Enclosure

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION RELATED TO THE 1985 LICENSE CONDITION 3.E STEAM GENERATOR INSPECTION

SOUTHERN CALIFORNIA EDISON COMPANY (SCE) SAN ONOFRE NUCLEAR GENERATING STATION UNIT 1 DOCKET NO. 50-206

INTRODUCTION

By letter dated June 5, 1985, the NRC revised License Condition 3.E, Steam Generator Inspections, of Provisional Operating License No. DPR-13 to require that SCE provide the NRC with a plan for an inspection of the San Onofre Unit 1 steam generators during the refueling outage scheduled to begin no later than November 30, 1985, and, based upon the inspection results, request Commission approval of resumption of power operation following the inspection. SCE provided its plan to inspect the steam generators in accordance with License Condition 3.E, Steam Generator Inspections, by letter dated July 5, 1985. The report of the steam generator inspection results entitled "1985 License Condition 3.E Steam Generator Inspection" was provided by letter dated March 10, 1986.

DISCUSSION

The March 10, 1986, report provides a description of the results of the steam generator inspection performed to comply with License Condition 3.E. The report contains a discussion of the actions performed to complete the 3.E inspection program and a discussion of the eddy current testing (ECT) and analytical methodology used in the inspection program.

A. Inspection Scope Planned

The general plan submitted in the SCE letter of July 5, 1985, consisted of three basic areas:

1. Cold Secondary Side Leakage Test (If Necessary)

The cold secondary side leakage test would consist of an 800 psid secondary-to-primary differential pressure test. The cold secondary side leakage test is intended to locate the source of primary-to-secondary leakage.

2. ECT of Non-Sleeved Steam Generator Tubes

Approximately 30% of the non-sleeved tubes in steam generator "B" would be inspected from the hot leg side to just below the first tube support plate. Only "B" steam generator would be inspected since the results of previous inspections have indicated that all steam generators are performing in a like manner.

The inspection program would consist of all non-sleeved tubes within two tubes of the sleeving repair boundary and a four-by-four pattern throughout the remainder of the periphery. This program would be conducted utilizing the latest eddy current equipment available to the industry. Data would be collected using a MIZ-18 digital analysis system. As stated in the submittal dated July 5, 1985, the ECT inspection program would use two different probes, the standard bobbin coil probe and the 8 x 1 probe. Information gathered from the bobbin coil probe allows correlation to previous inspection data to further assess the *IGA progression rate in the non-sleeved region.

If any tube inspected had an IGA indication greater than or equal to 50%, then additional tubes would be inspected until one tube without detectable IGA is found. In addition, the other two steam generators would be inspected in accordance with the above inspection plan.

*intergranular attack

3. Steam Generator Inspection Data Evaluation and Repair

All tubes with detectable IGA indications at the top of the tubesheet would be plugged. In addition, any non-sleeved tube immediately adjacent to a tube with an IGA indication greater than or equal to 50% will be plugged.

B. Inspection Scope Performed

1. Cold Secondary Side Leakage Test

The cold secondary side leakage test discussed above was to be conducted due to an indication of primary-to-secondary leakage that had been occurring at various leakage rates since the SONGS 1 returned to service on November 27, 1984. The leakage started during March 1985 and had an average leak rate of approximately 1 gallon per day (gpd) with a onetime peak of 5 gpd. The leak rate was 1 gpd when the unit shut down on November 21, 1985.

The leak behavior was similar to the leakage experienced before SONGS 1 shut down for an interim eddy current inspection on February 27, 1982. During this February 27 outage, a leak test was conducted on all three steam generators and in steam generator "C" three tubes with leak limiting sleeves were found to be leaking at about 1-2 drops per minute. The results of that inspection were reported to the NRC as part of a report contained in a letter dated September 21, 1982. The recently observed leak rate is consistent with the allowable leakage design margin for leak limiting sleeves and the limits as stated in the Technical Specifications. Therefore, considering its similarity to the previous leakage and its technical specification acceptability, the test was not performed.

2. Eddy Current Testing

Multiple frequency ECT of 417 tubes (approximately 30% of the non-sleeved tubes in the "B" steam generator) was conducted with the standard bobbin coil probe and the 8 x 1 surface riding probe. The inspection pattern consisted of all non-sleeved tubes which lie within either two rows or columns of the sleeving repair boundary plus every fourth row and column (one sixteenth of the tubes) of the remainder of the non-sleeved tubes.

3. Steam Generator Inspection Data Evaluation and Repair

When the results of this inspection were evaluated, the licensee concluded that no tubes with IGA indications at the top of the tube sheet were detected in the 417 tubes inspected and no tubes required repair.

C. ECT Data Gathering and Data Analysis

Each tube was inspected on the hot leg side of the steam generator from the entrance of the tube to just below the first tube support plate with two different probes, the standard bobbin coil and the 8 x 1 probe. The bobbin coil inspection was conducted utilizing the following frequencies; 400 KHz, 340 KHz, 100 KHz and 10 KHz. Each frequency was generated in both the differential and absolute modes.

To confirm the ability of the bobbin coil probe to detect the IGA which has occurred at San Onofre Unit 1, tube lengths were removed from hot leg sides of steam generators A and C during the 1980-81 Sleeving Repair Project. The field eddy current data collected from these tubes prior to removal were reevaluated and compared to the metallurgical examination results.

The comparisons show that in all cases the 100 KHz absolute bobbin coil detects the IGA condition reported by the metallurgical examination. The results further indicate that the 400 KHz differential bobbin coil exhibits a response to the IGA condition in the majority of cases where the metallurgical examination shows an IGA depth of >40%. Based on the correlation of bobbin coil responses with pulled tube metallurgical examination results, it was concluded that the bobbin coil can detect IGA, as found at San Onofre Unit 1, at levels exceeding 20%. The bobbin coil information also allows correlation to previous eddy current inspection data to further assess the IGA progression rate in the non-sleeved peripheral region of the steam generator.

The 8 x 1 probe has eight individually monitored pancake probes which provide an indication of the circumferential extent of a defect. Each of the eight coils can be operated at two separate frequencies (300 KHz and 100 KHz) providing the capability to "mix out" the tubesheet entry signal. SONGS 1 and industry experience has shown that pancake probes are better than the bobbin coil in detecting circumferential IGA. In past eddy current inspections, the pancake probe was used at SONGS 1 as the final test to identify if IGA was present and to aid in the determination of whether a tube should be removed from service. ECT data was collected utilizing the MIZ-18 digital data collection system and analyzed with the DDA-4 digital analysis system.

D. Inspection Results

The licensee concluded that the ECT results did not identify any tubes with IGA. When the results of the 417 tubes were compared to corresponding historical data, 47 tubes that had apparent new degradation above the top of the tubesheet were identified. This degradation was indicated to possibly be wastage.

To investigate if the degradation was new or due to improved detection capabilities, the 1985 ECT results were compared to the 1980 results for 52 indications in 47 tubes. This comparison was done utilizing the DDA-4 to provide consistent results. This comparison identified 12 tubes with new >20% indications and no cases of existing >20% indications that showed >10% growth. Out of the 12 tubes with new >20% indications only two tubes had no previous detectable defects. The licensee concluded that the apparent degradation was in fact due to improved detection capabilities.

E. Evaluations and Conclusions

Subsequent to the 1980-81 Sleeving Repair Project eddy current examinations of the non-sleeved steam generator tubes were performed in 1982, 1984, and 1985. These examinations followed approximately 4.3 EFPM* of operation in 1982, 26 months of lay-up between 1982 and 1984, and an additional 9.2 EFPM of operation until the 1985 inspection. These inspection results showed negligible progression of IGA.

The degradation rates applied to non-sleeved tubes evaluated in post-sleeving SER's have been based upon analysis of degradation data of tubes in the sleeved region (or active region) near the boundary with the non-sleeved region (or inactive region). In the SER issued on June 5, 1985, the staff conclusions were based upon a conservatively assumed IGA degradation rate of 1% per EFPM. Based upon the results of the last three inspections and the adequacy of the licensee's inspection techniques and evaluation methodology, we have concluded that there is sufficient evidence to indicate that the San Onofre 1 steam generators can be safely operated for a full refueling cycle until the next inspection of the non-sleeved tubes. This corresponds to a degradation rate of 10% per 15 EFPM assuming an IGA level of 40%.

*effective full power months

The data and inspection techniques have been reviewed by our eddy current inspection consultant, C. V. Dodd of Oak Ridge National Laboratory. He has concluded that there does not appear to be any indication of IGA of the type existing before the sleeving project in 1980-81. He has concluded that the licensee's use of the 8 x 1 probe and the bobbin coil probe is appropriate. He has recommended and the staff agrees that some destructive examination be performed at the next refueling outage to determine the exact nature of the degradation in the 47 tubes discussed in part D of the Discussion section of this safety evaluation. He also concurs in the staff's conclusion that the SONGS 1 steam generators can be safely operated until the next refueling outage when the next steam generator inspection will be conducted.

The licensee has requested that the next inspection of the non-sleeved tubes be performed as part of the overall inspection required by Technical Specification 4.16, Inservice Inspection of Steam Generator Tubing. Specification 4.16.A.1 requires that the tubes selected for inspection include those where experience at San Onofre 1 or experience in similar plants indicates critical areas to be inspected. Since the non-sleeved tubes in the periphery of the hot-leg side are still considered to be a critical area, the licensee has been informally requested and has agreed to provide specific plans within 90 days after restart for inspection of this region, including the number of tubes to be inspected, the generators to undergo inspection, the ECT techniques to be used and comparisons to be made with prior inspection results.

In the inspection plans provided in the July 5, 1985 letter to the NRC, the licensee committed to plug any non-sleeved tube immediately adjacent to a tube with an IGA indication greater than or equal to 50%. Based upon the detectability inherent in the inspection techniques used, the licensee has requested to rely upon the plugging criteria in Technical Specification 4.16.E.1.c which states that any tube with an imperfection depth of greater than or equal to 50% of nominal tube wall thickness shall be plugged. This is acceptable.

Based upon our evaluation of the information presented, we have concluded that License Condition 3.E has been satisfactorily addressed and the approval of resumption of power operation at San Onofre 1 as it relates to this license condition is granted.

ACKNOWLEDGEMENT

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