May 8, 2007

Mr. Gordon Bischoff, Manager
Owners Group Program Management Office
Westinghouse Electric Company
P.O. Box 355
Pittsburgh, PA 15230-0355

SUBJECT: FINAL SAFETY EVALUATION FOR PRESSURIZED WATER REACTOR OWNERS GROUP (PWROG) TOPICAL REPORT (TR) WCAP-15831-P, REVISION 1, "WOG RISK-INFORMED ATWS ASSESSMENT AND LICENSING IMPLEMENTATION PROCESS" (TAC NO. MB5741)

Dear Mr. Bischoff:

By letter dated September 14, 2004, the PWROG (formerly known as the Westinghouse Owners Group) submitted TR WCAP-15831-P, Revision 1, “WOG Risk-Informed ATWS [Anticipated Transient Without Scram] Assessment and Licensing Implementation Process,” to the U.S. Nuclear Regulatory Commission (NRC) staff. By letter dated April 26, 2005, an NRC draft safety evaluation (SE) regarding our approval of TR WCAP-15831-P, Revision 1, was provided for your review and comments. By letter dated December 6, 2005, the PWROG commented on the draft SE. The NRC staff's disposition of PWROG’s comments on the draft SE are discussed in the attachment to the final SE enclosed with this letter.

The NRC staff has found that TR WCAP-15831-P, Revision 1, is acceptable for referencing in licensing applications for Westinghouse designed pressurized water reactors to the extent specified and under the limitations delineated in the TR and in the enclosed final SE. The final SE defines the basis for our acceptance of the TR.

Our acceptance applies only to material provided in the subject TR. We do not intend to repeat our review of the acceptable material described in the TR. When the TR appears as a reference in license applications, our review will ensure that the material presented applies to the specific plant involved. License amendment requests that deviate from this TR will be subject to a plant-specific review in accordance with applicable review standards.

In accordance with the guidance provided on the NRC website, we request that the PWROG publish accepted proprietary and non-proprietary versions of this TR within three months of receipt of this letter. The accepted versions shall incorporate this letter and the enclosed final SE after the title page. Also, they must contain historical review information, including NRC requests for additional information and your responses. The accepted versions shall include an "-A" (designating accepted) following the TR identification symbol.

If future changes to the NRC's regulatory requirements affect the acceptability of this TR, the PWROG and/or licensees referencing it will be expected to revise the TR appropriately, or justify its continued applicability for subsequent referencing.

Sincerely,

/RA/

Jennifer M. Golder, Acting Deputy Director
Division of Policy and Rulemaking
Office of Nuclear Reactor Regulation

Project No. 694

Enclosure: Final SE

cc w/encl:
Mr. James A. Gresham, Manager
Regulatory Compliance and Plant Licensing
Westinghouse Electric Company
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Pittsburgh, PA 15230-0355

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FINAL SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

PRESSURIZED WATER REACTORS OWNERS GROUP (PWROG)

TOPICAL REPORT (TR) WCAP-15831-P, REVISION 1,

"WOG RISK-INFORMED ATWS [ANTICIPATED TRANSIENT WITHOUT SCRAM]

ASSESSMENT AND LICENSING IMPLEMENTATION PROCESS"

1.0 INTRODUCTION

By letter dated September 14, 2004 (Reference 1), and supplemented by letter dated December 6, 2005 (Reference 2), the PWROG (formerly known as the Westinghouse Owners Group) submitted TR WCAP-15831-P, Revision 1, "WOG Risk-Informed ATWS Assessment and Licensing Implementation Process," to the U.S. Nuclear Regulatory Commission (NRC) for review and approval. This TR contains the PWROG's risk-informed methodology for reviewing plant- and cycle-specific core designs to ensure sufficient safety margins are maintained during an ATWS. The attachment provides the NRC staff's review and disposition of the comments made in the PWROG's December 6, 2005, letter.

For more than 30 years, the NRC and nuclear industry have placed considerable emphasis on ATWS events because they pose a unique challenge for ensuring the safety of nuclear power plants and the public. An ATWS is defined in Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.62 as "...an anticipated operational occurrence [(AOO)] as defined in appendix A of this part followed by the failure of the reactor trip portion of the protection system specified in General Design Criterion 20 of appendix A of this part." As stated, Appendix A of 10 CFR Part 50 defines AOOs as "...those conditions of normal operation which are expected to occur one or more times during the life of the nuclear power unit...." The two limiting ATWS AOOs are the loss of normal feedwater (LONF) event and the loss of load (LOL) event. ATWS events result from a precursor anticipated transient (e.g., LONF or LOL) which requires the automatic shutdown of the plant via a reactor trip and control rod insertion (CRI). However, during a postulated ATWS event, the reactor trip system is assumed to fail such that no CRI occurs. If there is insufficient reactivity feedback, the ATWS results in an unmitigated increase in reactor coolant pressure that leads to failure of the reactor coolant system (RCS) pressure boundary and subsequent core damage.

The TR contains three distinct aspects that required NRC staff review. First, the calculation of a plant- and cycle-specific unfavorable exposure time (UET) is essential in determining the duration during the operating cycle that a plant is susceptible to ATWS-induced RCS pressure boundary failure and subsequent core damage. The UET is typically defined as the duration of the fuel cycle, for a specific plant configuration, for which the core reactivity feedback is insufficient to preclude exceeding a RCS pressure of 3200 pounds per square inch gauge (psig) following an ATWS event. This is essentially equivalent to the term unfavorable moderator temperature coefficient (MTC) used in the bases documentation of 10 CFR 50.62.

Based on information presented in TR WCAP-15831-P, Revision 1, the Westinghouse Electric Company (Westinghouse) plants that follow the proposed methodology would be designed for zero UET every cycle for specified design conditions. Secondly, the NRC staff reviewed the probabilistic risk assessment (PRA) analysis performed by the PWROG. The PWROG stated that its PRA analysis followed previously issued NRC staff guidance from Regulatory Guide (RG) 1.174, Revision 1, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis" (Reference 3), and RG 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications" (Reference 4). The NRC staff reviewed the TR sections describing the PRA analysis to ensure that the analysis methodology and results complied with the previously-issued NRC staff guidance. Finally, the NRC staff reviewed the ATWS defense-in-depth mechanisms. The PWROG's TR requires that each licensee that implements the methodology provided in the TR develop a plant-specific ATWS Configuration Management Program (CMP). The ATWS CMP will be updated every fuel cycle to ensure that ATWS mitigative equipment inoperability is minimized during periods where its inoperability would cause the plant to enter a UET.

2.0 REGULATORY EVALUATION

The regulations at 10 CFR 50.62, “Requirements for reduction of risk from anticipated transients without scram (ATWS) events for light-water-cooled nuclear power plants” (Reference 5), lists the NRC regulatory requirements to minimize the risk of an ATWS event for pressurized and boiling water reactors. For the Westinghouse plant design, 10 CFR 50.62 requires that each reactor "...have equipment from sensor output to final actuation device, that is diverse from the reactor trip system, to automatically initiate the auxiliary (or emergency) feedwater system and initiate a turbine trip under conditions indicative of an ATWS.” All Westinghouse plants installed ATWS Mitigation System Actuation Circuitry (AMSAC) systems to accomplish the regulatory requirements of 10 CFR 50.62. These systems reduced the risk from an ATWS to levels assumed during the development of the rule and ensured that key safety systems would respond automatically during an ATWS event. TR WCAP-15831-P, Revision 1, does not propose to change any of the requirements listed in 10 CFR 50.62. Instead, it provides a standard risk-informed methodology that all Westinghouse plants can implement. This methodology can be used to ensure that future core and plant design changes, licensing issues, and plant operability concerns are properly evaluated to minimize risk and maintain defense-in-depth.

Since TR WCAP-15831-P, Revision 1, does not propose any changes to the AMSAC systems, licensees who implement the TR methodologies will continue to comply with 10 CFR 50.62. Therefore, the NRC staff did not review the TR against the requirements of the rule except to ensure that the methodology proposed would not alter the operation or availability of equipment that is part of the AMSAC systems.

RG 1.174 provides decisionmaking guidance for proposed risk-informed license changes and RG 1.177 provides more specific guidance related to risk-informed technical specification (TS) changes. Though specific licensees that implement the TR WCAP-15831-P, Revision 1, methodology may or may not need to request specific TS changes, depending on their plant-specific licensing basis and TSs, the three-tiered approach described in RG 1.177 is an acceptable approach for evaluating the implementation of the TR WCAP-15831-P, Revision 1, methodology.

RG 1.174 specifically states that a risk-informed license application should be evaluated to ensure that the proposed changes meet the following key principles:

- The proposed change(s) meets the current regulations, unless it explicitly relates to a requested exemption or rule change.
- The proposed change(s) is consistent with the defense-in-depth philosophy.
- The proposed change(s) maintains sufficient safety margins.
- When the proposed change(s) increases core damage frequency (CDF) or risk, the increase should be small and consistent with the Commission's Safety Goal Policy Statement.
- The impact of the proposed change(s) should be monitored using performance measurement strategies.

RGs 1.174 and 1.177 provide more specific guidance and acceptance guidelines for assessing the nature and impact of licensing basis changes by considering engineering issues and applying risk insights. Specifically, for this application, the three-tiered approach described in RG 1.177 includes:

- Tier 1 evaluates the plant-specific risk associated with the proposed TS change, as shown by the change in CDF (ΔCDF), change in large early release frequency (LERF) (ΔLERF), incremental conditional core damage probability (ICCDP), and incremental conditional large early release probability (ICLERP).
- Tier 2 identifies and evaluates, with respect to defense-in-depth, any potential risk-significant plant equipment outage configurations associated with the proposed change. The licensee should provide reasonable assurance that the risk-significant plant equipment outage configurations will not occur when equipment associated with this application is out of service.
- Tier 3 provides for the establishment of an overall ATWS CMP and confirmation that its insights are incorporated into the decisionmaking process before taking equipment out of service before or during an UET period. Compared with Tier 2, Tier 3 provides additional coverage based on any other risk-significant configurations that may be encountered during maintenance and equipment outage scheduling over extended periods of plant operation.

RG 1.177 also describes acceptable implementation strategies and performance monitoring plans to help ensure that the assumptions and analysis used to support the implementation of the TR WCAP-15831-P, Revision 1, methodology will remain valid.

3.0 TECHNICAL EVALUATION

In determining the acceptability of TR WCAP-15831-P, Revision 1, the NRC staff reviewed the following three aspects of the TR: 1) the calculation methodology used to determine cycle- and plant-specific UETs, 2) the PRA analysis employed to determine the overall change in risk of

the proposed methodology, and 3) the defense-in-depth characteristics contained in the proposed ATWS CMP. For each part of the review, the NRC staff evaluated whether the TR's analyses and methodologies provided reasonable assurance that adequate protection, including safety margins, in accordance with NRC regulations and guidance documents, could be maintained upon implementation of the proposed methodology at Westinghouse plants.

3.1 UET Calculational Methodology

As previously stated, the UET is defined as the duration of the fuel cycle, for a specific plant configuration, for which the core reactivity feedback is insufficient to preclude exceeding an RCS pressure of 3200 psig following an ATWS event. In 1983, the NRC staff prepared SECY-83-293, "Amendments to 10 CFR 50 Related to Anticipated Transients Without Scram (ATWS) Events" (Reference 6) and in SECY-83-293, the NRC staff used 3200 psig as an approximation of the acceptance limit. The actual acceptance limit is the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code (Code) Service Level C limit, above which RCS piping failure is anticipated to occur. Since the UET represents plant conditions which result in susceptibility to ATWS-induced core damage, minimizing the existing UET at a plant can reduce risk. In SECY-83-293, the NRC staff concluded that an unfavorable MTC could exist for 10 percent of every cycle for non-turbine trip events and 1 percent of the cycle for turbine trip events. An unfavorable MTC is essentially identical to an UET in that it reflects portions of the operating cycle where the MTC is insufficiently negative to preclude the RCS from exceeding the acceptance limit during an ATWS event. Westinghouse quantified the unfavorable MTC in its generic analysis documented in letter NS-TMA-2182, "ATWS Submittal" (Reference 7). In its analysis, that was based on 1979 plant operating and design data, Westinghouse determined that its plants would be more negative than the unfavorable MTCs of -8 percent mill (pcm)/°F and -7 pcm/°F for 95 and 99 percent of the operating cycle, respectively.

In order to minimize the UET at operating nuclear facilities, it is imperative to have an approved methodology capable of evaluating core, operational, and design changes and their affects on the plant's UET. In TR WCAP-15831-P, Revision 1, the PWROG presented a detailed methodology to perform deterministic analyses of plant UETs. The PWROG's methodology focuses on the determination of the Critical Power Trajectories (CPTs) for specific plant configurations. The PWROG used the LOFTRAN (Reference 8) computer code to determine the ATWS plant conditions that would result in a peak RCS pressure of 3200 psig. The variable conditions of significance to the resulting peak RCS pressure following the LONF and LOL ATWS events are total reactivity feedback (primarily MTC), primary-side pressure relief capacity, and auxiliary feedwater (AFW) capacity. For a given primary-side pressure relief configuration and AFW capacity, the reactivity feedback can be adjusted in the ATWS analysis until the peak RCS pressure during the specific ATWS event equals the plant specific RCS pressure limit . At these specific reactivity feedback conditions, the change in power with increasing temperature represents the CPT. The heatup/shutdown characteristics of a given core at various times in the cycle can then be compared to the CPT to establish the UET for the given core at the specific plant configuration conditions.

The PWROG's determination of the ATWS CPTs and resulting UETs was based primarily on plant design and operating conditions used in the 1979 generic ATWS analysis. For example, the ATWS CPTs presented in TR WCAP-15831-P, Revision 1, were generated based on the generic 4-Loop Westinghouse plant configuration with Model 51 steam generators (SGs). This

is consistent with the generic case presented in NS-TMA-2182. However, the PWROG did update some of the initial conditions and assumptions it used in TR WCAP-15831-P, Revision 1, to reflect current plant operating and design conditions. For example, to reflect uprated power conditions, the PWROG used a Nuclear Steam Supply System (NSSS) power level of 3579 megawatts-thermal (MWt). Additionally, the PWROG considered plant conditions such as three primary-side relief configurations (0 power-operated relief valves (PORVs), 1 PORV, 2 PORVs), two AFW capacities (full AFW, half AFW), and elevated transient inlet temperatures (i.e., > 600 °F). Tables 4-1 and 4-2 of the TR present the results of the PWROG's generic analysis and determination of ATWS CPTs for the LONF and LOL events, respectively. Additionally, Tables 4-1 and 4-2 show the expected decreasing trend in ATWS CPTs as ATWS mitigation equipment is made unavailable (i.e., fewer PORVs, less AFW) or inlet temperature increases.

Once the CPTs are calculated for all the plant conditions previously described, the PWROG's methodology employs the advanced nodal [computer] code (ANC) (Reference 9) to determine the critical power as a function of inlet temperature at various cycle burnups. The PWROG defines the "critical power" as the power that results in reactor criticality for a given set of conditions (inlet temperature, pressure, etc.). The methodology then compares these ANC critical power results to the ATWS CPTs. The time that the ANC calculated critical power is greater than the ATWS CPT represents the UET. Therefore, the PWROG's methodology determines the times where specific plant conditions, such as operating with 1 PORV available and half AFW, would result in UET conditions. Tables 4-3 through 4-14 of the TR presented the PWROG's calculated UETs for a myriad of plant operating and design conditions such as low, high, and bounding reactivity cores (i.e., increasing hot zero power (HZP) MTCs), xenon concentration, and CRI credit. Specifically, Table 4-8 presents the UET results of a high reactivity core model (most positive HZP MTC = +5 pcm/°F) with equilibrium xenon and 1 minute of CRI credit (72 steps). The PWROG considers these realistic design and operating conditions. Table 4-8 shows that for these initial conditions a Westinghouse plant can be designed to maintain zero UET. Table 4-8 also shows that the unavailability of PORVs or less than full AFW capacity can result in considerable UETs. This demonstrates that UET conditions are highly sensitive to the initial conditions assumed in the analysis as well as the availability of ATWS mitigation equipment.

As previously stated, the PWROG's methodology for determining the ATWS CPTs is based on plant design and operating data from its 1979 generic analyses, with limited updates to reflect current operating conditions and practices as well as plant design changes. Additionally, the methodology presented in TR WCAP-15831-P, Revision 1, neither provides the specific details for some of the assumptions and initial conditions used in the determination of the ATWS CPTs nor does it provide sufficient detail to determine that these assumptions and conditions represent bounding conditions for Westinghouse plants that might adopt this methodology. As such, each licensee that adopts the methodology and begins using it for the determination of ATWS CPTs and plant UETs must input its own plant operating and design conditions. Since numerous advancements have occurred over the past 28 years (since the 1979 publication of NS-TMA-2182), it is possible that many of the assumptions used in TR WCAP-15831-P, Revision 1, may no longer represent bounding or limiting plant conditions for many licensees. Therefore, each licensee that adopts the methodology presented in TR WCAP-15831-P, Revision 1, must perform plant- and cycle-specific analyses (similar to plant reload analyses) based on current design and operating conditions. The NRC staff expects that any licensee that adopts the TR WCAP-15831-P, Revision 1, methodology will submit, on a first-time-only

basis, a plant-specific license application requesting to implement the methodology, including discussions of plant-specific procedures, compensatory measures, performance monitoring activities, and presenting the results of its analyses. This limitation is further explained in Section 4.0 of this SE.

3.2 PRA Analysis

While Section 3.1 addresses the deterministic calculational aspects of the methodology presented in TR WCAP-15831-P, Revision 1, this section addresses the probabilistic risk calculation aspects of the methodology. Chapters 5 and 8 of TR WCAP-15831-P, Revision 1, provide the general approach to the probabilistic risk analysis of the ATWS assessment and demonstrates the methodology for three types of core design:

- The Westinghouse low reactivity core has a 5 percent UET for the ATWS Rule reference configuration of no CRI, 100 percent AFW, and all PORVs available. This core has the largest burnable absorber inventory and a maximum HZP MTC of +3.5 pcm/°F.

- The Westinghouse high reactivity core has excess reactivity between the low and bounding core designs. This core represents an aggressive, but realistic use of positive MTC TS with a most positive HZP MTC of +5 pcm/°F.

- The Westinghouse bounding reactivity core was developed such that its most positive HZP MTC is +7 pcm/°F, which is consistent with the MTC TS for some plants. This core model was specifically developed to address ATWS performance of cores with minimum moderator temperature feedback.

The NRC staff recognizes that the risk associated with ATWS events is driven by the probability that insufficient CRI will occur. Given the multiple means of causing rod insertion, the failure probability is very low. However, if an ATWS event does occur and it occurs when the plant is operating in a UET condition, core damage is likely and there is also the potential for the event to directly result in a large release by failing SG tubes. This potential for an ATWS event to cause core damage and a large release is a major factor in the NRC staff's concern with defense-in-depth and safety margins, which are addressed in Section 3.3 of this SE.

The NRC staff review of the probabilistic risk aspects of the TR WCAP-15831-P, Revision 1, methodology, determined that the methodology is appropriate for this application when taken with the conditions and limitations identified in Section 4.0 of this SE. The probabilistic considerations are described further below.

To implement the TR WCAP-15831-P, Revision 1, methodology, a licensee will need to submit a plant-specific license application to the NRC for its review and approval. In addition, as part of its implementation, licensees will need to re-perform these analyses during subsequent reload analyses, or document justifications for why some of these analyses are not required for the specific core design, to ensure that the results are maintained acceptable (i.e., shown to meet the RG 1.174 acceptance guidelines for no more than a small ΔCDF and ΔLERF). The probabilistic risk analyses will need to address all five operating states identified in the TR for both the ΔCDF and the ΔLERF and will need to reflect the latest operational information, as reflected in the current plant-specific PRA (i.e., updated failure rates and operating conditions of

ATWS mitigating equipment), or document justifications for why some of these analyses are not required for the specific core design. In performing the change in risk calculations, the baseline CDF and baseline LERF values should be derived from the plant-specific PRA using the low reactivity core design conditions, which has a 5 percent UET for the ATWS Rule reference configuration, as identified in the TR.

The event tree logic and end states presented in the TR are appropriate for typical core design conditions, but may not accurately reflect all plant and core design conditions. For specific core designs, such as the bounding reactivity core condition, sequences assumed to be successful mitigation may not actually avoid core damage, if the sequence of events still creates a UET condition. Thus, each licensee will need to ensure the validity of the event tree logic and end state conditions for the plant-specific operations and core design utilized, including revising the event tree logic, end states, and results, as appropriate.

In calculating the impact on LERF, the TR uses a pressure of 3584 pounds per square inch (psi), which is stated in the TR as the pressure at which SG tubes will fail. This pressure is greater than the ASME Code Service Level C stress limit of 3200 psig that was used in the ATWS Rule and that is used in the TR in assessing the impact on CDF. Since SG tube failure is one of the dominant contributors to LERF for pressurized water reactors, the NRC staff accepts the use of the cited SG tube failure pressure in determining the impact on LERF. However, if there are indications that the SG tubes are susceptible to failure at a lower pressure, the licensee must use the lower pressure in determining these impacts and their acceptability. Further, when a licensee implements the TR WCAP-15831-P, Revision 1, methodology, the core design evaluation during the reload analyses must include the evaluation of the impacts on CDF and LERF and shown to meet the RG 1.174 acceptance guidelines, as no more than a small ΔCDF and ΔLERF. As stated previously, in performing these change in risk calculations, the low reactivity core design conditions should be used in developing the baseline CDF and baseline LERF values.

The NRC staff agrees with the conclusion that though PORV availability may not be important for total CDF, as shown in the TR, PORV availability can have a significant impact on ATWS CDF, especially during the worst time in the cycle. Since ICCDP and ICLERP are not expected to impact plant-specific decisionmaking (i.e., are expected to always meet the RG 1.177 acceptance guidelines due to the small contribution of ATWS to overall CDF and LERF, respectively), the calculations of ICCDP and ICLERP could be further simplified by setting the baseline CDF and baseline LERF, respectively, to zero. However, since these metrics will not impact plant-specific decisionmaking regarding core design and plant operations for this application, the NRC staff agrees that these calculations do not need to be performed on a plant-specific basis.

The methodology is further demonstrated in Chapter 9 of TR WCAP-15831-P, Revision 1, using Braidwood Nuclear Power Station (Braidwood) as the demonstration plant. Though the information provided in Chapter 9 for Braidwood demonstrates the use of the methodology, the information is not sufficient to allow approval in this SE, especially given the conditions identified in Section 4.0 of this SE. As such, as stated previously, the Braidwood licensee will need to submit a plant-specific license amendment, consistent with this SE, to request to implement this methodology and remove the current restriction in its TS.

Upon review of the probabilistic risk aspects of the TR WCAP-15831-P, Revision 1, methodology, the NRC staff finds the methodology appropriate for this application when taken with the conditions and limitations identified in Section 4.0 of this SE.

3.3 ATWS CMP

RG 1.174 lists five principles of risk-informed decisionmaking for the review of licensing basis changes. Two of those principles are that licensing basis changes must be consistent with the defense-in-depth philosophy and must maintain sufficient safety margins. In Section 7.0, "Configuration Management Program," of TR WCAP-15831-P, Revision 1, the PWROG presented its methodology for ensuring adequate safety margins and defense-in-depth are maintained at Westinghouse plants for ATWS events.

The PWROG stated in TR WCAP-15831-P, Revision 1, that the ATWS CMP will have the following five capabilities:

- Identify plant configurations (i.e., unfavorable configurations) that do not maintain defense-in-depth to an ATWS event.
- Track the time for individual occurrences when the plant is in an unfavorable plant configuration.
- Track the cumulative time per cycle when the plant is in an unfavorable plant configuration.
- Provide information on the length of time remaining in the UET for plant configurations.
- Provide compensatory actions to take if the unfavorable condition cannot be exited prior to expiration of the time allowed in the unfavorable configuration.

The NRC staff reviewed the TR WCAP-15831-P, Revision 1, methodology for the development and implementation of an ATWS CMP to determine if it could maintain adequate safety margins, maintain defense-in-depth, and accomplish the five capabilities described.

3.3.1 Applicability of the ATWS Configuration Management Program

In determining which plants would be required to implement the ATWS CMP, the PWROG sorted the existing Westinghouse plants into the following three groups:

- Group 1: Plants with a Diverse Scram System (DSS)
- Group 2: Plants without a DSS, but are consistent with the ATWS Rule (installed AMSAC) and the basis for the ATWS Rule
- Group 3: Plants without a DSS, but are consistent with the ATWS Rule (installed AMSAC), but not the basis for the ATWS Rule

The PWROG defined a plant as being consistent with the basis for the ATWS Rule (Group 2) if it has either of the following:

- A core design limit on UET of less than 5 percent of the cycle for the ATWS Rule reference configuration of no CRI, all AFW available, and no PORVs blocked, or

- A hot full power (HFP), equilibrium xenon MTC equal to or more negative than -8 pcm/°F for 95 percent of the cycle, provided that the validity of the MTC requirement is demonstrated via analysis (i.e., peak RCS pressures <3200 psia using an applicable model and the 95 percent MTC value) or evaluation (by comparing the current plant conditions to the key input parameters, including the MTC, used in the reference analysis that yielded peak RCS pressures <3200 psia.). (Note: The 95 percent MTC for a core design will be determined by calculating the best-estimate HFP MTC value as a function of cycle burnup. The best-estimate MTC values for the core will be less than or equal to the 95 percent MTC value over 95 percent of the cycle burnup range.)

The PWROG stated that plants in Groups 1 or 2 will not be required to implement the ATWS CMP. Plants in Group 3 would be required to implement the ATWS CMP. The NRC staff agrees with the PWROG's classification of the three groups; however, the NRC staff does not agree with the designation of which plants are consistent with the basis of the ATWS Rule (i.e., Group 2), nor does the NRC staff agree that only Group 3 plants must implement the ATWS CMP. The NRC staff accepts that plants which meet a UET core design limit of equal to or less than 5 percent of the cycle for the ATWS Rule reference configuration of no CRI, all AFW available, and no PORVs blocked should be considered consistent with the basis for the ATWS Rule. As previously stated an unfavorable MTC is essentially identical to an UET in that it reflects portions of the operating cycle where the MTC is insufficiently negative to preclude the RCS from exceeding the ASME Code Service Level C acceptance criteria during an ATWS event. Therefore, the NRC staff agrees that it is possible to identify a threshold '95 percent MTC' at which the plant would operate at or below for 95 percent of the cycle and would meet the ATWS basis acceptance criterion. However, the '95 percent MTC' must be based on a plant specific analysis to the ATWS basis acceptance criterion. Subsequent reload cores may be evaluated against the analysis until those evaluations indicate a reanalysis is required.

First, in SECY-83-293, the NRC staff presented the NRC Commission with its analysis of the susceptibility of Westinghouse plants to an ATWS event. For non-turbine trip events, the NRC staff assumed that the MTC was at an unfavorable value 10 percent of the time. For turbine trip events, the NRC staff assumed that the MTC value was at an unfavorable value only 1 percent of the time. The PWROG's value of -8 pcm/°F for 95 percent of the cycle resulted from its 1979 generic analyses presented in NS-TMA-2182. The NRC staff, in its presentation of ATWS Rule alternatives, SECY-83-293, did not provide this value to the NRC Commission as part of the basis for the development and issuance of the ATWS Rule. Secondly, the PWROG's determination of the -8 pcm/°F MTC value is based on generic 1979 plant operating and design data. Changes in the design and operation of nuclear power plants over the last 35 years may result in this value being non-conservative when applied to currently operating plants. Additionally, future core design and operating conditions may make this rigid value incapable of ensuring acceptable UET limits are met. Since the PWROG did not provide any supporting information in its TR to demonstrate that this value remains bounding and conservative, the NRC staff cannot generically accept that a plant which currently meets an MTC value of -8 pcm/°F for 95 percent of the cycle is consistent with the basis for the ATWS Rule. While, the NRC staff has determined that UET limits are more appropriate than MTC limits for ensuring adequate safety margin and sufficient defense in depth, a plant may use the MTC

method provided it is based on a plant specific analysis to the ATWS basis acceptance criterion. This limitation is listed in Section 4.0 of this SE.

3.3.2 Development of the ATWS CMP

In Section 7.2.3, "Core Design Considerations," of TR WCAP-15831-P, Revision 1, the PWROG states that the primary approach to maintain defense-in-depth, or ATWS pressure transient mitigation capability, is to operate each plant in a configuration with zero UET. A plant designed and operated with zero UET will maintain sufficient defense-in-depth during an ATWS event to prevent the peak RCS pressure from reaching the ASME Code Service Level C limit. The determination of a plant configuration that has a zero UET condition is highly dependent on the initial core design conditions and assumptions. A licensee that adopts this ATWS risk-informed methodology must demonstrate in its reload analysis that it will have zero UET at the most limiting point in the cycle based on the following zero UET design conditions:

1) hot full power MTC,
2) equilibrium xenon,
3) nominal hot full power inlet temperature,
4) 72 steps of CRI of the lead bank,
5) all PORVs operable, and
6) 100 percent (all) AFW flow available.

Since the determination of zero UET for each cycle is a crucial aspect of the TR's defense-in-depth methodology, the NRC staff considers this an important limitation and condition of its approval of TR WCAP-15831-P, Revision 1. Therefore, the determination of a plant- and cycle-specific zero UET based on the zero UET design conditions listed above is included as a limitation in Section 4.0 of this SE.

The 72 steps of CRI credit is a pivotal assumption in the design and operation of every cycle with zero UET. The 72 steps of CRI credit provides considerable negative reactivity feedback during the initial minute of an ATWS event. This negative reactivity feedback limits the peak RCS pressure attained during the event. Typically, the NRC staff does not credit the operation of the rod control system during accident conditions because it is a "control" system. However, since ATWS is a beyond design-basis accident (DBA), which has an extremely low probability of occurrence, credit for CRI is potentially acceptable for mitigation and defense-in-depth purposes. In order for CRI credit to be acceptable, the system reliability must be demonstrated to be sufficiently high such that it can be reasonably expected to operate as credited under conditions indicative of an ATWS. The PWROG presented information to support the conclusion that the rod control system is highly reliable. The PWROG's information represented a general data collection spanning all Westinghouse plants. However, the NRC staff expects that the reliability of the rod control system can vary from one plant to another. Therefore, the NRC staff requires that a licensee that adopts the methodology provided in TR WCAP-15831-P, Revision 1, must provide sufficient plant-specific data to demonstrate that the rod control system at its facility is highly reliable and should be expected to operate as required under conditions indicative of an ATWS. This limitation is listed in Section 4.0 of this SE.

The remaining conditions defined in the zero UET design conditions reflect optimal plant conditions for ATWS transient mitigation. However, numerous operating conditions such as

required preventive maintenance and surveillance testing can result in the necessary removal of vital ATWS transient mitigation equipment from service to ensure continued reliability. The removal of this equipment from service can adversely affect the UET of the plant. Since ATWS is a low risk event and much of this mitigative equipment is credited for the defense-in-depth of DBAs that have a higher risk, it is appropriate to perform all essential maintenance and surveillance requirements (SRs) on ATWS mitigation equipment to ensure it remains operable and capable of performing its safety function.

Controlling when the preventive maintenance and surveillance testing is performed can limit the effects on the UET and reduce the overall risk to the plant while maintaining adequate defense-in-depth capabilities. To accomplish this, TR WCAP-15831-P, Revision 1, provides a methodology for the development and implementation of a plant- and cycle-specific ATWS CMP. Based on the methodology described in TR WCAP-15831-P, Revision 1, for calculating CPTs and UETs, a licensee can determine specific time intervals, based on effective full power days of operation, during each cycle where the removal of ATWS mitigation equipment from service would cause the plant to enter a UET period. Following the methodology outlined in the TR, licensees can chart these specific time periods and ensure that during these periods they limit the unavailability of the systems important to ATWS event mitigation. Specific precautionary actions during such times may include the following: 1) operate with the rod control system in the automatic mode; 2) limit blocking pressurizer PORVs; and 3) limit activities on the AFW system, AMSAC, and reactor protection system that result in the unavailability of components within these systems. Since the CPT and UET determinations presented in TR WCAP-15831-P, Revision 1, reflect moderately updated 1979 generic analyses and therefore are not necessarily bounding, each licensee will be required to develop its own plant- and cycle-specific ATWS CMP.

The NRC staff agrees that the completion of SRs is essential for ensuring the reliability of mitigative equipment for DBAs. However, surveillance completion that results in entry into a UET cannot be ignored because of its adverse effects on defense-in-depth. The PWROG proposed that time intervals for completing SRs, irrespective of the length, should not count against the allowed cumulative UET permitted for each cycle. The NRC staff instead believes that a cap on the amount of time permitted, for tracking and monitoring purposes only, for individual surveillances is necessary and appropriate to maintain adequate defense-in-depth. A cap limits the potential that licensees will spend excessive periods of time in a UET completing an individual SR and places emphasis on proper planning and timely completion for surveillance activities. Based on information presented by the PWROG, the majority of SRs that could result in a plant entering a UET condition can be completed in significantly less than 24 hours. Therefore, the NRC staff has determined that a 24-hour limit on the completion of SRs that result in UET conditions is reasonable. This provides licensees adequate time to complete required surveillance activities, yet provides reasonable controls and limits on remaining in a UET due to a SR. Therefore, any entry into a SR that requires greater than 24 hours to complete must be tracked and counted, in its entirety, against the licensee's allowed 30-day cumulative UET. This limitation does not authorize a licensee to forego a SR because its performance would count against the allowed 30-day cumulative UET. Instead, this limitation places appropriate emphasis on proper planning and timely completion of SRs that result in entries into a UET condition. This limitation is listed in Section 4.0 of this SE.

In its PRA presented in TR WCAP-15831-P, Revision 1, the PWROG states that part-power conditions (i.e., < 100 percent rated thermal power) have a low contribution to the overall risk

for ATWS events. Because of the low calculated risk from part-power conditions, the PWROG's ATWS CMP focuses solely on ATWS events initiated from HFP conditions when all of the zero UET design conditions mitigative equipment is available. Tables 4-24 through 4-28 of the TR present the results of limited UET analyses performed at part-power conditions. The results demonstrate that the UET at part-power conditions is highly dependent on the xenon concentration in the core. Additionally, at lower power levels, the MTC will be more positive, resulting in less inherent reactivity feedback and potentially higher peak RCS pressures during an ATWS event. Because of the calculated low risk from part-power conditions, the PWROG did not address the need for mitigative capabilities at part-power conditions in its TR. Therefore, since TR WCAP-15831-P, Revision 1, does not present sufficient information to demonstrate that defense-in-depth will be maintained at part-power conditions, the NRC staff has determined that a licensee that adopts the TR WCAP-15831-P, Revision 1, methodology must treat all part-power operating conditions that create a UET as fully counting against the allowed cumulative UET for that cycle, and not prorated based on operation below rated thermal power. Additionally, since the risk associated with operating in a part-power UET condition is independent of the plant-power level (i.e., a 50 percent power UET condition poses the same risk as a 75 percent power UET condition), the licensee must track time spent in a part-power UET condition based on the actual time and not the effective full power days of operation. Finally, the licensee must cumulatively count this actual UET spent operating at part-power conditions against its allowed 30-day cumulative UET. This limitation is listed in Section 4.0 of this SE.

3.3.3 Compensatory Actions for the ATWS CMP

As part of its CMP, the PWROG recognized and the NRC staff concurs that, despite designing each cycle to zero UET design conditions, the potential exists for a plant to enter a UET due to unforeseen operating conditions or maintenance activities. A licensee is able to identify whether it will enter a UET by comparing its current plant operating conditions and equipment availability to its CMP. The PWROG proposed multiple compensatory actions that licensees can implement to restore defense-in-depth capabilities during the UET period. The three actions include the following: 1) implementing a back-up reactor trip capability; 2) performing a UET re-calculation; and 3) initiating a power reduction. Implementing any one or more of these actions may further reduce the potential for an ATWS event and could potentially extricate the plant from the UET condition and restore adequate ATWS mitigative capability and defense-in-depth. Additionally, since ATWS is a low-probability event, the PWROG proposed a cumulative time allowed in an unfavorable configuration prior to implementing the aforementioned compensatory actions.

The first compensatory action involves an alternate reactor trip method based on removing power to the control rod drive mechanisms (CRDMs). Two potential methods exist for an operator to initiate a backup reactor trip. These are for the operator to interrupt power to the motor generator (MG) sets of the CRDMs or to interrupt power from the MG sets to the CRDMs.

When power is interrupted to the MG sets a long coastdown may occur. This coastdown occurs as the MG slows to a speed at which the voltage degrades to a level that the CRDMs release the control rods. According to the PWROG's initial analysis, a coastdown to the required "reactor trip speed" could exceed 30 seconds. The PWROG's analyses showed that it would take the limiting ATWS event only approximately 90 seconds to reach 3200 psig.

Therefore, a licensee that intends to implement a backup reactor trip that relies on de-energizing power to the MG sets must demonstrate that sufficient time exists for the operators to diagnose the event, interrupt power to the MG sets, and allow the MG sets to coastdown such that the acceptance criterion is not reached.

Another alternate reactor trip method is to remove power from the MG sets to the CRDMs. Removing power directly from the MG sets to the CRDMs would provide a nearly instantaneous de-energization of the CRDMs and, therefore, preclude the coastdown concerns described for the previous method. This method would involve installing equipment that would provide an undervoltage trip of the MG set breakers, located on the output of the MG sets, based on an undervoltage signal from the buses that power the MG sets. This setup is similar, but not identical, to the DSS installed at some Westinghouse plants and all other pressurized water reactors as required by 10 CFR 50.62. The major difference between this approach and an installed DSS is the dependence on operator action to initiate the backup trip. As proposed by the PWROG in TR WCAP-15831-P, Revision 1, this action could be taken by operators located either in the control room, with the appropriate equipment installed, or by a dedicated operator at the MG sets if an unfavorable configuration exists. The reliance on operator action to initiate a backup trip raises human factor concerns, not addressed in TR WCAP-15831-P, Revision 1, due to the short duration available to operators to diagnose the event and initiate the action. In particular, the NRC staff is concerned with relying on operator actions outside the control room and believes such reliance is not consistent with the defense-in-depth philosophy presented in RG 1.174, one element which states, “Over-reliance on programmatic activities to compensate for weaknesses in plant design is avoided.” A licensee that implements the TR WCAP-15831-P, Revision 1, methodology must address the human factor and defense-in-depth concerns related to reliance on operator actions to implement either of the proposed backup reactor trip compensatory actions. The licensee must demonstrate that operators will have sufficient time and training to diagnose an ATWS event and take appropriate actions to implement the backup reactor trip such that the acceptance criterion is not reached. This limitation is listed in Section 4.0 of this SE.

Additional compensatory actions include UET re-calculation and power reduction. As stated by the PWROG, a re-calculation of UETs can be done based on plant-specific information using analysis enhancements that may provide a shorter estimate of UETs. For example, a licensee may have conservatively used in its original analysis the generic rated thermal power from TR WCAP-15831-P, Revision 1, which is greater than its current operating conditions. That licensee could perform new UET analyses at its licensed rated thermal power level and likely identify shorter UET intervals. Likewise, a licensee may take compensatory actions to reduce power to levels where the RCS pressures following an ATWS event can be mitigated with reduced pressure relief capacity. However, detailed CPT and UET analyses, performed in accordance with the TR WCAP-15831-P, Revision 1, methodology, would be required for lower power levels to determine the power reduction necessary to eliminate the UET under all potential operating configurations at the reduced power level. Assuming an acceptable power level could be determined, the licensee could then operate at the reduced power level until the configuration becomes favorable as the time into the cycle increases.

As part of the development and implementation of the ATWS CMP, the PWROG proposed a 30-day cumulative time limit in an unfavorable condition. The PWROG stated that this 30-day limit would provide sufficient time for the licensee to exit the unfavorable configuration or implement the appropriate compensatory actions. The NRC staff considers a 30-day

cumulative limit acceptable because it correlates well to a UET of less than 5 percent of the cycle for a plant operating on a two-year cycle, which was reviewed and approved for the Byron and Braidwood Nuclear Power Stations. Additionally, in the development of the ATWS Rule (10 CFR 50.62), the NRC staff accepted that there would be limited periods of time where unfavorable plant conditions existed and that this was acceptable due to the low probability of an ATWS event. This acceptance was accounted for in the development of the ATWS Rule as well as the classification of an ATWS as a beyond DBA.

As described above, the TR identifies three types of compensatory actions that licensees may implement if the 30-day cumulative limit on UET is reached. These actions range from analytical approaches (i.e, re-analysis of UET conditions for the specific cycle to show that the 30-day cumulative limit is not reached), to reliance on operator actions (i.e., interrupt power to the MG sets or interrupt power directly to the CRDMs), to power level reductions (i.e., interrupt power to a level such that a UET is reduced or eliminated). The NRC staff recognizes that these actions are not equally effective in mitigating an ATWS. Therefore, licensees must describe the compensatory actions that they will implement through plant-specific procedures and under what plant conditions these compensatory actions will be implemented.

4.0 LIMITATIONS AND CONDITIONS

TR WCAP-15831-P, Revision 1, is based on generic analyses. In many cases, the TR identifies the need for conditions to be addressed on a plant-specific basis. In addition to these recognized conditions in TR WCAP-15831-P, Revision 1, the NRC staff's approval is subject to the following limitations and conditions:

1. A licensee that implements TR WCAP-15831-P, Revision 1, is required as part of each cycle's reload analysis to verify that its core is designed for zero UET at the most limiting point in the cycle based on the following zero UET design conditions:

    a. hot full power MTC,
    b. equilibrium xenon,
    c. nominal hot full power inlet temperature,
    d. 72 steps of CRI of the lead bank,
    e. all PORVs operable, and
    f. 100 percent (all) AFW flow available.

2. A plant may be considered consistent with the basis for the ATWS Rule (i.e., Group 2) if its cycle-specific reload analysis demonstrates that its UET is less than 5 percent of the cycle length for the ATWS Rule reference configuration of no CRI, no PORVs blocked, and all AFW available, or analysis has demonstrated that for the ATWS Rule reference configuration it operates at an unfavorable MTC for less than 5 percent of the cycle length for which the ASME Code Service Level C is exceeded in the event of an ATWS.

3. A plant that implements the TR WCAP-15831-P, Revision 1, methodology must submit a plant-specific implementation license application to the NRC for its review and approval prior to first implementing this approach. The license application must include discussions of plant-specific procedures, compensatory measures, plant- and cycle-specific calculations, and performance monitoring activities that will be utilized in implementing the TR WCAP-15831-P, Revision 1, methodology. The application must

also contain the following plant- and cycle-specific information for the current plant design and operating conditions:

a. The results of its CPT and UET calculations for the zero UET design conditions showing that the plant is designed and can be operated with zero UET for the upcoming cycle.

b. The plant- and cycle-specific ATWS CMP demonstrating that ATWS mitigation equipment will be available and capable of performing its defense-in-depth function during intervals when its unavailability would result in an UET.

c. An analysis of the minimum time to the ASME Code Service Level C limit under the most limiting operating conditions. The licensee must define its most limiting ATWS mitigation conditions (i.e., manual rod control, no PORVs, half AFW, etc.) and provide a basis for why these represent the most limiting conditions for its plant.

d. A plant-specific list of proceduralized compensatory actions the licensee will take to further reduce the risk associated with a UET condition should it reach the 30-day cumulative limit on UET including a description of the specific conditions under which each of the various compensatory actions will be implemented.

e. If the compensatory actions proposed include installation of a backup reactor trip, or any other action that requires a rapid response by operations personnel, the licensee must sufficiently address human factor concerns regarding the ability of the operators to diagnose the event and take appropriate actions such that the ASME Code Service Level C limit is not reached. This evaluation must include a determination that any credited operator action is highly reliable considering operational/environmental factors and is consistent with the defense-in-depth philosophy presented in RG 1.174, especially when crediting local (non-control room) operator actions and the extremely limited time available to perform these actions.

f. A plant-specific analysis of the rod control system that demonstrates that it has a high degree of reliability and would be expected to operate as required under conditions indicative of an ATWS.

g. A plant-specific risk analysis, similar to the generic analyses presented in TR WCAP-15831-P, Revision 1, that will address all five operating states identified in the TR for both the ΔCDF and the ΔLERF and will reflect the latest operational information, as reflected in the current plant-specific PRA. In performing the change in risk calculations, the baseline CDF and baseline LERF values should be derived from the plant-specific PRA using the low reactivity core design conditions, as identified in the TR.

h. A description of the analyses and controls (procedures) that will be implemented during each cycle's reload analysis to ensure the licensee's results are consistent with the methodology approved by the NRC staff.

4. The time a plant spends in an unfavorable configuration due to the completion of a SR does not need to be tracked as part of the plant's 30-day cumulative UET unless the time required to complete any individual surveillance exceeds 24 hours. Should the time necessary to complete any individual surveillance, which results in a UET condition, exceed 24 hours, the licensee must count that time, in its entirety, against its allowed 30-day cumulative UET limit.

5. The UET at part-power conditions is highly dependent on the xenon concentration in the core. Additionally, at lower power levels, the MTC can be more positive, resulting in less inherent reactivity feedback and potentially higher peak RCS pressures during an ATWS event. Therefore, licensees must track and count all part-power operating conditions that create a UET against the allowed 30-day cumulative UET for that cycle. Additionally, since the risk associated with operating in a part-power UET condition is independent of the plant-power level (i.e., a 50 percent power UET condition poses the same risk as a 75 percent power UET condition), the licensee must track time spent in a part-power UET condition based on the actual time and not the effective full power days of operation.

6. The event tree logic and end states presented in the TR are appropriate for typical core design conditions, but may not accurately reflect all plant and core design conditions. Thus, each licensee will need to ensure the validity of the event tree logic and end state conditions for the plant-specific operations and core design utilized, including revising the event tree logic, end states, and results, as appropriate.

7. In calculating the impact on LERF, the TR uses a pressure of 3584 psi, which is stated as the pressure at which SG tubes will fail. This pressure is greater than the ASME Code Service Level C stress limit of 3200 psig that was used in the ATWS Rule and that is used in the TR in assessing the impact on CDF. Since SG tube failure is one of the dominant contributors to LERF for pressurized water reactors, the NRC staff accepts the use of the cited SG tube failure pressure in determining the impact on LERF. However, if there are indications that the SG tubes are susceptible to failure at a lower pressure, the licensee must use the lower pressure in determining these impacts and their acceptability.

8. When a licensee implements the TR WCAP-15831-P, Revision 1, methodology, the core design evaluation during the reload analyses must include the evaluation of the impacts on CDF and LERF and be shown to meet the RG 1.174 acceptance guidelines as no more than a small ΔCDF and ΔLERF or provide justifications for why some of these analyses are not required for the specific core design. The plant-specific, core design-specific risk analyses will need to address all five operating states identified in the TR for both the ΔCDF and the ΔLERF and will need to reflect the latest operational information, as reflected in the current plant-specific PRA. In performing the change in risk calculations, the baseline CDF and baseline LERF values should be derived from the plant-specific PRA using the low reactivity core design conditions as identified in the TR.

9. The PWROG's analyses showed that it would take the limiting ATWS event only approximately 90 seconds to reach 3200 psig. Therefore, a licensee that intends to implement a backup reactor trip that relies on de-energizing power to the MG sets must

demonstrate that sufficient time exists for the operators to diagnose the event, interrupt power to the MG sets, and allow the MG sets to coastdown such that the ASME Code Service Level C limit is not reached.

5.0 CONCLUSIONS

The NRC staff reviewed the analyses and methodologies presented in TR WCAP-15831-P, Revision 1, and determined that they were developed in accordance with published NRC guidance documents. The NRC staff found that the ATWS risk-informed methodology would minimize the risk from an ATWS event while maintaining adequate safety margins and ensuring defense-in-depth is maintained. Therefore, the NRC staff finds the TR WCAP-15831-P, Revision 1, methodology acceptable for use in license applications requesting to implement the methodology for performing a risk-informed analysis of ATWS events and developing an effective ATWS CMP at Westinghouse plants. The NRC staff's approval is subject to the limitations and conditions set forth in Section 4.0 of this SE.

The NRC staff has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the commission's regulations, and (3) issuance of license applications and amendments utilizing the approved methodology will not be inimical to the common defense and security or to the health and safety of the public.

6.0 REFERENCES

1. Letter from F. P. Schiffley (WOG) to U.S. Nuclear Regulatory Commission, "Transmittal of WCAP-15831-P, Rev. 1 (Proprietary) and WCAP-15831-NP (Non-Proprietary), "WOG Risk-Informed ATWS Assessment and Licensing Implementation Process" (TAC No. MB5741)," September 14, 2004, ADAMS Accession No. ML042610398.

2. Letter from F. P. Schiffley (WOG) to U.S. Nuclear Regulatory Commission, "Westinghouse Owners Group Comments and Resolution of Comments on the NRC's Draft Safety Evaluation on WCAP-15831-P, Rev. 1, "WOG Risk-Informed ATWS Assessment and Licensing Implementation Process," December 6, 2005, ADAMS Accession No. ML053420378.

3. Regulatory Guide 1.174, "An Approach for Using Probabilistic Risk Assessment in Risk-Informed Decisions on Plant-Specific Changes to the Licensing Basis," Revision 1, November 2002.

4. Regulatory Guide 1.177, "An Approach for Plant-Specific, Risk-Informed Decisionmaking: Technical Specifications," August 1988.

5. Title 10 of the *Code of Federal Regulations*, Part 50 Section 62, "Requirements for reduction of risk from anticipated transients without scram (ATWS) events for light-water-cooled nuclear power plants."

6. SECY-83-293, "Amendments to 10 CFR 50 Related to Anticipated Transients Without Scram (ATWS) Events," July 19, 1983.

7. Letter from T. M. Anderson (Westinghouse) to S. H. Hanauer (NRC), NS-TMA-2182, "ATWS Submittal," December 30, 1979.

8. "LOFTRAN Code Description," W. T. Burnett, et al., WCAP-7907-P-A (Westinghouse Proprietary), WCAP-7907-A (Non-Proprietary), April 1984.

9. "ANC: Westinghouse Advanced Nodal Computer Code," S. L. Davidson, et al., WCAP-19065-P-A (Westinghouse Proprietary), WCAP-10966-P-A (Non-Proprietary), September 1986.

Attachment: Resolution of Comments

Principle Contributors: R. Taylor
D. Harrison
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Date: May 8, 2007

RESOLUTION OF COMMENTS

ON DRAFT SAFETY EVALUATION (SE) FOR

PRESSURIZED WATER REACTOR OWNERS GROUP (PWROG)

TOPICAL REPORT (TR) WCAP-15831-P, REVISION 1,"WOG RISK-INFORMED ATWS

ASSESSMENT AND LICENSING IMPLEMENTATION PROCESS"

By letter dated September 14, 2004, as supplemented by letter dated December 6, 2005, the PWROG submitted TR WCAP-15831-P, Revision 1, to the U.S. Nuclear Regulatory Commission (NRC) for review and approval. This attachment provides the NRC staff's review and disposition of each comment made by the PWROG in its December 6, 2005, letter.

PWROG Comment 1 (Page 2, Lines 21-22)

The draft SE states "The WOG's topical report requires that each licensee develop a plant-specific ATWS Configuration Management Program (CMP)". All licensees are not required to implement an ATWS CMP. As a clarification, an ATWS CMP will only be required for plants that are in Group 3 as defined in Section 7.2.1 of the WCAP. Group 3 includes plants that have not installed a diverse scram system, are consistent with the ATWS Rule (installed ATWS Mitigation System Actuation Circuitry, AMSAC), but are not consistent with the basis for the ATWS Rule. This is consistent with Section 7.2.1 of the WCAP which states "Plants in Groups 1 or 2 will not be required to implement the ATWS CMP. Plants in Group 3 will be required to implement the ATWS CMP."

PWROG Suggested Resolution of Comment

To ensure it is clear that only Group 3 plants will need to develop an ATWS CMP, the following text will be added at the end of WCAP Section 11. "The ATWS CMP will only be required for plants that implement the WCAP methodology and meet Group 3 criteria. Group 3 plants are those that have not installed a diverse scram system, are consistent with the ATWS Rule (installed AMSAC), but are not consistent with the basis for the ATWS Rule. Group 1 and 2 plants will not be required to implement an ATWS CMP."

WCAP Revisions

On Page 11-3, the following text will be added at the end the paragraph.

The ATWS CMP will only be required for plants that implement the WCAP methodology and meet Group 3 criteria. Group 3 plants are those that have not installed a diverse scram system, are consistent with the ATWS Rule (installed AMSAC), but are not consistent with the basis for the ATWS Rule. Group 1 and 2 plants will not be required to implement an ATWS CMP.

NRC Response 1

The NRC staff agrees that the requirements of TR WCAP-15831-P, Revision 1, and the SE, would only apply to plants that implement TR WCAP-15831-P, Revision 1, methodology. In the NRC staff's review of TR WCAP-15831-P, Revision 1, the Configuration Management Plan (CMP) is essential to the success of the methodology presented in the TR. It is unclear how the methodology in the TR would be implemented without a CMP. While it is currently expected that Group 3 plants would benefit the most from implementing TR WCAP-15831-P, Revision 1, the possibility exists that Group 2 or even Group 1 plants may implement the TR. Therefore, the NRC staff maintains that any plant which implements TR WCAP-15831-P, Revision 1, must fully comply with the TR and the SE. The NRC staff's approval does not include different requirements for different plants.

Therefore, the NRC staff is changing the subject sentence to read as follows: "The PWROG's TR requires that each licensee that implements the methodology provided in the report develop a plant-specific ATWS Configuration Management Program (CMP)."

<u>PWROG Comment 2 (Page 2, Lines 22-24)</u>

> The draft SE states, "The ATWS CMP will be updated every fuel cycle to ensure that ATWS mitigative equipment is not removed from service during periods where its inoperability would cause the plant to enter a UET." Removal of ATWS mitigative equipment should be limited to voluntary removal of equipment. Forced removal of equipment may be required to address equipment failures.

PWROG Suggested Resolution of Comment

> As a clarification, it should be stated that this applies to voluntary removal of equipment. The SE text should be changed as follows (the underlined word is the change): "The ATWS CMP will be updated every fuel cycle to ensure that ATWS mitigative equipment is not voluntarily removed from service during periods where its inoperability would cause the plant to enter a UET."

WCAP Revisions

> None required.

NRC Response 2

Whether the equipment is voluntarily or involuntarily removed from service it would be unavailable to provide the mitigation function for which it is credited. Therefore, its removal from service may cause the plant to enter a UET condition, depending on the time in cycle of the plant. This time would then count against the cumulative 30-day allowance of operation in UET conditions. The NRC staff believes the cumulative 30-day allowance of operation in UET conditions, as provided for in TR WCAP-15831-P, Revision 1, is ample time for the plant to recover the equipment without undue hardship. Therefore, the NRC staff does not accept Comment 2.

PWROG Comment 3 (Page 5, Lines 20-23)

The draft SE states "Additionally, the WOG considered plant conditions such as three primary-side relief configurations ... and elevated inlet temperatures (i.e., > 600°F)." As a clarification, the inlet temperatures referenced are those experienced during the ATWS transient and not the initial inlet conditions.

PWROG Suggested Resolution of Comment

To ensure that the meaning of elevated inlet temperature is understood, the word "transient" should be placed in front of "inlet temperatures". The SE text should be changed as follows (the underlined word is the change): "Additionally, the WOG considered plant conditions such as three primary-side relief configurations... and elevated transient inlet temperatures (i.e., > 600°F)."

WCAP Revisions

On Page 4-2 the word "transient" will be added after the word "elevated" in the 10th line of the second paragraph. With this change, the sentence will be "The resulting CPT values at elevated transient inlet temperatures ...." On Page 4-23 the word "transient" will be added after the word "elevated" in the 5th line of the third paragraph. With this change, the sentence will be "The resulting CPT values at elevated transient inlet temperatures..."

NRC Response 3

The NRC staff agrees with the proposed change and has incorporated it into the SE. However, the word “WOG” has been replaced with “PWROG.”

PWROG Comment 4 (Page 6, Lines 13-15)

The draft SE states "Therefore, each licensee that adopts the methodology presented in WCAP-15831-P, Revision 1, must perform plant- and cycle-specific analyses based on current design and operating conditions." The WOG's position is that a complete plant specific analysis is not necessary in every case.

PWROG Suggested Resolution of Comment

The critical power trajectories (CPTs) utilized in this methodology are based on the representative plant model developed in NS-TMA-2182. The model is confirmed to be applicable to a given plant by ensuring that the key design and operating conditions assumed in the model, namely plant type (number of loops), core power, AFW system performance, steam generator type, pressurizer relief valve capacity, and pressurizer safety valve capacity, are bounding. If these key parameters are bounded, the model is considered to be representative of that plant.

It is recommended that the above statement (Page 6, Lines 13-15) of the draft SE be changed to (the underlined words show the change) "Therefore, each licensee that adopts the methodology presented in WCAP-15831-P, Revision 1, must justify that the

analysis performed is applicable to its plant considering the current design and operating conditions."

WCAP Revisions

None required.

NRC Response 4

In the draft SE, the NRC staff had decided that plant-specific and cycle-specific analyses were required. This requirement is a corollary to the requirement for plant specific license amendments to implement TR WCAP-15831-P, Revision 1. The NRC staff believes that the TR leaves a significant number of issues for resolution in plant- and cycle-specific analyses. For example, the development of the ATWS CMP, the reliability of the control rod system, and the compensatory actions are all plant-specific aspects of the methodology that require further NRC staff review prior to implementation. The PWROG comment does not provide any additional information to warrant changing that decision. Therefore, the NRC staff has determined that to ensure the appropriate application of the methodology, the NRC staff must review the initial plant specific implementation of the methodology. Therefore, this comment is not incorporated. However, the NRC staff did add a parenthetical clarification indicating the similarity between the cycle-specific and reload analyses.

<u>PWROG Comment 5 (Page 7, Lines 7-8)</u>

The draft SE states "To implement the WCAP-15831-P, Revision 1, methodology, a licensee will need to submit a plant-specific license amendment to the NRC for its review and approval."

PWROG Suggested Resolution of Comment

A license amendment is not required to implement the methodology contained in WCAP-15831-P, Revision 1, unless an unfavorable exposure time (UET) requirement is included in the Technical Specifications, or a review of the activity to implement the methodology determines that prior NRC review and approval is required. The requirement for submittal of a plant-specific license amendment should be eliminated from the SE.

WCAP Revisions

None required.

NRC Response 5

In the draft SE, the NRC staff had decided that an plant-specific license amendment request would be required of plants implementing TR WCAP-15831-P, Revision 1, due to a number of issues being left for resolution in plant- and cycle-specific analyses. For example, the development of the ATWS CMP, the reliability of the control rod system, and the compensatory actions are all plant-specific aspects of the methodology that require further NRC staff review prior to implementation. The PWROG comment does not provide any additional information to warrant changing that decision. Therefore, the NRC staff has determined that to ensure the

appropriate application of the methodology, the NRC staff must review the initial plant specific implementation of the methodology. Therefore, this comment is not incorporated.

PWROG Comment 6 (Page 7, Lines 8-14)

The draft SE states: "In addition, as part of its implementation, licensees will need to re-perform these analyses for subsequent reloads to ensure that the results are acceptable. The probabilistic risk analyses will need to address all five operating states identified in the topical report for both CDF and LERF and will need to reflect the latest operational information (i.e., updated failure rates and operating conditions/positions of ATWS mitigating equipment) or provide a justification for why these analyses are not required for the specific core design." The WOG disagrees that this information is necessary for subsequent reloads and the WCAP only requires an assessment of the impact on CDF, not LERF, for the at-power operating state. The justification for this is further explained in the following paragraphs.

Core Damage Frequency Assessments

The approach proposed in the WCAP only requires the at-power operating state, including shutdown (power reduction) to 40% power, to be addressed for ATWS. This is referred to as ATWS Operating State 3/4. It was concluded that it is not necessary to assess the core damage frequency (CDF) impact from the other states by reviewing the analysis for these states presented in the Section 5.1 of the WCAP. Table 5-25 of the WCAP shows the results of the CDF evaluations for the various ATWS operating states. It is concluded from this information that ATWS Operating State 3/4 accounts for the vast majority of the ATWS CDF contribution for each of the cores, and also for the increase in CDF between the high and bounding reactivity cores as compared to the low reactivity core. The CDF sum for ATWS Operating States 1,2, and 5 contribute less than 4E-08/yr to CDF for all three core types, which is a very small contribution and will not play a role in the core reload decision-making process.

A summary of the CDF impact (the increase in CDF for the high and bounding reactivity cores compared to the low reactivity core) by ATWS operating state is provided in Table C6-1. This shows that the ATWS Operating State 3/4 accounts for the vast majority of the increase in CDF. This is true for both the high reactivity and bounding reactivity cores. The sum of the CDF increases for the other states (ATWS Operating States 1, 2, and 5) accounts for about 5% (2.1E-08/ye) of the total ATWS CDF increase from the low reactivity core to the bounding reactivity core and for about 10% (7.1E-09/yr) of the ATWS CDF increase from the low reactivity core to the high reactivity core. Also note that the absolute values for the increase in CDF from ATWS Operating States 1, 2, and 5 are very small.

Given these results, it was concluded in Section 5.1.5 of the WCAP that it is not necessary to quantify the small contribution to CDF from ATWS Operating States 1, 2, and 5, since it will not play a role in the decision-making process for core reloads with regard to ATWS risk issues.

Table C6-1: Summary of ATWS CDF Increase Relative to the Low Reactivity Core by Plant Operating State

ATWS State				High Reactivity Core Compared to Low Reactivity Core		Bounding Reactivity Core Compared to Low Reactivity Core	
State Identifier	Plant Activity	Power Level	Xenon Equilibrium	ΔCDF	Percent of Total ΔCDF	ΔCDF	Percent of Total ΔCDF
1	Startup	<40%	No	5.7E-09	8.4%	1.2E-08	3.2%
2	Startup	≥40%	No	1.4E-09	2.1%	1.9E-09	0.5%
3/4	Power Operation and Shutdown	≥40%	Yes	6.1E-08	89.7%	3.6E-07	94.7%
5	Shutdown	<40%	Yes	Small	Small	6.6E-09	1.7%
Total ATWS ΔCDF				6.8E-08	--	3.8E-07	--

Large Early Frequency Assessments

A very conservative approach was used to determine the impact of core reactivity changes on large early release frequency (LERF). This approach is based on the bounding reactivity core in comparison to the low reactivity core, and assumes that the highest RCS pressure attained during the cycle for a particular plant configuration is applicable for 50% of the full cycle. Note that the UETs provided in Tables 4-11 and 4-12 of the WCAP, for the bounding core, are all less than 50% except for one configuration. Since these UETs are based on 3200 psi, UETs for higher pressures, such as the 3584 psi required for a large release, would be significantly smaller.

In addition, the bounding core has no plant configuration with a 0 UET. A requirement is proposed in the WCAP to design the core with a 0 UET for the following conditions:

- Hot full power moderator temperature coefficient
- Equilibrium xenon
- Nominal hot full power inlet temperature
- 72 steps of control rod insertion of the lead bank
- All PORVs available
- 100% (all) auxiliary feedwater flow

A core designed with a 0 UET for these conditions will result in shorter times when RCS pressure may exceed 3584 psi. Therefore, the WCAP analysis was based on a very conservative core design, with regard to reactivity, that would not be considered for a core reload.

Due to the very conservative nature of this analysis and the acceptable results, with regard to LERF impact, it was concluded that a LERF analysis will not be the important measure for determining the acceptability of the reload design with regard to ATWS risk.

The WCAP recommends assessing the impact of the core reload on CDF, and not on LERF. If CDF is found to be acceptable, then LERF will be acceptable due to the conservative approach taken in the WCAP and the proposed UET restriction on core designs (a 0 UET for once configuration). Therefore, the LERF assessment will not play a role in the decision-making process for core reloads with regard to ATWS risk issues and is not required.

Furthermore, the ATWS CMP approach proposes to limit the amount of time that the plant can operate in an unfavorable configuration to 30 days. After accumulating 30 days of time operating in unfavorable conditions, compensatory actions are required to be taken to address further operation in an unfavorable configuration. Therefore, although the LERF assessment applies the highest RCS pressure attained during the cycle for a particular plant configuration to 50% of the full cycle, the actual time a plant can operate in an unfavorable condition is severely limited by this 30 day limitation proposed as part of the configuration management approach.

PWROG Suggested Resolution of Comment

Additional information will be added to the WCAP to further justify basing the core reload risk acceptability determination on CDF for ATWS Operating State 3/4 only. This will include:

- Additional discussion in Section 5.1.5 on the CDF impact for each ATWS operating state for the high and bounding reactivity cores relative to the low reactivity core.
- Additional information in Section 5.2.1 discussing the conservative nature of the LERF analysis.
- Additional summary information provided in Section 5.4.
- A minor change in Section 10.
- Additional information in Section 11 summarizing the need to only consider the impact on CDF.

WCAP Revisions

<u>On Page 5-44, the first paragraph will be replaced with the following text.</u>

The results of the ATWS CDF analysis are summarized on Tables 5-25 and 5-26. The CDF values are provided for each ATWS state and for the total of all ATWS states on Table 5-25. Table 5-26 provides the CDF increase for each ATWS state for the high and bounding reactivity cores relative to the low reactivity core. Table 5-27 provides a summary of the important characteristics that define each ATWS state and the important model features for each ATWS state.

<u>On Page 5-44, the following bulleted text will be added after the third bulleted item.</u>

- The information in Table 5-26 shows that ATWS Operating State 3/4 accounts for the vase majority of the increase in CDF for both the high reactivity and

bounding reactivity cores. The other states (ATWS Operating States 1, 2, and 5) account for about 5% of the ATWS CDF increase, from the low reactivity core to the bounding reactivity core, and for about 10% of the ATWS CDF increase, from the low reactivity core to the high reactivity core. Again, these other ATWS operating states are small contributors to plant risk and will not be important to the plant risk profile or to the risk-informed decision process involving evaluations of plant changes.

On Page 5-44, the following paragraph will be added after the last bulleted item.

Based on this analysis, it is concluded that ATWS Operating State 3/4 is the only state that needs to be considered in further ATWS risk-informed evaluations. The ATWS operating states other than 3/4 are very small contributors to ATWS risk and do not need to be considered further since they will not be important to ATWS related risk-informed decisions.

On Page 5-46, the following table will be added before the currently numbered Table 5-26

Table 5-26: Summary of ATWS CDF Increase Relative to the Low Reactivity Core by Plant Operating State

ATWS State				High Reactivity Core Compared to Low Reactivity Core		Bounding Reactivity Core Compared to Low Reactivity Core	
State Identifier	Plant Activity	Power Level	Xenon Equilibrium	ΔCDF	Percent of Total ΔCDF	ΔCDF	Percent of Total ΔCDF
1	Startup	<40%	No	5.7E-09	8.4%	1.2E-08	3.2%
2	Startup	≥40%	No	1.4E-09	2.1%	1.9E-09	0.5%
3/4	Power Operation and Shutdown	≥40%	Yes	6.1E-08	89.7%	3.6E-07	94.7%
5	Shutdown	<40%	Yes	Small	Small	6.6E-09	1.7%
Total ATWS ΔCDF				6.8E-08	--	3.8E-07	--

The following table numbers will be changes:

Page	Current Table Number	New Table Number
5-46	5-26	5-27
5-49	5-27	5-28
5-49	5-28	5-29

5-49	5-29	5-30
5-50	5-30	5-31
5-50	5-31	5-32
5-56	5-32	5-33
5-57	5-33	5-34
5-58	5-34	5-35

On Page 5-54, the following text will be added prior to the paragraph that starts "RCS pressures were calculated...".

A very conservative approach was used to determine the impact of core reactivity changes on LERF. This approach is based on the bounding reactivity core in comparison to the low reactivity core, and assumes that the highest RCS pressure attained during the cycle for a particular plant configuration is applicable to 100% or 50% of the full cycle. Note that the UETs provided in Tables 4-11 and 4-12, for the bounding core, are all less than 50% except for one configuration. Since these UETs are based on 3200 psi, UETs for higher pressures, such as the 3584 psi required for a large release, would be significantly smaller. Also note that further restrictions on the core design discussed in Section 7.2.3 require a 0 UET for the following conditions:

- Hot full power moderator temperature coefficient
- Equilibrium xenon
- Nominal hot full power inlet temperature
- 72 steps of control rod insertion of the lead bank
- All PORVs available
- 100% (all) auxiliary feedwater flow

The bounding reactivity core does not meet this restriction, therefore, the UETs for core designs following the approach proposed in this WCAP will be significantly smaller than those used in the assessment, and therefore, the LERF impact will be significantly smaller.

On Page 5-54, the following text will be added prior to Section 5.2.2.

Due to the very conservative nature of this analysis and the acceptable results, it is concluded that a LERF analysis will not be an important metric in ATWS related risk-informed decisions.

On Page 5-64, the following text will be added as a bulleted item after the third bulleted item.

- ATWS State 3/4 also accounts for the vast majority of the increase in CDF for both the high reactivity and bounding reactivity cores compared to the low reactivity core. The other states account for about 5% of the ATWS CDF increase for the bounding reactivity core, and for about 10% of the ATWS CDF increase for the high reactivity core.

On Page 5-64, the following text will be added as a bulleted item after the (current) 8th bulleted item.

- A very conservative approach was used to determine the impact of core reactivity changes on LERF. This approach is based on the bounding reactivity core in comparison to the low reactivity core, and assumes that the highest RCS pressure attained during the cycle for a particular plant configuration is applicable to 50% of the full cycle. Note that the UETs provided in Tables 4-11 and 4-12, for the bounding core, are all less than 50% except for one configuration. Since these UETs are based on 3200 psi, UETs for higher pressures, such as the 3584 psi required for a large release, would be significantly smaller. Also note that further restrictions on the core design discussed in Section 7.2.3 require a 0 UET for a specific set of plant conditions. The bounding reactivity core does not meet this restriction, therefore, the UETs for core designs following the approach proposed in this WCAP will be significantly smaller than those used in the assessment, and there, the LERF impact will be significantly smaller and will not be an important risk metric in ATWS related risk-informed decisions.

On Page 10-2, the following text will be added to the sentence on lines 12-14.

"using a very conservative approach." Therefore, the complete sentence will be "The LERF impact was evaluated and determined to be small for core designs considered in this analysis using a very conservative approach, therefore, ..."

On Page 11-1, the following text will be added to the second bulleted item after the second sentence.

ATWS State 3/4 also accounts for the vast majority of the increase in CDF for both the high reactivity and bounding reactivity cores compared to the low reactivity core.

On Page 11-1, the following text will be added at the end of the fourth bulleted item.

This is still very conservative since the UETs for the bounding core are all less than 50% except for one configuration. Since these UETs are based on 3200 psi, UETs for higher pressures would be significantly smaller. Also note that further restrictions on the core design discussed in Section 7.2.3 require a 0 UET for a specific set of plant conditions. The bounding reactivity core does not meet this restriction, therefore, the UETs for core designs following the approach proposed in this WCAP will be significantly smaller than those used in this assessment, and therefore, the LERF impact will be significantly smaller and will not be an important risk metric in ATWS related risk-informed decisions.

Furthermore, the configuration management approach proposes to limit the amount of time that the plant can operate in an unfavorable configuration based on CDF considerations (3200 psi) to 30 days. After accumulating 30 days of time operating in unfavorable conditions, compensatory actions are required to be taken to address further operation in an unfavorable configuration. Therefore, although the LERF assessment applies the highest RCS pressure attained during the cycle for a particular plant configuration over 50% of the full cycle, the actual time a plant can operate in an unfavorable condition is severely limited by this 30 day limitation specified in the configuration management approach.

From this it is concluded that the LERF impact related to ATWS is very small and it is not necessary to further consider the LERF metric.

<u>On Page 11-2, the following text will be added at the end of the first bulleted item.</u>

The impact on LERF is not required to be evaluated. If CDF is found to be acceptable, then LERF will be acceptable due to the conservative approach taken in the LERF analysis approach and the restrictions on core designs (a 0 UET is required for one configuration). Therefore, the LERF assessment will not play a role in the decision-making process for core reloads with regard to ATWS risk issues and is not required.

NRC Response 6

Though the PWROG provides substantial information to support its contention that only CDF under at-power operating conditions needs to be evaluated, it does not address a number of factors that would demonstrate the analyses is bounding for all plant types, configurations, and operating conditions. There is no analysis that demonstrates that two-loop or three-loop plants are bounded by the four-loop plant analyses and there is no analysis that demonstrates how different plant operating conditions and approaches may influence the analyses, especially different management operating approaches to lower power and shutdown operations. In addition, the values used in the probabilistic risk analysis may not bound all conditions. For example, in Section 5.1.1.11 of the TR, it is stated that “The following probabilities of blocked PORVs were assumed in this analysis. These values were chosen as a reasonably conservative set, but it is acknowledged that they may not envelope all plants.”

Finally, in calculating the impact on LERF, the TR uses a pressure of 3584 psi, which is stated as the pressure at which SG tubes will fail. This pressure is greater than the ASME Code Service Level C stress limit of 3200 psig that was used in the ATWS Rule and that is used in the topical report in assessing the impact on CDF. Since SG tube failure is one of the dominant contributors to LERF for pressurized water reactors, the NRC staff accepts the use of the cited SG tube failure pressure in determining the impact on LERF. However, the NRC staff SE includes a condition that if there are indications that the SG tubes are susceptible to failure at a lower pressure, the licensee must use the lower pressure in determining these impacts and their acceptability. It is not demonstrated in the TR that the CDF acceptance guideline is the controlling metric. Clearly, if SG tube failure pressure approaches the ASME Code Service Level C stress limit, then the LERF acceptance guideline, which is an order of magnitude lower than the CDF acceptance guideline, could control the core design decisionmaking process.

Based on the above considerations, the NRC staff does not agree with the PWROG comment and maintains that any licensee that implements the TR will need to provide, as part of its initial plant-specific license application to the NRC for its review and approval, probabilistic risk analyses of the ΔCDF and ΔLERF, addressing all five operating states identified in the TR. Subsequently, as part of its implementation, the licensee will need to re-perform these analyses for subsequent reloads to ensure that the results are maintained acceptable. The subsequent probabilistic risk analyses will need to address all five operating states identified in the TR for the ΔCDF and ΔLERF and will need to reflect the latest operational information that is included in the plant-specific PRA model (i.e., updated failure rates and operating conditions/positions of ATWS mitigating equipment) or provide justifications for why some of these analyses are not required for the specific core design.

For added clarity, the NRC staff will provide additional information in the NRC staff SE regarding the performance of these calculations. Specifically, the base CDF and base LERF calculations used in determining the ΔCDF and ΔLERF, respectively, that is submitted as part of the initial license application, as well as for subsequent reload analyses, should be derived based on the plant-specific PRA using the low reactivity core design conditions identified in the TR.

PWROG Comment 7 (Page 7, Lines 22-25)

> The draft SE states "The licensee implementing this methodology will need to show for sequences that have an end state designated as CD-LTS, that 72 steps of insertion actually mitigate the transient for the specific plant and core design such that the pressure does not exceed 3200 psi." The UET is defined as the time in the cycle when the reactivity feedback is not sufficient to prevent the RCS pressure from exceeding 3200 psi. The 72 steps of CRI is factored into the UETs. The UETs are factored into the pressure relief fault trees (see Appendix D of the WCAP). If pressure relief (PR in the event tree) is successful, then the RCS pressure does not exceed 3200 psi and long-term shutdown is required. The only time long-term shutdown is addressed is following successful pressure relief (RCS pressure <3200 psig). Therefore, this issue is already addressed in the calculation of the UETs and use of the UETs in the PRA model. It is recommended that this requirement be eliminated since it is inherent in the approach.

PWROG Suggested Resolution of Comment

> Since this issue is already addressed in the calculation of the UETs and use of the UETs in the PRA model, it is recommended that this requirement be eliminated from the SE since it is inherent in the approach.

WCAP Revisions

> None required.

NRC Response 7

The NRC staff agrees with the PWROG comment and resolution and has deleted the discussion related to the CD-LTS end state in the cited paragraph and in Limitation and Condition 6. However, the NRC staff still requires that any licensee that implements this TR must ensure the validity of the event tree logic and end state conditions for their plant-specific operations and core design and make, as appropriate, revisions to the event tree logic, end states, and results to reflect these plant-specific modifications.

PWROG Comment 8 (Page 7, Line 42 to Page 8, Line 2)

> The draft SE states "As such, when a licensee implements the WCAP-15831-P, Revision 1, methodology, the core design evaluation during the reload analyses must include the evaluation of the impacts on CDF and LERF and be shown to meet RG 1.174 acceptance guidelines." This is discussed in detail in Comment 6. As stated in Comment 6, there is no need to assess the impact on LERF due to the very conservative assessment included in the WCAP and the limitation of operating in a

unfavorable exposure configuration, with regard to 3200 psi, for a maximum of 30 days. Only the CDF evaluation is required.

PWROG Suggested Resolution of Comment

The requirement to perform a LERF calculation should be removed from the SE.

WCAP Revisions

None required.

NRC Response 8

This comment is also addressed in Comment 6. See NRC Response 6 for details.

PWROG Comment 9 (Page 9, Lines 24-26)

The draft SE states "However, the staff does not accept that a plant with an MTC of less than -8 pcm/°F for 95 percent of the cycle is consistent with the basis for the ATWS Rule and should instead be considered part of Group 3." The WOG's position is that consistency with the ATWS Rule can still be demonstrated in this manner, with supporting evaluations or analyses.

PWROG Suggested Resolution of Comment

The WOG agrees that simply demonstrating that a plant's 95% MTC is more negative that -8 pcm/°F is not sufficient to demonstrate consistency with the basis of the ATWS Rule. An implicit assumption in the statement in the WCAP is that the generic analysis supporting this conclusion remains representative for the plant in question given current design and operating conditions. In practice, the key input parameters utilized in the generic analysis are reviewed to ensure that they are bounding for the plant. Additionally, the plant's current best estimate 95% MTC is confirmed to be bounded by the -8 pcm/°F value. If the key input parameters and/or MTC are not bounded, the generic analysis reference case is reanalyzed with the plant specific values to ensure that the RCS pressure limit continues to be met. If the RCS pressure limit continues to be met using the plant specific values, the plant is then considered to be consistent with the basis for the ATWS Rule. Plant specific UET calculations are not required to make this conclusion.

WCAP Revisions

Revisions for Section 7.2.1

Replace the fifth bulleted item in this section "An MTC of < -8 pcm/F for 95% of the cycle." with the following text.

- A HFP, equilibrium xenon MTC equal to or more negative than -8 pcm/°F for 95% of the cycle, provided that the validity of the MTC requirement is demonstrated via analysis (i.e., peak RCS pressures <3200 psia using an applicable model and the 95% MTC value) or evaluation (by comparing the

current plant conditions to the key input parameters, including the MTC, used in the reference analysis that yielded peak RCS pressures <3200 psia.). (Note: The 95% MTC for a core design will be determined by calculating the best-estimate HFP MTC value as a function of cycle burnup. The best-estimate MTC values for the core will be less than or equal to the 95% MTC value over 95% of the cycle burnup range.)

Revisions for Appendix G

Under "Technical Clarification i.a, ATWS CMP Key Characteristics," replace the fifth bulleted item with the following text.

- A HFP, equilibrium xenon MTC equal to or more negative than -8 pcm/°F for 95% of the cycle, provided that the validity of the MTC requirement is demonstrated via analysis (i.e., peak RCS pressures <3200 psia using an applicable model and the 95% MTC value) or evaluation (by comparing the current plant conditions to the key input parameters, including the MTC, used in the reference analysis that yielded peak RCS pressures <3200 psia.). (Note: The 95% MTC for a core design will be determined by calculating the best-estimate HFP MTC value as a function of cycle burnup. The best-estimate MTC values for the core will be less than or equal to the 95% MTC value over 95% of the cycle burnup range.)

NRC Response 9

As stated in the SE, the NRC staff considers an unfavorable MTC as essentially identical to a UET in that it reflects portions of the operating cycle where the MTC is insufficiently negative to preclude the RCS from exceeding the ASME Code Service Level C acceptance criteria during an ATWS event. Therefore, the NRC staff agrees that it is possible to identify a threshold '95 percent MTC' at which the plant would operate at or below for 95 percent of the cycle and would meet the ATWS Rule's basis acceptance criterion. However, the '95 percent MTC' must be based on a plant-specific analysis to the ATWS basis acceptance criterion for the ATWS Rule reference configuration. Subsequent reload cores may be evaluated against that analysis until those evaluations indicate a new analysis is required. The SE has been revised to reflect the acceptability of determining an threshold '95 percent MTC' in determining whether or not a plant is in compliance with the ATWS Rules basis. The NRC staff's rationale is outlined in the SE.

TR WCAP-15831-P, Revision 1, defines two means of determining whether or not a plant is in compliance with the basis for the ATWS Rule. The PWROG and any licensee implementing the TR is cautioned that determination is dynamic and may change with changes in core or plant design, plant operating practices, and even from cycle to cycle.

PWROG Comment 10 (Page 10, Lines 15-16; Page 15, Line 29)

Page 10, Line 15, the draft SE states "... is to operate each plant in a configuration with a zero percent UET."

Page 10, Line 16, the draft SE states "A plant designed and operated with a zero percent UET...".

Page 15, Line 29, the draft SE states "... and can be operated with a zero percent UET...".

The term "zero percent UET" should be replaced with "zero UET" since the UETs represent time, such as days, of the fuel cycle, and not a percentage of the fuel cycle.

PWROG Suggested Resolution of Comment

Replace the term "zero percent UET" with the term "zero UET" in the SE.

WCAP Revisions

None required.

NRC Response 10

TR WCAP-15831-P, Revision 1, uses the term “5% UET” throughout when discussing current limits, and uses the term 0 percent UET in Technical Clarification 1.c in Appendix G. Therefore, the NRC staff believes the term ‘zero percent UET’ is reasonably consistent with the terminology used in the TR. However, TR WCAP-15831-P, Revision 1, Section 7.2.3 and the remainder of Technical Clarification 1.c uses the term ‘zero UET’ when discussing the development of the CMP. Mathematically ‘zero UET’ is equivalent to ‘zero percent UET.’ Therefore, to be consistent with the wording in the applicable sections of TR WCAP-15831-P, Revision 1, the NRC staff accepts the wording change proposed by the PWROG. The NRC staff has changed the wording in the instances identified in the PWROG comment and others where appropriate.

WCAP Revisions

Replace the phrase term ‘0 percent UET’ in Technical Clarification 1.c with ‘zero UET.’

<u>PWROG Comment 11 (Page 12, Lines 22-31)</u>

The draft SE states "Therefore, since WCAP-15831-P, Revision 1, does not present sufficient information to demonstrate that defense-in-depth will be maintained at part-power conditions, the staff has determined that a licensee that adopts the WCAP-15831-P, Revision 1, methodology must treat all part-power operating conditions as counting against the allowed cumulative UET for that cycle. Additionally, since the risk associated with operating in a part-power UET condition is independent of the plant power level (i.e., a 50 percent power UET condition poses the same risk as a 75 percent UET condition), the licensee must track time spent in a part-power UET condition based on the actual time and not the effective full power days (EFPDs) of operation. Finally, the licensee must cumulatively count this actual time spent operating at part-power conditions against its allowed 30-day cumulative UET." The PWROG's position is that it is not appropriate to assume all part-power operation will result in unfavorable exposure time. The WCAP does not support the NRC's position.

PWROG Suggested Resolution of Comment

As discussed further below, UETs based on 100% power are bounding over those at lower power levels, even considering the change in MTC with decreasing power. As such, the methodology conservatively applies the 100% power level UETs to lower power levels if and only if the plant is in an unfavorable configuration. One day of operation in the unfavorable part-power condition will be considered one EFPD for the purpose of accumulating UET. Furthermore, the time prior to achieving equilibrium xenon will be treated as unfavorable time and added to the cumulative UET.

The Staff is also concerned that the UETs for lower power levels may be greater than those at 100% power due to the trade-off between the lower power level which reduces peak ATWS pressure and the less negative MTC which increases peak ATWS pressure. A sensitivity study was performed for the Loss of Load ATWS event to show that the reduction in power has a dominant effect on the transient results. These results are shown below and will be added to the WCAP. It can be seen that the 100% power case yields limiting peak RCS pressures over cases at 70% and 85% power, even with a less negative MTC at these lower power levels. This provides further justification for applying 100% power UETs to lower power levels.

PWROG Suggested WCAP Revisions

Revisions for Section 4.3

After the last paragraph in Section 4.3, the following text will be added.

With regard to the effect of more positive MTCs at lower powers on the peak RCS pressure, analysis has shown that the reduction in core power has a bigger effect on peak pressure than the change in MTC. The results from this analysis are shown below. The peak RCS pressure results shown in Tables 4-20 and 4-21 are therefore based on 100% power.

ATWS Loss of Load, 3579 MWt, 2 PORVs, Full AFW, High Reactivity Core		
CASE	Description	Peak RCS Pressure (psia)
1	100% power, HZP MTC = -6.18 pcm/°F	3222
2	85% power, MTC = -4.59 pcm/°F	2999
3	70% power, MTC = -3.08 pcm/°F	2570

Revisions for Appendix B

Under "Issue 6, Response," the following text will be added to the end of the response.

With regard to the effect of more positive MTCs at lower powers on the peak RCS pressure, analysis has shown that the reduction in core power has a bigger effect on peak pressure than the change in MTC. The results from this analysis are shown below.

ATWS Loss of Load, 3579 MWt, 2 PORVs, Full AFW, High Reactivity Core		
CASE	Description	Peak RCS Pressure (psia)
1	100% power, HZP MTC = -6.18 pcm/°F	3222
2	85% power, MTC = -4.59 pcm/°F	2999
3	70% power, MTC = -3.08 pcm/°F	2570

NRC Response 11

The NRC staff agrees that being at a reduce power level does not in of itself create a UET. However, it is possible to be in a UET condition at reduced power level. TR WCAP-15831-P, Revision 1, does not differentiate the risk between a plant operating at 99 percent of rated thermal power (RTD) and one operating at 40 percent of RTD. Therefore the CMP must apply at all power levels and part-power operating conditions that create a UET must be fully counted against the allowed cumulative UET for that cycle, and not prorated based on power level. Therefore, the NRC staff accepts this comment and has made changes to the SE accordingly.

PWROG Comment 12 (Page 15, Lines 6-8; Limitation and Condition 1)

The draft SE states "A licensee that implements WCAP-15831-P, Revision 1, is required, as part of each cycle's reload analysis, to verify that its core is designed for a zero percent UET at the most limiting point in the cycle based on the following reference-case conditions:" The term "reference-case" may be confused with the term "ATWS reference configuration" used in the WCAP which refers to the configuration of no rod insertion, 100% auxiliary feedwater, and no blocked power operated relief valves.

PWROG Suggested Resolution of Comment

It is suggested that the term "reference-case" be eliminated from this sentence in the SE or be changed to "zero UET design conditions".

WCAP Revisions

None required.

NRC Response 12

The NRC staff recognizes the potential for confusion and the need to differentiate between the conditions used to determine compliance with the basis of the ATWS Rule and the conditions used to develop the CMP. Therefore, the NRC staff accepts this change and has changed the SE to incorporate the proposed wording in the instance cited in the comment and others where appropriate.

PWROG Comment 13 (Page 15, Lines 16-19; Limitation and Condition 2)

Limitation and Condition 2 is addressed in Comment 9.

PWROG Proposed Resolution of Comment

See discussion of Comment 9. It is suggested that this SE restriction be eliminated or changed as follows.

Limitation #2 on page 15:

"A plant may be considered consistent with the basis for the ATWS Rule (i.e., Group 2) if its cycle-specific reload analysis demonstrates that its UET is less than 5 percent for the ATWS Rule reference configuration of no control rod insertion, no PORVs blocked, and all AFW available.

A plant may also be considered consistent with the basis for the ATWS Rule if the 95% MTC is equal to or more negative than -8 pcm/° F, provided that the licensee demonstrates the validity of the MTC requirement via analysis (i.e., peak RCS pressures <3200 psia using an applicable model and the 95% MTC value) or evaluation (by comparing the current plant conditions to the key input parameters, including the MTC, used in the reference analysis that yielded peak RCS pressures <3200 psia.)."

WCAP Revisions

WCAP markups are provided in Comment 9.

NRC Response 13

See the NRC Response 9 for the discussion on the use of MTC in determining whether or not a plant is consistent with the ATWS Rule basis. The NRC staff's position is that the use of MTC must be based on a plant-specific analysis to the ATWS basis acceptance criterion for the ATWS Rule reference configuration.

Limitation and Condition 2 has been revised to reflect the acceptability of using a threshold '95 percent MTC' in determining whether or not a plant is in compliance with the ATWS Rule basis.

<u>PWROG Comment 14 (Page 15, Lines 20-27: Limitation and Condition 3)</u>

The draft SE states "A plant that implements the WCAP-15831-P, Revision 1, methodology must submit a plant-specific implementation license amendment to the NRC for its review and approval prior to first implementing this approach. The license amendment must include ... ". As noted in Comment 5, a license amendment is not required to implement the methodology contained in WCAP-15831-P, Revision 1, unless a UET requirement is included in the Technical Specifications, or a review of the activity to implement the methodology determines that prior NRC review and approval is required.

PWROG Suggested Resolution of Comment

The requirement for submittal of a plant-specific license amendment should be revised as discussed above.

WCAP Revisions

None required.

NRC Response 14

This comment is the same as Comment 5, which was not incorporated. This comment is not incorporated. See NRC Response 5 for details.

PWROG Comment 15 (Page 15, Lines 28: Limitation and Condition 3a)

The draft SE states "The results of its CPT and UET calculations for the reference-case conditions ..." The term "reference-case" may be confused with the term "ATWS reference configuration" used in the WCAP which refers to the configuration of no rod insertion, 100% auxiliary, and no blocked power operated relief valves. Also see Comment 12.

Resolution of Comment

It is suggested that the term "reference-case" be changed to "zero UET design conditions".

WCAP Revisions

None required.

NRC Response 15

This comment is the same as Comment 12, which was incorporated. This comment is incorporated. See NRC Response 12 for details.

PWROG Comment 16 (Page 15, Lines 34-37: Limitation and Condition 3c)

The draft SE states "An analysis of the minimum time to the 3200 psig limit under the most limiting operating conditions. The licensees must define its most limiting ATWS mitigation conditions (i.e., manual rod control, no PORVs, half AFW, etc.) and provide a basis for why these represent the most limiting conditions for its plant." The WOG's position is that an explicit analysis is not required in every case.

PWROG Suggested Resolution of Comment

The 90 second time cited in Section 4.3 is intended to be a bounding value for all plants. It is based on the limiting 4-loop plant configuration with no control rod insertion, no PORVs, 50% AFW, and a bounding reactivity core model. It is likely that this minimum time can easily be shown to apply to most plants without an explicit analysis in every case. An explicit analysis may be warranted in some cases in which the assumptions above are not bounding, but should not be required for every application.

WCAP Revisions

Revisions for Appendix G

Under "Supplementary Clarification 2," the following text will be added to the end of the response.

The licensee must justify the use of 90 seconds as the minimum time to the 3200 psig limit for their plant. The licensee should review the analysis assumptions described in Section 4.3 (i.e., those that form the basis for the 90 seconds time) and confirm that these represent the most limiting conditions for its plant.

NRC Response 16

TR WCAP-15831-P, Revision 1, does not provide any information to justify that the 90 second minimum time is bounding for any Westinghouse plant design. The PWROG comment does not provide any new information. The NRC staff's review was independent of the specific minimum time limit. Instead the NRC staff focused on whether defense-in-depth and safety margin concerns could be resolved if a licensee demonstrated the ability to implement the proposed compensatory action and mitigate and ATWS event in a timely manner. Additionally, the TR does not address human factor concerns such as operating procedures and personnel training. Therefore this comment is not accepted.

Limitation and Condition 3.c. has been revised to reflect that the acceptance criterion is ASME Code Service Level C not 3200 psig.

PWROG Comment 17 (Page 16, Lines 16-17; Limitation and Condition 3g)

The draft SE states "A plant-specific risk analysis, similar to the generic analyses presented in WCAP-15831-P, Revision 1, addressing the risks for all five operating states." As discussed in Comment 6, it is not necessary to consider all five operating states. See Comment 6 for the details of this justification.

PWROG Suggested Resolution of Comment

This Condition and Limitation should be eliminated.

WCAP Revisions

As discussed in Comment 6.

NRC Response 17

This comment is also addressed in Comment 6. See NRC Response 6 for details.

PWROG Comment 18 (Page 16, Lines 18-20: Limitation and Condition 3h)

The draft SE states "A description of the analyses and controls (procedures) that will be implemented during each cycle's reload analysis to ensure the licensee's results are consistent with the methodology approved by the staff."

PWROG Suggested Resolution of Comment

The reload process for confirming that a core design meets ATWS requirements will be further described as provided in the following paragraphs.

WCAP Revisions

The following text, which specifically addresses L&C 3h, should replace the final paragraph on Page 10-2 in Section 10 of the WCAP.

Insert for page 10-2:

With respect to the ATWS reload analysis process, plants can be grouped into the following categories (see also Section 7.2.1 and Appendix G, page G-2):

- Group 1: Plants with a Diverse Scram System (DSS)
- Group 2: Plants without a DSS, consistent with the ATWS Rule (installed AMSAC) and the basis for the ATWS Rule.
- Group 3: Plants without a DSS, consistent with the ATWS Rule (installed AMSAC) but not the basis for the ATWS Rule.

A plant consistent with the basis for the ATWS Rule (Group 2) will have either:

• a core design with a best estimate UET of < 5% for the ATWS Rule reference configuration/condition of no control rod insertion, all auxiliary Feedwater (AFW) available, and no PORVs blocked, or
• a HFP, equilibrium xenon MTC equal to or more negative than -8 pcm/°F for 95% of the cycle, provided that the validity of the MTC requirement is demonstrated via analysis (i.e., peak RCS pressures <3200 psia using an applicable model and the 95% MTC value) or evaluation (by comparing the current plant conditions to the key input parameters, including the MTC, used in the reference analysis that yielded peak RCS pressures <3200 psia.).

Plants in Groups 1 and 2 are not required to implement the methodology in this WCAP for a reload core since these plants, by definition, have installed a DSS or are consistent with the ATWS Rule and the basis for the ATWS Rule.

Group 3 plants that implement the methodology in this WCAP will be required to develop and maintain an ATWS CMP and to demonstrate that the impact of the reload core design on CDF meets the RG 1.174 acceptance guideline shown on Figure 3Hof RG 1.174.

For these plants, critical power trajectories as a function of transient inlet temperature will be generated for the plant for use in UET calculations. For each reload core design, these critical power trajectories will be reconfirmed to be applicable to the upcoming cycle by ensuring that the plant systems and operating conditions remain consistent with the assumptions used in generating the trajectories. With these critical power trajectories, UET calculations will then be performed for the twelve ATWS cases described in Tables 4-36 and 4-37 assuming HFP and equilibrium xenon initial conditions. These twelve cases include six different plant configurations (0, 1, or 2 PORVs available with either 50% or 100% AFW) and two different control rod insertion assumptions (no insertion or 1 minute of insertion of the lead control bank). The UET calculations must demonstrate that a favorable plant configuration is available

throughout the cycle. For example, a plant configuration having full AFW and no PORVs blocked and employing automatic rod control would be a favorable configuration. If no favorable plant configuration is available, then either reanalysis of the critical power trajectories and UETs must be performed using improved plant/cycle specific information or the core must be redesigned to enhance moderator feedback. In either case, favorable plant configurations would ultimately be identified.

The results of the UET calculations will be part of the reload evaluation documentation routinely provided for each reload core design. Using this UET information, the licensee will develop an ATWS CMP for the upcoming cycle and perform a CDF evaluation. The ATWS CMP can be maintained as part of the licensee's Configuration Risk Management Program (10 CFR 50.65 (a)(4), Maintenance Rule). The requirement for an ATWS CMP will be documented in the reload evaluation for the upcoming cycle.

NRC Response 18

See the NRC Response 9 for the discussion on the use of MTC in determining whether or not a plant is consistent with the ATWS Rule basis. The NRC staff's position is that the use of MTC must be based on a plant-specific analysis to the ATWS basis acceptance criterion for the ATWS Rule reference configuration.

See NRC Response 1 for a discussion on TR WCAP-15831-P, Revision 1, implementation. Any plant that implements the TR must fully comply with all of its requirements and the NRC's SE.

While the NRC staff acknowledges the additional information to be placed in TR WCAP-15831-P, Revision 1, with respect to the administrative controls for managing the implementation of the TR methodology, given the potential for plant specific requirements, the NRC staff believes it is prudent to retain Limitation and Condition 3.h.

PWROG Comment 19 (Page 16, Lines 27-35: Limitation and Condition 5)

Limitation and Condition 5 is addressed in Comment 11.

PWROG Suggested Resolution of Comment

See the discussion of Comment 11. The WOG will treat unfavorable part-power operation as full power operation for the purpose of determining UET. The WOG will also track UET in part-power operation as if the plant were at full power (1 calendar day in an unfavorable condition at part-power will be tracked as 1 EFPD). It is suggested that the text in the SE be revised to reflect this.

WCAP Revisions

Markups are provided in the response to Comment 11.

NRC Response 19

See NRC Response 11. The NRC staff believes the original wording of this Limitation and Condition adequately captures the main point that only part-power conditions that actually create a UET need to be counted against the 30-day UET limit for that cycle's 30-day UET limit

and that the part-power UET can not be prorated based on a reduced power level. Therefore, no change was made to Limitation and Condition 5.

PWROG Comment 20 (Page 16, Line 36 to Page 17, Line 12; Limitation and Condition 6)

Limitation and Condition 6 is addressed in Comment 7.

PWROG Suggested Resolution of Comment

Since this issue is already addressed in the calculation of the UETs and use of the UETs in the PRA model, it is recommended that this Limitation and Condition be eliminated from the SE since it is inherent in the approach.

WCAP Revisions

None required.

NRC Response 20

This comment is also addressed in Comment 7. Limitation and Condition 6 has been modified to be consistent with NRC Response 7. See NRC Response 7 for details.

PWROG Comment 21 (Page 17, Lines 20-25: Limitation and Condition 8)

Limitation and Condition 8 is addressed in Comment 8 which refers to Comment 6.

PWROG Suggested Resolution of Comment

As stated in Comment 6, there is no need to assess the impact on LERF due to the very conservative assessment included in the WCAP and the limitation of operating in a unfavorable exposure configuration, with regard to 3200 psi, for a maximum of 30 days. Only the CDF evaluation is required. This Limitation and Condition should be modified to only required that CDF be addressed.

WCAP Revisions

As discussed in Comment 6.

NRC Response 21

This comment is also addressed in Comment 6. Limitation and Condition 8 has been modified to be consistent with NRC Response 6. See NRC Response 6 for details.

PWROG Comment 22 (Page 15, Lines 2-5)

As noted in comment 1, all licensees are not required to implement an ATWS CMP. As a clarification, an ATWS CMP will only be required for plants that are in Group 3 as defined in Section 7.2.1 of the WCAP and implement the WCAP methodology. Group 3 includes plants that have not installed a diverse scram system, are consistent with the ATWS Rule (installed AMSAC), but are not consistent with the basis for the ATWS Rule. This is consistent with Section 7.2.1 of the WCAP which states "Plants in Groups 1 or 2

will not be required to implement the ATWS CMP. Plants in Group 3 will be required to implement an ATWS CMP."

PWROG Suggested Resolution of Comment

To ensure that it is clear that only Group 3 plants will need to develop an ATWS CMP, it is recommended that this be clarified in the lead-in to the Limitations and Conditions. It is recommended that the following text be added in Line 5. "These Limitations and Conditions only apply to those plants that use the WCAP-1583 1-P, Revision 1 methodology (Group 3 plants) to address ATWS."

WCAP Revisions

None required.

NRC Response 22:

As previously stated, the NRC staff agrees that not all licensees are required to implement TR WCAP-15831-P, Revision 1. However, the NRC staff requires that all plants implementing the TR must do so fully and in accordance with the NRC staff's SE, which includes developing a CMP.

<u>PWROG Miscellaneous Clarifications</u>

For consistency throughout the WCAP, the following changes will be made.

Page 7-4 and Page G-3: In the bulleted item "A core design limit on UET of < 5% for the ATWS Rule reference configuration...", the < will be changed to ≤.

NRC Response

The NRC staff agrees with the miscellaneous clarification.