

SAFETY EVALUATION OF  
SAN ONOFRE UNIT 1  
SOUTHERN CALIFORNIA EDISON  
STEAM GENERATOR TUBE INSPECTION REPORT  
DOCKET NO. 50-206

Introduction

In accordance with the requirements of Technical Specification 4.16, the licensee performed an Inservice Inspection of steam generator tubes during December 1985 as part of the San Onofre Unit 1 Cycle 9 refueling outage activities. The report was submitted in an April 14, 1986, letter as an attachment entitled "1985 Steam Generator Inspection Results, San Onofre Unit 1". Based upon the degradation detected during this inspection, the results of the inspection were reported for Commission approval of the remedial action. The San Onofre Unit 1 Steam Generator Tube Technical Specification Inspection was performed during the December 8, 1985, through December 31, 1985 time period. The previous Steam Generator Tube Technical Specification Inspection was performed in May 1984. The May 1984 inspection results and earlier inspection results indicated the pattern of denting in steam generators "A" and "C" is unchanged and in all other respects steam generators "A", "B", and "C" (SG-A, SG-B and SG-C) are behaving in a like manner. Based on Technical Specification 4.16.A.3, which allows the inspection of steam generators on a rotating schedule if they are performing in a like manner, SG-B was selected for the general inspection and special inspection of anti-vibration bar (AVB) wear. SG-C was selected for the special inspection for denting.

Technical Specification Inspection

A. Denting Inspection

As a result of previous steam generator inspections, 192 tubes in SG-C hot and cold legs were identified as having restrictions due to steam generator tube denting. These tubes were gauged through the fourth support plate using eddy current probes. Out of 192 tubes gauged, only six tubes were

more restricted than in previous inspections. The licensee stated that these results are within the expected variability of the gauging process and are not attributable to a significant progression of the denting process. The licensee has concluded that steam generator tube denting, as compared to previous inspection results, is not progressing at San Onofre Unit 1.

B. Anti Vibration Bar (AVB)

As required by Technical Specification 4.16.C the 131 tubes in SG-B having previous indications of AVB wear were inspected. These tubes were inspected from the cold leg due to accessibility limitations from restricted or sleeved tubes.

The results of the SG-B AVB inspection indicated that 3 tubes required plugging. These tubes had indications at the AVBs of greater than or equal to 50% through-wall degradation and were plugged per the criteria of Technical Specification 4.16.E.1.c. The AVB inspection program was expanded to include 191 more tubes in SG-B and 166 tubes in SG-C for a total of 488 tubes to evaluate whether any other previously detected AVB indications required plugging. The licensee concluded that the indications at the AVBs have not changed and the apparent growth of the indications since the last inspection is due to the change in data acquisition and analysis techniques rather than increased degradation between inspections. Since the SG-A tubes had previously been inspected with the improved techniques, a reinspection of SG-A for AVB wear was not conducted.

C. General Inspection

The general inspection program consisted of inspecting the unsleeved length of 312 steam generator tubes (at least 3% of the total number of tubes in service) in SG-B. In addition, the sleeved portion of 272 tubes (approximately 4% of the total sleeved tubes) was inspected. Pluggable

defects were identified in three areas of the steam generators. No progression of degradation was detected in any other region of the steam generator, including the sleeves. The sleeved tubes inspected showed no sign of imperfections and no detectable structural changes were observed in the sleeves and sleeve-to-tube joints. The three areas with pluggable defects are (1) near the top of the hot leg tubesheet and (2) near the top of the cold leg tubesheet, (3) at the AVBs. The ABV inspection results are discussed above. The remaining two areas are addressed below.

1. Top of the Hot Leg Tubesheet

One tube, R20C94, inspected due to a previous 44% through-wall indication near the top of the tubesheet, had exhibited an apparent increase in the indication to 64%. Based on the 64% through-wall indication, the tube was plugged per Technical Specifications. It is concluded that based on the comparison of the 1982 and 1985 data and techniques, there has been no real growth in the indication for this tube.

2. Top of the Cold Leg Tubesheet

A total of 400 tubes were inspected on the cold leg side of SG-B. The results were compared to previous inspection results and 39 indications exhibited apparent growth. The calculated mean growth of the 39 indications from 1980 to 1985 (13.5 EFPM) was 4.5% through-wall. Although none of these indications required plugging, one tube was preventively plugged due to a distorted ECT signal near the top of the cold leg tubesheet.

This confirmation of active growth of indications in SG-B necessitated an expansion of the inspection program into one of the uninspected steam generators as required by Technical Specification 4.16.B.1. A total of 546 tubes were inspected in the cold leg of SG-C. The results

were compared to previous inspection results and 59 indications exhibited apparent growth. The calculated mean growth of the 59 indications from 1980 to 1985 (13.5 EFPM) was 2.3%. One of the indications was identified as pluggable. In addition, two tubes with distorted ECT signals near the top of the cold leg tubesheet were preventively plugged. At least two tube pitches (24 tubes) surrounding the plugged tubes were inspected and it was verified that no other pluggable tubes existed in that area.

The pluggable tube in SG-C required an expansion into SG-A as required by Technical Specification 4.16.B.1. A total of 1,118 tubes were inspected on the cold leg side and compared to previous results. There were 198 indications which exhibited apparent growth. The calculated mean growth of the 198 indications from 1980 to 1985 (13.5 EFPM) was 0.4%.

The indications in SG-A were located within 5 inches above the cold leg tube sheet rather than at the top of the cold leg tubesheet as in SG-C. A total of 19 tubes had indications which required plugging and 16 additional tubes with distorted ECT signals were preventively plugged. All tubes within two tube pitches of each tube plugged were inspected to bound the problem area.

The single tube which was plugged due to a defect near the top of the hot leg tubesheet does not indicate an active problem that requires further action at this time. The indications at or near the top of the cold leg tubesheet that indicate growth, do represent a potentially active region. However, the calculated growth rate is well within that assumed in the safety analysis which defines the basis for the Technical Specification 4.16. Therefore, existing requirements to inspect previously identified problem regions during

further inspections will ensure corrective actions are performed as necessary to prevent potential failures. If growth in this area is evident from the next inspection the licensee should perform a thorough assessment to determine its cause and possible corrective actions.

D. Wrapper Support Bar Inspection

The original wrapper support design for the Westinghouse Series 27 steam generator, including San Onofre Unit 1, included six symmetrically located and vertically positioned bars welded to the base of the wrapper on the ID and threaded into the tubesheet. The wrapper rested on these bars and the bars were intended to accept the vertical wrapper loads specified in the steam generator equipment specification.

Subsequent modifications to Series 27 steam generators involved installing two brackets in each steam generator, one end of the bracket welded to the transition section of the upper portion of the wrapper assembly with the end attached to the feedwater ring bracket close to the steam generator shell. These brackets were designed to prevent vertical displacement of the wrapper assembly even if all of the existing wrapper support bars were not in place. In order to provide further support to the wrapper, these two support brackets were supplemented by a third bracket welded to the wrapper and attached to the feedwater ring nozzle support.

During the secondary side visual inspections conducted in 1982 all but three of the wrapper support bars were found to be either broken or missing. The subsequent investigation required the loose support bars to be removed but allowed the three intact support bars to remain.

A visual inspection of the intact wrapper support bars was conducted during the Cycle 9 refueling outage. The results of the inspection of the wrapper support bars in SG-A and SG-B showed that the support bars are still intact and have not moved.

The licensee has concluded that the wrapper support bars can be left in place without affecting tube integrity.

Summary and Conclusions

As part of the Inservice Inspection of steam generator tubes required by Technical Specification 4.16, a total of 2336 tubes (22 percent of the tubes in service) were inspected. The results indicate limited degradation is occurring, but only in the cold leg near the top of the tubesheet. In general, the inspection demonstrated there has been no detectable progression of intergranular attack (IGA), denting, or antivibration bar wear. The licensee further stated that there has been no sleeve degradation. Of the tubes inspected, 63 were removed from service by mechanical plugging. The breakdown of imperfection location is as follows: 39 tubes with imperfections near the top of the cold leg tubesheet, 1 tube with an imperfection near the top of the hot leg tubesheet, and 23 tubes with imperfections at the antivibration bars. More than half of these, however, showed no real growth since previous inspections but required plugging as a result of improved inspection and analysis techniques.

During the 1982 steam generator inspection, a secondary side visual inspection discovered all but three wrapper support bars to be broken or missing in steam generator "C". For this reason, a supplemental visual inspection was performed as part of the 1985 steam generator inspection to assess the intact wrapper support bars in steam generators "A" and "B". The results of the inspection demonstrated continued integrity, however, these support bars will be reinspected during the next refueling outage as part of the secondary side inspection program.

The staff concludes that the remedial actions taken are appropriate to resolve the steam generator tube degradation identified during the 1985 Steam Generator Inspection. Further, the staff concludes that there is reasonable assurance that operation of the steam generators will not result in undue risk to public health and safety.

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