March 24, 2008

Mr. Randy C. Bunt, Chair
BWR Owners' Group
Southern Nuclear Operating Company
40 Inverness Center Parkway/Bin B057
Birmingham, AL 35242

SUBJECT: PROPOSED LIMITATIONS AND CONDITIONS RESULTING FROM US NUCLEAR REGULATORY COMMISSION (NRC) STAFF REVIEW OF THE BOILING WATER REACTOR OWNERS' GROUP (BWROG) LICENSING TOPICAL REPORT (LTR) NEDO-33148, REVISION 2, "SEPARATION OF LOSS OF OFFSITE POWER FROM LARGE BREAK LOCA" (TAC NO. MD2917)

Dear Mr. Bunt:

By letter dated August 25, 2006 (Agencywide Documents Access and Management System (ADAMS) Package Accession No. ML062480321), the BWROG submitted the LTR NEDO-33148, "Separation of Loss of Offsite Power from Large Break LOCA," Revision 2, for NRC staff review. The revised report is a guidance document to help individual licensees to prepare an exemption request to remove the requirement to consider a large break loss-of-coolant accident (LOCA) coincident with a loss-of-offsite power from the current licensing basis. The BWROG provided responses to the NRC staff's requests for additional information (RAIs) on September 28, 2007 (ADAMS Accession No. ML072750041). An additional RAI was issued on March 14, 2008 (ADAMS Accession No. ML080720484).

Enclosed are the proposed limitations and conditions for approval of the LTR and other comments on the LTR. These proposed limitations and conditions and comments will be discussed in a public meeting to be scheduled in April 2008.

If you have any questions, please contact Michelle Honcharik at 301-415-1774.

Sincerely,

/RA/

Stacey L. Rosenberg, Chief
Special Projects Branch
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 691

Enclosure: As stated

cc w/encl: See next page

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PROPOSED LIMITATIONS AND CONDITIONS AND ADDITIONAL COMMENTS

BOILING WATER REACTOR OWNERS' GROUP

LICENSING TOPICAL REPORT NEDO-33148, "SEPARATION OF LOSS OF

OFFSITE POWER FROM LARGE BREAK LOCA"

PROJECT NO. 691

All section, page, table, or appendix numbers below refer to items in the boiling water reactor owners' group (BWROG) licensing topical report (LTR) NEDO-33148, unless specified otherwise.

1. Remove broad scoping language on Page 2-8 of Section 2.4, which states:

   > It is possible that other plant changes that are not explicitly described in this LTR can be justified using the analyses presented herein. A licensee desiring to implement another change must demonstrate that the change is equivalent to those presented in this LTR. If the change is not equivalent, the plant must provide a plant-specific evaluation similar to that presented in this LTR; and the plant must obtain approval from the NRC that the analysis method of this LTR is applicable to that change.

This language is too broad in scope for an LTR, as the changes must be defined within the LTR itself, and the process that a licensee would use to demonstrate that a different, undescribed change is equivalent has not been defined. Licensees could misconstrue the U.S. Nuclear Regulatory Commission (NRC) staff's approval of this LTR to imply that the NRC would not repeat its review of such applications. Without a review of such an application of this LTR, the NRC staff would not have reasonable assurance of adequate protection of public health and safety. Therefore, the NRC staff recommends this paragraph be removed from the LTR. If a licensee wants to make a similar change, which is not covered in the LTR, they should submit a plant-specific exemption request for those changes.

If the BWROG does not want to remove the paragraph as recommended by the NRC staff, they must at a minimum revise the paragraph to clearly state that licensee's desiring to implement any changes not explicitly described in the LTR, must provide a plant-specific evaluation, whether or not the change is equivalent to those specified in the LTR. The NRC staff will determine the acceptability of such requests on a case-by-case basis.

2. Address compliance on a plant-specific basis with regulatory requirements from which exemption has not been requested.

The NRC staff safety evaluation will include a list of pertinent regulatory requirements that could, in the NRC staff's view, be impacted by the changes requested. Although most of these requirements are addressed in the LTR, each licensee must confirm, on a plant-specific basis, how each of the licensee's proposed changes will impact the regulatory requirements, and confirm that the changes will not affect compliance with these requirements. This condition may be addressed by appending a template submittal to the LTR that contains a generic process for addressing remaining regulatory requirements, or by imposing a limitation that requires each licensee to address specifically the listed regulatory requirements. Due to the plant-specific

nature of the possible changes, the NRC staff recommends imposing this limitation and reviewing on a plant-specific basis.

Among the requirements applicable to the residual heat removal (RHR) system, the requirements of Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Appendix A, General Design Criteria (GDC) 4, 17, and 34, 36, and 37 were found by the NRC staff to be especially applicable in light of the requested exemption. A licensee requesting to implement these changes would need to demonstrate compliance with the intent of the above GDC as outlined below.

GDC 4, *Environmental and dynamic effects design bases*. A licensee would need to confirm that proposed emergency diesel generator (EDG) loading changes, valve stroke time changes, and valve realignments would not leave its plant susceptible to water hammer events.

GDC 17, *Electric power systems*. A licensee would need to confirm that proposed system changes would not affect those anticipated operational occurrence (AOO) and accident sequences that are not affected by the requested exemption and plant changes. If the AOO and/or accident sequences do change, the results must be re-analyzed and presented for NRC staff review. NRC staff did not evaluate compliance with those provisions of GDC17 requiring onsite and offsite electrical power.

GDC 34, *Residual heat removal*. A licensee would need to confirm that proposed system changes would not compromise the capability of the RHR system to remove decay heat from the core, specifically during a loss-of-offsite-power (LOOP)/large break loss-of-coolant accident (LBLOCA).

GDC 36, *Inspection of emergency core cooling system* [(ECCS)]. On a plant-specific basis, licensees must confirm that proposed modifications do not inhibit the inspectability of ECCS components. This may be of concern for modifications that replace valve operators, for instance.

GDC 37, *Testing of emergency core cooling system*. A licensee would need to confirm that the proposed modifications do not impair the ability of the ECCS to withstand periodic pressure-testing as required by GDC 37.

PROPOSED CONDITION FOR APPROVAL OF LTR*:*

On a plant-specific basis, licensees must evaluate and confirm compliance with the intent of GDC 4, 17, 34, 36, and 37.

3. Rewrite the discussions on Pages 3-3 and 3-4 aimed at demonstrating that specific criteria for special circumstances are satisfied.

These discussions describe how the requested exemptions will satisfy the second, fourth, and sixth criteria for special circumstances in 10 CFR 50.12. The LTR implies that, after the LTR is endorsed, satisfaction of these criteria is assured for any one, and for any combination, of the proposed changes.

Based on the discussions provided in the LTR, the NRC staff is not able to conclude generically that special circumstances exist that satisfy the second and fourth criteria. Further, the NRC staff can not fully evaluate the appropriateness of a description of how a particular change

satisfies one or more of these criterion without knowledge of the systems, structures, and components (SSCs) and activities that are going to be changed, and the regulations which govern those particular activities. In other words, whether a licensee satisfies the second or fourth criteria can only be determined on a plant-specific basis for the specific changes being requested. The LTR may provide guidance or sample wording that plants may propose to demonstrate that one or both of these criteria are met, but the LTR needs to clarify that each licensee is responsible for proposing and justifying that these criterion are met.

It may be reasonable to argue that the sixth criterion is satisfied because of advances in probabilistic risk assessment (PRA) and LOCA break frequency estimates. However, the NRC staff disagrees with some of the arguments presented in the LTR. For example, the NRC staff disagrees that, “so much conservatism exists that it constitutes an unnecessary burden on licensees that warrants relief….” The LTR should clearly describe the new material circumstances that have been developed that would support a conclusion that the sixth criterion is satisfied. The LTR should also clarify that, if only the sixth criteria is satisfied, the regulations require that the Commission be notified of the exemption request, and therefore, processing of the exemption request may be different than processing a request where other special circumstances are also satisfied.

4. Remove or rewrite the broad scoping language in the first paragraph on Page 3-2, which states, in part:

   > Under the proposed exemption, the ECCS design basis under §50.46(c)(1) and (d) for BWRs would no longer include an assumed LOOP coincident with breaks in "large" pipes (nominally pipe diameters greater than or equal to 10 inches) in the reactor coolant pressure boundary.

Any exemption request covered by the LTR will not change the ECCS design basis to “no longer include an assumed LOOP coincident with breaks in 'large' pipes.” The NRC staff has concluded, instead, that exemptions may be issued that would permit one or more of the proposed changes to be implemented contrary to the quoted regulations, upon approval of an analysis demonstrating that the proposed change(s) is(are) acceptable based on satisfying the risk-informed guidance and the criterion for granting an exemption in 10 CFR 50.12.

5. Remove or rewrite Steps 1, 2, and 3 in Figure 4-1 and Sections 4.1, 4.2, and 4.3 on Pages 4-1 through 4-7.

In these three steps, each licensee would be authorized to develop a plant-specific LBLOCA break size based on its quantitative estimates of the probability of a conditional LOOP and the LOCA size-frequency curves from NUREG-1829, "Estimating Loss-of-Coolant Accident (LOCA) Frequencies Through the Elicitation Process," June 2005. If the product of the LBLOCA frequency and the probability of a LOOP given that LBLOCA is 1E-6/year or less, then the licensee could use that LBLOCA break size in its exemption request. The NRC staff has concluded that a mechanistic process such as proposed by the LTR places unsupportable confidence in the accuracy of the various parameters and is not consistent with maintaining the defense-in-depth philosophy, because it fails to provide independence and diversity between challenges to the facility and protection against those challenges when they arise.

Step 1: Determine Plant-Specific LBLOCA Frequency

This step directs the licensee to obtain an estimate of the LBLOCA frequency from NUREG-1829 or other source (later discussion between the NRC and BWROG indicate that the BWROG will limit the source to NUREG-1829). In Step 3, this estimate of the LBLOCA frequency would be combined with the probability of a LOOP given a LBLOCA. The size of the LBLOCA for which the frequency is obtained is not fixed in the LTR, and therefore, may be selected by each licensee. The NRC staff believes that determination of the applicable LOCA size in this manner would overly complicate both preparation of the plant-specific submittal and the NRC staff review. Therefore, the NRC staff requests that the LTR identify and justify an appropriate break size that could be utilized by plant-specific applications plus identify any limitations that may apply. This is discussed in more detail in the following paragraphs.

There is significant uncertainty associated with the LOCA frequency estimates in NUREG-1829 caused both by individual expert opinion uncertainty and variability among experts' opinions, and by certain assumptions used to process the experts' input. The NRC staff notes that the NUREG-1829 frequency curves were used to support the development of the proposed 10 CFR 50.46a rulemaking. As described in SECY-07-0082 (ADAMS Package Accession No. ML070180692), the NRC staff considered the quantitative results of the full range of assumptions used to produce the curves together with other deterministic information to propose a transition break size for the rulemaking.

Based on expected estimates of the probability of a consequential LOOP resulting from a LOCA in Step 2, and the general approach utilized in the LTR, one reasonable approach might be that the LBLOCA break size should be chosen to have a frequency estimate of 1E-4/year or less. The NRC staff observes that in NUREG-1829, the arithmetic mean frequency estimate for a 7-inch break size is slightly less than 1E-4/year. In order to provide confidence that the 1E-4/year frequency bounds the expected LBLOCA frequency, the NRC staff suggests that the LTR evaluate the data from NUREG-1829 and propose a single LBLOCA break size that can be supported with high confidence for every plant-specific exemption request. If this is done, it seems reasonable that a frequency of 1E-4/year could be used for the bounding estimate of the frequency of a LBLOCA in Step 2 below.

For whatever break size is proposed, it should be large enough to provide confidence that the corresponding frequency of occurrence is sufficiently low to support granting the requested exemption, but it should still be small enough to allow the proposed plant changes, which provide a justifiable regulatory burden reduction and potential risk benefit for most current BWRs.

Step 2: Determine Plant-Specific LOCA/LOOP Frequency

This step directs the licensee to estimate the probability of a LOOP given a LBLOCA using the methods described in the LTR. Previous work indicates that conditional LOOP frequencies of 1E-2/demand or less are expected to be attainable at most plants. The NRC staff has concluded that plants that can not attain this conditional LOOP probability would be outliers, and these plants would be expected to improve the unreliability of their offsite power supply to 1E-2/demand or less before taking advantage of the flexibility afforded by these exemptions.

Step 3: Decision Point - Is LBLOCA/LOOP Frequency Greater Than 1E-6?

This step directs the licensee to estimate the frequency of an accident sequence initiator caused by a LBLOCA followed by the conditional LOOP (hereafter LOOP/LBLOCA initiator). If that frequency is 1E-6/year or less, the licensee could select that LBLOCA break size to use in the exemption request. If the calculated frequency is greater, this step directs the licensee to increase the size of the LBLOCA (decreasing the frequency) until the frequency of the LOOP/LBLOCA initiator is less than 1E-6/year. This step in the LTR does not state that, if the frequency of the initiator is less than 1E-6/year, the licensee may reduce the size of the LBLOCA under consideration (increasing the frequency). However, as discussed above, the LOCA size is not specified in the LTR, leaving the 1E-6/year LOOP/LBLOCA initiator frequency as the only guideline in the LTR to fix the LBLOCA break size.

Recommendations for Changes to Steps 1, 2, and 3.

As mentioned above, the NRC staff disagrees that a licensee may estimate the conditional LOOP probability and, based on this probability, select a LBLOCA break size whose frequency would result in an accident initiator caused by a LBLOCA of the selected size followed by a consequential LOOP with a compound frequency of 1E-6/year. The NRC staff has concluded that the selected LBLOCA break size should not rely exclusively on the estimate for either of the two parameters as would be permitted using the method proposed in the LTR. Independence and diversity needs to be maintained consistent with the philosophy of defense-in-depth and, in this application, diversity in protection would not be preserved if either the LOCA frequency or the LOOP probability was estimated to be so small that the other parameter could be very large. Therefore, consistent with the determination of the break size for the 10 CFR 50.46a rulemaking described in SECY 07-0082, the NRC staff has considered a variety of inputs as described above. Based upon this assessment, the NRC staff has concluded that the thermal-hydraulic analyses used to support each exemption request should be based on justification in the LTR of an appropriate break size where the frequency of 1E-4/year could be assigned with high confidence of nonexceedance. Plants that can not attain a conditional LOOP probability of 1E-2/demand or less would be outliers and would be expected to improve the reliability of offsite power to 1E-2/demand or less before taking advantage of the flexibility afforded by these exemptions. The conditional probability should include delayed LOOP.

6. Rewrite Step 12 on Pages 4-17 and 4-18.

The change in risk calculation described in this section first directs each licensee to perform a change in risk calculation as laid out in RG 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis" (ADAMS Accession No. ML003740133). That is, a) estimate the base line core damage frequency (CDF) and large early release frequency (LERF) before any changes related to the exemption request are incorporated into the PRA, and then b) incorporate all the relevant changes in the PRA and calculate the CDF and LERF again. The difference between a) and b) is the change in risk associated with plant changes approved in the exemption and should be the risk analysis results to be compared with the acceptance guidelines laid out in RG 1.174.

However, the LTR directs the licensee to perform three additional steps where the CDF contribution from all LOOP/LBLOCA initiated sequences is subtracted out of the PRA logic models to obtain the change in CDF associated with the affect the plant changes have on non-LOOP/LBLOCA initiated core damage sequences. The LTR proposes this process, because its acceptance guideline on LOOP/LBLOCA initiator frequency (i.e., 1E-6/year) is based on

assuming that all LOOP/LBLOCA initiators go to core damage. The final change in risk estimate proposed by the LTR is the sum of the LOOP/LBLOCA initiator frequency and any increase in CDF caused by the plant changes in the non-LOOP/LBLOCA initiated core damage sequences.

The NRC staff does not endorse the process described in the LTR. The change in risk estimate arising from all changes proposed in an exemption request is the only appropriate value to compare to the RG 1.174 guidelines. According to the thermal-hydraulic analysis, LOOP/LBLOCA initiating events are not expected to lead to core damage without additional random failures (although fewer failures may lead to core damage after the changes). The LTR proposes to sum this mostly non-core damage frequency with the increase in CDF from non-LOOP/LBLOCA initiated sequences yielding an ill-defined parameter. The proposed process yields an inappropriate value, because the value is not the increase in risk caused by the proposed changes which is what should be compared to the RG 1.174 acceptance guidelines. Furthermore, the process is unnecessarily complicated leading to a high potential for misapplication and to resource intensive analyses and reviews.

The change in risk may be estimated by identifying changes to the plant and changes to the PRA success criteria associated with the proposed changes to the plant. PRA may use best estimate thermal-hydraulic analyses to develop success criteria and, if the best estimate thermal-hydraulic analyses performed to support the exemption request continues to indicate successful mitigation following a change, then the PRA success criteria need not be changed. If an exemption from the single failure criteria is requested, because two successful trains are needed instead of one, changes to the success criteria in the PRA will yield the expected change in risk. In cases where limited data exists to quantify a change (e.g., slower diesel start), qualitative arguments are permitted by RG 1.174 if the change is not expected to increase risk and bounding estimates may be used if an increase in risk is expected.

The NRC staff has concluded that the guidance in RG 1.174 can and should be applied to these proposed changes.

7. Clarify when the single failure criterion will and will not be applied.

The LTR does not provide any clear directions on when a single failure must be assumed, and when there is no requirement to assume a single failure. The NRC staff believes that this lack of clarity arises, because the BWROG anticipated that an exemption would be authorized so that BWRs would no longer include an assumed LOOP coincident with breaks in “large” pipes in its design basis. If such as exemption were authorized, there would be no need to evaluate the affects of single failures for these beyond design basis LOOP/LBLOCA sequences.

As discussed above, the NRC staff does not agree that it will issue an exemption that will change the ECCS design basis to “no longer include an assumed LOOP coincident with breaks in 'large' pipes.” The NRC staff has concluded, instead, that exemptions may be issued that would permit one or more of the proposed changes to be implemented even if not fully complying with the quoted regulations upon approval of an analysis demonstrating that the proposed change(s) is (are) acceptable based on satisfying the risk-informed guidance and the criterion for granting an exemption in 10 CFR 50.12.

On Page 2-9, the LTR states that, “[t]he only potential detrimental effect of this change would be that some LBLOCA events with a concurrent loss-of-offsite power and an additional single failure may lead to core damage.” Based on this, other statements throughout the LTR, and

discussion with the BWROG, the NRC staff believes that following some, but not all, proposed changes, the thermal-hydraulic analyses will not demonstrate successful mitigation if a single failure is assumed.

Consistent with the NRC staff conclusion that exemptions to the regulations permitting the proposed changes may be issued on a plant-specific basis, the LTR should clarify that changes for which mitigation will not be successful assuming a single failure may be proposed. However, this clarification should direct each licensee proposing a change for which mitigation may not be successful following a single failure to identify the single failures that can not be tolerated and specifically request an exemption to the single failure provision in the applicable regulations for each specific case.

8. Rewrite the discussion about seismic initiating events on Page 2-6 and Appendix C, Page C.3-6.

The LTR discusses the effects of a seismic event on the mitigating equipment at a plant, and argues that seismic events large enough to cause LOCA events at the plants are quite strong and beyond the design basis and therefore do not need any additional consideration. However, the LTR does not address the issue that the elicitation used to develop the frequencies in NUREG-1829 focused solely on determining event frequencies that initiate by unisolable primary system side failures related to material degradation.

In its analysis reported in “Seismic Considerations For the Transition Break Size” (ADAMS Accession No. ML053470439), the NRC staff used different approaches in evaluating unflawed piping, flawed piping, and indirect failures of other components and component supports that could lead to piping failure. In summary, this study demonstrated that the critical flaws associated with the stresses induced by seismic events of 1E-5 and 1E-6 annual probability of exceedance are large, and coupled with other mitigative aspects, the probabilities of pipe breaks in a pressurized water reactor (PWR) with a diameter on the order of 12 inches or larger are likely to be less than 1E-5 per year. Piping systems of BWR and west coast plants were not studied in this report because required information was not readily available. However, the report noted that there are no inherent limitations in applying the approach used in the report to piping systems of BWRs and west coast plants.

Either the LTR or the individual licensees need to demonstrate that the seismic contribution to the failure of the proposed LBLOCA break size in BWRs is not significant contributor to the 1E-4/year failure frequency.

9. Rewrite the Discussion in Sections 2.4 and 4.2 to Better Address Double Sequencing Issues.

The double sequencing refers to an unintended sequence of operations at a nuclear power plant during which safety and accident mitigation loads automatically start, shut down and restart in rapid succession when called on to operate. This occurs when, for some combination of reasons, safety bus voltages fall below acceptable levels after the plant is shut down and mitigation loads are started. The buses must be isolated and then re-powered from diesel generators or some alternate offsite source. Following this, shutdown and mitigation loads can be restarted.

Double sequencing would most likely occur if there were a concurrent LOCA, with its associated plant trip and prior stressed transmission grid condition. In the LTR, the BWROG stated that

based upon published studies by EPRI and NRC, the BWROG does not believe that such double sequencing events create greater consequences than assumed in this LTR for both PRA and thermal-hydraulic evaluations. To ensure that the problem is bounded, it is assumed that all delayed LBLOCA/LOOP sequences go to core damage in the PRA evaluation. In the thermal-hydraulic evaluations, the impact is encompassed in the overall delay time for injection.

The BWROG stated the following in its response to EEEB staff RAI 2 (ADAMS Accession No. ML072750041):

b) During the July 25, 2007, meeting with the NRC staff, the BWROG agreed to address double sequencing when incorporating the modifications listed in Section 2.4 of the LTR, with the specific purpose of ensuring that new vulnerabilities are not introduced as a result. It is not intended that plants review their existing designs to address GSI-171 concerns.

Additional guidance on how double sequencing will be evaluated in these design changes is given below:

1. Because the LBLOCA/LOOP event (both simultaneous and delayed) is now treated as a "mitigated beyond design basis event," any design change will be based on realistic conditions and loads rather than the worst condition or most conservative loads.

2. Using realistic electrical loads, the licensees will verify that the batteries will have sufficient capacity for handling double sequencing events.

3. Since actuation of circuit breaker (CB) anti-pump logic due to double sequencing can result in a trip and lockout of CBs feeding safety equipment, unit-specific evaluation will be performed of the circuit breaker anti-pump logic and load sequencing logic for the double sequencing scenario. The licensees will verify that the CBs have the ability to function properly during a double sequencing evolution.

4. Licensees will review the 4 KV protective relays to minimize their potential to trip during a double sequencing event. Both load inertia and thermal overload protection memory feature need to be considered.

5. Licensees will review the motors with high-inertia loads in the emergency core cooling systems to verify that they can operate properly during a double sequencing event.

6. Licensees will evaluate the interruption to the flow of the service water to the diesel generators resulting from double sequencing and verify that the diesel generators will operate properly. (It should be noted that if the LOCA start signal is disabled per this LTR, then this issue is no longer a concern, as the EDG will not be running prior to the double sequencing of SW.)

7. Licensees will address any open GL 96-06 issues as part of implementing this LTR.

8. In general, the short duty cycle motors, such as those used to operate motor-operated valves, should be able to handle double sequencing events. However, for the short duty cycle motors wherein the thermal overloads are not bypassed either full time or upon occurrence of an accident event per NRC guidance, licensees will review the bounding case to determine if the thermal overload is appropriately sized. If the thermal overload is not appropriately sized, corrections will be required.

9. As with other ECCS pump[s], HPCS is also normally powered from the offsite power and is powered from diesel generators only when the offsite power is lost. Therefore, licensees should review the HPCS design and operation to ensure its availability following a double sequencing event.

The NRC staff considers that the above items 1 through 9 do not provide a complete resolution of all the concerns relating to LOCA with delayed LOOP. In a July 27, 2007, meeting between BWROG and NRC, the BWROG was advised to address the issues relating to Generic Safety Issue (GSI)-171, "ESF Failure from LOOP Subsequent to a LOCA," which in particular included concerns for LOCA with delayed LOOP. Section 2.2 of NUREG/CR-6538, “Evaluation of LOCA With Delayed LOOP and LOOP With Delayed LOCA Accident Scenarios - Technical Findings Related to GSI-171, ESF Failure From LOOP Subsequent to LOCA” (ADAMS Accession No. ML071630062), provides additional concerns. The concerns identified in NUREG/CR-6583 are: overload of EDGs, non-recoverable damage to EDGs and ECCS pump motors, lockup of the load sequencers, double sequencing resulting into net effect of delaying water-makeup injection into the reactor coolant system, and water hammer.

The NRC staff does not agree with the BWROG that double sequencing events cannot create greater consequences than assumed in this LTR for both PRA and thermal-hydraulic evaluations when considering consequences such as non-recoverable damage to EDGs and ECCS pump motors, lockup of the load sequencers, double sequencing resulting into net effect of delaying water-makeup injection into the reactor coolant system, and water hammer. In Table 2 of Attachment A of the BWROG RAI responses it is stated that the thermal-hydraulic evaluation of LOCA for small and medium size LOCAs (less than typical 10-inch transition size) will continue to not be based on consideration of LOCA with delayed LOOP, or LOCA with double sequencing. In other words, the current treatment of small- and medium-sized break LOCAs is unchanged by this LTR.

Based on its review of licensee responses to Generic Letter (GL) 2006-02, “Grid Reliability and the Impact on Plant Risk and the Operability of Offsite Power,” the NRC staff has a renewed interest in licensees’ capability to mitigate appropriately the potential consequences associated with a double sequencing event at nuclear power plants.

In GL 2006-02, the NRC staff requested licensees to describe the effect of double sequencing on their respective nuclear power plants. After reviewing the responses to GL 2006-02, the NRC staff found that all licensees, except the licensees for San Onofre and Waterford, stated that double sequencing was not part of the licensing basis for their respective nuclear power plants and therefore, have not studied the full effect of a delayed LOOP event.

The original design basis accident for nuclear power plants is a simultaneous LBLOCA/LOOP. The purpose of this LTR is to support exemption requests from certain requirements of the simultaneous LBLOCA/LOOP event. A simultaneous LBLOCA/LOOP results in an immediate start of onsite emergency power sources including EDGs. One specific exemption request

would allow a delayed start of the onsite power sources. The delayed start of the onsite power sources, coupled with the slower loading of the EDG, increases the possibility of double sequencing as a result of a LOOP event. Therefore, the NRC staff finds that the consequences of double sequencing need be addressed by licensees. The LTR or the plant-specific submittal needs to demonstrate that the plant can handle a delayed LOOP with a LOCA.

PROPOSED CONDITION FOR APPROVAL OF LTR:

Each licensee shall address all the concerns of the LOCA with delayed LOOP, as detailed in Section 2.2 of NUREG/CR-6538.

10. Revise Section 2.4, Description of Potential Changes

The following options are discussed in Section 2.4 of the LTR:

2.4.1 Optimize EDG Loading
2.4.2 One RHR LOOP in Suppression Pool Cooling Mode
2.4.3 Eliminate LPCI Loop Select
2.4.4 Allow EDG Warm Up Prior to Loading (slow start)
2.4.5 Start EDGs Only When Needed (start only on loss-of-offsite power)
2.4.6 Simplified EDGs Starting
2.4.7 Increased MOV Stroke Times

The above options, if selected, would have a great impact on various documents. The LTR should advise licensees to list in their application which safety-related documents (especially the safety-related calculations) the licensee would be revising as part of above modifications. The modifications should be supported by the requisite diesel generator calculations and applicable changes to the Technical Specifications of the plant.

11. Revise Section 2.5, Thermal-Hydraulic Analysis

The LTR states that in order to demonstrate defense-in-depth for the LBLOCA/LOOP separation exemption, per RG 1.174, the BWROG will demonstrate that the LBLOCA/LOOP event can continue to be mitigated, even after the implementation of the plant modifications discussed in Section 2.4. However, as discussed in Section 4.0, "Process For Making LBLOCA/LOOP Changes," individual licensees requesting exemptions will have to either verify that these analyses are applicable for their plants or perform the needed plant-specific analyses. The thermal-hydraulic analyses summarized in this section and detailed in Appendix B are not applicable to BWR/2 plants. BWR/2 plants will need to perform a plant-specific thermal-hydraulic analysis as part of their exemption request.

PROPOSED CONDITION FOR APPROVAL OF LTR:
The impact of various changes, including those necessary to address double-sequencing, must be addressed in the thermal-hydraulic analysis by each individual plant.

12. Revise Section 4.0, Process For Making LBLOCA/LOOP Changes

This section of the LTR describes the process that each licensee must follow for preparing the exemption request. The process includes both a probabilistic as well as a deterministic evaluation, as outlined in RG 1.174. The process is broken down into 24 steps.

The LTR should state that the modifications made as a result of the 24 steps should be supported by the requisite calculations and applicable changes to the Technical Specifications of the plant.

13. Proposed Limitations regarding MAAP4 analyses

a. The generic MAAP4 analyses presented in Appendix B shows acceptable results for plants whose proposed changes are bounded by the analyses. A licensee must confirm that its proposed changes are enveloped by the MAAP4 analyses shown in Appendix B. The existing wording in Section 2.5 of the LTR is sufficient to address this concern. However, for thoroughness and efficiency of review the NRC staff requests that LTR be revised requiring licensees to delineate in their submittal how each of the proposed changes are enveloped by the MAAP4 analyses shown in Appendix B.

b. If a licensee cannot confirm that the generic MAAP4 analyses bound its proposed changes, further evaluation will be required, and the TRACG02 confirmation may be invalid for a benchmark comparison. The licensee would need to rerun the TRACG02 analyses in cases where the generic MAAP4 analysis in the LTR did not bound the plant-specific thermal-hydraulic analysis. Alternatively, the licensee could analyze their sequenced LOOP/LBLOCA scenario using their referenced LOCA method as a confirmation of the MAAP4 results.

c. The MAAP4 analyses are evaluated for 5 percent and 25 percent uprates, which is, in a sense, bounding of certain expansions to the operating domain, including EPU. The analyses are not seen by the NRC staff to be bounding, however, of operating domain expansions that reduce the power-to-flow ratio (i.e., MELLLA+). The NRC staff did not evaluate the effects such an expansion would have on the generic analyses, and does not conclude, at this point, that the LTR applies to such expansions. Any licensee seeking an operating domain expansion that reduces the power-to-flow ratio would have to re-justify the exemptions or remove the modifications to implement an operating domain expansion.

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