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Note:

[1] Although the curves were developed for 33 EFPY, they are limited to 28 EFPY (corresponding to the end of cycle 28) by WPSC Letter NRC-99-017.

4.2 ASME CODE CLASS IN-SERVICE INSPECTION AND TESTING

APPLICABILITY

Applies to in-service structural surveillance of the ASME Code Class components and supports and functional testing of pumps and valves.

OBJECTIVE

To assure the continued integrity and operational readiness of ASME Code Class 1, 2, 3, and MC components.

SPECIFICATION

a. ASME Code Class 1, 2, 3, and MC Components and Supports

1. In-service inspection of ASME Code Class 1, Class 2, Class 3, and Class MC components and supports shall be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code and applicable Addenda as required by 10 CFR 50.55a(g), except where relief has been granted by the Commission pursuant to 10 CFR 50.55a(g)(6)(i). The testing and surveillance of shock suppressors (snubbers) is detailed in TS 3.14 and TS 4.14.

2. In-service testing of ASME Code Class 1, Class 2 and Class 3 pumps and valves shall be performed in accordance with Section XI of the ASME Boiler and Pressure Vessel Code and applicable Addenda as required by 10 CFR 50.55a(f), except where relief has been granted by the Commission pursuant to 10 CFR 50.55a(f)(6)(i).

3. Surveillance testing of pressure isolation valves:

   a. Periodic leakage testing[1] on each valve listed in Table TS 3.1-2 shall be accomplished prior to entering the OPERATING mode after every time the plant is placed in the COLD SHUTDOWN condition for refueling, after each time the plant is placed in a COLD SHUTDOWN condition for 72 hours if testing has not been accomplished in the preceding 9 months, and prior to returning the valve to service after maintenance, repair, or replacement work is performed.

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[1]To satisfy ALARA requirements, leakage may be measured indirectly (as from the performance of pressure indicators) if accomplished in accordance with approved procedures and supported by computations showing that the method is capable of demonstrating valve compliance with the leakage criteria.

b. Whenever integrity of a pressure isolation valve listed in Table TS 3.1-2 cannot be demonstrated, the integrity of the remaining pressure isolation valve in each high pressure line having a leaking valve shall be determined and recorded daily. In addition, the position of the other closed valve located in the high pressure piping shall be recorded daily.

b. Steam Generator Tubes

Examinations of the steam generator tubes shall be in accordance with the in-service inspection program described herein. The following terms are defined to clarify requirements of the inspection program.

Imperfection is a deviation from the dimension, finish, or contour required by a design drawing or specification.

Degradation means service-induced cracking, wastage, wear or corrosion of a tube wall.

% Degradation is the amount in percent of tube wall thickness affected or removed by degradation.

Degraded Tube means a tube containing degradation that is $\geq$ 20% of nominal wall thickness.

Defect means an imperfection that violates criteria used to determine acceptability of a tube for continued use in operation.

Tube Inspection means the detailed examination of a steam generator tube from the point of entry (e.g., hot leg side) around the U-bend to the level of the top tube support plate of the opposite leg (cold leg).

Tube is a single hollow metal cylinder that is an element of an array of similar cylinders inside each steam generator, through which Reactor Coolant flows, and by which heat is transferred from the Reactor Coolant to the secondary system feedwater. Taken as a whole, steam generator tubes form a major portion of the reactor coolant pressure boundary.

Plugged Tube is a tube that has been removed from service by installing a mechanical device in each end of the tube to seal the tube in a manner that isolates it from the reactor coolant system.

1. Steam Generator Sample Selection and Inspection

In-service inspection of steam generators may be limited to one steam generator per inspection period on an alternating basis. The tubes shall be selected for inspection as set forth in TS 4.2.b.2.a, provided that previous inspections indicate the two steam generators are performing in an acceptably similar manner.

2. Steam Generator Tube Sample Selection and Inspection

Each in-service inspection:

a. Shall include a number of tubes that is at least equal to 3% of the total number of non-plugged tubes contained in both steam generators. Tubes shall be selected for inspection on a random basis except as noted in TS 4.2.b.2.b.

b. Shall concentrate the inspection by selecting at least 50% of the tubes to be inspected from critical areas where experience in similar plants with similar water chemistry indicates higher potential for degradation.

c. Shall include all non-plugged tubes in which previous inspections revealed degradation that exceeded 20% of nominal wall thickness. For these tubes, only the area previously identified as degraded must be inspected, unless their inspection is also performed to satisfy requirements of TS 4.2.b.2.a and TS 4.2.b.2.b above.

d. May not require inspection of the full length of each tube during the second and third sample inspections but may concentrate the inspection only on those portions of the tubes previously found degraded.

e. Shall perform a tube inspection on each selected tube. If the eddy current inspection probe will not pass through the entire length of a tube, including the U-bend, it shall be so recorded and the tube shall be characterized as degraded. An adjacent tube shall also be inspected.

f. Shall classify sample inspection results as belonging to one of the following three categories, and actions shall accordingly be taken as described in Table TS 4.2-2.

Category	Inspection Results
C-1	Less than 5% of the total tubes inspected are degraded tubes, and none of the inspected tubes are defective.
C-2	Between 5% and 10% of the total tubes inspected are degraded tubes, or one or more tubes, but not more than 1% of the total tubes inspected, are defective.
C-3	More than 10% of the total tubes inspected are degraded tubes,or more than 1% of the inspected tubes are defective.

NOTE: For all inspections, previously degraded tubes must exhibit significant (>10%) added wall penetration to be included in the above percentage calculations.

3. Inspection Frequency

In-service inspection of steam generator tubes shall be performed at the following intervals:

a. In-service inspections may be performed during refueling outages, but shall be performed at intervals not to exceed 24 calendar months, except that the inspection interval may be extended to a maximum of 40 months if:

   1. two consecutive inspections following service under AVT conditions, not including the pre-service inspection, yield results that fall into the C-1 category, or

   2. two consecutive inspections demonstrate that previously documented degradation sites have not continued to deteriorate and no new degradation is found.

b. If the result of a steam generator in-service inspection conducted in accordance with Table TS 4.2-2 falls into Category C-3, the inspection interval shall be reduced to 20 months. The 20 month interval shall apply until a subsequent inspection meets the conditions set forth in TS 4.2.b.3.a for extending the interval to 40 months.

c. Additional, unscheduled in-service inspections of each steam generator shall be performed using the criteria set forth in Table 4.2-2 for a "1st SAMPLE INSPECTION" during shutdowns consequent to:

1. Primary-to-secondary tube leaks (not including leaks originating from tube-to-tubesheet welds) in excess of the limits of TS 3.1.d and TS 3.4.d, or

2. A seismic event having a magnitude greater than the Operating Basis Earthquake, or

3. A loss-of-coolant accident requiring actuation of engineered safeguards, where the Reactor Coolant System cooldown rate exceeded 100°F/hr, or

4. A main steam line or feedwater line break, where the Reactor Coolant System cooldown rate exceeded 100°F/hr.

d. If there is a significant change in steam generator chemistry control methodology, the steam generators shall be operated at power for three months while using the new treatment and shall then be inspected during the next outage of sufficient duration.

4. Plugging Limit Criteria

Any tube with tube wall degradation of 50% or more shall be plugged before returning the steam generator to service. If significant general tube thinning occurs, this criterion is reduced to 40% wall degradation.

5. Deleted

6. Deleted

7. Reports

a. Following each in-service inspection of steam generator tubes during which tubes are plugged, the number of tubes plugged shall be reported to the Commission within 30 days.

b. The results of each steam generator tube in-service inspection shall be included in the Annual Operating Report for the reporting period that included completion of the inspection. The report shall include:

   1. Number of tubes inspected and extent of inspection.

   2. Location of each tube wall degradation and its percent of wall penetration.

   3. Identification of tubes plugged.

c. If a steam generator tube inspection result falls into Category C-3, the Commission shall be promptly (within 4 hours) notified according to requirements of 10 CFR 50.72(b)(2)(i). A Licensee Event Report shall then be filed with the Commission as described by Specification 4.2.b.7.a and as set forth in 10 CFR 50.73(a)(2)(ii).

BASIS

Kewaunee Nuclear Power Plant design was not designed to Section XI of the ASME Code; therefore, 100% compliance may not be practically achievable. However, the design process did consider access for in-service inspection, and made modifications within design limitations to provide maximum access. To the extent practical, NMC performs inspection of ASME Code Class 1, Class 2, Class 3, and Class MC components in accordance with Section XI of the ASME Code. If an inspection required by the Code is impractical, NMC requests Commission approval for deviation from the requirement.

The basis for surveillance testing of the Reactor Coolant System pressure isolation valves identified in Table TS 3.1-2 is contained within "Order for Modification of License" dated April 20, 1981.

Technical Specification 4.2.b

These Technical Specifications provide inspection and plugging requirements for Kewaunee Nuclear Power Plant steam generator tubes. Fulfilling these requirements assures that KNPP steam generator tubes are inspected and maintained in a manner consistent with current NRC regulations and guidelines including the General Design Criteria of 10 CFR Part 50, Appendix A.

General Design Criterion (GDC) 14, "Reactor Coolant Pressure Boundary," and GDC 31, "Fracture Prevention of Reactor Coolant Pressure Boundary," require the reactor coolant pressure boundary to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture. Also, GDC 15, "Reactor Coolant System Design," requires the Reactor Coolant System and associated auxiliary, control, and protection systems to be designed with sufficient margin to ensure that design limits of the reactor coolant pressure boundary are not exceeded during normal operation, including during anticipated operational transients. Furthermore, GDC 32, "Inspection of Reactor Coolant System Pressure Boundary," requires components that are part of the reactor coolant pressure boundary to be designed to permit periodic inspection and testing of critical areas in order to assess their structural and leak tight integrity.

The NRC has developed guidance for steam generator tube inspection and maintenance including Regulatory Guides 1.83 and 1.121. Regulatory Guide 1.83, "In-service Inspection of Pressurized Water Reactor Steam Generator Tubes," forms the basis for many of the requirements in this section and should be consulted before revising them. Regulatory Guide 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes," defines steam generator tube minimum wall thickness.

Technical Specification 4.2.b.1

If the steam generators are performing in an adequately similar manner, it is appropriate to limit the inspection to one steam generator per inspection interval on an alternating basis. This offers economic savings as well as reduction of radiation exposure and outage duration.

Technical Specification 4.2.b.2

Inspection of the steam generator tubes provides evaluation of their service condition. Operational experience has shown that certain types of steam generators are susceptible to generic degradation mechanisms. It has also revealed site-specific steam generator tube degradation mechanisms. The Kewaunee inspection program assesses both generic and site-specific tube degradations.

Kewaunee uses various eddy current (EC) testing methodologies to inspect steam generator tubes. EC technology has improved considerably since Kewaunee began commercial operation in 1974, and NMC is committed to use advanced EC methods and technology, as appropriate, to assure accurate assessment of steam generator tube service condition.

Technical Specification 4.2.b.3

Kewaunee Nuclear Power Plant steam generator tube inspections are typically conducted during refueling outages. Criteria used to select tubes for inspection are based, in part, on tube service condition determined during previous inspections, and on operational experience from other plants with similar steam generators and water chemistry. Identification of degraded steam generator tubes results in expansion of the current inspection as well as increased frequency of subsequent inspections. In this manner, steam generator tube surveillance remains consistent with tube service condition.

Several operational events or transients require consequent steam generator tube inspections. These inspections must be performed after occurrence of excessive primary-to-secondary leakage or after transients that impose large mechanical and thermal stresses on the tubes.

Technical Specification 4.2.b.4

Procedures, calculations, and analyses found in WCAP-15325,[1] combined with conservative allowances, such as general corrosion and measurement error, are the bases for the tube plugging criteria set forth in TS 4.2.b.4. Tubes that exceed the limits established by these criteria must be removed from service by plugging.

Steam generator tube plugging is a common method of preventing excessive primary-to-secondary steam generator tube leakage. This method is relatively uncomplicated and isolates a defective tube from the reactor coolant system by installing mechanical devices to block its hot and cold leg tubesheet openings.

Technical Specification 4.2.b.5 (Deleted)

Technical Specification 4.2.b.6 (Deleted)

Technical Specification 4.2.b.7

Category C-3 inspection results are considered abnormal degradation to a principal safety barrier and are therefore reportable under 10 CFR 50.72(b)(2)(i) and 10 CFR 50.73(a)(2)(ii).

[1]WCAP 15325, "Regulatory Guide 1.121 Analysis for the Kewaunee Replacement Steam Generators."

TABLE TS 4.2-2

STEAM GENERATOR TUBE INSPECTION

1ST SAMPLE INSPECTION			2ND SAMPLE INSPECTION		3RD SAMPLE INSPECTION	
Sample Size	Result	Action Required	Result	Action Required	Result	Action Required
A minimum of S Tubes per S.G.	C-1	None	N/A	N/A	N/A	N/A
	C-2	Plug defective tubes and inspect additional 2S tubes in this S.G. (2)	C-1	None	N/A	N/A
			C-2	Plug defective tubes and inspect additional 4S tubes in this S.G. (2)	C-1	None
					C-2	Plug defective tubes
					C-3	Perform action for C-3 result of first sample
			C-3	Perform action for C-3 result of first sample	N/A	N/A
	C-3	Inspect all tubes in this S.G., (2) plug defective tubes and inspect 2S tubes in the other S.G. (2) Prompt notification of the Commission. (1)	The other S.G. is C-1	None	N/A	N/A
			Other S.G. is C-2	Perform action for C-2 result of second sample	N/A	N/A
			Other S.G. is C-3	Inspect all tubes in other S.G. and plug defective tubes. Prompt notification of the Commission. (1) (2)	N/A	N/A

S=6%/n Where n is the number of steam generators inspected during an inspection.

Notes: 1. Refer to Specification 4.2.b.7.c

2. As allowed by TS 4.2.b.2.d, the second and third sample inspections during each inservice inspection may be less than the full length of each tube by concentrating the inspection on those portions of the tubes where imperfections were previously found.

TABLE TS 4.2-3

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Figure TS 4.2-1

Amendment No. 158