"Paragraphs 50.46a(e)(1) and (e)(2) would require that the worst break size and location be calculated separately for breaks at or below the TBS and for breaks larger than the TBS up to and including a double-ended rupture of the largest pipe in the RCS" (FR p. 67607)

"The NRC expects that the level of conservatism of an analysis method used for breaks larger than the TBS would be less than for breaks at or below the TBS" (FR p.67606), "Section 50.46a(e)(1) of the proposed rule retains the high level of probability as the statistical acceptance criterion for breaks at or below the TBS. Because of the much lower frequency of pipe breaks larger than the TBS, proposed § 50.46a(e)(2) relaxes the criterion to" reasonably" describe the system behavior for breaks larger than the TBS." (FR p. 67607)

"For breaks larger than the TBS, credit may be taken for operation of any and all equipment supported by availability data, along with the use of nominal operating conditions rather than technical specifications limits. This would also include combining actual fuel burn up in decay heat predictions with the corresponding operating peaking factors at the appropriate time in the fuel cycle." (FR p. 67607)

"Commensurate with the lower probability of occurrence, the acceptance criteria in proposed § 50.46a(e)(4) for breaks larger than the TBS are less prescriptive:
i. Maintenance of coolable geometry, and ii. Maintenance of long-term cooling. The proposed rule would afford licensees flexibility in establishing appropriate metrics and

quantitative acceptance criteria for maintenance of coolable geometry. A licensee's metrics and acceptance criteria must realistically demonstrate that coolable core geometry and long-term cooling will be maintained. Unless data or other valid justification criteria are provided, licensees should use 2200 °F and 17 percent for the limits on PCT and MLO, respectively, as metrics and quantitative acceptance criteria for meeting the proposed rule's acceptance criteria." (FR p. 67607)

"LOCA analyses for break sizes larger than the TBS (but using the more realistic analysis requirements) should also be applied to all locations in the RCS to find the limiting break size and location." (FR p. 67606)

Current State of Industry PWR LOCA Evaluation Models

The NRC has reviewed and approved the LOCA evaluation models that are used to perform the LOCA analyses to meet the requirements of 10 CFR 50.46. These LOCA evaluation models are typically developed by the NSSS vendors or the fuel fabrication vendors, and are applied by these vendors or by licensees. The two types of evaluation models are generally referred to as Appendix K evaluation models, or as best-estimate evaluation models. In addition, the large-break LOCA and the small break LOCA may be addressed with the same or with separate evaluation models. These evaluation models have been applied for each plant or grouping of similar plants to determine the limiting break sizes and locations relative to the acceptance criteria of 50.46. These applications typically consist of a break spectrum analysis for the full range of break sizes and locations. The break spectrum and initial conditions and boundary conditions are selected in a bounding deterministic manner for the Appendix K evaluation model approach, and by statistical sampling for the best-estimate evaluation model approach. The Appendix K evaluation model approach also requires an assumption of a concurrent loss of offsite AC power, and an assumed limiting single failure.

The industry experience base with LOCA evaluation models and applications is very substantial and mature, and represents a very large investment of resources. Demonstrating compliance with the NRC regulations for design basis LOCAs has always been a cornerstone of nuclear safety and protection of the public health and safety. With the proposed designation of the TBS via 50.46a, the current regulations will be maintained for break sizes at or below the TBS. For break sizes larger than the TBS the proposed regulations will require continued demonstration of mitigation capability. As stated in the proposed rule change and supplementary information, the analysis method requirements and the acceptance criteria for the beyond TBS break sizes will be different commensurate with the lower probability of larger break sizes.

Based on the current state of the PWR LOCA evaluation models, the extensive knowledge base resulting from application of these evaluation models since the 1970s, and the different requirements for the future analysis of the beyond TBS / beyond design basis LOCA events, the industry is proposing several options for the beyond TBS analysis methods. The objective of these options is to meet all of the technical requirements while taking advantage of the investment in the existing approved LOCA evaluation models and application base. This approach will result in an appropriate use of industry and regulatory resources commensurate with the safety significance and low likelihood of the beyond TBS events.

Proposed Acceptance Criteria

The acceptance criteria proposed by the NRC staff in 50.46a(e)(4) are endorsed by the industry:

> *"(4) Acceptance criteria for LOCAs involving breaks larger than the TBS.*
>
> *(i) Coolable geometry. Calculated changes in core geometry must be such that the core remains amenable to cooling.*
>
> *(ii) Long term cooling. After any calculated successful initial operation of the ECCS, the calculated core temperature must be maintained at an acceptably low value and decay heat must be removed for the extended period of time required by the long-lived radioactivity remaining in the core."*

Each licensee submitting a risk-informed LOCA application for NRC review will need to propose metrics that support maintaining a coolable geometry and long-term cooling. These metrics can draw upon the extensive experimental data base for post-LOCA cladding behavior. For example, quench survivability may be proposed as the metric for maintaining a coolable geometry. As an alternative, the WOG endorses the NRC proposal that a peak cladding temperature of less than 2200 °F, and a maximum local cladding oxidation of less than 17%, are appropriate metrics.

Proposed Analysis Methods for Performing Beyond TBS Mitigation Capability Analyses

Option A – Existing Best-Estimate LOCA Methodology with a Lower Metric

This option is available to licensees that have an NRC-approved best-estimate evaluation model. The current 50.46 requirement (50.46(a)(1)(i)) has the metric "a high level of probability that the criteria would not be exceeded." Under the existing regulations this is typically the 95th percentile with 95% confidence. The NRC staff has proposed a metric (50.46a(e)(2)) for the beyond TBS break size of "a reasonable level of probability that the criteria would not be exceeded." A metric of the 70th percentile is proposed by the WOG as a reasonable level of probability. With this option, the existing best-estimate LOCA evaluation model would be run with the initial and boundary conditions and uncertainty distributions consistent with the intended plant operating conditions. The results of the 70th percentile case would then be used for comparison with the beyond TBS acceptance criteria.

The advantage of this option is that the only change is that a more probable case is selected to represent a realistic result. The results of this case are then compared to the acceptance criteria.

Option B – Simplified Best-Estimate LOCA Methodology

This option is available to licensees for whom NRC-approved best-estimate evaluation models are available. The best-estimate LOCA code is run for the historically limiting break size and location for that plant design. The analysis is run for one set of realistic values for the plant-specific inputs and code physical models. For those physical models for which biases and uncertainties are normally accounted for in a detailed uncertainty analysis, the best-estimate values will be used. In addition, no loss of offsite power or single failure is modeled.

SECY-05-0052 includes use of realistic power distributions for beyond TBS breaks. Industry recommends that realistic power distributions be interpreted as nominal depletion peaking factors and power shapes.

This option has the advantage of using the NRC-approved best-estimate LOCA code for the established limiting break size, with the only changes being associated with running the code with realistic assumptions to obtain a realistic result. The results of this case are then compared to the acceptance criteria.

Option C – Appendix K Methodology with Realistic Inputs and Models

This option is available to licensees that have an NRC-approved Appendix K evaluation model. The Appendix K LOCA code(s) is/are run for the historically limiting break size and location for that plant design. The analysis is run for one set of realistic values for the following input parameters and models. In addition, no loss of offsite power or single failure is modeled.

- Core power level
- Realistic power distributions (see Option B)
- Realistic decay heat
- Realistic metal-water reaction
- Reflood steam cooling restriction removed
- Fuel rod stored energy
- Initial RCS pressure and temperature
- Primary loop flow
- Steam generator inventory
- Accumulator pressure, temperature, and level
- Safety injection flows and temperatures
- Containment backpressure

This option has the advantage of using the NRC-approved Appendix K LOCA code(s) for the established limiting break size and location, with the only changes being associated with running the code with realistic assumptions to obtain a realistic result. The results of this case are then compared to the acceptance criteria.

Option D – New Beyond TBS Methodology

This option is available to any licensee since it involves developing and submitting for NRC review and approval a new LOCA analysis method with the sole purpose of demonstrating mitigation capability for the beyond TBS LOCA. Any system thermal-hydraulic simulation code with the capability to model the most important LOCA phenomena may be submitted. Such a methodology could be wholly new or an NRC-approved LOCA methodology (best estimate or Appendix K) with modifications significant enough to require NRC review. In the case of a modification to an NRC-approved methodology, the unmodified aspects of the methodology would only require consideration of applicability. Modifications or a new analysis method must be validated by comparison to other code predictions or data so that a conclusion can be supported that the code reasonably describes the behavior of the reactor system during a LOCA from the TBS up to the double-ended rupture of the largest reactor coolant system pipe. Realistic models and input parameter values can be assumed. A spectrum of break sizes and locations must be considered to demonstrate that the limiting beyond TBS case has been identified. The results of these cases are then compared to the acceptance criteria.

Industry Position Concerning Reanalyzing the Beyond TBS Break Spectrum (50.46a(e)(2))

The NRC staff position on the scope of the LOCA analysis for the beyond TBS LOCA is stated in proposed 50.46a(e)(2):

> *"The evaluation must be performed for a number of postulated LOCAs of different size and locations sufficient to provide assurance that the most severe postulated LOCAs larger than the TBS up to the double-ended rupture of the largest pipe in the reactor coolant system are analyzed."*

The WOG proposes that the need for a break spectrum be considered for new analysis methods, such as Option D in the industry proposal. However, for beyond TBS analysis methods that use NRC-approved best-estimate or Appendix K evaluation models, this requirement for a spectrum analysis is unwarranted. The large experience base with applying these existing LOCA evaluation models is justification for crediting the results of previous analyses as adequate for selecting the limiting break size and location to be analyzed for the beyond TBS case. This position also seems reasonable for analysis results that do not approach the 2200°F peak cladding temperature.

Conclusions

The proposed rule to provide a voluntary risk-informed alternative to the current requirements for analyzing the performance of emergency core cooling systems during LOCAs has the potential to enable the industry to take advantage of the substantial improvement in the understanding of LOCA-related phenomena and risk. The WOG is proposing a range of options for analysis methods to analyze the beyond TBS LOCA, which draw on the extensive experience and knowledge of LOCA phenomena and simulation that have been gained since the 1970s. These options allow use of both the Appendix K and the best-estimate LOCA evaluation models that have been previously reviewed and approved by the NRC. The option for a licensee to submit a new beyond TBS analysis method is also included. Each of these options involve more realistic models, inputs, or probabilities, consistent with the NRC staff's intent as stated in the proposed 50.46a rule and the accompanying supplemental information. The intent of this white paper is to assist the NRC staff in the development of the regulatory guide to be used for implementation of the proposed rule.