ENCLOSURE 2

MFN 13-094

Description of Evaluation

Non-Proprietary Information - Class I (Public)

IMPORTANT NOTICE

This is a non-proprietary version of Enclosure 1 to MFN 13-094, from which the proprietary information has been removed. Portions of the enclosure that have been removed are indicated by open and closed double square brackets as shown here [[ ]].

Description of Evaluation

Technical Background

Description of the NUMAC Voter Interface with Reactor Protection System (RPS)

There are four Voters installed in each PRNM System. The Voters are designated as Voter 1, Voter 2, Voter 3, and Voter 4. Each Voter contains [[ ]] Relay Logic Card Modules. On an individual Voter basis, [[ ]] Relay Logic Card Modules each control a Neutron Monitoring System (NMS) HFA Relay [[

]]

The RPS uses One-Out-of-Two taken twice logic. Therefore, in order for a scram to occur, a RPS Division 1 Sub-Channel and a RPS Division 2 Sub-Channel must both be in a trip condition at the same time. [[

]] Normally, all four channels trip if plant conditions warrant RPS action.

The logic is fail-safe. This means that the logic must be energized for the plant to operate and that each RPS Sub-Channel will fail to the safe condition during a loss of power.

Due to the inherent redundancy in the system design described above, a reactor scram will occur as long as [[

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The above analysis is generally true for any plant that has been updated with a NUMAC based PRNM System with the following exceptions:

a. Some plants use different types of functionally equivalent relays in place of HFA Relays (the term HFA Relay and Electro-Mechanical Relay will be used interchangeably for the remainder of this letter).

b. One plant has a unique configuration because an additional relay is installed in parallel with the HFA Relay.

c. [[

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d. [[

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Description of [[ ]] **Relay Logic Card Module**

[[ ]] Relay Logic Card Module [[

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As described in the previous section of this letter, [[ ]] Relay Logic Card Modules interface with the RPS for each plant. [[

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NOTES

There are additional Solid State Relays on each Relay Logic Card Module but these are beyond the scope of this letter because their outputs do not perform Safety-Related Functions.

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Discussion of the Failures under Evaluation

A domestic BWR contacted GE-Hitachi (GEH) I&C Engineering to request technical assistance following the observed failure of three [[ ]] Relay Logic Card Modules during surveillance testing. The Relay Logic Card Modules were located in three separate Voters located in two separate units. GEH provided technical assistance and requested the subject BWR return the failed Relay Logic Card Modules to GEH for failure analysis. The subject BWR reported that the affected Voters failed to de-energize their downstream HFA Relays during some portion of the surveillance test.

Relay Logic Card Modules [[
]] were returned to GEH and initial failure testing was performed. Each Relay Logic Card Module was found to contain a similar failure. [[

]]

The observed failures were determined to be a 10 CFR Part 21 concern for two reasons. First, because the Relay Logic Card Modules failed to a non-conservative condition, and second, because the failure of a [[ ]] on all three Relay Logic Card Modules was considered possible evidence of a common cause failure.

During the 10 CFR Part 21 Evaluation a separate domestic BWR also encountered a similar failure of a Relay Logic Card Module. [[
]] This failure was also considered in the overall evaluation.

Discussion of the Failure Analysis

Seven separate and specific causes of failure were investigated:
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Summarized Results of the Failure Analysis

Finding 1

The analysis suggests the Solid State Relay failures represent a common cause failure. The common cause is long-term operation of the chips at elevated temperatures.

This conclusion is based on the following facts:
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Finding 2

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Finding 3

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Finding 4

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Finding 5

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Finding 6

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Recommendations

For [[ ]] Relay Logic Card Modules that have been in operation for over ten years, Relay Logic Card Module replacement should be scheduled and accomplished at the first reasonable opportunity.

For plants with Relay Logic Card Modules in operation for less than ten years, a program should be implemented to replace the [[ ]] Relay Logic Card Modules before the 10 years is reached.

[[

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Without additional data, the 10 year replacement recommendation would continue to apply to the replacement Relay Logic Card Module as well.

GEH recommends plants with NUMAC Power Range Neutron Monitoring Systems periodically trend the steady state operating currents of their NMS Electro-Mechanical Relays to ensure the steady state operating currents of the relays are not degrading and causing the Solid State Relays to operate at elevated temperatures.

ABWR and ESBWR Design Certification Documentation Applicability

The issue described above has been reviewed for applicability to documentation associated with 10 CFR 52, and determined to have no effect on the technical information contained in either the ABWR certified design or the ESBWR design in certification. This is true because the Design Certification Documentation does not include the specific design details associated with this hardware.