March 8, 1983

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Docket No. 50-244
LS05-83-03-012

Mr. John E. Maier, Vice President
Electric and Steam Production
Rochester Gas and Electric Corporation
89 East Avenue
Rochester, New York 14649

Dear Mr. Maier:

SUBJECT: CONTAINMENT VESSEL TENDON EVALUATION PROGRAM

Your letter dated February 1, 1982 transmitted GAI Report 2347 outlining the results of the investigation of problems relating to the containment prestressing tendons.

Our review of the report indicates that there is still staff concern regarding the reasons for loss of tension in the Containment Vessel Tendons. Our comments and recommendations are contained in the enclosure.

Please provide your response within 90 days of receipt of this letter.

Sincerely,

Original signed by

Dennis M. Crutchfield, Chief
Operating Reactors Branch #5
Division of Licensing

Enclosure:
As stated

cc w/enclosures:
See next page

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NRC FORM 318 (10-80) NRCM 0240 **OFFICIAL RECORD COPY** USGPO: 1981—335-960

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ENCLOSURE

R. E. GINNA NUCLEAR POWER PLANT

REVIEW OF CONTAINMENT VESSEL TENDON EVALUATION PROGRAM

References: (1) Letter from J. Maier, RG&E to D. Crutchfield, NRC, on Ginna Tendon Evaluation Program, Feb. 1, 1982.

(2) Memo from E. Jordan, IE to L. Shao, NRR, dated Nov. 30, 1979

(3) Letter from L. White, Jr., RG&E to D. Ziemann, NRR, on Tendon Inspection and Lift-Off Verification, Dec. 12, 1979

(4) Letter from D. Ziemann, NRR to L. White, RG&E, on Tendon Inspection, March 26, 1980

(5) Trip Report from A. Hafiz and J. Chen to J. Knight on Field Observation of Tendon Surveillance, Nov. 25, 1980

(6) Letter from J. Maier, RG&E to D. Crutchfield, NRR, on Tendon Surveillnce Program, April 29, 1981.

At the Ginna Nuclear Plant in 1977, as a result of required surveillance, the tendons were found to have lost tension in excess of that predicted to be lost over the 40-year lifetime of the plant (Ref. 2). The tendons and associated rock anchors serve to prestress the concrete in order that only compressive loads are applied to the concrete during any accident which could pressurize containment. In order to assure resistance to overturning moment during seismic events, in 1980 the tendons were retensioned to meet design requirements. An investigation was made to determine the cause(s) of the detensioning and evaluate the adequacy and capability of the containment building/rock anchor system (Refs. 3 thru 6). The subject report (Enclosure to Ref. 1)* describes the results of that investigation.

Based on the review of the licensee's submittals in above references and in particular the enclosure to Reference 1,* the staff has concluded that the licensee has not demonstrated conclusively that the stress relaxation of the tendon wires is the only single cause for the larger-than-predicted force loss in the tendons (as the licensee concludes) because:

(1) The small scale rock anchor tests cited by the licensee as the proof of the bond capacity between the grout plug surrounding the rock anchor and the rock indicate that the design bond strength is adequate. However,

*GAI Report No. 2347, February 1982. Unless otherwise noted, comments apply to that document.

the test results (FSAR Figures 5.6.1-6 thru 8) reveal that the slip took place at random loading levels and a slip may take place at a load level somewhat lower than the design bond capacity. These results also show that the load-deformation relationship varied in a wide range and the ultimate bond capacity becomes lower when the effective grout depth increases. No discussion about this unusual behavior is provided in the report.

(2) The time effect on the bond capacity has not been investigated. The small scale anchor test results indicate the load-deformation relationship of the rock anchor bond is nonlinear; therefore, the time effect on bond capacity may be significant.

(3) Four full-size rock anchors tested during installation indicated that bond slip at the grout-rock interface did occur (p. 2-3). The ratio of measured to predicted elongation of the rock anchors varied from 1.68 to 2.02, indicating that the elongation prediction could be off by as much as 100 percent. The causes for this, i.e., because of in-situ rock conditions, grout-rock interface conditions or other reasons, have not been investigated.

(4) The comparison of measured to predicted elongations for "rock anchored tendons" and "non-rock anchored tendons" (Table 2.1-1) indicates that the prediction of the elongations for "rock anchored tendons" is much more uncertain than for "non-rock anchored tendons."

(5) The stress relaxation tests conducted at Lehigh University (Section 3) indicate that two of the three sample wires exhibit greater stress relaxation properties than what was used in the original design while one sample wire exhibits less relaxation. This does not totally support the licensee's contention that stress relaxation is the sole cause of prestress loss.

(6) The 1981 tendon surveillance results (Table 5-2) show that the ratio of measured to predicted tension loss of same type tendons (from same heat) varied in a wide range, from 1.0 to 3.2. The 1981 prediction of the tendon force loss should have used the Lehigh test results.

For the above reasons, the staff remains concerned that part of the loss of prestress could be due to the rock anchor system or other factors (see comments below) in addition to stress relaxation of the wire. Since the rock anchors are not accessible, direct investigation of the rock anchors contribution to the tendon force loss is impracticable, if not impossible. Therefore, in order to assure the safety function of the tendon system, more frequent monitoring of tendon force is required.

Our additional comments concerning the report forwarded by reference (1) are as follows:

(7) The proposed future surveillance, Section 7.0, is not adequate in light of the Lehigh test results which indicate that two-thirds of the tendons may lose their design safety margin in about 10,000 hours due to stress

relaxation alone. Therefore, a more frequent inspection, on an annual basis, is required for this reason as well as that noted above.

(8) The licensee should provide the NRC staff with a schedule which indicates when the Lehigh tests for tendon wire relaxation will be available and, based on that schedule, when the licensee will provide an assessment of relaxation predictions by the factor method. The schedule should be provided immediately. That assessment should be included in the next tendon surveillance report and integrated with the data collected during the next surveillance. It is expected that a significant portion of the Lehigh test data will be available before the report of the summer 1983 tendon surveillance is required to be forwarded to the staff. Therefore, there should be sufficient data available in order to construct curves of tendon force vs. time, including tolerance bands of allowable upper and lower bounds for the tendons surveyed as outlined in Reg. Guide 1.35.1. It is expected that the next forthcoming surveillance report will contain such curves so that an extrapolation can finally be made of the tendon forces to be expected in the future. It is assumed that the next tendon surveillance will be conducted on tendons which include at least some of the same group as those surveyed in the 1981 inspection.

(9) In the discussion of the effects of the neoprene pads on the tendon prestress loss, it appears that this unique feature of the prestressed concrete system was rather summarily dismissed as a contributing factor to tendon losses. Specifically, a visual inspection of the pads should be performed even if some removal of concrete is involved. The thickness of the pad material should be measured and samples obtained for evaluation of the condition of the elastomeric material. The assumptions made in the report concerning pad deformation were extrapolated from handbook values and must therefore be considered optimistic especially since the pads are overstressed for such material. Since each 0.1 inch of inelastic deformation in the pads would reduce the tendon force by about 9 KIPS (at the 742 KIP design load), the contribution of the pads to loss of tendon force cannot be readily dismissed. Also, since these pads are designed to function as a hinge mechanism in the event of an accident that causes containment pressurization, specific information of their condition should be obtained rather than assuming that they are in serviceable condition.

(10) The report does not reference the load history which may have been collected by monitoring the four load cells which are installed in the tendon system. These load cells were used to record tendon force losses collected in original containment leak rate test (GAI Report No. 1720 dated October 3, 1969) and subsequently to continuously monitor tendon forces. The licensee should provide available data from the load cell readings taken since the retensioning of the tendons and since the 1981 surveillance along with a critical assessment of the information.

(11) The licensee should provide predictions about the expected behavior of the retensioned wire for the following potential conditions:

(a) If the tendons should ever need to be retensioned again in order to maintain prestress.

(b) Expected behavior of the retensioned wire in the event of containment pressurization. Such predicted behavior should be confirmed, to the extent possible, during the next integrated leak rate test.

(12) The long-term effects of variation of temperature on the stress relaxation properties of the wire and the tendon system have not been sufficiently addressed.