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1. SUMMARY

This report documents our review of AmerGen's Technical Specification Change Request No. 308 for Oyster Creek[1] and the supporting documentation provided in NEDC-33065P, [2] a licensing topical report that describes a plant-specific analysis that documents the applicability of Long Term Solution Option II to Oyster Creek, a boiling water reactor (BWR) of type BWR-2.

Our review is based on data presented in the submitted documentation, a meeting at the Oyster Creek plant on August 29, 2002, and during a number of previous meetings with the Boiling Water Reactor Owners' Group (BWROG) and General Electric (GE). Based on our technical evaluation of these data, we find that Long Term Solution Option II is applicable to Oyster Creek because of its low power density, the unfiltered flow-biased thermal-power scram, and the quadrant symmetry of its average power range monitoring (APRM) system.

The implementation of Option II in Oyster Creek will require modifications to the technical specifications to reflect the more restrictive flow-biased scram setpoints that are required to avoid safety limit violations. The implementation will also require the administrative enforcement of an exclusion region.

Based on this review, we conclude that, following the implementation proposed in Technical Specification Change Request No. 308[1] and NEDC-33065P,[2] General Design Criteria (GDC) 12 will be satisfied by Oyster Creek even in the unlikely event that unstable power oscillations were to develop.

2. BACKGROUND

A long term solution to the stability problem is required to prevent the violation of specified acceptable fuel design limits (SAFDL) in the event of out-of-phase instabilities or core-wide instabilities with large local power peaking. Under these events, the reactor protection system (specifically the high APRM scram, or the flow-biased thermal-power scram) may not provide sufficient margin to prevent SAFDL violations under all postulated operating conditions in all reactors.

The reactor protection system in BWR-2's (e.g., in Oyster Creek) is based on an APRM system with quadrant symmetry. All other BWRs have an APRM system that averages neutron flux measurements from all over the core. Because of the quadrant symmetry, the APRM signal in BWR-2's does not "average out" the oscillations in out-of-phase instabilities, and automatic protection for this type of instabilities is possible. Long Term Solution Option II takes advantage of this special configuration and shows by analysis that the existing reactor protection system in BWR-2's provides protection against all expected instability modes.

Only two BWR-2's are in operation in the U. S.: Oyster Creek and Nine Mile Point-1. Oyster Creek submitted a topical report[3] in 1991 showing by analysis that their plant satisfied the requirements of Long Term Solution Option II. This report was reviewed and accepted[4] in 1992 following the evaluation and acceptance of other Long Term Solutions.[5-8] Nine Mile Point-1, the other Solution II plant submitted a request[9,10] to fully implement Option II in 1995. The request was reviewed and accepted[11] in 1996 following the evaluation and acceptance of other *Detect and Suppress* based Long Term Solutions[11-13] and the review of the flow control trip reference (FCTR) card, which was originally designed for Enhanced Solution IA.[14]

3. EVALUATION

Topical report NEDC-33065P[2] documents a detailed evaluation of the applicability of Solution II to Oyster Creek. In addition, Section 7 of this report documents the reload confirmation evaluations that must be performed every cycle to confirm that the generic results in the topical report are still applicable. This report follows the methodology already used and approved for Nine Mile Point.[10]

Because Solution II is in essence a *Detect and Suppress* option, the evaluation in NEDC-33065P[2] follows a procedure similar to the one already submitted[12] and reviewed[13] for other *Detect and Suppress* options, such as Solution III and I-D. As with other application of the *Detect and Suppress* methodology, the Option II implementation in Oyster Creek has followed three major steps:

1. Step 1 is to define the minimum critical power ratio (MCPR) that exists prior to the onset of the oscillation. The topical report assumes two initial MCPR (IMCPR) conditions: (a) operation at operating limits with 45% flow at the 100% rod line, and (b) operation at nominal conditions with a conservative MCPR followed by an all pump coast down to natural circulation.

   The IMCPR values used in topical report NEDC-33065P[2] are consistent with the approved Detect *and Suppress* methodology and are technically acceptable. The selection of a conservative MCPR to avoid cycle-specific dependence is technically acceptable because the conservative value used is significantly larger than the present MCPR safety limit.

   The choice of "point 1" (45% flow and 100% rod line) for delta-CPR evaluation is technically acceptable, because that flow is the highest intercept of the exclusion region and the Oyster Creek operating map. Thus, instabilities are not expected in Oyster Creek for flows higher than 45%. Note that this choice of flow threshold affects the actual flow-biased scram setpoint, which has a discontinuity at 45% flow to cover the maximum extended road line operation.

2. Step 2 is to determine the magnitude of the peak fuel bundle power oscillation. The Oyster Creek implementation follows the approved Nine Mile Point methodology,[9-11] which deviates slightly from other approved *Detect and Suppress* methodologies (i.e., Solution III and I-D) in the following items:

   a. The flow-biased trip setpoint has been adjusted in NEDC-33065P[2] in order to satisfy the MCPR safety limit criteria. The existing flow-bias trip setpoint is not adequate and must be lowered to satisfy these criteria. While this is a technically acceptable deviation, it poses some possible future restrictions on reload confirmations; and the possibility exists that the flow-biased setpoints may have to be modified in the future.

b. The Oyster Creek implementation conservatively uses the most limiting oscillation contour to define the ratio between APRM and hot bundle oscillations. The implementation also uses a 1.10 penalty on the peak hot bundle oscillation to account in a deterministic manner for the overshoot caused by the oscillation growth rate and the scram time delay. The Use of conservatively limiting numbers avoids the need for the Monte Carlo-type calculations that are performed by other *Detect and Suppress* methodologies. This is a technically acceptable deviation.

c. The average power for the initial condition is assumed to be at the 100% rod line. The choice of a high average power reduces the oscillation amplitude required to reach the scram setpoint. If the oscillations were to occur at a lower operating power, the oscillation amplitude when the APRM scram setpoint is reached would be significantly larger and MCPR safety limits may be violated. This is the most questionable assumption in the topical report and must be weighted along with the other conservative assumptions and the proposed administrative restriction (an administratively-controlled exclusion region) to judge its technical acceptability. Because an administratively controlled exclusion region is enforced in Oyster Creek, the most likely instability scenario would be a flow-reduction event, which is likely to occur from the 100% rod line. The exclusion region would minimize the likelihood of startup instabilities. Thus, we conclude that the 100% rod line assumption for initial conditions is a technically acceptable assumption for these calculations.

3. The final step 3 is to determine the final MCPR by using a "generic" correlation that defines the loss in CPR for a given peak fuel bundle power oscillation. This generic correlation is known as the DIVOM curve, and its generic applicability has been question recently, resulting in Part 21 event, which is still on-going at this time.

   Oyster Creek has used the generic DIVOM curve for this application as the best available information at the time. Oyster Creek has made a verbal commitment to review the applicability of their current evaluation once the Part 21 DIVOM issue is resolved.

   We conclude that the use of the best-available information at this time (i.e., the generic DIVOM curve) is an acceptable technical approach for Oyster Creek because it will results in more conservative scram setpoints for Cycle 19 that the ones currently in place at Oyster Creek for cycle 18. We recommend that NRC follow up with Oyster Creek and review their evaluation once a final DIVOM approach is reached.

The application in topical report NEDC-33065P[2] of the three steps described above indicates that Oyster Creek satisfies the requirements of a Long Term Solution Option II if the flow biased scram setpoint is reduced to less than 54.6% of rated power at natural circulation conditions (22% rated flow) and 68.4% of rated power at 45% flow. In the Technical Specification Change Request No. 308 submittal,[1] Oyster Creek proposes to implement this change by replacing the flow reference trip control cards by the new cards developed originally for Option I-A,[14] because they allow significant flexibility to specify discontinuous scram set points as function of flow. This approach is similar to the one used in Nine Mile Point 1, and it is technically acceptable.

Section 7 of topical report NEDC-33065P [2] documents the reload confirmation procedures that will be required for future Oyster Creek core loadings. These procedures are consistent with those for other reviewed long-term solutions and are technically acceptable.

4. CONCLUSIONS AND TECHNICAL RECOMMENDATIONS

The main conclusions from this review are:

1. Long Term Solution Option II is applicable to Oyster Creek because of its flow biased, unfiltered scram system, and the quadrant symmetry of its average power range monitoring (APRM) system.

2. The proposed Oyster Creek Option II implementation satisfies the main criteria of a Long Term Solution by providing a viable detect and suppress function that will guarantee, in the case of instability, a very small likelihood of core damage without the need of operator intervention. This implementation is defined in Technical Specification Change Request No. 308[1] and NEDC-33065P,[2] and it includes a modification of the flow-biased scram hardware and a Technical Specifications modification to lower the setpoint to a value consistent with the calculation assumptions.

3. An administratively controlled exclusion region is required to minimize the probability of startup instabilities and to satisfy the 100%-rod-line initial-condition assumption in the analyses.

4. The reload confirmation procedures defined in Section 7 of and NEDC-33065P,[2] are consistent with other reviewed and approved long term solutions,[12] and they are technically acceptable for this Oyster Creek implementation.

Based on this review, we conclude that, following the implementation proposed in Technical Specification Change Request No. 308[1] and NEDC-33065P,[2] General Design Criteria (GDC) 12 will be satisfied by Oyster Creek even in the unlikely event that unstable power oscillations were to develop.

5. REFERENCES

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