UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

NRC INSPECTION MANUAL

EMCB

INSPECTION PROCEDURE 49001

INSPECTION OF EROSION-CORROSION/FLOW-ACCELERATED-CORROSION MONITORING PROGRAMS

PROGRAM APPLICABILITY: 2515 & 2516

FUNCTIONAL AREA: MAINTENANCE (MAINT)

49001-01 INSPECTION OBJECTIVE

01.01 To determine whether licensee activities relative to erosion-corrosion/flow-accelerated-corrosion (EC/FAC) monitoring and maintenance are being accomplished in accordance with 10 CFR 50.65, the Maintenance Rule, licensee activities to implement 10 CFR Part 54, License Renewal, commitments to Generic Letter 89-08, "Erosion/Corrosion Induced Pipe Wall Thinning," and licensee-approved procedures.

01.02 To determine whether or not management control problems or generic weaknesses exist relative to the licensee's implementation of its long-term EC/FAC monitoring program.

49001-02 INSPECTION REQUIREMENTS

02.01 Verify that the licensee's EC/FAC program includes systematic methods for predicting which systems are susceptible to EC/FAC, inspecting components determined to be susceptible, analyzing and trending inspection data to determine EC/FAC wear rates, determining future inspection times based on past inspection results, and repairing or replacing piping components determined or predicted to wear below minimum requirements.

When reviewing these systems consider that all safety-related piping systems and certain non-safety-related piping systems are under the regulatory auspices of the maintenance rule and license renewal, which require licensees to demonstrate that the performance or condition of these systems and components are being effectively controlled and managed through condition monitoring and preventive maintenance to ensure that they remain capable of performing their intended function.

Verify that the licensee's EC/FAC program contains specific guidance for those components requiring an aging management review that are susceptible to EC/FAC, such as an American Society of Mechanical Engineers (ASME) repair and replacement program. For repairing and replacing unacceptably eroded piping and components, the licensee should use approved procedures in accordance with the aging management program description, if applicable.

02.02 Review the analysis for EC/FAC for at least four systems and determine if these systems fall under the scope of the licensee's maintenance rule and/or licensee renewal programs with condition monitoring goals and/or performance measures established.

a. If computer analysis has been used, do the following:

1. Determine which computer program is being used for the analysis. If the computer program is not an industry sponsored computer program, determine how the licensee approved the program for use.

2. Determine if the information entered into the computer program (e.g., pipe diameter, PH, oxygen, flowrate, etc) was properly entered to conduct the analysis.

3. Review the computer program entry data sheets and verify if the licensee utilized them for proper data entry (e.g., geometry code, material type). Whether or not data sheets are used, verify the accuracy of entered data on a sampling basis.

4. Verify that all piping components of the system susceptible to EC/FAC have been entered into the computer program (including all straight sections of piping).

5. Review the entered data to ensure that it was reviewed by a second person to minimize the probability of data entry errors.

6. Review the inspection data used to verify and validate the computer program predictions.

7. Review the completed analysis to determine that it was reviewed by someone other than the originator to minimize the probability of errors.

b. If computer analysis has not been used, do the following:

1. Review the method used for analysis to determine if the information required by the process was properly used to conduct the analysis.

2. Review the piping components to determine if all susceptible components (including all straight sections of the piping system) have been analyzed.

3. Review the analyses and numerical calculations and determine if they have been reviewed by a second person to minimize the probability of errors.

4. Review the inspection data used to confirm the validity of the calculations. This comparison shall determine if the analysis technique and inspection data provide results that can be correlated.

02.03 Review the licensee's analysis for selection of inspection locations by doing the following:

a. Verify that the licensee's program has well defined criteria for selection of inspection locations.

b. For licensees utilizing industry sponsored predictive programs (e.g., CHECWORKS), verify the proper selection of the 10 most susceptible locations for inspection and 5 additional locations based on unique operating conditions or special considerations.

02.04 Determine whether the licensee's program has well-defined criteria for the following:

a. Inspection frequency and trending of inspection data.

b. Acceptance criteria for minimum wall thickness to ensure integrity under design basis conditions.

c. Actions taken when wall thinning is detected (e.g., additional inspections, repair or replacement requirements).

d. Evaluating the results of EC/FAC inspection monitoring data against established performance or condition measures to determine if aging management and preventive maintenance activities are effective. In addition, determine if structures, systems, and components (SSCs) require additional goals and monitoring to improve performance in accordance with the maintenance rule (see IPs 62706 and 62707).

02.05 Review the licensee's implementation of the EC/FAC monitoring program to determine the following:

a. If responsibility for proper execution of the EC/FAC program is appropriately designated.

b. If engineering (corporate and site) is involved in the planning and execution of the EC/FAC program.

c. If the inspection procedures are current and properly reviewed and approved for use.

d. If the licensee's method of performing ultrasonic testing (UT) (volumetric) inservice inspections (ISI) of carbon steel and low alloy steel piping is adequately described in a site-approved procedure.

e. If the licensee's program includes a means of evaluating the results from UT measurements and if potential deficiencies are appropriately documented in the licensee's non-conformance or deficiency reporting program.

f. If the personnel conducting the non-destructive examination (NDE) examinations are certified.

g. If the method of NDE and related equipment is within its calibration intervals and has been calibrated against known standards for the types of materials and range of thickness to be measured.

h. If the measurements of pipe wall thickness are being accomplished in accordance with established instructions and results are being appropriately documented.

i. If the grid patterns or other inspection area layout instructions are used and documented clearly, for example with a sketch, to allow repeatability and correlation of inspection data for subsequent examinations.

j. If the installed plant components conform to the plant isometrics with respect to size and type of material.

49001-03 INSPECTION GUIDANCE

General Guidance

Generic Letter 89-08 requested that all licensees implement a long-term EC/FAC detection program to prevent piping failures in high energy (two-phase as well as single-phase) carbon steel piping systems. The programs are developed by each utility using plant specific conditions, industry-wide operating experience, engineering judgement, NDE techniques, and computer analysis of high energy carbon steel systems. Piping failures at Surry 1, San Onofre 2, Millstone 2 and 3, and Fort Calhoun have called into question the successful implementation of long-term programs committed to by the licensees. The purpose of this inspection procedure is to determine if licensees have adequately implemented a long term EC/FAC monitoring program. The long term program must be well defined, with clearly documented results, and must include a complete analysis of the susceptible systems, inspection of the most susceptible piping components, repair or replacement of damaged piping components, trending of inspection data in order to determine EC/FAC rates, and continued analysis based on inspection findings.

Licensees utilizing industry sponsored programs for tracking and predicting wear (i.e. CHECWORKS or an equivalent program) must be vigorous in using the program for predicting susceptible configurations. The licensee's program should contain adequate criteria, trending requirements, and inspection activities to ensure that applicable piping and component integrity is maintained consistent with the current licensing basis throughout the life of the plant. EC/FAC monitoring and trending programs should define corrective actions and implement them as appropriate. Documentation of the program should be consistent with the requirements of licensee approved procedures. The systems typically susceptible to EC/FAC are discussed in Attachment A.

The licensee should use Electric Power and Research Institute (EPRI) Report NSAC-202L-R1, "Recommendations for an Effective Flow-Accelerated Corrosion Program"; the Nuclear Management and Resource Council (NUMARC) guidelines found in Appendix A to NUREG-1344, or other equally effective programs to select the most susceptible locations for inspection.

If computer codes are used, the licensee should include in the EC/FAC monitoring program feedback of inspection data into the computer model to predict EC/FAC damage in areas that were not inspected.

The EC/FAC monitoring program is a method that can be used to demonstrate that the condition of piping systems noted in Attachment A are being controlled through the performance of appropriate preventive maintenance so that they remain capable of performing their intended functions. Verify that the licensee's use of an EC/FAC monitoring program to meet the condition monitoring requirements of the maintenance rule is acceptable.

Condition monitoring goals or measures should be predictive in nature, providing early warning of degradation before failures occur. Appropriate EC/FAC condition monitoring performance goals or measures should be selected to ensure that SSCs remain capable of performing their intended function (i.e., maintain system piping and components above minimum applicable code wall thickness limits) as determined by design basis engineering analysis, industry-wide operating

experience, computer codes, and NDE techniques listed in this procedure. Verify that licensees take advantage of industry-wide operating experience under the requirements of the maintenance rule to identify EC/FAC problems and failures at other plants and apply the appropriate corrective actions taken through maintenance to prevent failures at their plant. If licensees discover that condition monitoring goals or measures are not being met, licensees should also take prompt corrective action through maintenance to preclude failures.

Maintenance Rule (10 CFR 50.65) requirements and License Renewal (10 CFR Part 54) commitments will apply to licensee EC/FAC programs. If significant monitoring program or SSC performance problems are identified within the auspices of the maintenance rule or license renewal, the inspector should consult with and identify any concerns to regional management who may consider a more detailed inspection in accordance with Inspection Procedure (IP) 62706, "Maintenance Rule" and/or IP 71002, "License Renewal."

The inspector should be aware of other potential problems that have been noted at other nuclear facilities as follows:

a. Inadequate interdepartmental review of the inspection program and coordination necessary to ensure that all operating conditions and procedures are accurately reflected in the analysis.

b. Improper establishment of specific responsibility for analysis and evaluation of the results.

c. A lack of continuity on responsibility for the EC/FAC program when personnel responsible for the EC/FAC program leave the organization.

d. Insufficient training in the use of the computer code selected (e.g., CHECWORKS, WATHEC or others) for EC/FAC analysis by the responsible engineer(s).

e. Inadequate verification that all susceptible systems selected for analysis have been analyzed.

f. Incomplete screening criteria that would allow systems or portions of systems to be eliminated from analysis due to only one variable (e.g., temperatures above 450°F or infrequent operation such as recirculation lines to condensers). The variables of temperature, water chemistry (pH, pH control agent, dissolved oxygen), flow rate, geometry, material, and steam quality (for two-phase systems), must all be considered when evaluating piping systems for susceptibility.

g. Insufficient attention to detail which can result in piping systems or specific components (e.g., straight sections of piping) being omitted from the computer model used for analysis.

h. Insufficient program maintenance. Long term programs require periodic program review and upgrading to accurately reflect plant operational conditions (e.g., revising computer models of susceptible systems to most recent versions of computer program used for analysis).

i. Lack of internal procedures established to provide a long term history and documentation of the analyses and inspections performed under the EC/FAC program.

j. Inadequate use of UT input data to calculate and predict wear rates using industry sponsored computer codes (e.g., CHEC family computer codes).

k. Failure to maintain accurate historical plant records of previous SSC failures due to EC/FAC and to implement followup inspections of similar SSCs in other plant locations.

Inspector Training and Preparation. Before conducting inspections, the inspectors assigned to the inspection task should familiarize themselves with current computer programs (e.g., CHECMATE, CHECWORKS, CHEC-NDE, etc) either by attending specialized training or by thoroughly reviewing guidelines and manuals for these programs. Inspectors should use the most recent training material produced by industry sources on these programs (e.g., EPRI), which provide examples of weaknesses found in current computer models for predicting loss of piping wall thickness.

Additional guidance is given in Attachment A to this IP, which is intended to assist the inspector in the evaluation of licensee's EC/FAC monitoring program. Attachment B, "Erosion-Corrosion/Flow-Accelerated-Corrosion Program Information Survey," can be used at the inspector's discretion as a means of consolidating and comparing licensee program information.

Specific Guidance

03.01 Documentation Inspection. Verify that the EC/FAC aging management program and activities are well documented and consistent with licensee approved programs and procedures. Verify that this information is maintained in an auditable and retrievable form.

03.02 Program Implementation. Verify that the EC/FAC program is being implemented by the licensee as follows:

- Verify that the program criteria, inspection activities, and corrective actions are being implemented.
- Verify that the licensee, if using an industry sponsored program for tracking and predicting wear (e.g., CHECWORKS or its equivalent), has a documented process to aggressively maintain and use the program to predict susceptible configurations, including criteria for selecting inspection locations and frequency of inspection.
- Verify that the components selected for inspection are consistent with the licensee's piping and instrumentation drawings, isometric drawings, or other plant-specific drawings used to aid the licensee with its inspections. Compare the components selected for inspection with the plant-specific drawings, and perform plant walkdowns of the selected systems to verify that the as-built configuration of the plant matches the plant-specific drawings, particularly in the balance of plant piping.
- Verify that the acceptance criteria for minimum wall thickness are consistent with maintaining structural integrity under applicable design basis conditions.
- Verify that trending activities are being implemented consistent with the licensee's commitments in the license renewal application, if applicable, and licensee approved procedures.

- Verify the effectiveness with which the plant staff responsible for implementing the EC/FAC program receive, analyze and act on data from industry-wide operating experience on instances where degradation or industry failures were caused by EC/FAC mechanisms.

- Verify that corrective actions and trending are being implemented as required by site-approved programs and procedures.

03.03 Program Effectiveness. Verify that the applicant is implementing the EC/FAC program such that the program will effectively manage the effects of EC/FAC throughout the life of the plant.

- Verify that the applicant's program activities (e.g., UT inspections) reflect current industry techniques and practices.

- Inspect the material conditions and/or review the maintenance history of piping and components within the licensee's program. Ensure that the inspections and reviews include a good cross-section of piping and component locations, configurations, and conditions. Verify that the physical condition and maintenance history of piping and components reflect that the loss of material due to EC/FAC is being monitored.

- Verify that the licensee uses qualified personnel and suitable procedures to control any repair or replacement activities for non-safety-related piping.

- Verify that the trending practices and inspection frequencies are reasonable for and consistent with maintaining the design requirements.

In general, the analysis of susceptible systems should consider the following:

a. Piping material (e.g., chromium, molybdenum, and copper content).

b. Piping configuration (e.g., fittings less than 10 pipe diameters apart).

c. pH of water in the system (e.g., pH less than 10).

d. System temperature (e.g., between 175°F and 500°F).

e. Fluid bulk velocity (e.g., greater than 10 ft/s).

f. Oxygen content in the system (e.g., oxygen content less than 50 ppb).

g. Unusual operating conditions (e.g., extended recirculation line flow) which are different from normal operating conditions.

h. Fluid state (e.g., single phase/two phase).

i. Industry-wide operating experience with previous SSC failures as a result of EC/FAC.

03.04 No inspection guidance provided.

03.05 See NUMARC guidelines (i.e., Appendix A to NUREG-1344) for acceptable criteria, for qualification or certification of NDE personnel and equipment. The personnel conducting NDE examination should be certified to American Society of Nondestructive Testing (ASNT) standard TC-1A.

49001-04 RESOURCE ESTIMATE

The estimated number of onsite inspection hours to complete this inspection is 80 staff-hours per plant. For multiplant sites, 8 additional hours of inspection will be needed, depending on the similarity of program between plants. If the inspection is to be performed at an offsite location, (e.g., corporate engineering office) inspection time required will vary. This inspection should be performed as determined by regional staff, on an as needed basis or as an event followup.

49001-05 REFERENCES

ASME Boiler and Pressure Vessel Code Section III

ASME Boiler and Pressure Vessel Code Section XI

ANSI/ASME Standard B31.1 "Power Piping"

Generic Letter 89-08, "Erosion/Corrosion Induced Pipe Wall Thinning"

NUREG-0800, Standard Review Plan, Sections 10.4.7, "Condensate and Feedwater Systems" and 10.4.9, "Auxiliary Feedwater System"

Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants"

Regulatory Guide 1.58, "Qualification of Nuclear Power Plant Inspection, Examination and Testing Personnel"

Draft Regulatory Guide DG-1047, "Standard Format and Content for Applications To Renew Nuclear Power Plant Operating Licenses"

NUREG-1344, "Erosion/Corrosion-Induced Pipe Wall Thinning in U.S. Nuclear Power Plants" (Microfilm Address: 49855-153 to 49855-202)

NUMARC Technical Subcommittee Working Group on Piping Erosion/Corrosion Summary Report (i.e., NUMARC Guidelines) (see Appendix A to NUREG-1344)

EPRI Report NSAC-202L-R1, "Recommendations for an Effective Flow-Accelerated Corrosion Program,"

NUMARC 93-01 "Industry Guideline for Monitoring the Effectiveness of Maintenance at Nuclear Power Plants"

Regulatory Guide 1.160 "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants"

END

Attachments:

A. Other Erosion-Corrosion/Flow-Accelerated-Corrosion (EC/FAC) Inspection Guidance
B. Erosion-Corrosion/Flow-Accelerated-Corrosion (EC/FAC) Program Information Survey

OTHER EROSION-CORROSION/FLOW-ACCELERATED-CORROSION (EC/FAC) INSPECTION GUIDANCE

Licensees should use one or more of the following models or an equivalent to predict wear in high energy carbon steel systems:[1]

a. Electric Power Research Institute (EPRI) CHECMATE/CHECWORKS computer codes.
b. Keller's Equation (described in EPRI Report NP-3944).
c. Massachusetts Institute of Technology method (described in NUREG/CR-5007).
d. NUMARC Guidelines listed in Appendix A of NUREG 1344.

The carbon steel systems which have been typically monitored for EC/FAC in the past include the following:

a. feedwater
b. condensate
c. feedwater heater drains
d. moisture separator drains
e. moisture separator reheater drains
f. extraction steam piping
g. steam generator blowdown (PWR)
h. high pressure coolant injection (HPCI)
i. main steam
j. reheat steam
k. auxiliary steam
l. auxiliary feedwater pump steam supply (PWR)
m. reactor core isolation cooling pump steam supply (BWR)
n. reactor water cleanup (RWCU)
o. crossover and crossunder piping
p. associated straight runs

Industry-wide operating experience has shown that components with complex geometries are frequently susceptible to EC/FAC. Typical components which have been most susceptible include the following:

a. control valves
b. tees and branches
c. expanders and reducers
d. flow nozzles or orifices
e. exit nozzles
f. long and short radius elbows
g. steam traps

The licensee should initially use predictive, analytical methods, such as those listed above to screen components for UT inspection. Other techniques that should be used to identify supplemental inspection locations may be designated by the following:

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[1] Inspectors should be aware that the NRC does not endorse any of the predictive computer models used by the industry. Inspectors should obtain the latest training material on weaknesses and limitations found in computer model output data used to estimate actual wear rates.

a. industry-wide operating experience
b. engineering judgment
c. sample (component location) expansion
d. plant specific design
e. ultrasonic testing (UT) results
f. plant historical records of previous SSC failures as a result of EC/FAC

A licensee's EC/FAC program should be well defined and described in an appropriate procedure approved by one of the management review committees defined in Section 6.0 of the licensee's Technical Specifications. The licensee's procedure should define the its method of doing the following:

a. performing ultrasonic measurements
b. defining and describing both grid spacing criteria and inspection zone criteria, if applicable
c. ensuring that measurements during followup inspections are accurately taken at the same grid locations as taken previously
d. verifying that certified individuals, with UT ISI level II certification, perform the ultrasonic measurements
e. analyzing the results of UT measurements
f. establishing acceptance criteria for evaluating UT data

A licensee's EC/FAC procedure should define the licensee's criteria for evaluating UT data. The method of analysis should enable the licensee to do the following:

a. calculate the current wear rate of the component
b. predict the thickness of the component at the next refueling outage
c. determine if the component is currently acceptable, and if it will be acceptable at the next refueling outage
d. calculate the remaining life of the component
e. provide for repair or replacement before plant startup of components that are to wear to below nominal wall thickness before the next outage

For additional guidance, review ASME Case N480 entitled "Examination Requirements for Pipe Wall Thinning Due to Single Phase Erosion and Corrosion Section XI, Division 1."

END

EROSION-CORROSION/FLOW-ACCELERATED-CORROSION (EC/FAC) PROGRAM INFORMATION SURVEY

Objective

This survey is issued to provide inspectors with a means of documenting whether or not licensees have implemented programs for long term monitoring of EC/FAC in single and two phase, high energy, carbon steel systems. Inspectors will use this survey to assess whether current EC/FAC programs are comprehensive enough to provide a reasonable assurance that EC/FAC in high energy, carbon steel systems will not threaten the structural integrity of the system's piping.

Definitions

t_{nom} the nominal design thickness of the pipe

t_{meas} the minimum measured thickness at the last refueling outage, or current refueling outage if UT measurements have already been made

t_{pred} the predicted measured thickness at the next refueling outage

t_{min} the minimum allowable thickness as set by the licensee's acceptance criteria

wr the current calculated wear rate of the component

Band Method - a method of calculating wear rates by taking a band around the circumference of the pipe and subtracting the minimum wall thickness reading in the band from the maximum wall thickness reading in the band

Point to Point - a method of calculating wear rates by subtracting the measurement taken at a grid point during the current refueling outage from the measurement taken at the same grid point during the previous refueling outage

Survey

I. System and Component Selection

A. Has the licensee implemented a long term EC/FAC program in accordance with the licensee's response to Generic Letter 89-08?

Yes ____ No ____

B. Does the licensee's EC/FAC program have a systematic method of predicting which carbon steel systems are most susceptible to EC/FAC?

Yes ____ No ____

C. Does the licensee's EC/FAC program identify susceptible systems which are included in the licensee's maintenance rule and/or licensee renewal programs with condition monitoring goals and/or performance measures established?

Yes____ No____

1. If so, which of the following predictive models are used? Check all that apply.[2]

___ Electric Power Research Institute (EPRI) CHEC computer code for single phase, carbon steel systems
___ EPRI CHECMATE computer code for single and two phase, carbon steel systems
___ Massachusetts Institute of Technology - NUREG CR-5007 method
____ NUMARC Guidelines found in Appendix A of NUREG-1344
____ Keller's Equation described in EPRI Report NP-3944
___ Other predictive model: _____

2. If the licensee uses a predictive model, are the systems which have been predicted to be susceptible to EC/FAC included in the licensee's EC/FAC program?

Yes ____ No ____

3. If the licensee uses a predictive model, does the model rank the system's components according to their EC/FAC susceptibility and overall risk?

Yes ____ No ____

D. What is the licensee's primary basis for selecting components for ultrasonic inspection at the next refueling outage? (Choose one.)

____ Engineering judgment
____ Results of predictive analyses
____ Industry or operating experience
____ Results of previous ultrasonic inspections

Does the licensee use any additional means to select supplemental inspection locations?

Yes ____: If so, how? (Select as many as apply and show an estimated percentage of use.)

____ Engineering judgment, including plant specific design
____ Results of predictive analyses
____ Industry or operating experience
___ Results of previous ultrasonic inspections, including sample expansion points

No ____

[2] Inspectors should be aware that the NRC does not endorse any of the predictive computer models used by the industry. Inspectors should obtain the latest training material on weaknesses and limitations found in computer model output data used to estimate actual wear rates.

E. Does the licensee have criteria for excluding a system from the EC/FAC program?

Yes ____ No ____

1. Which of the following systems have been included in the licensee's EC/FAC program?

____ Feedwater
____ Condensate
____ Feedwater Heater Drains
____ Moisture Separator Drains
____ Moisture Separator Reheater Drains
____ Extraction Steam
____ Steam Generator Blowdown (PWR only)
____ High Pressure Coolant Injection
____ Main Steam System
____ Main Steam System Drains
____ Residual Heat Removal and/or Safety Injection Systems
____ Auxiliary Steam
____ Auxiliary Feedwater Pump Steam Supply
____ Reactor Water Cleanup (BWR)
____ Crossover and Crossunder Piping
___ Other systems: _____

2. Which of the preceding systems are part of the Class 1 boundary?

_____
_____

3 . Which of the following components have been included in the licensee's EC/FAC program?

____ Control valves/Check valves
____ Tees and branches
____ Expanders and reducers
____ Flow nozzles or orifices
____ Exit nozzles
____ Elbows and reducing elbows
____ Steam traps
___ Other components: _____
_____

II. Ultrasonic Testing Inspections and Evaluations

A. Is the licensee's method of performing UT (volumetric) inspections of carbon steel piping described in a procedure approved by one of the management review committees defined in Section 6.0 of the licensee's Technical Specifications or the licensee's quality assurance program description?

Yes_____ No_____

Is the licensee inspecting small-bore piping (≤2")?

Yes_____ No_____

B. Do the licensee's procedures define its method of doing the following?

1. Performing ultrasonic measurements: Yes ____ No ____
2. Defining and describing grid spacing criteria and inspection zone criteria: Yes ____ No ____
3. Ensuring that measurements during followup inspections are accurately taken at the same locations as taken previously: Yes ____ No ____
4. Ensuring that certified individuals, with, UT ISI level II certification, perform the ultrasonic measurements: Yes ____ No ____
5. Analyzing the results of UT measurements: Yes ____ No ____
6. Establishing acceptance criteria for evaluating UT data: Yes ____ No ____

C. What criteria are used by the licensee to establish minimum wall thickness (t_{min}) requirements?

1. Safety related piping

*___ t_{min} set to code allowable minimum wall thickness or 0.875 of nominal wall thickness, whichever is greater
___ t_{min} set to 0.875 of nominal thickness, only
*___ t_{min} set to code allowable minimum wall thickness, only
___ t_{min} set to 2/3 of nominal wall thickness
___ other: _____

2. Balance of plant piping

*___ t_{min} set to code allowable minimum wall thickness or 0.875 of nominal wall thickness, whichever is greater
___ t_{min} set to 0.875 of nominal thickness, only
*___ t_{min} set to code allowable minimum wall thickness, only
___ t_{min} set to 2/3 of nominal wall thickness
___ other: _____

* Calculated minimum wall thickness for the piping is determined from the primary stress equations of the construction code. Both hoop and axial stress directions are considered and bending loads are included. Design pressure and design mechanical loads are used at design temperatures. When bending loads are not available, bounding values are used.

D. Does the licensee's method of analyzing UT data enable the licensee to do the following?

1. Calculate the current wear rate, wr, of the component?

Yes ____ If so, how?
___ Point to Point method of calculating wear rates
___ Band Method of calculating wear rates
___ other methods: _____

No ____

2. Predict the thickness of the component at the next refueling outage?

Yes ____ If so, how?

____ $t_{pred} = [t_{meas} - (wr \times \text{current operating cycle time})]$

____ $t_{pred} = [t_{nom} - (wr \times \text{total operating time to date})]$

____ other method: _____

No ____

3. Determine if the component is currently acceptable, and if it will be acceptable at the next refueling outage?

Yes ____ If so, how?

____ $t_{meas} > t_{min}$ and $t_{pred} > t_{min}$

____ other method: _____

No ____

4. Calculate the remaining life of the component?

Yes ____ If so, how?

____ remaining life = $(t_{meas} - t_{min})/wr$

____ other method: _____

No ____

III. Repairs or Replacements of Excessively Eroded Components (Eroded below the minimum acceptable wall thickness)

A. Are licensee repairs or replacements of excessively eroded areas in safety-related piping performed in accordance with the requirements specified in the ASME Code, Section XI, Article IWA 4000/7000, or applicable alternative rules found in IWB 4000/7000, IWC 4000/7000, or IWD 4000/7000?

Yes ____ No ____

1. Does the licensee have a repair or replacement program for balance of plant components which fail to meet the licensee's acceptance criteria?

Yes ____ No ____

2. Is welding and non-destructive testing of balance of plant piping done with qualified personnel and suitable procedures?

Yes ____ No ____

3. Does the licensee have a procedure that formally documents which plant SSCs have been replaced as a result of EC/FAC, and that follow up inspections were implemented for similar SSCs in other plant locations?

Yes ____ No ____

B. When excessively eroded components are found, did the licensee evaluate the effectiveness of implementation of the EC/FAC program and determine whether program enhancements are warranted?

Yes____ No____

IV. Management Oversight of the Licensee's EC/FAC Program

A. Which of the licensee's departments is delegated the responsibility for implementing the licensee's EC/FAC Program?

____ Corporate Nuclear Engineering Department
____ Site Inservice Inspection Department
____ Site Engineering Department
____ Other: _____

B. Does the licensee have a program to oversee and self assess the EC/FAC program?
Yes ____ No ____

1. If so, which of the licensee's management review organizations is responsible for overseeing the licensee's EC/FAC program?

____ Plant Operating Review Committee (PORC or equivalent)
____ Site Operating Review Committee (SORC or equivalent)
____ Nuclear Review Board (NRB or equivalent)

2. Is the EC/FAC program, as it relates to Class 1, 2, or 3 components, covered by the licensee's QA program?

Yes ____ No____

END