

March 1, 1988

Docket No. 50-305

Mr. D. C. Hintz  
Vice President - Nuclear Power  
Wisconsin Public Service Corporation  
Post Office Box 19002  
Green Bay, Wisconsin 54307-9002

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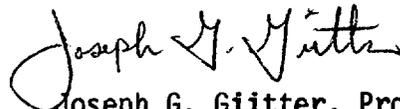
Dear Mr. Hintz:

The Commission has issued the enclosed Amendment No. 76 to Facility Operating License No. DPR-43 for the Kewaunee Nuclear Power Plant. This amendment is in response to your application dated November 30, 1987 as supplemented January 29 and February 23, 1988.

The amendment adds a license condition and revises the Technical Specifications to allow steam generator tube sleeving as a method to repair defective steam generator tubes.

A copy of the Safety Evaluation is also enclosed. The notice of issuance of this action will be included in the Commission's next regular biweekly Federal Register notice.

Sincerely,



Joseph G. Gitter, Project Manager  
Project Directorate III-3  
Division of Reactor Projects - III,  
IV, V and Special Projects

Enclosures:

1. Amendment No. 76 to License No. DPR-43
2. Safety Evaluation

cc w/enclosures:  
See next page

\* See previous concurrence

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Date:	02/18/88	02/18/88	02/18/88

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Date:	02/25/88	02/25/88	02/29/88

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P PDR

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Surname: CYCheng  
Date: 2/25/88

PD/PDIII-3  
KPerkins  
2/25/88

OGC  
MYoung  
2/18/88

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remains  
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**Mr. D. C. Hintz  
Wisconsin Public Service Corporation**

**Kewaunee Nuclear Power Plant**

**cc:  
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UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D. C. 20555

WISCONSIN PUBLIC SERVICE CORPORATION

WISCONSIN POWER AND LIGHT COMPANY

MADISON GAS AND ELECTRIC COMPANY

DOCKET NO. 50-305

KEWAUNEE NUCLEAR POWER PLANT

AMENDMENT TO FACILITY OPERATING LICENSE

Amendment No. 76  
License No. DPR-43

1. The Nuclear Regulatory Commission (the Commission) has found that:
  - A. The application for amendment by Wisconsin Public Service Corporation, Wisconsin Power and Light Company, and Madison Gas and Electric Company (the licensees) dated November 30, 1987, as supplemented January 29 and February 23, 1988, complies with the standards and requirements of the Atomic Energy Act of 1954, as amended (the Act), and the Commission's rules and regulations set forth in 10 CFR Chapter I;
  - B. The facility will operate in conformity with the application, the provisions of the Act, and the rules and regulations of the Commission;
  - C. There is reasonable assurance (i) that the activities authorized by this amendment can be conducted without endangering the health and safety of the public, and (ii) that such activities will be conducted in compliance with the Commission's regulations;
  - D. The issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public; and
  - E. The issuance of this amendment is in accordance with 10 CFR Part 51 of the Commission's regulations and all applicable requirements have been satisfied.
2. Accordingly, Facility Operating License No. DPR-43 is amended by changes to the Technical Specifications as indicated in the attachment to this license amendment, and by amending paragraph 2.C.(2) and adding paragraph 2.C.(5) to read as follows:

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(2) Technical Specifications

The Technical Specifications contained in Appendix A, as revised through Amendment No. 76, are hereby incorporated in the license. The licensees shall operate the facility in accordance with the Technical Specifications.

(5) Steam Generator Tube Repairs

Steam generator tube repairs may be made in accordance with the method described in WCAP 11643, Kewaunee Steam Generator Sleeving Report (Proprietary).

3. This license amendment is effective as of the date of its issuance.

FOR THE NUCLEAR REGULATORY COMMISSION

  
Kenneth E. Perkins, Director  
Project Directorate III-3  
Division of Reactor Projects - III,  
IV, V and Special Projects

Attachment:  
Changes to the Technical  
Specifications

Date of Issuance: March 1, 1988

ATTACHMENT TO LICENSE AMENDMENT NO. 76

FACILITY OPERATING LICENSE NO. DPR-43

DOCKET NO. 50-305

Revise Appendix A Technical Specifications by removing the pages identified below and inserting the enclosed pages. The revised pages are identified by amendment number and contain marginal lines indicating the area of change.

REMOVE

TS III  
TS viii  
TS 4.2-6  
TS 4.2-10  
TS 4.2-11  
-

INSERT

TS III  
TS viii  
TS 4.2-6  
TS 4.2-10  
TS 4.2-11  
Figure TS 4.2-1

<u>Section</u>	<u>Title</u>	<u>Page TS</u>
	4.2.b.3 Inspection Frequencies	4.2-5
	4.2.b.4 Plugging Limit Criteria	4.2-6
	4.2.b.5 Reports	4.2-7
4.3	Reactor Coolant System Tests Following Opening	4.3-1
4.4	Containment Tests	4.4-1
	4.4.a Integrated Leak Rate Tests	4.4-1
	4.4.b Isolation Valves and Local Leak Rate Tests	4.4-3
	4.4.c Residual Heat Removal System	4.4-5
	4.4.d Shield Building Ventilation System	4.4-5
	4.4.e Auxiliary Building Special Ventilation System	4.4-6
	4.4.f Containment Vacuum Breaker System	4.4-7
4.5	Emergency Core Cooling System and Containment Air Cooling System Tests	4.5-1
	4.5.a System Tests	4.5-1
	4.5.a.1 Safety Injection System	4.5-1
	4.5.a.2 Containment Vessel Internal Spray System	4.5-2
	4.5.a.3 Containment Fan Coil Units	4.5-2
	4.5.b Component Tests	4.5-2
	4.5.b.1 Pumps	4.5-2
	4.5.b.2 Valves	4.5-3
4.6	Periodic Testing of Emergency Power System	4.6-1
	4.6.a Diesel Generators	4.6-1
	4.6.b Station Batteries	4.6-2
4.7	Main Steam Isolation Valves	4.7-1
4.8	Auxiliary Feedwater System	4.8-1
4.9	Reactivity Anomalies	4.9-1
4.10	Deleted	
4.11	Deleted	
4.12	Spent Fuel Pool Sweep System	4.12-1
4.13	Radioactive Materials Sources	4.13-1
4.14	Testing and Surveillance of Shock Suppressors (Snubbers)	4.14-1
4.15	Fire Protection System	4.15-1
	4.15.a Fire Detection Instrumentation	4.15-1
	4.15.b Fire Water System	4.15-1
	4.15.c Spray/Sprinkler System	4.15-2
	4.15.d Low Pressure CO <sub>2</sub> System	4.15-2
	4.15.e Fire Hose Stations	4.15-3
	4.15.f Penetration Fire Barriers	4.15-3
4.16	Reactor Coolant Vent System Tests	4.16-1
4.17	Control Room Postaccident Recirculation System	4.17-1

## LIST OF FIGURES

<u>Figure - TS</u>	<u>Titles</u>
2.1-1	Safety Limits Reactor Core, Thermal and Hydraulic
3.1-1	Reactor Coolant System Heat-up Limitations
3.1-2	Reactor Coolant System Cool-down Limitations
3.1-3	Deleted
3.1-4	Deleted
3.10-1	Required Shut-down Reactivity vs. Reactor Boron Concentration
3.10-2	Hot Channel Factor Normalized Operating Envelope
3.10-3	Control Rod Insertion Limits as a Function of Power
3.10-4	Permissible Operating Band on Indicated Flux Difference as a Function of Burn-up (Typical)
3.10-5	Target Band on Indicated Flux Difference as a Function of Operating Power Level (Typical)
3.10-6	V(Z) as a Function of Core Height
3.10-7	Deleted
4.2-1	Application of Plugging Limits
6.2-1 (TS 6-26)	Deleted
6.2-2 (TS 6-27)	Deleted

1. Primary-to-secondary tube leaks (not including leaks originating from tube-to-tube sheet welds) in excess of the limits of Specification 3.1.d and 3.4.a.4,
  2. A seismic occurrence greater than the Operating Basis Earthquake,
  3. A loss-of-coolant accident requiring actuation of the engineering safeguards, where the cooldown rate of the reactor coolant system exceeded 100°F/hr, or
  4. A main steam line or feedwater line break, where the cooldown rate of the reactor coolant system exceeded 100°F/hr.
- d. If the type of steam generator chemistry treatment is changed significantly, the steam generators shall be inspected at the next outage of sufficient duration following three (3) months of power operation since the change.
4. Plugging Limit Criteria - The following criteria apply independently to tube and sleeve wall degradation:
- a. Any tube which, upon inspection, exhibits tube wall degradation of 50% or more shall be plugged or repaired prior to returning the steam generator to service. If significant general tube thinning occurs, this criterion will be reduced to 40% wall degradation. Repair methods will be submitted under 10 CFR 50.90 to be incorporated, as an amendment, in the facility license. The Commission will review the repair method, issue a significant hazards determination, and amend the facility license.
  - b. Any sleeve which, upon inspection, exhibits wall degradation of 31% or more shall be plugged prior to returning the steam generator to service. Figure 4.2-1 illustrates the application of tube, sleeve, and tube/sleeve joint plugging limit criteria.

## Basis

### Technical Specification 4.2.b.4

Steam generator tubes found with less than the minimum wall thickness criteria determined by analysis, as described in WCAP 7832(1) and (2), must either be repaired to be kept in service or removed from service by plugging.

Steam generator tube plugging is a common method of preventing primary-to-secondary steam generator tube leakage and has been utilized since the inception of PWR nuclear reactor plants. This method is relatively uncomplicated from a structural/mechanical standpoint as flow is cut-off from the affected tube by plugging it in the hot and cold leg faces of the tubesheet.

To determine the basis for the sleeve plugging limit, the minimum sleeve wall thickness was calculated in accordance with Draft Regulatory Guide 1.121 (August 1976). In addition, a combined allowance of 20 percent of wall thickness is assumed for eddy current testing inaccuracies and continued operational degradation per Draft Regulatory Guide 1.121 (August 1976).

Repair by sleeving, or other methods, has been recognized as a viable alternative for isolating unacceptable tube degradation and preventing tube leakage. Sleeving isolates unacceptable degradation and extends the service life of the tube, and the steam generator. Tube repair, by sleeving in accordance with Reference (3), has been evaluated and analyzed as acceptable. This reference establishes hydraulic equivalency ratios for the application of normal operating, upset, and accident condition bounding analyses. Design, installation, testing, and inspection of steam generator tube sleeves requires substantially more engineering than plugging, as the tube remains in service. Because of this, the NRC has defined steam generator tube repair to be an unreviewed safety question as described in 10 CFR 50.59(a)(2). As such, other tube repair methods will be submitted under 10 CFR 50.90; and in accordance with 10 CFR 50.91 and 92, the Commission will review the method, issue a significant hazards determination, and amend the facility license accordingly. A 90-day time frame for NRC review and approval is expected.

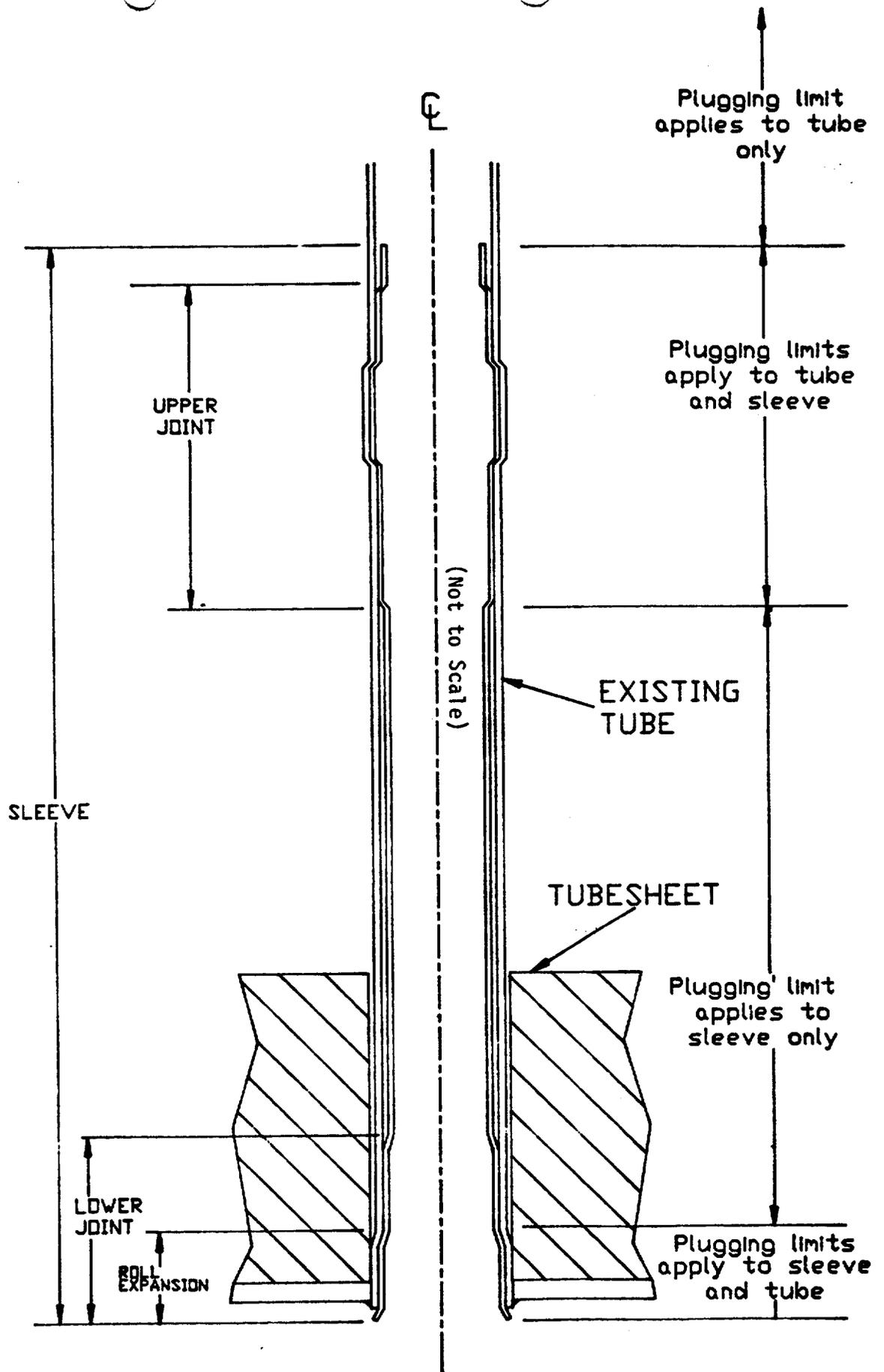
## Basis

### Technical Specification 4.2.b.5

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

### References

- (1) WCAP 7832: "Evaluation of Steam Generator Tube, Tube Sheet, and Divider Plate Under Combined LOCA Plus SSE Conditions".
- (2) E.W. James, WPSC, to A. Schwencer, NRC, dated September 6, 1977.
- (3) WCAP 11643, Kewaunee Steam Generator Sleaving Report, November 1987 (Proprietary).



Application of Plugging Limits  
Figure TS 4.2-1

Amendment No. 76



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

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION  
RELATING TO AMENDMENT NO. 76 TO FACILITY OPERATING LICENSE NO. DPR-43

WISCONSIN PUBLIC SERVICE CORPORATION  
WISCONSIN POWER AND LIGHT COMPANY  
MADISON GAS AND ELECTRIC COMPANY  
KEWAUNEE NUCLEAR POWER PLANT

DOCKET NO. 50-305

1.0 INTRODUCTION

By letter dated November 30, 1987, as supplemented and clarified January 29 and February 23, 1988, the Wisconsin Public Service Corporation (WPSC), the licensee, submitted a request to add a license condition and change the technical specifications to allow for the installation of steam generator repair sleeves in the Kewaunee Nuclear Power Plant. The January submittal provided a clarification to the sleeve plugging limit and modified the limit to reflect appropriate eddy current test uncertainty; and the February submittal provided additional information to support the request. These submittals did not substantially alter the action as noticed in the Federal Register on January 27, 1988 or affect the staff's proposed no significant hazards determination.

2.0 DISCUSSION

Westinghouse Report WCAP-11643, "Kewaunee Steam Generator Slewing Report," was submitted in support of the WPSC request for approval of slewing. Westinghouse provides a leak tight sleeve which is secured to the steam generator tube near each end of the sleeve. The sleeve spans the degraded area of the parent steam generator tube in the tube sheet region.

The operation of Pressurized Water Reactor (PWR) steam generators has, in some instances, resulted in localized corrosive attack on the inside (primary side) or outside (secondary side) of the steam generator tubing. This corrosive attack results in a reduction in steam generator tube wall thickness. Steam generator tubing has been designed with considerable margin between the actual wall thickness and the wall thickness required to meet structural requirements. Thus it has not been necessary to take corrective action unless structural limits are being approached.

Historically, the corrective action taken where steam generator tube wall degradation has been severe has been to install plugs at the inlet and outlet of the steam generator tube when the reduction in wall thickness reaches a calculated value referred to as a plugging criteria. Eddy current testing (ECT) has been used to measure steam generator tubing degradation and the tube plugging criteria accounts for ECT measurement uncertainty.

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Installation of the steam generator tube plugs removes the heat transfer surface of the plugged tube from service and leads to a reduction in the primary coolant flow rate available for core cooling. The steam generators at Kewaunee have been designed with excess heat transfer surface to allow for removal of some of the tubes from service. The sleeving concept and design are based on observations to date that the tube degradation due to operating environmental conditions has occurred near the tube sheet areas of the tube bundle. Installation of steam generator tube sleeves does not significantly affect the heat transfer capability of the tube being sleeved and a large number of sleeves can be installed without significantly affecting primary flow rate.

The objectives of installing sleeves in the steam generator tubes are twofold. The sleeve must maintain structural integrity of the steam generator tube during normal operating and postulated accident conditions. Additionally, the sleeve must prevent leakage in the event of a through hole in the wall of the steam generator tube. Tests and analyses were performed to demonstrate the capability of the sleeves to perform these functions under normal and postulated accident conditions.

Plugs are installed in the sleeved steam generator tubes when the tubes cannot be successfully repaired with sleeves.

The sleeve design qualified by Westinghouse is inserted in a degraded or defective tube and spans the degraded region of the original tube. The sleeve length is controlled by the insertion clearance between the channel head inside surface and the primary side of the tubesheet, and the tube degradation location above the tubesheet. The remaining design parameters such as wall thickness and material are selected to enhance design margins and corrosion resistance and/or to meet ASME Boiler and Pressure Vessel Code requirements. The upper joint is located so as to provide a length of free sleeve above the degraded region of the original tube. This length is added so that if in the unlikely event the existing tube were to become severed just above the upper edge of the joint, the tube would be restrained by the sleeve and lateral and axial motion, and subsequent leakage would be limited.

The sleeve material, thermally treated Inconel 690, is selected to provide additional resistance to stress corrosion cracking. Evaluations were performed by Westinghouse which (1) verified that thermally treated Inconel 690 is a suitable material for use in steam generator environments, and (2) verified that sleeving does not have a detrimental effect on the serviceability of the existing tube or the sleeve components.

The sleeve installation consists of a series of steps including tube preparation, sleeve insertion, joint formation and finally joint inspection. In preparation for sleeve insertion, the inside diameter areas of the tubes to be sleeved are cleaned to prepare the surface for joint formation and removal of loose oxide and foreign material. Cleaning also reduces the radiation shine from the tube inside diameter, thus contributing to reducing the man-rem exposure. Tube cleaning may be accomplished by either wet or dry methods. Both processes have been shown to be effective and evaluation has demonstrated

that neither process removes any significant fraction of the tube wall base material.

The installation process will utilize state of the art remotely operated robotics, when practical, to eliminate channel head entries and to complete the sleeving project with total exposures kept to a minimum, i.e., As Low As Reasonably Achievable (ALARA). Additional measures to ensure that radiation exposures are ALARA include: decontamination of steam generators; the use of shielding; extensive personnel training utilizing mock-ups; dry runs; and strict qualification procedures. Man-rem exposure results obtained during a recent Westinghouse steam generator sleeving operation showed approximately 50 to 100 millirem/tube, using the same remote technology that the licensee plans to employ.

After sleeve installation, all sleeved tubes are subjected to an eddy current inspection which includes a verification of correct sleeve installation for process control and a degradation inspection for baseline purposes to which all subsequent inspections will be compared.

### 3.0 EVALUATION

The Kewaunee sleeving proposal has been reviewed for its impact on safe plant operation, i.e., maintenance of steam generator tube integrity and thermal hydraulic performance of the steam generators. The sleeve design and installation process has been qualified through laboratory testing and actual field performance.

The objectives of the mechanical testing program included:

- Verification of the leak resistance of the upper and lower sleeve to tube joints
- Verification of the structural strength of the sleeved tube under normal and accident conditions
- Verification of the fatigue strength of the sleeved tube under transient loads considering the remaining design life objective of the plant.
- Confirmation of the capability for installation of sleeves in tubes with conditions such as deep secondary side hard sludge and tubesheet denting.
- Establishment of the process parameters required to achieve satisfactory installation and performance.

The results of the qualification testing, analyses and plant operating experience demonstrate that the sleeving process is an acceptable means of maintaining steam generator tube integrity. Furthermore, the sleeve assemblies can be monitored through periodic inspection with Eddy Current Test techniques per Regulatory Guide 1.83 recommendations.

The installation of a sleeve into a tube results in additional flow restrictions within the primary system with an associated increase in pressure drop in the steam generator. The effect of this flow restriction on plant operation was evaluated in the same manner that tube plugging effects were analyzed. Westinghouse identified the reduction in primary coolant flow caused by the projected sleeving under normal operating conditions and identified the number of sleeves which result in a flow reduction equivalent to one plugged tube. With the maximum expected number of sleeves installed and current number of plugged tubes, installation of additional plugs is possible without exceeding the flow reduction equivalent to 10 percent Steam Generator Tube Plugging (SGTP).

The postulated accidents assessed for the impact of sleeving included both LOCA and non-LOCA transients. The existing large break LOCA analysis assumes 10 percent SGTP. This analysis bounds the effects on all core and system parameters for a combination of plugging and sleeving up to 10 percent equivalent SGTP. In addition, in support of the steam generator sleeving program, Westinghouse evaluated selected LOCA transients to verify that the use of sleeves resulting in a plugging equivalency of up to 10 percent will not have an adverse effect on the thermal-hydraulic performance of the plant. For the accidents evaluated, the effect of a combination of plugging and sleeving up to the equivalent of 10 percent tube plugging would not result in any design or regulatory limit being exceeded. In a letter to NRC dated, February 23, 1988, the licensee described administrative methods that will be employed to assure that the allowable steam generator tube plugging level is not unintentionally exceeded.

There was some question concerning the adequacy of combined allowance for eddy current uncertainty and operational degradation to be used in connection with the proposed amendment. After discussions with the staff, the licensee proposed to clarify the uncertainty to be used and to adopt the staffs recommendation of a combined allowance of 20 percent. The licensee's letter of January 29, 1988 modified the sleeve plugging limit to 31 percent wall thickness in order to properly reflect this uncertainty. Therefore the operational sleeve thickness of 69 percent includes the minimum wall thickness calculated based on normal loading conditions, which are controlling, plus the margin for eddy current uncertainty and postulated operational degradation in accordance with Regulatory Guide 1.121 and staff positions. Thus, the sleeve plugging limit as defined below is 31 percent.

The staff finds that the use of the eddy current equipment and techniques as described in WCAP-11643 or their equivalent to be currently acceptable. However, the Licensee has committed to utilize advanced state of the art techniques as they are developed and verified.

The plugging limit for the tube, where applicable, is as specified in the Technical Specifications for the non-sleeved portions of the tube and is 50 percent of the tube wall thickness. This criterion is 40 percent of the tube wall thickness if significant general tube thinning occurs.

Sleeves or tubes which have eddy current indications of degradation in excess of the plugging limits must be repaired or plugged. Those portions

of the tube and the sleeve for which indications of wall degradation must be evaluated are summarized as follows:

- 1) Indications of degradation in the entire length of the sleeve must be evaluated against the sleeve plugging limit.
- 2) Indication of tube degradation of any type including a complete gullotine break in the tube between the bottom of the upper joint and the top of the lower roll expansion does not require that the tube be removed from service.
- 3) The tube plugging limit continues to apply to the portion of the tube in the upper joint and in the lower roll expansion. As noted above, the sleeve plugging limit applies to these areas also.
- 4) The tube plugging limit continues to apply to that portion of the tube above the top of the upper joint.

Based on the above information, the sleeve design and installation process has been verified by analytical methods, laboratory testing, and previous installations. Any combination of sleeving and plugging utilized at the Kewaunee Nuclear Power Plant up to the allowable 10 percent equivalent SGTP limit is bounded by analyses for 10 percent tube plugging. Application of the subject plugging limit criteria in the Kewaunee steam generators will provide a primary system boundary equivalent to that of the original steam generator tube and will not adversely affect the safe operation of the steam generators.

#### 4.0 ENVIRONMENTAL CONSIDERATION

This amendment involves a change in the installation or use of a facility component located within the restricted area as defined in 10 CFR Part 20. The staff has determined that the amendment involves no significant increase in the amounts, and no significant change in the types, of any effluents that may be released offsite and that there is no significant increase in individual or cumulative occupational radiation exposure. The Commission has previously issued a proposed finding that this amendment involves no significant hazards consideration and there has been no public comment on such finding. Accordingly, this amendment meets the eligibility criteria for categorical exclusion set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b) no environmental impact statement or environmental assessment need be prepared in connection with the issuance of this amendment.

#### 5.0 CONCLUSION

The staff has concluded, based on the considerations discussed above, that: (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner; and (2) such

activities will be conducted in compliance with the Commission's regulations and the issuance of this amendment will not be inimical to the common defense and security or to the health and safety of the public.

Principal Contributor: T. Quay

Dated: March 1, 1988