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SUBJECT: Forwards response to 970422 telcon RAI re core shroud insp results & proposed stabilizer assembly modifications.

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April 27, 1997
NMP1L 1211

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

RE: Nine Mile Point Unit 1
Docket No. 50-220
DPR-63

Subject: ***Responses to NRC Staff Questions Provided During Telephone Conversation of April 22, 1997, on Core Shroud Cracks and Repair***

Gentlemen:

By letter dated April 8, 1997, Niagara Mohawk Power Corporation (NMPC) submitted to the NRC the results of the inspection of Nine Mile Point Unit 1 (NMP1) Core Shroud and Stabilizer Assemblies conducted during the Spring 1997 refueling outage.

Following the submittal of April 8, 1997, the staff requested additional information from NMPC pertaining to the core shroud inspection results and the proposed stabilizer assembly modifications (during the telephone conversation on April 22, 1997). The responses to the questions are provided in the attachment to this letter.

Sincerely,

M. J. McCormick Jr.

Martin J. McCormick Jr.
Vice President - Nuclear Engineering

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Enclosures

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ATTACHMENT

APRIL 22, 1997 TELECON REQUEST FOR ADDITIONAL INFORMATION REGARDING CORE SHROUD WELD CRACKING NINE MILE POINT NUCLEAR STATION UNIT 1

Request for Information #1

Why is the minimum ligament calculation provided by the April 8, 1997 submittal different from the calculation provided by the submittal dated February 7, 1997?

Required Response #1

The earlier submittal provided a general, conservative, and bounding analysis in that:

1. A pressure of 63 psi was used for all locations. The revised minimum required ligament (Lmin) used the design basis pressure based on shroud location. This lowered the pressure for above core plate locations to 22 psi for the April 8, 1997 submittal.

2. An intentionally conservative inspection uncertainty was applied since the actual inspection technique was not defined. A value of 4T or 6 inches was applied for the February 1997 Lmin. The revised Lmin used the applied inspection method uncertainty as discussed in Enclosure 1, Table 5-2.

3. The February 7, 1997, analysis used a value of Sm of 16 ksi instead of the ASME acceptance criteria of 16.9 ksi.

Request for Information #2

Does minimum ligament calculation meet code allowable?

Required Response #2

The analysis was performed according to the NRC approved core shroud I&E document (9/94) (GENE-523-113-0894). The minimum ligament calculations met the safety margin equations of Appendix C, Section XI (i.e., 3 and 1.5 factors for axial cracks in piping).

Request for Information #3

What range of conductivity and data was used to support 5×10^{-5} crack growth rate development (i.e., basis for NUREG-0313)?

Required Response #3

The NRC rate of 5×10^{-5} in/hr was designed to represent a bounding crack growth rate for use in evaluating crack growth in internals. It can be considered bounding for several reasons: (1) the high conductivity and the specific anions responsible for the conductivity in the tests, (2) the stress intensity level used in the tests, and (3) the material condition used in the evaluation.

First, the data used to develop the crack growth rate information, that is the basis of the NRC disposition rate, were produced in laboratory facilities where the conductivity ranged from 0.3 μS/cm to 0.7 μS/cm for tests conducted in 288°C water containing 200 ppb oxygen, and from 0.5 to 1.5 μS/cm for tests conducted in 288°C water containing 6000 ppb oxygen. In all cases, the conductivity of the water resulted from additions of sulfate to the water. Both sulfate and chloride are widely considered to be the most aggressive anions in terms of accelerating crack growth in stainless steel in high temperature water. It required the addition of approximately 90 ppb to >200 ppb sulfate (mostly as sodium sulfate) to achieve the high conductivity levels. However, in operating BWRs over the last five to ten years, the sulfate and chloride species are nominally very low (1-2 ppb) under normal operation, and the chloride levels are restricted to a maximum of 200 ppb by the Technical Specifications. Further, the conductivity of the acid form (as almost always exists in BWRs) would be approximately a factor of 3 higher than in the laboratory tests. The conductivity in the NMP1 plant is due substantially to species other than sulfate and chloride; these species (like chromate) have much less effect on the crack growth rates. Therefore, the data used to develop the NRC position presented in NUREG-0313 represent an extreme condition that can safely be assumed to be bounding for normal operation and representative of the technical specification chloride and conductivity levels. Therefore, the crack growth rate can be viewed as bounding all plant operation water chemistry conditions.

The second critical consideration is the stress intensity factor associated with the bounding crack growth rate of 5×10^{-5} in/hr. The majority of tests were performed at values of approximately 25 ksi-in$^{1/2}$. For the shroud cracks, the residual stresses in the shroud produce a crack tip stress intensity factor that is significantly lower than the value used in the tests, particularly when the crack depth is greater than 20% of the shroud wall thickness. The lower stress intensity has a significant effect on reducing the crack growth rate as shown in Table 4-1 in GENE-B13-01869-043, Rev. 0. This consideration provides further support that 5×10^{-5} in/hr is a bounding rate, both under normal operating water chemistry, and for operation at the Technical Specification limit for water chemistry.

The final factor affecting the high crack growth rate in the data used to determine the NRC bounding rate was the level of sensitization of the laboratory test specimens. This level was, in many cases, highly furnace sensitized. The sensitization level is expected to bound the sensitization level found in the core shroud or any other welded structure, even after operation in conjunction with irradiation.

In summary, the bounding rate of 5×10^{-5} in/hr can be viewed as conservative even for operation at the technical specification limits. First, the levels and types of impurities

associated with technical specification limit are very similar to the levels and types used in the laboratory tests that produced the bounding 5×10^{-5} in/hr. Secondly, the expected stress intensity levels are much lower for the shroud cracks leading to lower crack growth rates under both normal water chemistry, and even under any postulated water chemistry conditions at the technical specification limit.

Crack growth rates have been calculated for expected plant conditions and result in values significantly lower than 5×10^{-5} in/hr as described in Enclosure 1 of our April 8, 1997, submittal.

Request for Information #4

Was GE's analysis done in accordance with ASME Code Section XI IWB3640 both for limit load and LEFM?

Required Response #4

The analysis was performed according to the NRC approved core shroud I&E document (9/94) (GENE-523-113-0894), and it is consistent with NRC SERs for Dresden and Quad Cities 1 shroud evaluations. The safety factors of 3 for normal and upset conditions and 1.5 for emergency and faulted conditions meet the ASME Code Section XI, IWB-3640. Both limit load and LEFM failure modes were included. Crack growth rates were consistent with NRC approved growth rates. Thus, all the ASME and NRC criteria are met.