IP2 Steam Generator Notes
Greg Cranston, 6/5/2000, Rev. A

I. EPRI, PWR Steam Generator Examination Guidelines: Rev 5, Vol. 1: Requirements, Sept 1997

A. The requirement provided by the EPRI document will assist, specifically, in meeting the objectives of NRC performance-based criteria. These performance-based criteria require utilities to develop and implement a program that monitors the condition of steam generator tubes against acceptable performance criteria in a manner sufficient to provide reasonable assurance that the steam generators remain capable of fulfilling their intended safety function.

B. Main contributors to tube degradation are:

Corrosion is the predominant tube degradation mechanism within and above the tube sheet crevice, and at support plates. Known corrosion mechanisms include thinning, secondary side intergranular attack (IGA) and stress corrosion cracking (SCC), pitting, primary side SCC, and denting. Mechanical wear related degradation is restrict to fretting at anti-vibration bars and at baffle plates in preheater models.

1. Intergranular corrosion (temperature sensitive degradation mechanism)
2. Stress corrosion cracking (temperature sensitive degradation mechanism)
3. Thinning
4. Pitting
5. Denting

C. Key requirements:

1. Establish a written program for SG management consistent with the EPRI guidelines.
2. Develop a knowledgeable SG examination engineering organization. The engineering function should include planning, directing and evaluation SG examination activities.
3. Support continuity of personnel within the SG examination engineering organization.
4. Designate an experienced Qualified Data Analyst to randomly sample inspection results to ensure proper disposition of resolved indications.

D. SG Pre-service Inspection (PSI)

1. The PSI of SGs shall be conducted on 100% of the tubing (full length) using general purpose eddy current bobbin probes.
2. A sample of abnormal conditions (e.g., over/under expansion transitions, manufacturing burnish marks providing unusual signals, dents) observed during the baseline examination shall be examined with rotating coil technology (RCT) which provides a basis for signal characterization.

E. Inspection requirements:

1. After the first cycle of operation
2. During subsequent ISIs, if active damage mechanisms are identified, all SG shall be examined a the end of each fuel cycle or 24 EFPM.
3. 100% of the tubing and 100% of each type of repair shall be inspected within a rolling 60 EFPM time frame.
   a. Each sample set during that period shall sample at least 20% of each type of tube (active, active sleeves, plugged, other types of repair).
   b. Selected randomly or systematically and evenly distributed throughout the SG.

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c. All non-repaired tubes which have prior indications of degradation shall be examined through the zone of degradation when the applicable generators are open for examination.

4. No SG shall operate more than two fuel cycles between inspections.

F. Active damage:

1. A combination of ten or more new indications of degradation (>20% TW) and previous indications of degradation which display an average growth rate of equal to or greater than 25% of the repair limit per cycle in any one SG, or
2. One or more new or previously identified indications of degradation, including cracks, which display a growth greater than or equal to the repair limit in one cycle of operation.

G. Inspection Results Categories:

1. C-1: less than 5% of total tubes inspected are degraded tubes and none of the inspected tubes are defective.
2. C-2: Between 5% and 10% of total tubes inspected are degraded, or one or more tubes, but not more than 1% of the total tubes inspected are defective.
3. C-3: More than 10% of total tubes inspected are degraded, or more than 1% of the tubes are defective.
4. Note: in all inspections, previously degraded tubes must exhibit growth of greater than 10% through wall or growth of greater than 25% of the repair limit to be included in the calculations that are performed in C-1, C-2 and C-3.

H. Selection of tubes from previous Critical Areas for the periodic sample.

1. Critical Area (C-A): an area of SG tubing which, on the basis of inspection results, engineering evaluation and related experience, is defined by the type of degradation, the cause of the degradation, and the boundary of the degradation.
2. If during the previous exam, the damage mechanism within a C-A was determined to be active, then 100% of the active tubes within the C-A shall be examined in the affected SG, along with at least a 20% sample of active tubes within the C-A of all other SG.
3. If during a previous exam, the damage mechanism within a C-A was determined to be non-active, then at least 20% of the active tubes within the C-A shall be examined in the affected SG.

I. Degradation Assessment

1. The degradation assessment is an integral part of the operational and condition monitoring assessments in determining the initial sample size, the extent of the examination, and the sampling expansion criteria.
2. Probability of detection (POD).

J. Operational Assessment (forward looking)

1. Projecting
2. Level of confidence

K. Inspection system performance

1. **Technique performance**, plus
   a. Probability of detection
   b. Measurement of uncertainties
   c. Calibration standards
2. **Analysis performance**, plus
   a. Analysis of all plant eddy current data shall be completed by two independent analysis teams.

b. Analyses done separately and by different inservice inspection organizations.
c. A discrepancy resolution team shall review and resolve discepancies between the results of the two independent analysis teams.
d.

3. **Field analysis feedback**
   a. Threshold detection
   b. Rule-based detection
   c. Overcall

II. Condition Reports Related to the Steam Generators

III. Condiion Monitoring and Operational Assessment Reports, 6/2/2000
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