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Vice President

January 19, 2007

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Subject: **San Onofre Nuclear Generating Station, Unit 2**
Docket No. 50-361
Response to Request for Additional Information Regarding Report of Inservice Inspection of Steam Generator Tubes, Cycle 14

References:

1. Letter from B. Katz (SCE) to Document Control Desk (NRC) dated February 7, 2006, Subject: Special Report: Inservice Inspection of Steam Generator Tubes, Cycle 14

2. Letter from N. Kalyanam (NRC) to Richard M. Rosenblum (SCE), dated September 28, 2006; Subject: San Onofre Nuclear Generating Station, Unit 2 (SONGS 2) – Request for Additional Information (RAI) Regarding the 2006 Steam Generator Tube Inspections (TAC NO. MC8395)

3. Letter from B. Katz (SCE) to Document Control Desk (NRC) dated October 26, 2006; Subject: Response to Request for Additional Information Regarding Report of Inservice Inspection of Steam Generator Tubes, Cycle 14

Dear Sir or Madam:

By Reference 1, Southern California Edison (SCE) submitted the reports required by Technical Specification 5.7.2.c of the inservice inspection of steam generator tubes at San Onofre Nuclear Generating Station Unit 2. Subsequently, by Reference 2, the NRC staff requested certain additional clarifying information. Reference 3 provided the requested information, with the exception of a response to Request Number 1, regarding sleeves which SCE forecasted to provide in late December 2006.

The enclosure, prepared by Westinghouse, provides our response to Request Number 1.

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If you have any questions or would like additional information concerning this subject, please contact Lynn Pressey at (949) 368-6351.

Sincerely,

Brian Katz

Enclosure

cc: B. S. Mallett, NRC Regional Administrator, Region IV
N. Kalyanam, NRC Project Manager, San Onofre Units 2 and 3
C. C. Osterholtz, NRC Senior Resident Inspector, San Onofre Units 2 and 3

ENCLOSURE

Response to Request for Additional Information
San Onofre Nuclear Generating Station, Unit 2
2006 Steam Generator Tube Inspection

For Completeness, the following acronyms are defined:

TIG	-	Tungsten Inert Gas
OD	-	Outside Diameter
ID	-	Inside Diameter
+Pt	-	Plus Point
EDM	-	Electrical Discharge Machining
ODSCC	-	Outside Diameter Stress Corrosion Cracking
TW	-	Through Wall

Request for Additional Information
San Onofre Nuclear Generating Station, Unit 2
2006 Steam Generator Tube Inspections

1. During a conference call in which the 2006 steam generator inspections were discussed (refer to U.S. Nuclear Regulatory Commission (NRC) letter dated April 3, 2006 – Agencywide Documents Access and Management System Accession No. ML060950305), there was some discussion concerning nickel migration associated with sleeved tubes. Please provide additional information concerning the nature of this phenomenon and the extent to which it could affect the detectability of flaws in the pressure boundary portion of the tube and sleeve.

Response:

The issue of nickel migration within the tube to sleeve crevice region of TIG sleeved tubes has previously been observed at other plants. In 1999 eddy current indications suggestive of axial or circumferential degradation of the parent tube were reported on 13 sleeved tubes at a plant with Model 51 steam generators. Of the 13 sleeved tubes in question, 11 had been installed in 1997, 1 in 1996, and 1 in 1990. Subsequent review of baseline data indicated that 3 of these 13 tubes exhibited these signals, thus, some of the signals were present prior to in service operation with the TIG sleeves.

Two of the sleeved tubes with indications were pulled for destructive examination. Destructive examination showed no degradation of the tube or sleeve. The source of the signals was attributed to areas of deposition of mainly pure nickel and pure chromium with traces of iron, sulfur, silicon, and aluminum. The nickel deposit was adjacent to the sleeve OD surface while the chromium was adjacent to the tube ID surface. In both pulled sleeved tubes, small, discontinuous subsurface inclusions were found in the weld. These inclusions did not affect the structural integrity or leaktightness of the weld.

The pressure boundary specification of the TIG sleeve per CEN-630-P, Revision 2 is the parent tube above the weld, through the weld into the sleeve, and to the end of the sleeve. The original technical document does not specify the parent tube in the hardroll joint region as part of the pressure boundary. An Addendum to CEN-630-P, Revision 2 was published in January 2006. The Addendum reported investigation of the structural and leakage integrity characteristics of the sleeve hardroll joint for postulated degradation of the parent tube adjacent to the sleeve nickel band. The conclusions of the Addendum are that significant degradation of the parent tube adjacent to the sleeve nickel band would not preclude the sleeve hardroll joint from satisfying its' intended design function. While CEN-630-P, Revision 2 does not specify the parent tube in the hardroll joint region as part of the pressure boundary, the Addendum considered it as such when evaluating the structural and leakage integrity characteristics of postulated degradation of the parent tube adjacent to the nickel band region.

The nickel deposit signals from the SONGS 2, 2006 inspection were reviewed with the intent of characterizing the signals in the pressure boundary detection channels to determine whether or not these signals could affect detection of degradation within the pressure boundary regions.

A total of 26 tubes/sleeves were reported with nickel deposit signals in SG 88 while 14 tubes/sleeves were reported with nickel deposit signals in SG89. The SG88 signals were judged more limiting based on the signal amplitudes in the P1 channel.

The nickel deposit signals are in the region of the tube/sleeve assemblies where the sleeve is the pressure boundary and the condition of the parent tube is not relevant. The nickel deposit signals are primarily located in the upper joint region at the bottom of the hydraulically expanded area, just below the weld. These deposits do not appear to extend to the weld, thus the presence of these deposits will not interfere with inspection of the weld. The nickel deposit signal with the lowest elevation with reference to the sleeve bottom end is located well above the tube/sleeve lower hardroll joint.

The 75 kHz channel is used for inspection of the parent tube; the 600 kHz channel is used for inspection of the sleeve. For the development of data contained herein the 75 kHz channel and 600 kHz channel amplitude calibration was performed by setting the response of the 100%TW axial EDM notch within the sleeve to 20V. Evaluation of the +Pt eddy current data indicates that the nickel deposit signal response in the 600 kHz channel is roughly $1/10^{th}$ of the signal amplitude response in the 75 kHz channel. Thus while the signal amplitude responses in 75 kHz appear large, the associated signal amplitude response in the frequency applied for inspection of the pressure boundary at the location of the nickel deposits (600 kHz) is significantly smaller. No correlation of signal amplitude responses across these frequencies could be developed, however, this aspect of the signals is shown to be moot. The signal amplitude response in the 600 kHz channel ranged from 0.47 volt to 0.10 volt with phase angles ranging from 143 to 178 degrees. The nickel deposit signals showed no evidence of distortion through lobe opening or phase shifts. Thus the phase angles of the nickel deposits in the 600 kHz channel lie significantly outside the flaw plane.

As the signal response of the nickel deposit in 600 kHz is analogous to typical OD deposit signal responses associated with normal tube inspection in 300 kHz, a simple signal to noise ratio analysis with vectoral addition of flaw and noise components to form a resultant signal can be used to judge detection conditions.

Signal amplitude characteristics of the axial OD EDM notches in the sleeve were performed in the +Pt 600 kHz channel. The 100% axial EDM notch was set to 20V. The 70% OD notch measured 1.25 V with 61 degrees phase while the 50% OD notch measured 0.49 V with 70 degrees phase. Previous evaluation of EDM and true flaw amplitudes for similar flaw shapes has indicated that for true flaws, the +Pt signal amplitude is roughly one half of the EDM notch amplitude, thus true flaws in the Alloy 690 sleeve material might be 0.63V at 70% throughwall and 0.25 V at 50% throughwall. Considering these amplitudes and phases, significant distortion of the signal in the 600 kHz channel would be expected, leading to a high likelihood of reporting. This judgment does not consider the high resistance to stress corrosion cracking associated with Alloy 690 thermally treated material. For postulated sleeve degradation of 0.25 V and 70 degrees phase adjacent to a nickel deposit region with 0.47 V amplitude and 180 degrees phase, the associated resultant signal would be expected to be have a phase angle of about 150 degrees, or within the range of phase angles for the currently reported nickel signals. While this phase angle is similar to the phase response of nickel deposit signals currently reported, there is no distortion of the nickel deposit signal, suggesting that no ODSCC signals are combining with, or affecting the nickel deposit response. However, for a postulated flaw amplitude of 0.63 V, 61 degrees phase and noise signal of 0.47 V, 180 degrees phase, the resultant would be expected to produce a phase angle of about 100 degrees. This phase response is more typical of an ODSCC response and well beyond the range of nickel deposit signals currently observed.

The field eddy current data report does not include any locations with nickel deposit signals within the microlok region or hardroll joint region of the sleeve/tube. The eddy current data for all sleeves with nickel deposit signals was reviewed for evidence of nickel deposition within the microlok region. If the source of the nickel deposits was associated with migration of the nickel from the nickel band (located below the microlok band) it is reasonable to expect nickel deposition within this region. No breaks or disruptions of the microlok region are observed on any of the affected sleeves however the eddy current response to the microlok is limited.

For signals of modest arc response, such as 107 degrees (the arc response from the lowest nickel deposit signal), or greater arc response, the +Pt coil is expected to "null itself" within this region making flaw detection more apparent. This has been shown in recent digital data superposition studies. Thus any parent tube degradation of about 50%TW or greater located in the middle of the nickel deposit signal would produce a resultant signal that is highly distorted, and as such, may be interpreted as flaw-like. Therefore the only region of the parent tube that postulated flaw detection may be influenced by nickel deposit signals is likely only the edge of the nickel deposit signal where the +Pt coil is affected by the change in response associated with nickel or no-nickel influence.

Conclusions

1. The experience from the other plant shows that the nickel deposits can be associated with the as-installed condition, prior to operation. Thus the source of the deposits can be associated with the original sleeve installation, possibly related to the tube cleaning operation, or a by-product of the welding operation.
2. There are no industry reports of stress corrosion cracking of Alloy 690 thermally treated material. Thus the likelihood of stress corrosion degradation in Alloy 690 thermally treated with limited operational exposure is extremely low.
3. The signal amplitude response of the nickel deposits in the sleeve inspection frequency (600 kHz) are judged to have a negligible impact upon detection capabilities of postulated degradation within the sleeve pressure boundary that could affect leakage integrity of the sleeved tube.