1/18/01

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter of:	)	
	)	
Consolidated Edison Company	)	Docket No. 50–247
of New York, Inc.	)	
(Indian Point Nuclear Station,	)	
Unit No. 2)	)	

AFFIDAVIT OF GREGORY M. TURLEY

I, Gregory M. Turley, being duly sworn, state as follows:

1. I am a shareholder of CoreStar International Corporation (CoreStar) and hold the title of Vice President Operations.

2. I was recently asked to examine elements of a nondestructive examination (NDE) of the steam generators (SG) at the Indian Point 2 (IP2) nuclear power plant conducted in the spring of 1997 utilizing a technique referred to as eddy current testing (ECT). Indian Point 2 is owned and operated by the Consolidated Edison Company (ConEd) of New York, Inc.

3. I have had previous involvement with the Consolidated Edison Company, Indian Point 2 regarding steam generator issues, including those issues associated with steam generator inspections occurring in 1997.

4. I was involved with the 2000 SG ECT inspection as follows. My involvement was at the conclusion of the inspection and at ConEd's request:

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- I interfaced with the ConEd Project Manager to negotiate the terms of a contract for CoreStar to perform an independent review of the Westinghouse inspection database to confirm that all tubes that required plugging were on the final tube plug list.
- I interfaced with the ConEd Project Manager during the independent database review process to discuss deliverables and schedule logistics.
- I did not personally perform the independent database review tasks. The tasks were assigned to and performed by CoreStar personnel that report to me.

5. My professional qualifications and experience are outlined in Exhibit 1.

6. Prior to preparing this affidavit I reviewed the following documents and data sources:

- 2/7/97 ConEd letter to NRC describing 1997 SG ECT inspection program plans
- Slides from 4/24/97 ConEd presentation to NRC (re: SG ECT inspection program)
- 5/29/97 NRC letter to ConEd approving SG ECT inspection program plans
- Westinghouse data analysis guideline DAT-IP2-001, Revision 0
- Westinghouse field service report from 1997 SG ECT inspection
- 7/16/97 NRC Integrated Inspection Report 50-247/97-07
- 1997 plugged tube list (and history) for row 2 and 3 tubes
- 11/1/00 NRC Lessons Learned Task Force Report
- 11/20/00 NRC Final Significance Determination for a Red Finding and Notice of Violation at Indian Point 2 – Report No. 05000247/2000-010.

7. The purpose of this affidavit is to summarize the 1997 SG ECT inspection activities at Consolidated Edison's (ConEd) Indian Point Unit 2 station (IP2). Topics

covered herein will address the NRC criticisms contained in the NRC Final Significance Determination for a Red Finding and Notice of Violation at Indian Point 2 – Report No. 05000247/2000-010. The affidavit will contain three major sections. The first section will list the industry codes and standards in effect at the time of the 1997 outage. The second section will summarize the pre-outage activities. The third section will summarize the outage oversight activities.

8. My roles and responsibilities during the preparation and execution of the 1997 SG ECT inspection included:

- Technique qualification oversight at Westinghouse's Waltz Mill facility
- ACTS and ANTS development and/or review
- Data analysis guideline development and/or review
- NRC interface support
- Site specific performance demonstration (SSPD) data set development and/or review
- Proctoring of SSPD (i.e. Data analyst training & testing)
- Data review during SG ECT inspection for procedure/guideline validity and adherence

9. The following codes and standards were in effect at the time of the 1997 outage at IP2. The list forms the basis for measuring compliance to industry approved methodologies for SG ECT inspection activities. The codes and standards were reviewed for their applicability to the SG inspection activities at IP2 in 1997.

- ASME Boiler & Pressure Vessel Code, Section XI, "Rules for In-Service Inspection of Nuclear Power Plant Components"

- EPRI TR-106589, Revision 4, "Pressurized Water Reactor SG Examination Guidelines"
- ETSS 96511, "EPRI qualification for PWSCC detection in low row u-bends"
- Plant Technical Specification
- NRC Generic Letters, 95-03 & 95-05
- NRC Information Notices 90-49, 91-67, 92-80, 94-88, 95-40, 96-09, 96-38, and 97-26

10. Exhibits 2-5 contain tables that summarize the requirements of the industry codes and standards. The industry requirement is noted in the table on a paragraph by paragraph basis. The means of implementation and compliance to the requirement is noted in the "1997 Reference" column. All requirements have been complied with unless the comment section indicates otherwise.

11. Exhibit 2 contains a table of the requirements set forth in Section XI of the ASME Boiler & Pressure Vessel Code. All Code requirements were complied with as indicated in the table.

12. Exhibit 3 contains a table of the requirements set forth in Revision 4 of the EPRI PWR SG Examination Guidelines. A non-compliance is noted in the table. The non-compliance involves a deviation between the EPRI defined parameters for proper calibration of data for low row u-bend exams versus the parameters implemented at site. The EPRI eddy current technique specification sheet (ETSS) 96511 called for EDM notch standards with a 40% ID circumferential notch to be used in the data analysis setup. While the calibration standards used at site contained many more

notches than the calibration standards used in the EPRI qualification, the site calibration standards did not contain the required 40% ID circumferential notch.

13. ETSS 96511 also required the data analyst to set the phase of the 40% ID circumferential notch at 10 degrees. The analysis technique sheet (ANTS) called for probe motion to be set horizontal. While the site setup parameters failed to meet the absolute requirements of the EPRI ETSS, setting probe motion horizontal proved to be equivalent. In other words, setting probe motion horizontal results in a calibration setup that is equivalent to setting the 40% ID circumferential notch to 10 degrees. This has been proven and documented by Westinghouse. All other EPRI requirements were complied with as indicated in the table. Based upon my review and considering the non-compliance had no effect on the end result, I believe it can stated that we met the intent of the requirements set forth in Revision 4 of the EPRI PWR SG Examination Guidelines.

14. Exhibit 4 contains a table of regulatory guidance available to the industry at the time of the 1997 outage at IP2. NRC Generic Letters (GL) and Information Notices (IN) with content concerning SG ECT inspection activities were reviewed. All recommendations and requirements were complied with as indicated in the table.

15. Newer codes and standards [Revision 5 of the EPRI PWR SG Examination Guidelines (released September 1997), NEI 97-06 "SG Program Guidelines" (released April 1998), and DG-1074 "Draft Regulatory Guide for SG Tube Integrity"(still a draft today)] have been distributed within the industry since the spring 1997 outage at IP2. I recognized prior to the 1997 outage that there were draft codes and standards in the

process of industry review and eventual release to the industry, but chose not to address them since the content was still evolving.

16. The first order of business in any SG ECT inspection project is to develop inspection plans commensurate with the critical regions of the tubes and known degradation morphologies expected in a particular model SG.

17. The IP2 SGs are Westinghouse model 44 designs.

18. The definition of the critical regions for the 1997 outage was based on industry experience in like SG designs and past experience at IP2. The critical tube regions of the IP2 SGs were defined to be the tubesheet (TS) crevice, sludge pile above the tubesheet, dented tube support plates (TSP), and low row u-bends. The definition of critical regions does not mean that other regions of the tube were non-critical and would be ignored.

19. The 1997 tube inspection plans at IP2 were designed to meet or exceed the requirements set forth in Revision 4 of the EPRI PWR SG Examination Guidelines, which governed the requirements at the time. Revision 4 of the EPRI PWR SG Examination Guidelines required minimum sample sizes >=20% of all tubes in all SGs with 100% inspection required within 60 effective full power months (EFPM).

20. A summary of the initial inspection plan can be found in Exhibit 5, hereto. The freespan and dented TSP plans were subsequently expanded to 100% full length during the outage as a result of degradation indications found at the TSPs. All other critical tube regions had a 100% sample size defined pre-outage. Since the sample size for all critical tube regions was >20%, it can be stated that the 1997 inspection plan exceeded the requirements of Revision 4 of the EPRI PWR SG Examination Guidelines.

21. Qualified inspection techniques must be utilized for SG ECT tube examinations per Revision 4 of the EPRI PWR SG Examination Guidelines.

22. The inspection techniques were chosen for each critical region of the tube based on the list of industry-qualified techniques summarized in Table 7-1 in Revision 4 of the EPRI PWR SG Examination Guidelines lists. Specific to the low row u-bend exams, the mid-range (MR) frequency +Point probe was used.

23. Industry peer review of the MR +Point probe qualification data provided evidence that the MR +Point probe was the best available technique for PWSCC detection in low row u-bends. The MR +Point probe was generally accepted in the industry to be state of the art. The NRC also endorsed the use of the MR +Point probe over its predecessor techniques, namely the bobbin coil and various pancake coil probes. There are direct and indirect statements in the NRC GL and IN documents to validate this statement of general industry endorsement.

24. Beaver Valley, Diablo Canyon, and Sequoyah are three domestic utilities that began to use the MR +Point probe for their low row u-bend exams in the 1996-1997 timeframe. Therefore, IP2 was not the first utility to implement the MR +Point probe for low row u-bend exams.

25. Consistent with the requirements set forth in Revision 4 of the EPRI PWR SG Examination Guidelines, the following documents were developed:

- Data acquisition procedure (MRS 2.4.2 GEN-35, Revision 6)
- Acquisition technique sheets (ACTS IP2-97-001 through IP2-97-012, various revisions)
- Data analysis guidelines (DAT-IP2-001, Revision 0)

• Analysis technique sheets (ANTS IP2-97-A through IP2-97-G, all revision 0).

MRS 2.4.2 GEN-35 was a generic Westinghouse data acquisition procedure. I provided no review or approval to MRS 2.4.2 Gen-35. The ACTS and ANTS documented the site specific data acquisition and data analysis parameters respectively. DAT-IP2-001 was the site specific data analysis guideline. I reviewed and approved the ACTS and ANTS prior to use. I reviewed DAT-IP2-001 prior to use.

26. Westinghouse was responsible to develop the first draft of each of the aforementioned documents. It was my responsibility to review them for compliance to the industry codes and standards of the time. My comments and input were formally transmitted to Westinghouse for inclusion in the final documents. Within the data analysis guideline, we incorporated detailed language and/or evaluation flowcharts for each probe type.

27. The repair logic planned for the 1997 outage was very conservative. All tubes with Cecco 5, bobbin, or +Point degradation indications were to be plugged. A degradation indication is defined to be any signal representative of tube wall degradation. Percent through wall and I-codes are two examples of degradation indications. Our practice of plugging degradation indications based on detection by any one qualified technique exceeded the industry norm in that most other plants required +Point confirmation of Cecco 5 and/or bobbin degradation indications prior to plugging those tubes. The plugging logic at IP2 applied to all degradation indications at all tube locations.

28. The week of February 24-28, 1997, ConEd was visited by an INPO audit team. INPO audit teams were focusing on plants with Inconel 600 (I600) mill annealed (MA) tubing like IP2. The INPO audit team goals were defined to be:

- Identify increased potential for tube rupture
- Identify strengths and weaknesses of SG maintenance programs

29. ConEd personnel stated that they believed the good SG performance (to date) was attributable to low T_{hot}, Huntington Alloy tubes, and good chemistry controls and condenser in-leakage controls.

30. At the exit meeting, the INPO audit team noted three strengths and seven recommendations related to the SG program. All of the recommendations were incorporated in the 1997 outage inspection and repair plans. INPO strongly suggested ConEd strive to meet the requirements of Revision 4 of the EPRI PWR SG Examination Guidelines. INPO added a closing comment that ConEd may want to consider a meeting with the NRC prior to the outage. The thought process was that ConEd could present its overall inspection and repair plan to the NRC to seek the NRC's comments.

31. IP2's plant technical specification required ConEd to submit its SG inspection program to the NRC for review and approval. ConEd submitted its proposed 1997 SG tube examination program plans to the NRC in February 1997. The SG program plan included the MR +Point probe for low row u-bend tube regions. On April 24, 1997, a meeting was held with the NRC Staff to present the overall inspection and repair plan. In the April 24, 1997 meeting, the NRC Staff communicated their believe that the MR +Point probe was the best available technique for SCC detection in all critical tube regions. On May 29, 1997, the NRC stated in a letter to ConEd, "The NRC Staff has

completed its review of the proposed 1997 refueling outage SG tube examination program and finds it acceptable based on the information submitted. In addition, the number of tubes scheduled to be examined exceeds the requirements of the IP2 technical specifications." The 5/29/97 NRC letter also concluded "... that the proposed program to inspect the IP2 SG tubes during the 1997 refueling outage is acceptable because it sufficiently covers the areas of the tube bundle that are susceptible to degradation."

32. I was responsible to proctor the SSPD program. The SSPD program consisted of a written exam and a practical exam. The written exam tested the QDA's knowledge of the data analysis guidelines. The practical portion of the SSPD program included ECT data from past IP2 inspections (all techniques except MR +Point for low row u-bends) and ECT data from past inspections at similar plants (MR +Point for low row u-bends). All of the data sets utilized were representative of the degradation morphologies expected in the critical regions of the tubes. All of the data sets, except the MR +Point for low row u-bends, met the statistical rigor required by Revision 4 of the EPRI PWR SG Examination Guidelines. Flawed (1/3 of total) and un-flawed (2/3 of total) grading units are required to build a statistically valid data set for SSPD purposes. Low row u-bend data were requested from Beaver Valley, Diablo Canyon, and Sequoyah. Only Diablo Canyon agreed to supply data to IP2. Less than twenty tubes of data were obtained. All of the data represented flawed tubes because Diablo Canyon did not want to release data for un-flawed tubes that were still in service. As is stated above, this did not meet the statistical rigor of the time, but was a "best effort" with the data available.

33. During the inspection process I performed the role of resolution (RES) analysis oversight, which exceeded the requirements of Revision 4 of the EPRI PWR SG Examination Guidelines. I reviewed all degradation indications (i.e. degradation) that were called by either PRI or SEC or both, that were being discarded by RES. If I did not concur with the decision to discard the degradation indication, Westinghouse was obligated to keep the degradation indication and repair the tube in accordance with the inspection/repair plan. Revision 4 of the EPRI PWR SG Examination Guidelines defines the minimum expected requirements for the PRI/SEC/RES process as:

- PRI and SEC analysis of all tube data
- RES analysis of PRI/SEC discrepancies only

34. Neither the RES analysts or myself were required by IP2 procedure or any other industry document to review the low row u-bend MR +Point data unless a PRI/SEC discrepancy was noted, a repairable indication was reported, or a degradation indication was being discarded by the RES process. Since the degradation indication in Row 2 Column 67 was reported by both PRI and SEC, the tube was placed on the repair list. No further action was warranted or taken. There was precedence in the industry to justify our action of plugging the tube upon detection of an degradation indication. Additional actions such as re-training of analysts and re-analysis of data was unwarranted due to the text book nature of the signal detected. In other words, the analysts were trained to detect the type of signal that was found in Row 2 Column 67.

35. During the initial days of the SG ECT inspection, daily conference calls were held between the site and the remote data analysis facility. The overall lead analyst, the RES lead analyst, the PRI/SEC analysts, and myself discussed hits, misses, and

overcalls from the previous days analysis activities. Hits are defined to be calls made by the PRI and/or SEC analysts that RES agrees should have been reported. Misses are defined to be calls missed by the PRI or SEC analysts that RES feels should have been reported. Overcalls are defined to be calls made by the PRI and/or SEC analysts that RES feels should not have been reported. This process of reviewing hits, misses, and overcalls exceeded the industry requirements of the time. Revision 4 of the EPRI PWR SG Examination Guidelines did not require this process in 1997. It was not formally documented and computerized as it is today, but it occurred nonetheless. Today, this process is commonly referred to as analyst performance tracking.

36. An example of the benefits realized by the early form of analyst performance follows. The example also exemplifies mid-course corrections taken to address an emergent issue in the SG ECT inspection results. On May 21, 1997, a non-quantifiable indication (NQI) was detected in the hot leg tubesheet of a tube in SG 22. After discussing the situation amongst the ECT Level IIIs from Westinghouse and myself, a better approach for the data analyst training and testing process was identified. The actions that were immediately taken included:

- Communication with all data analysts on that day to inform them of this condition.
- Instructed the data analysts to no longer trust only the Cecco 5 probe in this critical tube region.
- Instructed the data analysts to analyze the Cecco 5 and bobbin data for the entire length of this critical tube region. Provided graphics illustrating proper detection and measurement techniques for both techniques.

• Selected a group of experienced QDAs for re-analysis of this critical tube region for all tube data collected up to that point.

37. Another example of mid-course corrections taken involves the Cecco 5 sample plan for the dented TSPs. The initial inspection plan included 100% TSH-2H, 100% TSC-1C, and 33% full length. If one or more TSP locations above 2H or 1C exhibited degradation indications, the sample plan was to be expanded based on the logic contained in a decision tree. One or more degradation indications was encountered above the 2H elevation noted above. The Cecco 5 and bobbin sample plans were expanded to 100% full length in all SGs at that point.

38. The low row u-bend exams (i.e. rows 2 & 3) were examined for the first time with a rotating probe technique. Industry experience at the time of the 1997 SG ECT inspection at IP2 suggested that we should expect to find 1-2 degradation indications. My experience prior to the 1997 SG ECT inspection at IP2 including a review of performance at plants with similar SG designs (i.e. Model 44 and 51), suggested that two or fewer degradation indications had been detected in low row u-bend rotating probe exams in any given outage. At the plants where I had direct involvement, to my knowledge no re-analysis of the low row u-bend tube data or retesting of tubes occurred upon detection of a degradation indication following the first application of a rotating probe. In such instances, the tubes were plugged. The IP2 plan from the start included a sample size of 100% with the best available inspection technique. If one or more degradation indications was found the tube was to be repaired by plugging both tube ends. This is not atypical of low row u-bend methodologies and inspection results implemented at other plants as described in NRC IN 97-26.

39. A single axial indication (SAI) was found in Row 2 Column 67 during the course of the MR +Point low row u-bend exams. The signal was detected and reported by both PRI and SEC analysts. The RES analyst confirmed the degradation indication at which point the tube was added to the repair list for plugging. As far as I was concerned, the plan was implemented as intended and as set forth in the inspection plan and the examination described to the NRC in the February 7, 1997 submittal and April 24, 1997 meeting with the NRC Staff. There was nothing unique about the degradation indication; it was a "text book" SAI, consistent with the SSPD training program. It validated the belief that the MR +Point probe was functioning properly. It also validated the industry experience model. In other words, we found one degradation indication, which is consistent with past experience at similar plants with similar SG designs.

40. The identification of the degradation indication in Row 2 Column 67 is noted as a finding in the NRC Final Significance Determination for a Red Finding and Notice Of Violation report 05000247/2000-010, dated November 20, 2000. The finding goes on to state that:

- "... a PWSCC defect was identified for the first time, at the apex of one row 2 tube, signifying the potential for other similar cracks in low row tubes""
- "ConEd did not adequately evaluate the susceptibility of low row tubes to PWSCC and the extent to which this degradation existed"

I do not concur with the NRC statements. The sample size for low row (i.e. rows 2 & 3) u-bend MR +Point exams was already 100%. The entire critical region of concern was bounded by the sample size. In addition, the best available and qualified technique was employed. From an ECT perspective, there was no industry experience or site specific

condition that would suggest an action plan more extensive than the tube plugging actions taken in 1997.

41. Row 2 Column 5 is the tube that leaked in February 2000. Noise has been suggested to be the cause of the missed degradation indication in 1997. This item was noted as a finding in the NRC Final Significance Determination for a Red Finding and Notice Of Violation report 05000247/2000-010, dated November 20, 2000. The finding goes on to state that:

- "significant ECT signal interference (noise) was encountered in the data ..."
- "... significant noise level reduced the probability of identifying an existing PWSCC tube defect"
- "... the 1997 SG inspection program was not adjusted to compensate for the adverse effects of the noise ..."

I do not concur with the NRC statement that the 1997 SG Program was susceptible to adjustments to compensate for noise. There was no evidence that the data quality was suspect in 1997. The tubes exhibited varying degrees of ovality and outside diameter (OD) deposits. Ovality and OD deposits are sometimes referred to as noise in low row u-bend exams. The amount of ovality and OD deposits in the 1997 data was not deemed to be atypical of low row u-bend rotating probe data seen elsewhere. Flaw detection was not believed to be compromised by the site-specific conditions. A degradation indication in Row 2 Column 5 cannot be readily detected. It is only with hindsight that one can reasonably be expected to detect a degradation indication in Row 2 Column 5. A statement quoted from the November 2000 NRC Lessons Learned report coincides with the previous statement. In that report the NRC states "Experts

that the Task Group interviewed held different views on whether the flaw in Row 2 Column 5 could have reasonably been detected from the data."

42. The ECT sample size for the low row u-bend region was at 100% with the best available technique. Westinghouse/ConEd employed a group of QDA personnel from all over the country to support the SG ECT inspection program. Individuals were encouraged to request tube retests if they questioned data quality. A large percentage of the QDA personnel assigned to this job have worked for other inspection vendors and at other plants, thus their experiences are diverse. None of the individuals expressed a concern with the MR +Point data in terms of being atypical of their knowledge and experience with its application elsewhere in the industry.

43. Nineteen (19) row 2 and 3 tubes were preventatively plugged in 1997 because they would not permit passage of a 0.610" probe. This item was noted as a finding in the NRC Final Significance Determination for a Red Finding and Notice Of Violation report 05000247/2000-010, dated November 20, 2000. The finding goes on to state that:

- "... indications of denting were identified for the first time ..."
- "Restrictions ... signified increased probability of deformed flow slots (hour-glassing) at the upper TSP"
- "Hour-glassing ... increases stresses at the u-bend apex ..."
- "...stresses are ... precurser for PWSCC"
- ConEd did not adequately evaluate the potential for hour-glassing based on the indications of the low row tube denting"

I do not share the NRC's viewpoint that ConEd did not adequately evaluate hour-glassing. Let's examine two of the nineteen tubes from SG 24 a little more closely. Row 2 Column 7 and Row 2 Column 76 were plugged based on a "610 obstruction at 6C". If you examine the results database carefully you will find that both of those tubes passed a 0.610" bobbin probe through 6C in 1995 and 1997. This indicates that denting had not progressed at the top TSP location. The 6C intersection would not pass a straight-section rotating probe in 1997. A 0.610" bobbin probe is designed to traverse the full length of SG tubes including the low row u-bend region. The bobbin probe head has a rigid length of approximately one inch. Approximately six inches of flex shaft interface the bobbin probe head to the poly shaft. The straight-section rotating probe head has a rigid length of approximately three inches. Approximately three inches of flex shaft interface the rotating probe head to the motor unit that spins the probe head. The motor unit has a rigid length of approximately three to four inches. The motor unit is attached directly to the poly shaft. It is my opinion that the 6C intersection could not be traversed by the straight-section rotating probe because of the significant mechanical differences of the probe design. I do not believe any ECT inspection information presented itself in 1997 to indicate denting had progressed at the top TSP locations. In fact, the only logical inference to be drawn was that the probe dimensions rather than the tube denting caused the probe passage results experienced in the 1997 inspection.

44. It is unfortunate that a leak occurred in February 2000. I do not think the leak can be attributed to a lack of focus or attention to detail on the 1997 inspection. The pre-outage plan and emergent issues were acted upon in a prudent and conservative manner.

45. Qualified techniques, personnel, and procedures were utilized. Every applicable industry code and standard of the time was met or exceeded. INPO's feedback was included in the overall SG program. The inspection results were consistent with industry experience. I concur with this report, which is well documented and supported by direct NRC observation of the 1997 inspection.

46. On July 16, 1997 NRC Integrated Inspection Report 50-247/97-07 was submitted to ConEd. In the report, the Region 1 Inspection Specialist stated that ConEd's ISI Program, with particular emphasis on the ISI of SGs, was effectively monitored and controlled. The Inspection Specialist measured ConEd's ISI Program against plant technical specification, ASME Section XI, and EPRI PWR SG Examination Guideline requirements. It was concluded in the report that the techniques, personnel, and procedures were both qualified and acceptable.

47. Perfection is a great objective, but let's face the fact that the industry standard for qualified techniques, personnel, and procedures results in a probability of detection (POD) of 80% with a 90% confidence level. Statistically speaking, that means we, as an industry, recognize and accept that missed degradation indications will happen.

48. The foregoing statements are true and correct to the best of my knowledge and belief.

Gregory M. Turley

Sworn and subscribed to before me on this 18 day of January 2001.

Notary Public

My Commission expires:

Notarial Seal
Marion Rayman, Notary Public
Hempfield Twp., Westmoreland County
My Commission Expires Aug. 5, 2002

Exhibit 1
Resume of Gregory M. Turley

Education

BS Applied Mathematics, University of Pittsburgh, [ ] EX. 6

NDE Credentials

ET Level III/Qualified Data Analyst

Work Experience

May 1996 – Present
CoreStar International Corporation

Title:	Vice President Operations/Shareholder
Responsibilities:	Manage all aspects of HX and SG ET inspection projects, including personnel training, data acquisition procedure development, data analysis guideline development, data management guideline development, inspection plan development, schedule logistics, and project management.

February 1986 – May 1996
Westinghouse Electric Company

Title:	Manager, NDE Field Operations
Responsibilities:	Managed data analysis and data management aspects of SG ET inspection projects, including personnel training, data analysis guideline development, data management guideline development, inspection plan development, schedule logistics, and project management.

Other Relevant Experience

- Have 15 years experience in the application of ET inspection techniques.
- Have been closely involved in hundreds of HX and SG inspection projects.
- Have a thorough knowledge of the industry codes and standards.
- Have been involved in ET system and technique qualifications.

Exhibit 2
ASME Boiler & Pressure Vessel Code
Section XI Compliance

Section/Paragraph	Requirement	1997 Reference	Comments
	Rules for Inservice Inspection of Nuclear Power Plant Components		
IWA-2233	Eddy current examination of heat exchanger tubing shall be in accordance with the provisions of Appendix IV		Details to follow in Appendix IV below
IWA-2300	Qualifications of NDE personnel	See certifications for assigned personnel & written practices for each NDE vendor	References ASNT SNT-TC-1A
Appendix IV	*Eddy Current Examination of Nonferromagnetic SG Heat Exchanger Tubing*		
IV-2100	Written procedures required. Certain information shall be included:	MRS 2.4.2 GEN-35 DAT-IP2-001	
a)	Tube material, diameter, & wall thickness	ACTS	
b)	Size & type of probe, manufacturers name, description or part #, & length of probe & probe ext. cables	ACTS	
c)	Examination frequencies	ACTS	
d)	Manufacturer & model of ET equipment	ACTS	
e)	Scanning direction & speed during examination	ACTS	
f)	Inspection technique e.g. hand	ACTS	

Section/Paragraph	Requirement	1997 Reference	Comments
	probe, mechanized probe driven, remote control fixture		
g)	Description of calibration procedure & calibration stds.	MRS 2.4.2 GEN-35 ACTS	
h)	Description of data recording equip. & procedures	MRS 2.4.2 GEN-35 ACTS	
i)	Procedure for analysis of examination results & applicable criteria for reportable indications	DAT-IP2-001 ANTS	
j)	Procedure for reporting examination results	DAT-IP2-001 ANTS	
k)	Personnel requirements	MRS 2.4.2 GEN-35 DAT-IP2-001	
l)	Fixture location verification	MRS 2.4.2 GEN-35	
IV-2200	Personnel		
a)	Data acquisition personnel shall receive specific training	See certifications for assigned personnel & written practices for each NDE vendor	References ASNT SNT-TC-1A
b)	Data analysis personnel shall receive specific training	See certifications for assigned personnel & written practices for each NDE vendor	References ASNT SNT-TC-1A
IV-2310	General data acquisition		
a)	Multi-frequency instrument	TC6700 complies	
b)	Phase & amplitude output	TC6700 complies	
c)	Can detect dimensional, metallurgical, deposits, & flaws (OD & ID)	TC6700 complies	
IV-2331	Digital instrument requirements		
a)	30 samples per inch of tubing	TC6700 complies	

Exhibit 2
ASME Boiler & Pressure Vessel Code
Section XI Compliance

Section/Paragraph	Requirement	1997 Reference	Comments
b)	12 bits per data point resolution	TC6700 complies	
c)	Frequency response +/- 2%	TC6700 complies	
d)	Selectable lissajous display	ANSER complies	
e)	Lissajous 7 bits full scale	ANSER complies	
f)	2 strip chart traces	ANSER complies	
g)	Selectable strip chart display	ANSER complies	
h)	Strip chart 6 bits full scale	ANSER complies	
IV-2332	Recording system		
a)	Record & play back all test frequencies	ANSER complies	
b)	Record & play back all text information	ANSER complies	
c)	12 bits per data point resolution	ANSER complies	
IV-2410	Bobbin coils		
a)	Detect calibration standard flaws	ACTS	Per EPRI Appendix H requirements
b)	Operate at frequencies for flaw detection & sizing	ACTS	Per EPRI Appendix H requirements
IV-2510	General data analysis system		
a)	Display all test frequencies	ANSER complies	
b)	Multiparameter mixes	ANSER complies	
c)	Record tube ID	ANSER complies	
d)	Phase in 1 degree increments	ANSER complies	
e)	Amplitude in 0.1 volt increments	ANSER complies	
IV-2531	Digital data analysis system display		
a)	Present signals & text	ANSER complies	
b)	12 bits per data point resolution	ANSER complies	
c)	Lissajous 7 bits full scale	ANSER complies	
d)	Selectable strip chart display	ANSER complies	
e)	Strip chart 6 bits full scale	ANSER complies	
IV-2532	Digital data analysis system recording		
a)	Play back signals & text	ANSER complies	

Exhibit 2
ASME Boiler & Pressure Vessel Code
Section XI Compliance

Section/Paragraph	Requirement	1997 Reference	Comments
b)	12 bits per data point resolution	ANSER complies	
IV-2700	Fixture location verification		
a)	Verify visually & record	MRS 2.4.2 GEN-35	
b)	Errors shall result in reexaminations	MRS 2.4.2 GEN-35	
IV-3210	General cal std		
a)	Shall be same mat'l spec, heat treatment, & nominal size	Complied	See as-built drawings
b)	Different heat treatments must be approved by ANII	Complied	Reference Code Case N-402
c)	UNS alloy N06600 may be used in lieu of a) & b) requirements	N/A	
d)	As-built drawing & ET response shall be recorded	Complied	See as-built drawings
IV-3220	Bobbin coil cal stds		
a)	Shall contain 100%TW hole 0.067" dia, 4 x 100% TW holes 0.033" dia (90 degrees apart in same plane), 60% TW hole 0.109" dia, 40% TW hole 0.187" dia, & 4 x 20% TW holes 0.187" dia (90 degrees apart in same plane)	Complied	See as-built drawings
b)	Depths shall be within +/- 20% or 0.003", whichever is less	Complied	See as-built drawings
c)	Discontinuities shall be sufficiently separated to avoid interference	Complied	See as-built drawings
IV-3400	Digital system calibration shall be performed off line by data analysts	DAT-IP2-001 ANTS	
IV-3500	System calibration verification		
a)	Any change to ET system (i.e. Probe, probe extensions, & test instrument) shall require recalibration	MRS 2.4.2 GEN-35 DAT-IP2-001	

Exhibit 2
ASME Boiler & Pressure Vessel Code
Section XI Compliance

Section/Paragraph	Requirement	1997 Reference	Comments
b)	System calibration shall occur at beginning & end of data set	MRS 2.4.2 GEN-35 DAT-IP2-001	
c)	Data analyst determines retest requirements if system found out of calibration	MRS 2.4.2 GEN-35 DAT-IP2-001	
IV-4100	General examination		
a)	ET data for all test frequencies shall be recorded	MRS 2.4.2 GEN-35 ACTS	
b)	Bobbin coil must be sensitive to 100% TW hole (i.e. 50% FSH)	MRS 2.4.2 GEN-35 ACTS	
IV-4200	Probe traverse speed shall not exceed frequency response & sensitivity to cal std flaws	MRS 2.4.2 GEN-35 ACTS	
IV-5111	Depths shall be correlated to cal std that has been qualified	DAT-IP2-001 ANTS	Per EPRI Appendix H
IV-5112	Indications shall be reported from qualified frequencies or mixes	DAT-IP2-001 ANTS	Per EPRI Appendix H
IV-5210	Reporting criteria		
a)	Location along tube length	DAT-IP2-001 ANTS	
b)	Depth through tube wall	DAT-IP2-001 ANTS	If technique qualified for sizing
c)	Signal amplitude	DAT-IP2-001 ANTS	
d)	Frequency or mix channel	DAT-IP2-001 ANTS	
IV-5220	Flaws >=20% TW shall be reported	DAT-IP2-001 ANTS	
IV-5300	NQI shall be considered a flaw until otherwise resolved	DAT-IP2-001 ANTS	
IV-5410	Tube support members shall be used as reference points for location	DAT-IP2-001	Dimensions taken from drawings in SG design handbook

Exhibit 2
ASME Boiler & Pressure Vessel Code
Section XI Compliance

Section/Paragraph	Requirement	1997 Reference	Comments
IV-6100	Record identification		
a)	Owner	ANSER summary	Stored on optical disk
b)	Plant site	ANSER summary	Stored on optical disk
c)	SG ID	ANSER summary	Stored on optical disk
d)	Data storage unit #	ANSER summary	Stored on optical disk
e)	Date of exam	ANSER summary	Stored on optical disk
f)	Serial # of cal std	ANSER summary	Stored on optical disk
g)	Operators ID & level	ANSER summary	Stored on optical disk
h)	Exam frequencies	ANSER summary	Stored on optical disk
i)	Length of probe & probe extension cables	ANSER summary	Stored on optical disk
j)	Size & type of probe	ANSER summary	Stored on optical disk
k)	Probe manufacturer, part #, & description	ANSER summary	Stored on optical disk
IV-6200	Tube identification		
a)	Each tube shall be identified	MRS 2.4.2 GEN-35	
b)	Recorded tube ID shall correlate with actual tube ID	MRS 2.4.2 GEN-35	
IV-6300	Records		
a)	Owner or agent shall prepare report of exams	See W report	
b)	Report shall contain tubes examined, scanning limitations, location & depth of reported flaws, ID & level of operators & analysts	See W report	
c)	Report shall identify tubes removed from service or repaired	See W report	

Exhibit 3
EPRI PWR SG Examination Guidelines
TR-106589 Revision 4 Compliance

Section/Paragraph	Requirement	1997 Reference	Comments
Section 4	*Data Acquisition Procedures*		
4.1	Volumetric exams (i.e. ET)	ACTS	Used ET
4.2.1	Digital instrumentation	ACTS	Used digital instruments
4.2.2	Multi-frequency tests	ACTS	Ran 3 or more frequencies
4.2.3.1	Bobbin coils for detection of axial & volumetric flaw types	ACTS	Used bobbin in unison with C5
4.2.3.2	Rotating coils for detection of circumferential flaw types & in critical areas (i.e. u-bend)	ACTS	Used + Point
4.2.3.3	Array coils for critical areas (i.e. dented TSP)	ACTS	Used C5 in unison with bobbin
4.3	Qualified techniques (i.e. recommended applications)	ACTS	Used best qualified technique for each application
4.4.1	Rotating coils for diagnostic exams	ACTS	Used + Point
4.4.2	Rotating coils for signal characterization	ACTS	Used + Point
4.5	Calibration standards defined (EDM definition is generic)	ACTS	Used ASME, AVB, & EDM as applicable. See affidavit text for description of non-compliance with EDM standards used.
Section 5	*Data Analysis Procedures*		
5.1	Structured approach for data analysis	DAT-IP2-001 & ANTS	
5.2	Independent analysis teams & definition of responsibilities & data handling	DAT-IP2-001	Two independent analysis teams employed. Recommended categories covered.
5.3	Written analysis guidelines	DAT-IP2-001 & ANTS	Recommended categories covered
5.4	Analysis methods	DAT-IP2-001 & ANTS	"Analysis rules" consistent with qualified techniques. See affidavit text for description of non-compliance with

Exhibit 3
EPRI PWR SG Examination Guidelines
TR-106589 Revision 4 Compliance

Section/Paragraph	Requirement	1997 Reference	Comments
			EDM standards used.
5.5	Computer data screening	N/A	Not used
5.5.1	Simple threshold data screening	N/A	Not used
5.5.2	Rule based threshold data screening	N/A	Not used
5.5.3	Computer based analysis	N/A	Not used
Section 6	*Qualification of Data Analysts*		
6.1	Qualified data analysts	See individual QDA training records	All data analysts held valid QDA certifications
6.2	Site specific performance demonstration	See SSPD documentation	Written & practical exams implemented.
6.2.1	Lecture and laboratory session	See SSPD documentation	Implemented a self-study review of data analysis guidelines followed by Lead Analyst Q&A session. Recommended course topics covered.
6.2.2	Practical examination content	See SSPD documentation	Practical exams contained IP2 specific data except for + Point technique. This is because "... lack of associated data (required) reliance on similar plants with active damage mechanisms to assemble a data set."
6.2.3	Acceptance criteria	See SSPD documentation	All recommended criteria measured except false calls. Did not want analysts to be non-conservative due to complexity of data.
6.2.4	Re-examination	See SSPD documentation	Applied as applicable
6.2.5	Site specific re-qualification	N/A	Not applied
6.2.6	Documentation	On file with ConEd	

Exhibit 3
EPRI PWR SG Examination Guidelines
TR-106589 Revision 4 Compliance

Section/Paragraph	Requirement	1997 Reference	Comments
Section 7	*Qualification of Examination Techniques*		
7.1	"NDE of SG tubes shall be conducted using techniques capable of detecting and/or sizing the types of degradation known or reasonably expected to exist in accordance with industry experience. An inspection technique is qualified if sensors used have been proven capable by performance demonstration to meet the requirements of Appendices H and/or J."	See ACTS and Westinghouse documentation for qualification of C5 probe	Best available techniques used.
7.2	Technique qualifications shall comply with the minimum acceptance criteria of App. H	ACTS	All techniques were qualified to meet or exceed the App. H requirements. See affidavit text for description of non-compliance with EDM standards used.
7.3	Qualified techniques (list)	See ACTS and Westinghouse documentation for qualification of C5 probe	Industry peer reviews existed for all techniques used except the C5 probe. Other than the C5 probe, the applied techniques were documented in the EPRI "List of Qualified Techniques".

Exhibit 4
NRC Generic Letter
& Information Notice Compliance

Letter or Notice	Section/Paragraph	Requirement	1997 Reference	Comments
Generic Letters	*95-03*	*Circumferential Cracking of SG Tubes*		
	Reference plant	Circ cracking at Maine Yankee		
	Alerts licensees to	Importance of performing comprehensive exams using techniques & equipment capable of reliably detecting degradation	Inspection plans MRS 2.4.2 GEN-35 ACTS	Used techniques qualified to EPRI Appendix H
	Discussion	Detection factors are scope, technique, analysis guideline, training, etc.	Inspection plans MRS 2.4.2 GEN-35 ACTS DAT-IP2-001 ANTS SSPD	Used techniques qualified to EPRI Appendix H
	Licensee action	Develop plans for next scheduled SG tube inspections. Plans need to include scope including expansion plans, methods, equipment, criteria, & personnel training & qualification	Inspection plans MRS 2.4.2 GEN-35 ACTS DAT-IP2-001 ANTS SSPD	Used techniques qualified to EPRI Appendix H
	95-05	*Voltage Based Repair Criteria for Westinghouse SG Tubes Affected by ODSCC*	N/A	Applies to non-dented TSPs only

Exhibit 4
NRC Generic Letter
& Information Notice Compliance

Letter or Notice	Section/Paragraph	Requirement	1997 Reference	Comments
Information Notices	*90-49*	*SCC in PWR SG Tubes*		
	Reference plant	Millstone 2		
	Discussion	Circ SCC is a source of significant degradation to PWR SG tubes		Concur
		Circ SCC not detectable with bobbin		Concur. Cecco 5 and/or +Point used in critical areas where circ cracking could be present
		Low S/N ratios challenge detection & sizing of SCC	DAT-IP2-001 ANTS	Concur.
		Voltage threshold reporting is non-conservative	DAT-IP2-001 ANTS	Zero voltage threshold used
		Distorted or undefined signals should be dispositioned conservatively	DAT-IP2-001 ANTS	Concur.
	91-67	*Problems With Reliable Detection of IGA of SG Tubing*		
	Reference plant	Trojan		
	Discussion	Plant employed voltage threshold of >= 1.5 volts for reporting & missed 2,500 signals	DAT-IP2-001 ANTS	Zero voltage threshold used
		Experience further underscores non-conservatisms with voltage amplitude criteria	DAT-IP2-001 ANTS	Zero voltage threshold used

Exhibit 4
NRC Generic Letter
& Information Notice Compliance

Letter or Notice	Section/Paragraph	Requirement	1997 Reference	Comments
	92-80	*Operation of SG Tubes Seriously Degraded*		
	Reference plant	ANO-2		
	Discussion	Lack of data analysis guideline training	DAT-IP2-001 ANTS SSPD written exam implemented	
		Lack of performance demonstration test for data analysts	DAT-IP2-001 ANTS SSPD practical exam implemented	
		Inherent difficulties with interfering signals (i.e. geometry & deposits)	DAT-IP2-001 ANTS	
		Use of inappropriate probes for tube locations with circumferential crack potential	MRS 2.4.2 GEN-35 ACTS	Used techniques qualified to EPRI Appendix H
	94-88	*Inservice Inspection Deficiencies Result in Severely Degraded SG Tubes*		
	Reference plant	Maine Yankee		
	Discussion	Inadequate ET test procedures & inappropriate probes used	MRS 2.4.2 GEN-35 ACTS DAT-IP2-001 ANTS	Used techniques qualified to EPRI Appendix H
		Demonstrates importance of optimizing test methods to minimize electrical noise & signal interference & to maximize flaw sensitivity	MRS 2.4.2 GEN-35 ACTS DAT-IP2-001 ANTS	Used techniques qualified to EPRI Appendix H
		Demonstrates importance of	DAT-IP2-001	Used techniques qualified to EPRI

Exhibit 4
NRC Generic Letter
& Information Notice Compliance

Letter or Notice	Section/Paragraph	Requirement	1997 Reference	Comments
		anticipating potential sources of interfering signals (i.e. liftoff, geometry, etc.) & the effects on flaw detection	ANTS	Appendix H
		Demonstrates importance of developing adequate analysis procedures for the conditions noted above	DAT-IP2-001 ANTS	
		Demonstrates importance of being alert to plant specific conditions necessitating special procedures	DAT-IP2-001 ANTS	
	95-40	*Supplemental Information to GL 95-03*		
	Reference plant	Maine Yankee		
	Discussion	Licensee compared the ET techniques used to detect & size the indications & concluded the 0.080" HF pancake coil was the most sensitive technique	MRS 2.4.2 GEN-35 ACTS DAT-IP2-001 ANTS	0.080" HF pancake coil was not an industry recommended technique for low row U-bend exams. It was also not EPRI Appendix H qualified.
	96-09	*Damage in Foreign SG Internals*		
	Reference plant	Foreign plant		
	Discussion	Need to assess TSP integrity for upper most elevation		G. Pierini, Westinghouse, performed an assessment. See report of results.
	96-38	*Results of SG Tube Examinations*		
	Reference plant	Various		
	Discussion	Comprehensive exams with	Inspection plans	Used techniques qualified to EPRI

Exhibit 4
NRC Generic Letter
& Information Notice Compliance

Letter or Notice	Section/Paragraph	Requirement	1997 Reference	Comments
		appropriate techniques are paramount to ensure tube integrity	MRS 2.4.2 GEN-35 ACTS DAT-IP2-001 ANTS	Appendix H
		Generically qualified techniques may need to be supplemented to account for plant specific conditions (i.e. test variables, probe designs, & frequencies should be optimized)	Inspection plans MRS 2.4.2 GEN-35 ACTS DAT-IP2-001 ANTS	Used techniques qualified to EPRI Appendix H. No other supplemental techniques existed.
		Degradation mechanisms with no qualified depth sizing technique shall be considered defective	DAT-IP2-001 ANTS	Used techniques qualified to EPRI Appendix H.
	97-26	*Degradation in Small Radius U-bend Regions of SG Tubes*		
	Reference plant	Various		
	Discussion	Recent findings emphasize importance of using appropriate inspection techniques	Inspection plans MRS 2.4.2 GEN-35 ACTS DAT-IP2-001 ANTS	Used techniques qualified to EPRI Appendix H
		Indications are plugged on detection due to lack of sufficient tube pull ground truth results	DAT-IP2-001 ANTS	That is exactly what we did with R2C67

Exhibit 5
Initial SG ET Inspection Plan

Region	Initial Extent of Test	Probe Type
Tubesheet crevice	100%	MR +Point
Sludge pile	100% TSC to 1C 100% TSH to 2H	Cecco 5
Sludge pile	20% TSC + 20" 20% TSH + 20"	MR +Point
Freespan	33% full length per SG 100% TSC to 1C 100% TSH to 2H	Bobbin
Dented TSP	33% full length per SG 100% TSC to 1C 100% TSH to 2H	Cecco 5
Low row u-bends	100% rows 2 & 3	MR +Point
Dents restricted > 0.680"	100%	Cecco 5
Dents restricted > 0.640"	100%	MR +Point
Rerolled tubesheets for F* verification	100%	Combo RPC/Bobbin

TSC = Tubesheet Cold Leg
TSH = Tubesheet Hot Leg
1C = 1st TSP Cold Leg
2H = 2nd TSP Hot Leg