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Enclosure 2

SUMMARY

This report documents our review of Niagara Mohawk letter number NMP1L-0985[1] and GENE-A13-00360-02,[2] a licensing topical report that describes a plant-specific analysis that documents the applicability of Long Term Solution Option II to Nine Mile Point 1, a boiling water reactor (BWR) of type BWR-2.

Our review is based on data presented in the submitted topical report and during a number of meetings with the Boiling Water Reactor Owners' Group (BWROG) and General Electric (GE). Based on our evaluation of these data, we find that Long Term Solution Option II is applicable to Nine Mile Point-1 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 Nine Mile Point-1 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 NMP1L-0985[1] and GENE-A13-00360-02,[2] General Design Criteria (GDC) 12 will be satisfied by Nine Mile Point-1 even in the unlikely event that unstable power oscillations were to develop..

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 Nine Mile Point-1) 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 these 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 has been operating under the BWROG Interim Corrective Actions (ICAs) and is ready now to fully implement Option II based on the calculations presented in NMP1L-0985[1] and the GENE-A13-00360-02[2] licensing topical report.

EVALUATION

Topical report GENE-A13-00360-02[2] documents a detailed evaluation of the applicability of Solution II to Nine Mile Point-1. 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.

Because Solution II is in essence a *Detect and Suppress* option, the evaluation in GENE-A13-00360-02[2] follows a procedure similar to the one already submitted[9] and reviewed[10] 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 Nine Mile Point-1 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 40% flow at the 100% rod line, which results in a IMCPR of 2.05, and (b) operation at nominal conditions with a conservative MCPR of 1.20 followed by an all pump coast down to natural circulation, which results in an IMCPR of 1.65.

The IMCPR values used in topical report GENE-A13-00360-02[2] are consistent with the approved *Detect and Suppress* methodology and are technically acceptable. The selection of a conservative 1.20 MCPR to avoid cycle-specific dependence is technically acceptable because the present MCPR safety limit is 1.07 and it is not likely to ever be greater than 1.20.

(2) Step 2 is to determine the magnitude of the peak fuel bundle power oscillation. The Nine Mile Point-1 implementation of this step deviates 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 GENE-A13-00360-02[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 this 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 will have to be modified in the future.

(b) The Nine Mile Point-1 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 Nine Mile Point-1, the most likely instability scenario would be a flow-reduction event, which is likely to occur from the 100% rod line. The likelihood of startup instabilities would be minimized by the exclusion region. 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. The use of a "generic" delta-CPR correlation would not be possible if a "bounding" answer was required; however, the *Detect and Suppress* methodology[9] that has been reviewed[10] previously is based on a 95-95 statistical approach. In our review,[10] we found that the use of a "fairly-conservative" delta-CPR correlation in conjunction with a statistical distribution of operating conditions results in a high-likelihood that fuel integrity will not be compromised for the likely instability events. This conclusion applies to the Nine Mile Point-1 implementation with the use of conservative limiting values instead of the statistical distributions of the standard *Detect and Suppress* methodology.[9]

The application in topical report GENE-A13-00360-02[2] of the three steps described above indicates that Nine Mile Point-1 satisfies the requirements of a Long Term Solution Option II if the flow biased scram setpoint is reduced to less than 52.1% of rated power at natural circulation conditions (24.3% rated flow) and 72.3% of rated power at 40% flow. In the NMP1L-0985[1] submittal, Niagara Mohawk proposes to implement this change by modifying the flow reference trip control cards (possibly by replacing them by the new cards developed for Option I-A[11]). The implementation of Option II in Nine Mile Point-1 will not be completed until the modified technical specifications are submitted reflecting the new recommended flow-biased setpoints and the enforcement of the administratively controlled exclusion region.

Section 7 of topical report GENE-A13-00360-02[2] documents the reload confirmation procedures that will be required for future Nine Mile Point-1 core loadings. These procedures are consistent with those for other reviewed long term solutions and are technically acceptable.

Oyster Creek is the only other U.S. BWR to which Option II applies. The results presented in the old Oyster Creek licensing topical report[3] indicate that, based on these old calculations, BWR2's would not require a reduction in flow-biased scram setpoint, and the Oyster Creek implementation of Option II was reviewed and approved in 1992 based on those results. We have not been able to ascertain the exact difference why the standard flow-biased scram setpoints are adequate for Oyster Creek and not for Nine Mile Point-1. The calculational methods used in the old Oyster Creek licensing topical report[3] are similar, but not exactly the same as those used in the new Nine Mile Point-1 report.[2] The main differences are two:

1. The delta-CPR correlation used in the new Nine Mile Point-1 report[2] is a more accurate correlation, that was developed after significant effort and documented in NEDO-32465.[9]

2. The second difference is the use of more current oscillation contours and calculation methodology in the new report.

CONCLUSIONS AND TECHNICAL RECOMMENDATIONS

The main conclusions from this review are:

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

(2) The proposed Nine Mile Point-1 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 an instability, a very small likelihood of core damage without the need of operator intervention. This implementation is defined in Niagara Mohawk letter number NMP1L-0985[1] and GENE-A13-00360-02,[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 GENE-A13-00360-02,[2] are consistent with other reviewed and approved long term solutions,[8] and they are technically acceptable for this Nine Mile Point-1 implementation.

Based on this review, we conclude that, following the implementation proposed in NMP1L-0985[1] and GENE-A13-00360-02,[2] General Design Criteria (GDC) 12 will be satisfied by Nine Mile Point-1 even in the unlikely event that unstable power oscillations were to develop.

REFERENCES

1. NMP1L-0985. Letter from C. D. Terry, Niagara Mohawk, to the U. S. Nuclear Regulatory Commission. October 2, 1995.

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11. NEDO-32339, *Reactor Stability Long-Term Solution: Enhanced Option I-A,* Licensing Topical Report, GE Nuclear Energy, March 1994.