Entergy

Entergy Nuclear Operations, Inc.
Palisades Nuclear Plant
27780 Blue Star Memorial Highway
Covert, MI 49043
Tel 269 764 2000

Thomas P Kirwin
Acting Site Vice President

PNP 2011-11

March 3, 2011

U. S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

SUBJECT: License Amendment Request for Steam Generator Cold-Leg Tubesheet Inspection

Palisades Nuclear Plant
Docket 50-255
License No. DPR-20

REFERENCE:

1. Letter from NRC to Entergy Nuclear Operations, Inc., dated May 31, 2007, Palisades Nuclear Plant – Issuance of Amendment Re: Tubesheet Inspection Depth for Steam Generator Tube Inspections (TAC No. MD2125) (ADAMS Accession No. ML071420216)

2. Letter from Arizona Public Service Company to NRC, dated May 26, 2005, Palo Verde Nuclear Generation Station Units 1, 2, and 3, "Application for Technical Specification Improvement Regarding Steam Generator Tube Integrity and Steam Generator Tube Inspection Length through the Tubesheet" (ML051520413)

Dear Sir or Madam:

Pursuant to 10 CFR 50.90, Entergy Nuclear Operations, Inc. (ENO) requests Nuclear Regulatory Commission (NRC) review and approval of a proposed license amendment to revise Renewed Facility Operating License DPR-20 for the Palisades Nuclear Plant (PNP). ENO proposes to revise Appendix A, Technical Specifications (TS), as they apply to the steam generator program in TS section 5.5.8. The purpose of the change is to revise the repair criteria for the cold-leg side of the steam generator tubesheet. The proposed change would allow not having to inspect the lower portion of the cold-leg steam generator tubes within the tubesheet, since flaws in this lower portion, would be acceptable. A similar change to the TS was approved in operating license amendment no. 225 for the hot-leg side of the steam generator tubesheet (Reference 1).

The technical bases addressing steam generator tube structural and leakage integrity are provided in the attached Westinghouse report, "Palisades Cold Leg Tubesheet Inspection Depth, C*," (Attachment 5) and Westinghouse report WCAP-16208-P, Revision 1, dated May 2005, entitled, "NDE Inspection Length for CE Steam Generator Tubesheet Region Explosive Expansions."

WCAP-16208-P, Revision 1, was previously submitted to the NRC by Arizona Public Service Company (Reference 2) for Palo Verde Units 1, 2 and 3. Therefore, the report is not being resubmitted to the NRC as part of this license amendment request. The WCAP-16208-P report was also part of the technical bases supporting NRC approval of PNP operating license amendment no. 225 (Reference 1).

This proposed change has been evaluated in accordance with 10 CFR 50.91(a)(1) using criteria in 10 CFR 50.92(c), and it has been determined that this change involves no significant hazards consideration. The bases for this determination are included in Attachment 1, which provides a description of the proposed change, background discussion, technical analysis, regulatory analysis, and environmental review. Attachment 2 provides the revised TS pages reflecting the proposed changes. Attachment 3 provides the annotated TS pages showing the proposed changes.

Attachment 4 provides the Westinghouse Electric Company LLC proprietary authorization affidavit, CAW-10-2752, supporting the proprietary nature of Attachment 5. The affidavit sets forth the basis for which the information may be withheld from public disclosure by the NRC and addresses the specific considerations listed in paragraph (b)(4) of 10 CFR 2.390.

Attachment 5 contains the proprietary Westinghouse Electric Company LLC report, "Palisades Cold Leg Tubesheet Inspection Depth, C*." ENO requests that Attachment 5 be withheld from public disclosure in accordance with 10 CFR 2.390. Correspondence regarding the proprietary aspects of the Westinghouse Electric Company LLC report or the supporting affidavit should reference the affidavit CAW-10-2752 and be addressed to J.A. Gresham, Manager, Regulatory Compliance and Plant Licensing, Westinghouse Electric Company LLC, Suite 428, 1000 Westinghouse Drive, Cranberry Township, PA 16066.

Attachment 6 contains the non-proprietary version of the Westinghouse Electric Company LLC report with the proprietary information deleted.

ENO requests approval of the proposed license amendment request, by March 8, 2012. The amendment will be implemented within 60 days of approval.

In accordance with 10 CFR 50.91, ENO is notifying the State of Michigan of this proposed license amendment by transmitting a copy of this letter and non-proprietary attachments to the designated state official.

Summary of Commitments

This letter identifies no new commitments and no revisions to existing commitments.

I declare under penalty of perjury that the foregoing is true and correct. Executed on March 3, 2011.

Sincerely,

Thomas P Kirwin

tpk/jlk

Attachments:

1. Description and Evaluation of Requested Change
2. Renewed Operating License Page Change Instructions and Revised Technical Specifications Pages
3. Mark-up of Technical Specifications Pages
4. CAW-10-2752, Affidavit
5. Westinghouse Proprietary Class 2, SG-SGMP-10-4-P, Revision 1, February 2010, "Palisades Cold Leg Tubesheet Inspection Depth, C*"
6. Westinghouse Non-Proprietary Class 3, SG-SGMP-10-4-NP, Revision 1, February 2010, "Palisades Cold Leg Tubesheet Inspection Depth, C*"

cc: Administrator, Region III, USNRC
Project Manager, Palisades, USNRC
Resident Inspector, Palisades, USNRC
State of Michigan

ATTACHMENT 1
DESCRIPTION AND EVALUATION OF REQUESTED CHANGE

1.0 DESCRIPTION

Entergy Nuclear Operations, Inc. (ENO) requests amending the Renewed Facility Operating License DPR-20 for Palisades Nuclear Plant (PNP) to revise Appendix A, Technical Specification (TS) 5.5.8, "Steam Generator (SG) Program," which ensures SG tube integrity is maintained. The license amendment would add repair criteria for the SG cold-leg side of the tubesheet. The proposed change would allow not having to inspect the lower portion of the cold-leg steam generator tubes within the tubesheet, since flaws in this lower portion, would be acceptable. A similar change to the TS was approved in amendment no. 225, for the SG hot-leg side of the tubesheet (Reference 4).

ENO proposes to modify the SG repair criteria requirements in TS 5.5.8 by incorporating new alternative repair criteria for the SG cold-leg side of the SG tubesheet. The proposal provides a cold-leg side inspection length of 12.5 inches. The cold-leg inspection lengths provided in this supplement have been developed using methods and test data used in the C* (C star) generic report for Combustion Engineering (CE) designed steam generators (WCAP-16208-P, "NDE Inspection Length for CE Steam Generator Tubesheet Region Explosive Expansions," Revision 1, May 2005, Reference 3) as supplemented for PNP in Attachment 5.

The supporting analysis in Attachment 5 is unique. As a result, the proposed changes to the TS do not conform to the verbiage from NUREG-1432, "Standard Technical Specifications – Combustion Engineering Plants." The verbiage of the proposed TS adheres to that previously approved in amendment no. 225.

2.0 PROPOSED CHANGE

ENO proposes a revision to the PNP TS 5.5.8. Specifically, the current SG tube repair criteria, in TS 5.5.8c., would be revised to add a new requirement. The proposed changes also include some formatting changes. The proposed changes are as follows:

a. In TS 5.8.8c.1. add a period at the end of the paragraph.

b. New TS section 5.5.8c.2. would be added and read as follows:

> "2. Tubes found by inservice inspection to contain flaws within 12.5 inches below the bottom of the cold-leg expansion transition or top of the cold-leg tubesheet, whichever is lower, shall be plugged. Flaws located below this elevation may remain in service."

c. TS 5.8.8d. would be moved to page 5.0-12, and sub-sections 5.8.8c through 5.8.8d would be reformatted, by indenting the paragraphs, to be consistent with previous subsections in TS 5.8.8.

3.0 BACKGROUND

As described in section 1.1, "Background," of Attachment 5, the Pressurized Water Reactors Owners Group (PWROG) program, for plants with CE supplied SGs with explosive tube expansions, provided recommended tubesheet region inspection lengths based on the generic WCAP-16208-P, Revision 1, report. This inspection length is referred to as C*. Following the completion of the Westinghouse report, applications for license amendments were submitted for several plants, including PNP. Those applications included additional plant specific information to supplement the report.

The NRC issuance of amendment no. 225 (Reference 4) followed a license amendment request, dated May 30, 2006 (ML061560406), and supplemental letters of February 27 (ML070640056), and April 10, 2007 (ML071030330), which were submitted by Nuclear Management Company, LLC (NMC), the former license holder for PNP. Amendment no. 225 approved requirements for SG tube repair in the hot-leg tubesheet region by applying a methodology called C*. The C* methodology was developed for CE plants with SG tubes that were expanded into the tubesheet with an explosive process called explansion.

With the implementation of amendment no. 225 and the C* methodology, the need to inspect the lower portion of the SG tubes within the hot-leg tubesheet region below the C* distance was eliminated. The approved TS alternate repair criteria in TS 5.5.8c.1. requires that:

> "Tubes found by inservice inspection to contain flaws within 12.5 inches below the bottom of the hot-leg expansion transition or top of the hot-leg tubesheet, whichever is lower, shall be plugged. Flaws located below this elevation may remain in service."

ENO is proposing a similar requirement for the cold-leg tubesheet of the SGs. The attached Westinghouse report SG-SGMP-10-4-P, Revision 1, February 2010, "Palisades Cold-leg Tubesheet Inspection Depth, C*," (Attachment 5) provides the technical basis for the proposed change.

The purpose of the Attachment 5 report is to calculate the C* inspection depth for the cold-leg side of the tubesheet using the same methods and techniques that were previously used to compute the C* inspection depth on the hot-leg side of the tubesheet. Attachment 5, section 1.1, indicates that the only difference, between the calculation of the C* inspection depth for the cold-leg of the SG tubesheet, and the calculation of the C* inspection depth for the hot-leg is the lower temperature at the cold-leg tube, tubesheet, and channelhead compared to the higher hot-leg temperature.

This cold-leg C* inspection distance was calculated to be 12.5 inches below the bottom of the tube to tubesheet expansion transition. This is the same distance currently in TS 5.5.8c.1 (above) for the hot-leg C* inspection distance. The value applies to each tube in the cold-leg tubesheet region for the PNP SGs. Refer to Attachment 5, section 3.0, "Calculation Methodology," for details.

PNP operating license amendment no. 223, issued July 6, 2006 (Reference 11), incorporated Technical Specifications Task Force (TSTF) Standard Technical Specification Change Traveler, TSTF-449, "Steam Generator Tube Integrity," Revision 4. TSTF-449 incorporated the Nuclear Energy Institute, NEI 97-06, "Steam Generator Program Guidelines" (Reference 1). Amendment no. 223 changes include, in part modification to TS 3.4.13, PCS Operational LEAKAGE, and addition of TS 3.4.17, SG Tube Integrity. The new program requirements, implemented with amendment no. 223, became effective after the 2006 refueling outage.

4.0 TECHNICAL ANALYSIS

Design

PNP is a two-loop CE design plant. The two replacement SGs at PNP were installed during an outage that began in the fall of 1990. The tube material is mill annealed Alloy 600 with a 0.75-inch outside diameter and a 0.042-inch tube wall thickness. Each SG has 8219 tubes. The tubes were expanded through the full depth of the tube sheet using an explosive process. The resultant interference fit between each of the tubes and tubesheet provides structural integrity to resist tube pull-out, and a leak resistant boundary between the primary and secondary systems. A seal weld joins the tube end to the cladding on the primary face of the tubesheet. The tube bundle is supported by stainless steel supports comprised of horizontal lattice-type eggcrate supports, vertical straps and diagonal straps. Tube rows 1-18 are U-bends and rows 19-165 are square bends.

Prior to the installation of the replacement SGs, the potential susceptibility to fretting wear at the bat wing locations, in the area around the center stay cylinder region, was identified by CE. As a result, 308 tubes in SG 'A' and 309 tubes in SG 'B' were preventatively plugged.

In subsequent years, additional SG tubes have been plugged. The current total tubes plugged, following the October 2010 refueling outage, are 486 for SG 'A' and 425 for SG 'B,' and the current number of active tubes in SG 'A' and 'B' are 7733 and 7794 respectively. Note that Attachment 5 indicates the current limiting active tube count is 7826 tubes in SG 'B,' which was the active tube count following the 2009 refueling outage and was the count when the report was generated.

Inspection Practices/Results

The PNP SG program requires that a degradation assessment be performed prior to each refueling outage. The degradation assessment is done to determine the susceptible areas of the tubing to be inspected, and to select the appropriate eddy current techniques for the inspection of each area. Data gathered during the inspection is used as input to the subsequent SG condition monitoring and operational assessments. The PNP SG program satisfies the intent of Nuclear Energy Institute (NEI) 97-06, "Steam Generator Program Guidelines."

The PNP 2004 refueling outage SG tube inspections, of the cold-leg tubesheet, included +Point™ probe examinations of the two outer rows cold-leg +2 inches to -2 inches referenced to the secondary faces of the tubesheets in both SGs. The percent inspected of the total SG cold-leg tube population was 8.6%. Only the two outer rows were included in the inspection.

The 2006, 2007, 2009 and 2010 refueling outage SG tube inspections, of the cold-leg tubesheet, included +Point™ probe examinations of the three outer rows cold-leg +2 inches to -2 inches referenced to the secondary faces of the tubesheets in both SGs. The percent inspected of the total SG cold-leg tube population was 10.9%. Only the three outer rows were included in the inspection.

There were no outside diameter stress corrosion cracking (ODSCC) or primary water stress corrosion cracking (PWSCC) flaws identified in the two outer rows cold-legs for the 2004 refueling outage and three outer rows in the 2006, 2007, 2009 and 2010 refueling outages. These results indicate there is no active damage mechanism in the areas examined in the cold-leg tube sheets of the SGs.

Analysis

SG tubes are an integral part of the primary coolant pressure boundary and serve to isolate radiological fission products in the primary coolant from the secondary coolant and the environment. Because of the importance of SG tube integrity, periodic inservice inspections of the SG tubes are required and are completed as part of the TS 5.5.8 SG Program. These inspections detect degradation in the tubes resulting from interaction with the SG operating environment. In addition, these inspections provide a means of characterizing the nature and cause of any tube degradation so that corrective measures can be taken. Tubes with degradation that exceed the tube repair limits specified in the TS are removed from service by plugging. The TS provide the acceptance criteria related to the results of SG tube inspections.

SG tube inspections are intended to ensure that this portion of the primary coolant system maintains its integrity. Tube integrity means that the tubes are capable of performing their functions in accordance with the plant design and licensing basis. Tube integrity includes both structural and leakage integrity. Structural integrity refers to maintaining adequate margins against gross failure, rupture, and collapse of the SG tubes. Leakage integrity refers to limiting primary-to-secondary leakage during normal operation, plant transients, and postulated accidents to ensure that the radiological dose consequences are within acceptable limits.

A joint industry test program, WCAP-16208-P (Reference 3), was conducted by Westinghouse to determine the recommended inspection length (C*) in the tubesheet region of CE design SGs that would ensure the structural and accident-induced leakage criteria of NEI 97-06 are met. Specifically, the tube to tubesheet joints must resist burst with an internal pressure of 3 x NODP (normal operating differential pressure) or 1.4 x MSLB (main steam line break) conditions, and they must maintain primary to secondary accident-induced leakage below one gpm/SG. It should be noted that C* is intended to define the minimum tube engagement length within the tubesheet. As such, this distance is referenced from the bottom of the hot leg expansion transition.

Tube burst is prevented for a tube with defects in the tubesheet region because of the constraint provided by the tubesheet. Therefore, tube pullout would be a prerequisite for tube burst under the limiting internal pressure conditions of NEI 97-06. WCAP-16208-P evaluated the minimum joint length required to preclude tube pull-out at a load of 3 x NODP, which bounds 1.4 x MSLB differential pressure.

The NEI 97-06 primary to secondary accident-induced leakage criteria of one gpm per SG exceeds the LCO and accident analysis leakage limits for PNP, which has a limit of 0.3 gpm per SG. To account for this disparity and to allow margin for other possible leak sources, WCAP-16208-P evaluated the minimum joint length required to maintain primary to secondary accident-induced leakage at 0.1 gpm per SG, assuming that 100% of the SG tubes were leaking below the C* depth. The TSTF-449 submittal to the NRC, which was approved as PNP operating license amendment no. 223, established the current PNP TS SG program that ensures tube integrity is maintained. In TS 3.4.13., "PCS Operational Leakage," LCO 3.4.13, item d, states that operational leakage through any one SG shall be limited to 150 gallons per day. The UFSAR chapters 14.14, "Steam Line Rupture Incident," 14.15, "Steam Generator Tube Rupture with a Loss of Offsite Power," and 14.16, "Control Rod Ejection," accident-induced leakage limit assumption is 0.3 gpm (432 gallons per day). For the tube rupture accident, this 0.3 gpm leakage is in addition to the leakage rate associated with the rupture of a single SG tube. Therefore, the LCO leakage limit is conservatively less than the design basis accident-induced leakage limit.

WCAP-16208-P generated empirical pullout load and leakage rate test data for a number of tube to tubesheet joint mock-up samples. The testing determined that the joint length required to satisfy the pull-out criteria was bounded by that required to satisfy the leakage rate criteria. Analytical methods were utilized to correct the empirical data for tubesheet deflection effects on both the joint strength and leakage resistance. Axial position uncertainties associated with eddy current examinations were also accounted for by adding a correction factor to the data. An additional conservatism was introduced by assuming that 100% of the SG tubes were severed by a 360° circumferential crack immediately below the C* inspection length. The final result of WCAP-16208-P for PNP was a C* value of 11.6 inches.

In 2006, the C* inspection distance was analyzed (Reference 5) for the SG hot-leg to include additional allowances for T_{hot} temperature difference effects for PNP compared to the WCAP-16208 analysis, and for potential differences associated with use of first slip pullout loads compared to peak pullout loads of test specimens described in

WCAP-16208-P. The re-calculated C* inspection distance including the above effects has increased the inspection depth to 12.5 inches below the bottom of the expansion transition. Attachment 5 includes the specific analysis for the SG cold-leg. The only difference, in the calculation of the C* inspection depth for the cold-leg of the SG tubesheet, as compared to the calculation of the C* inspection depth for the hot-leg, is the lower temperature at the cold-leg tube, tubesheet, and channelhead compared to the hot-leg.

The PNP SG tube inspection methods meet SG program requirements in TS 5.5.8. The rotating +Point™ probe employed in the inspection of the tubesheet region is fully capable of detecting axial and circumferential flaws. All tubes exhibiting degradation within the C* length of the tubesheet region are plugged upon detection of such flaws.

5.0 REGULATORY EVALUATION

Applicable Regulatory Requirements/Criteria

Regulatory Guide 1.121 (Reference 2), *Bases for Plugging Degraded PWR Steam Generator Tubes* - The tube burst and collapse criteria of RG 1.121 would continue to be satisfied with the proposed changes. Operation of the SGs with potential tube degradation below the C* inspection length would continue to meet the historical safety margin guidance in RG 1.121.

10 CFR 50.65, *Requirements for monitoring the effectiveness of maintenance at nuclear power plants* – Under the requirements, licensees classify SGs as risk significant components because they are relied on to remain functional during and after design basis events. The performance criteria in the Technical Specifications (TS 5.5.8b.) are used to demonstrate that the condition of the SG "is being effectively controlled through the performance of appropriate preventive maintenance" (10 CFR 50.65(a)(2)). Meeting the TS performance criteria that were incorporated from NEI 97-06, Rev. 2, "Steam Generator Program Guidelines," provides reasonable assurance that the steam generator tubing remains capable of fulfilling its specific safety function of maintaining the primary coolant pressure boundary.

NEI 97-06, and its referenced EPRI guidelines, define a SG program that provides the appropriate preventive maintenance that meets the intent of the 10 CFR 50.65. The SG performance criteria in NEI 97-06 are;

> *The structural integrity performance criterion is the following:*
> *All in-service steam generator tubes shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, cool-down and all anticipated transients included in the design specification) and design basis accidents. This includes retaining a safety factor of 3.0 against burst under normal steady state full power operation primary-to-secondary pressure differential and a safety factor of 1.4 against burst*

applied to the design basis accident primary-to-secondary pressure differentials. Apart from the above requirements, additional loading conditions associated with the design basis accidents, or combination of accidents in accordance with the design and licensing basis, shall also be evaluated to determine if the associated loads contribute significantly to burst or collapse. In the assessment of tube integrity, those loads that do significantly affect burst or collapse shall be determined and assessed in combination with the loads due to pressure with a safety factor of 1.2 on the combined primary loads and 1.0 on axial secondary loads.

The accident-induced leakage performance criterion is the following:
The primary to secondary-accident induced leakage rate for any design basis accident, other than a steam generator tube rupture, shall not exceed the leakage rate assumed in the accident analysis in terms of total leakage rate for all steam generators and leakage rate for an individual steam generator. Leakage is not to exceed 1 gpm per steam generator, except for specific types of degradation at specific location when implementing alternate repair criteria as documented in the Steam Generator Program technical specifications.

The operational leakage performance criterion is the following:
The RCS [reactor coolant system] *operational primary-to-secondary, leakage through any one steam generator shall be limited to 150 gallons per day.*

The safety significant portion of the SG tube is the length of the tube that is required to maintain structural and leakage integrity over the full range of SG operating conditions, including the most limiting accident conditions. The evaluation in the attached analysis has determined that degradation in tubing below the safety significant portion of the tube does not require plugging and serves as the bases for the tubesheet inspection program. As such the PNP SG inspection program provides a high level of confidence that the structural and leakage criteria are maintained during normal operating and accident conditions.

10 CFR 50, Appendix A, *General Design Criteria* [GDC] *for Nuclear Power Plants* – GDC 14, 30, and 32 define requirements for the reactor coolant pressure boundary with respect to structural and leakage integrity. SG tubing and tube repair constitutes a major fraction of the reactor coolant pressure boundary surface area. SG tubing and associated repair techniques and components, such as plugs and sleeves, must be capable of maintaining reactor coolant inventory and pressure. The SG program establishes performance criteria, repair criteria, repair methods, inspection intervals and the methods necessary to meet them. These requirements provide reasonable assurance that tube integrity would be maintained in the interval between SG inspections.

10 CFR 50, Appendix A, GDC 19, defines requirements for the control room and for the radiation protection of the operators working within it. Accidents involving the leakage or burst of SG tubing are a challenge to the habitability of the control room.

10 CFR 50, Appendix B, *Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,* the quality assurance criteria established in this appendix contain pertinent requirements that apply to all activities affecting the safety related functions of these component. These requirements are described in criteria IX, Control of Special Processes, XI, Test Control, and XVI, Corrective Action.

10 CFR 100, *Reactor Site Criteria,* established reactor siting criteria, with respect to the risk of public exposure to the release of radioactive fission products. Accidents involving leakage or tube burst of SG tubing may result in a challenge to containment and, therefore, involve an increased risk of radioactive release.

<u>Precedent</u>

On November 9, 2006, Southern California Edison Company was issued license amendments for San Onofre Nuclear Generating Station (SONGS), Units 2 and 3 (Reference 8). The amendments revised the requirements for SG tube repair in the hot-leg and cold-leg tubesheet regions by applying the C* methodology. WCAP-16208-P provided the recommended tubesheet region inspection length for the SONGS, Unit 2 and 3, along with the plant specific technical basis for the recommended inspection length.

Similar to the SONGS amendments, PNP operating license amendment no. 225 (Reference 4), dated May 31, 2007, approved requirements for SG tube repair in the hot-leg tubesheet region by applying the C* methodology and was based on WCAP-16208-P and plant specific analysis.

Additionally, in 2006, the NRC approved a similar redefinition of the hot-leg tubesheet repair criteria, based on C* methodology, in WCAP-16208-P, for St Lucie, Unit 2 (Reference 9) and Waterford, Unit 3 (Reference 10).

<u>No Significant Hazards Consideration</u>

Entergy Nuclear Operations, Inc. (ENO) has evaluated whether or not a significant hazards consideration is involved with the proposed amendment, to the Palisades Nuclear Plant (PNP)Technical Specification (TS) 5.5.8, "Steam Generator (SG) Program" by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of Amendment," as discussed below:

1. Does the proposed amendment involve a significant increase in the probability or consequences of an accident previously evaluated?

Response: No.

Previously evaluated accidents are initiated by the failure of plant structures, systems, or components. The proposed change that alters the SG cold-leg repair criteria does not have a detrimental impact on the integrity of any plant structure, system, or component that initiates an analyzed event. The proposed change would not alter the operation of, or otherwise increase the failure probability of any plant equipment that initiates an analyzed accident.

The proposed amendment, to the revise the PNP SG tube repair criteria in TS section 5.5.8c, does not involve a significant increase in the probability of an accident previously evaluated. Alternate repair criteria are being proposed for the cold-leg side of the SGs that duplicate the current alternate repair criteria for the hot-leg side of the SGs, in TS section 5.5.8c.1. The proposed revision maintains the existing design limits of the SGs and would not increase the probability or consequences of an accident involving a tube rupture or primary to secondary accident-induced leakage, as previously analyzed in the PNP Updated Final Safety Analysis Report (UFSAR). Also, the Nuclear Energy Institute (NEI) "Steam Generator Program Guidelines," (NEI 97-06), performance criteria for structural integrity and accident-induced leakage, incorporated in PNP TS 5.5.8, would continue to be satisfied.

Tube burst is prevented for a tube with defects within the tubesheet region because of the constraint provided by the tubesheet. As such, tube pullout resulting from the axial forces induced by primary to secondary differential pressures would be a prerequisite for tube burst to occur. A joint industry test program report, WCAP-16208-P, "NDE Inspection Length for CE Steam Generator Tubesheet Region Explosive Expansions," Revision 1, May 2005, has defined the non-degraded tube to tubesheet joint length required to preclude tube pullout (C*) and maintain acceptable primary to secondary accident-induced leakage, assuming a 360 degree circumferential through wall crack existed immediately below this length. For PNP, C* for the cold-leg side of the SGs is proposed to be 12.5 inches, which is the same C* length, as the current TS, for the hot-leg side of the SGs. Any degradation below C* is shown by test results and analysis to be acceptable, thereby precluding an event with consequences similar to a postulated tube rupture event.

The WCAP-16208-P report incorporates an assumed primary to secondary accident-induced leakage value of 0.1 gallon per minute (gpm) per SG. The TS Limiting Condition for Operation (LCO) 3.4.13d, "PCS Operational Leakage," states that operational primary to secondary leakage through any one SG shall be limited to 150 gallons per day (~0.1 gpm). The UFSAR chapters 14.14, "Steam Line Rupture Incident," 14.15, "Steam Generator Tube Rupture with a Loss of Offsite Power," and 14.16, "Control Rod Ejection," accident-induced leakage limit assumption is 0.3 gpm (432 gallons per day). For the tube rupture accident, this 0.3 gpm leakage is in addition to the leakage rate associated with the rupture of a single SG tube. Therefore, the WCAP-16208 report assumed accident-induced primary to secondary leakage limit is equivalent to the TS limit on operational leakage and conservatively less than the design basis accidents induced leakage limits.

In summary, the proposed modifications to the PNP TS maintain existing design limits and do not involve a significant increase in the probability or consequences of an accident previously evaluated in the UFSAR.

Therefore, operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?

Response: No.

The proposed amendment does not introduce any new equipment, change existing equipment, create any new failure modes for existing equipment, nor introduce any new malfunctions. SG tube integrity is shown to be maintained for all plant conditions upon implementation of the proposed alternate repair criteria for the cold-leg SG tubesheet.

The proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated because SG tube leakage and structural integrity would continue to be maintained during all plant conditions upon implementation of the proposed inspection scope to the PNP TSs. The revised inspection scope does not introduce any new mechanisms that might result in a different kind of accident from those previously evaluated. Even with the limiting circumstances of a complete circumferential separation (360 degree through wall crack) of a tube below the C* length, tube pullout is precluded and leakage is predicted to be maintained within the TS limits during all plant conditions.

Therefore, the proposed amendment does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. Does the proposed amendment involve a significant reduction in a margin of safety?

Response: No.

The proposed change alters the SG repair criteria. The proposed amendment does not involve a significant reduction in a margin of safety since the proposed requirements for the inspection of SG tubes are intended to ensure that the cold-leg side of the SGs, in the primary coolant system, maintains its integrity. Tube integrity means that the tubes are capable of performing these functions in accordance with the plant design and licensing basis. Tube integrity includes both structural and leakage integrity. The proposed cold-leg tubesheet inspection C* depth, of 12.5 inches, would ensure tube integrity is maintained because any degradation below C* is shown by test results and analyses to be acceptable.

Operation with potential tube degradation below the proposed C* 12.5 inch cold-leg inspection length within the tubesheet region of the SG tubing meets the recommendations of the NEI 97-06 SG program guidelines. Additionally, the proposed changes also maintain the structural and accident-induced leakage integrity as required by NEI 97-06.

The total leakage from an undetected flaw population below the C* inspection length for the cold-leg tubesheet under postulated accident conditions is accounted for, in order to assure it is within the bounds of the accident analysis assumptions.

Therefore, the proposed amendment does not involve a significant reduction in a margin of safety.

Based on the evaluation above, ENO concludes that the proposed amendment presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration" is justified.

Conclusion

In conclusion, based on the considerations described above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

6.0 ENVIRONMENTAL CONSIDERATION

The proposed amendment would change a requirement with respect to installed facility components located within the restricted area of the plant as defined in 10 CFR 20. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in

10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

7.0 REFERENCES

1. NEI 97-06, Rev. 2, Nuclear Energy Institute, "Steam Generator Program Guidelines," May 2005

2. Regulatory Guide 1.121, "Basis for Plugging Degraded PWR Steam Generator Tubes," August 1976

3. WCAP-16208-P, "NDE Inspection Length for CE Steam Generator Tubesheet Region Explosive Expansions," Rev. 1, May 2005

4. Letter from NRC to Entergy Nuclear Operations, Inc., dated May 31, 2007, "Palisades Nuclear Plant – Issuance of Amendment Re: Tubesheet Inspection Depth for Steam Generator Tube Inspections (TAC No. MD2125)" (ADAMS Accession No. ML071420216)

5. Letter from Nuclear Management Company, LLC to NRC, dated May 30, 2006, "License Amendment Request Regarding Tubesheet Inspection Depth for Steam Generator Tube Inspections" (ML061560406)

6. Letter from Nuclear Management Company, LLC to NRC, dated February 27, 2007, "Response to Request for Additional Information Regarding Proposed C* License Amendment Request for Steam Generator Tube Repair in the Tubesheet (TAC No. MD2125)" (ML070640056)

7. Letter from Nuclear Management Company, LLC to NRC, dated April 10, 2007, "Response to Request for Additional Information Regarding Proposed C* License Amendment Request for Steam Generator Tube Repair in the Tubesheet (TAC No. MD2125)" (ML071030330)

8. Letter from NRC to Southern California Edison Company, dated November 9, 2006, "San Onofre Nuclear Generating Station, Units 2 and 3 – Issuance of Amendments RE: Change, Define the extent of the Required Tube Inspections, and Repair Criteria Within the Tubesheet Region of the Steam Generators (TAC Nos. MC8850 and MC8851)" (ML062970444 and ML063130496)

9. Letter from NRC to Florida Power and Light Company, dated April 11, 2006, "St. Lucie Plant, Unit No. 2 – Issuance of Amendment Regarding Depth of Required Tube Inspections and Plugging Criteria Within the Tubesheet Region of the Original Steam Generators (TAC No. MC5084)" (ML060790216)

10. Letter from NRC to Entergy Operations, Inc., dated August 29, 2009, "Waterford Steam Electric Station, Unit 3 – Issuance of Amendment Re: Steam Generator Tube Inspections and Repair Criteria Within The Hot-Leg Tubesheet Region (TAC No. MC6421)" (ML062220137 and ML062420156)

11. Letter from NRC to Nuclear Management Company, LLC, date July 6, 2006, "Palisades Plant – Issuance of Amendment Re: Steam Generator Tube Integrity Technical Specifications (TAC No. MD0196)" (ML061880165 & ML061660197)

ATTACHMENT 2

RENEWED OPERATING LICENSE PAGE CHANGE INSTRUCTIONS

AND

REVISED TECHNICAL SPECIFICATIONS PAGES

5.0-12 and 5.0-13

3 pages follow

ATTACHMENT TO LICENSE AMENDMENT NO.

RENEWED FACILITY OPERATING LICENSE NO. DPR-20

DOCKET NO. 50-255

Remove the following pages of Appendix A Technical Specifications and replace with the attached revised pages. The revised pages are identified by amendment number and contain lines in the margin indicating the areas of change.

REMOVE	INSERT
Pages 5.0-12 and 5.0-13	Pages 5.0-12 and 5.0-13

5.5.8 Steam Generator (SG) Program

b. Performance criteria for SG tube integrity. (continued)

1. Structural integrity performance criterion: All in-service SG tubes shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, hot standby, and cool down and all anticipated transients included in the design specification) and design basis accidents. This includes retaining a safety factor of 3.0 against burst under normal steady state full power operation primary-to-secondary pressure differential and a safety factor of 1.4 against burst applied to the design basis accident primary-to-secondary pressure differentials. Apart from the above requirements, additional loading conditions associated with the design basis accidents, or combination of accidents in accordance with the design and licensing basis, shall also be evaluated to determine if the associated loads contribute significantly to burst or collapse. In the assessment of tube integrity, those loads that do significantly affect burst or collapse shall be determined and assessed in combination with the loads due to pressure with a safety factor of 1.2 on the combined primary loads and 1.0 on axial secondary loads.

2. Accident induced leakage performance criterion: The primary to secondary accident induced leakage rate for any design basis accident, other than a SG tube rupture, shall not exceed the leakage rate assumed in the accident analysis in terms of total leakage rate for all SGs and leakage rate for an individual SG. Leakage is not to exceed 0.3 gpm.

3. The operational LEAKAGE performance criterion is specified in LCO 3.4.13, "PCS Operational LEAKAGE."

c. Provisions for SG tube repair criteria. Tubes found by inservice inspection to contain flaws with a depth equal to or exceeding 40% of the nominal tube wall thickness shall be plugged. The following alternative repair criteria may be applied as an alternate to the 40% depth based criteria:

1. Tubes found by inservice inspection to contain flaws within 12.5 inches below the bottom of the hot-leg expansion transition or top of the hot-leg tubesheet, whichever is lower, shall be plugged. Flaws located below this elevation may remain in service.

2. Tubes found by inservice inspection to contain flaws within 12.5 inches below the bottom of the cold-leg expansion transition or top of the cold-leg tubesheet, whichever is lower, shall be plugged. Flaws located below this elevation may remain in service.

5.5.8 Steam Generator (SG) Program

d. Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube repair criteria. The tube-to-tubesheet weld is not part of the tube. In addition to meeting the requirements of d.1, d.2, and d.3 and d.4 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. An assessment of degradation shall be performed to determine the type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

1. Inspect 100% of the tubes in each SG during the first refueling outage following SG replacement.

2. Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.

3. If crack indications are found in any SG tube, then the next inspection for each SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever is less). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

4. When the alternate repair criteria of TS 5.5.8.c.1 are implemented, inspect 100% of the inservice tubes to the hot-leg tubesheet region with the objective of detecting flaws that may satisfy the applicable tube repair criteria of TS 5.5.8.c.1 every 24 effective full-power months, or one refueling outage, whichever is less.

e. Provisions for monitoring operational primary to secondary LEAKAGE.

ATTACHMENT 3

MARK-UP OF TECHNICAL SPECIFICATIONS PAGES

(showing proposed changes; additions are highlighted)

2 pages follow

5.5 Programs and Manuals

5.5.8 Steam Generator (SG) Program

b. Performance criteria for SG tube integrity. (continued)

1. Structural integrity performance criterion: All in-service SG tubes shall retain structural integrity over the full range of normal operating conditions (including startup, operation in the power range, hot standby, and cool down and all anticipated transients included in the design specification) and design basis accidents. This includes retaining a safety factor of 3.0 against burst under normal steady state full power operation primary-to-secondary pressure differential and a safety factor of 1.4 against burst applied to the design basis accident primary-to-secondary pressure differentials. Apart from the above requirements, additional loading conditions associated with the design basis accidents, or combination of accidents in accordance with the design and licensing basis, shall also be evaluated to determine if the associated loads contribute significantly to burst or collapse. In the assessment of tube integrity, those loads that do significantly affect burst or collapse shall be determined and assessed in combination with the loads due to pressure with a safety factor of 1.2 on the combined primary loads and 1.0 on axial secondary loads.

2. Accident induced leakage performance criterion: The primary to secondary accident induced leakage rate for any design basis accident, other than a SG tube rupture, shall not exceed the leakage rate assumed in the accident analysis in terms of total leakage rate for all SGs and leakage rate for an individual SG. Leakage is not to exceed 0.3 gpm.

3. The operational LEAKAGE performance criterion is specified in LCO 3.4.13, "PCS Operational LEAKAGE."

c. Provisions for SG tube repair criteria. Tubes found by inservice inspection to contain flaws with a depth equal to or exceeding 40% of the nominal tube wall thickness shall be plugged. The following alternative repair criteria may be applied as an alternate to the 40% depth based criteria:

1. Tubes found by inservice inspection to contain flaws within 12.5 inches below the bottom of the hot-leg expansion transition or top of the hot-leg tubesheet, whichever is lower, shall be plugged. Flaws located below this elevation may remain in service.

INSERT 1 →

d. Provisions for SG tube inspections. Periodic SG tube inspections shall be performed. The number and portions of the tubes inspected and methods of inspection shall be performed with the objective of detecting flaws of any type (e.g., volumetric flaws, axial and circumferential cracks) that may be present along the length of the tube, from the tube-to-tubesheet weld at the

5.5.8 Steam Generator (SG) Program

d. Provisions for SG tube inspections. (continued)

tube inlet to the tube-to-tubesheet weld at the tube outlet, and that may satisfy the applicable tube repair criteria. The tube-to-tubesheet weld is not part of the tube. In addition to meeting the requirements of d.1, d.2, and d.3 and d.4 below, the inspection scope, inspection methods, and inspection intervals shall be such as to ensure that SG tube integrity is maintained until the next SG inspection. An assessment of degradation shall be performed to determine the type and location of flaws to which the tubes may be susceptible and, based on this assessment, to determine which inspection methods need to be employed and at what locations.

1. Inspect 100% of the tubes in each SG during the first refueling outage following SG replacement.

2. Inspect 100% of the tubes at sequential periods of 60 effective full power months. The first sequential period shall be considered to begin after the first inservice inspection of the SGs. No SG shall operate for more than 24 effective full power months or one refueling outage (whichever is less) without being inspected.

3. If crack indications are found in any SG tube, then the next inspection for each SG for the degradation mechanism that caused the crack indication shall not exceed 24 effective full power months or one refueling outage (whichever is less). If definitive information, such as from examination of a pulled tube, diagnostic non-destructive testing, or engineering evaluation indicates that a crack-like indication is not associated with a crack(s), then the indication need not be treated as a crack.

4. When the alternate repair criteria of TS 5.5.8.c.1 are implemented, inspect 100% of the inservice tubes to the hot-leg tubesheet region with the objective of detecting flaws that may satisfy the applicable tube repair criteria of TS 5.5.8.c.1 every 24 effective full-power months, or one refueling outage, whichever is less.

e. Provisions for monitoring operational primary to secondary LEAKAGE.

INSERT 1 2. Tubes found by inservice inspection to contain flaws within 12.5 inches below the bottom of the cold-leg expansion transition or top of the cold-leg tubesheet, whichever is lower, shall be plugged. Flaws located below this elevation may remain in service.

ATTACHMENT 4

CAW-10-2752

AFFIDAVIT

WESTINGHOUSE ELECTRIC COMPANY LLC

PROPRIETARY INFORMATION NOTICE

COPYRIGHT NOTICE

Seven Pages Follow

CAW-10-2752

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

Before me, the undersigned authority, personally appeared B. F. Maurer, who, being by me duly sworn according to law, deposes and says that he is authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of his knowledge, information, and belief:

B. F. Maurer, Manager
ABWR Licensing

Sworn to and subscribed before me
this 17th day of November 2010

Notary Public

COMMONWEALTH OF PENNSYLVANIA
NOTARIAL SEAL
Renee Giampole, Notary Public
Penn Township, Westmoreland County
My Commission Expires September 25, 2013

(1) I am Manager, ABWR Licensing, in Nuclear Services, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitute Westinghouse policy and provide the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iii) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390; it is to be received in confidence by the Commission.

(iv) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(v) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in SG-SGMP-10-4-P, Revision 1, "Palisades Cold Leg Tubesheet Inspection depth, C*" (Proprietary) dated February 2010, for submittal to the Commission, being transmitted by Entergy Nuclear Operations, Inc. letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with implementing a steam generator tube alternate repair criterion called C* that does not require an eddy current inspection and plugging of the tubes below a distance of 12.5 inches from the top of the tubesheet on the cold leg side of the tubesheet region and may be used only for that purpose. The cold leg inspection length is essentially the same as the hot leg inspection length that has been previously approved for Palisades.

This information is part of that which will enable Westinghouse to:

(a) Provide documentation of the analyses, methods, and testing which support the implementation of an alternate repair criterion, designated as C*, for a portion of the tubes within the cold leg side of the tubesheet region of the Palisades steam generators.

(b) Assist the customer in obtaining NRC approval of the Technical Specification changes associated with the alternate repair criterion.

Further this information has substantial commercial value as follows:

(a) Westinghouse plans to sell the use of similar information to its customers for the purpose of meeting NRC requirements for licensing documentation.

(b) Westinghouse can sell support and defense of the technology to its customers in the licensing process.

(c) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar calculation, evaluation and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and/or non-proprietary versions of documents furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

COPYRIGHT NOTICE

The reports transmitted herewith each bear a Westinghouse copyright notice. The NRC is permitted to make the number of copies of the information contained in these reports which are necessary for its internal use in connection with generic and plant-specific reviews and approvals as well as the issuance, denial, amendment, transfer, renewal, modification, suspension, revocation, or violation of a license, permit, order, or regulation subject to the requirements of 10 CFR 2.390 regarding restrictions on public disclosure to the extent such information has been identified as proprietary by Westinghouse, copyright protection notwithstanding. With respect to the non-proprietary versions of these reports, the NRC is permitted to make the number of copies beyond those necessary for its internal use which are necessary in order to have one copy available for public viewing in the appropriate docket files in the public document room in Washington, DC and in local public document rooms as may be required by NRC regulations if the number of copies submitted is insufficient for this purpose. Copies made by the NRC must include the copyright notice in all instances and the proprietary notice if the original was identified as proprietary.

ATTACHMENT 6

WESTINGHOUSE NON-PROPRIETARY CLASS 3

SG-SGMP-10-4-NP, REVISION 1
FEBRUARY 2010

PALISADES COLD LEG TUBESHEET INSPECTION DEPTH, C*

16 Pages Follow

Westinghouse Non-Proprietary Class 3

SG-SGMP-10-4-NP
Revision 1

February 2010

Palisades Cold Leg Tubesheet Inspection Depth, C*

Prepared for
Entergy Nuclear Operations, Inc.

Westinghouse

LEGAL NOTICE

This report was prepared as an account of work performed by Westinghouse Electric Company LLC. Neither Westinghouse Electric Company LLC, nor any person acting on its behalf:

A. Makes any warranty or representation, express or implied including the warranties of fitness for a particular purpose or merchantability, with respect to the accuracy, completeness, or usefulness of the information contained in this report, or that the use of any information, apparatus, method, or process disclosed in this report may not infringe privately owned rights; or
B. Assumes any liabilities with respect to the use of, or for damages resulting from the use of, any information, apparatus, method, or process disclosed in this report.

SG-SGMP-10-4-NP
Revision 1

Palisades Cold leg Tubesheet Inspection Depth, C*

Prepared for Entergy Nuclear Operations, Inc.

Prepared by: **Electronically Approved*
David J. Ayres, Consultant
Steam Generator Management Programs

Reviewed by: **Electronically Approved*
P.J. Prabhu, Fellow Engineer
Steam Generator Management Programs

Approved by: **Electronically Approved*
Damian Testa, Manager
Steam Generator Management Programs

* Electronically Approved Records Are Authenticated in the Electronic Document Management System

Westinghouse Electric Company LLC
P.O. Box 355
Pittsburgh, PA 15230-0355

© 2010 Westinghouse Electric Company LLC
All Rights Reserved

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

EXECUTIVE SUMMARY

Nondestructive Examination NDE inspection by a qualified nondestructive examination technique to a defined inspection length below the top of the tubesheet ensures that steam generator tube burst and leakage requirements are met in the tubesheet region. A hot leg side NDE inspection length was provided in the C* generic topical report for Combustion Engineering designed steam generators (WCAP-16208, Revision 1, Reference 1) and supplemented for Palisades by Reference 3. This supplement provides the cold leg side inspection length in the event that a cold leg side examination is performed. The cold leg inspection lengths provided in this supplement have been developed using the methods and test data used in the C* generic topical report and the subsequent responses to the Nuclear Regulatory Commission (NRC) requests for additional information.

The cold leg inspection length is essentially the same as the hot leg inspection length reported in References 3 and 7. The resolution of the NRC equests for Additional Information (RAIs) on the submittal for the hot leg C*, Reference 7, were included in the calculations for the cold leg C* value. The inspection lengths in the table below provide assurance that the NEI 97-06 requirements for tube burst and leakage are met and that the conservatively derived maximum combined leakage from both tubesheet joints (hot and cold legs) is less than 0.2 gpm at accident conditions. This combined leakage of 0.2 gpm in the faulted loop is below the Palisades Nuclear Plant Technical Specification allowable accident-induced leakage of 0.3 gpm per steam generator.

Plant	Leak Rate Based Inspection Length Corrected for Dilation and NDE (inches)
Palisades Hot Leg	12.5
Palisades Cold Leg	12.5

1.0 INTRODUCTION

1.1 BACKGROUND

The PWR Owners Group program to provide recommended tubesheet (TS) region inspection lengths, for plants with Combustion Engineering supplied steam generators with explosive expansions, was documented in report WCAP-16208-P, Revision 1,Reference 1. This inspection length is commonly referred to as C* ("C-Star"). Reference 1 was first submitted to the NRC by other participants within the PWR Owners Group program. In preparation to submit Reference 1 to support the application of C* to Palisades, responses to NRC Requests for Additional Information (RAIs) which were relevant to the Palisades application were submitted to the NRC in Reference 2. A letter summarized the plant-specific application of Reference 1 to the hot leg side of the Palisades tubesheet, Reference 3 which incorporated the RAI responses.

The calculation of the C* inspection depth for the cold leg of the tubesheet at Palisades is similar to the calculation of C* for the hot leg. The only difference is the lower temperatures at the cold leg tube, tubesheet, and channelhead compared to the hot leg. The purpose of this document is to calculate the C* inspection depth for the cold leg side of the tubesheet using the same methods and techniques that were used to compute the C* inspection depth on the hot leg side of the tubesheet.

1.2 SUMMARY

The cold leg C* inspection distance has been calculated to include all of the effects that were included in the hot leg C* final documentation. The resulting cold leg C* distance is 12.5 inches below the bottom of the tube-to-tubesheet expansion transition. This value applies to each tube at the cold leg tubesheet region for the Palisades steam generators.

Leakage Based Inspection Length Including Tubesheet Deflection and NDE Corrections for Palisades Cold Leg

Plant	Leak Rate Based Inspection Length Adjusted for TS Dilation (inches)	Leak Rate Based Inspection Length Adjusted for TS Dilation and NDE (inches)
Palisades Cold Leg	[ ]a,c,e	12.5

1.3 QUALITY ASSURANCE

The work that is presented in this document was completed and reviewed under the requirements of the Westinghouse Level II Policies and Procedures (Reference 4).

2.0 COLD LEG JOINT INSPECTION DISTANCE TECHNICAL APPROACH

The technical approach is the method used in the generic C* topical report (Reference 1) and the subsequent responses to the NRC requests for additional information (References 3 and 7).

2.1 ACCEPTANCE CRITERION

Acceptable joint length as reported for the hot leg joints in the C* topical report was determined by testing for two categories of concern: pullout load and leak rate. Pullout load and leak rate testing data were used to show compliance with the acceptance criteria (Reference 8). As reported in the C* topical report, the length needed to ensure that both the burst integrity and the leakage criteria are met was dominated in all cases by the threshold length required to meet the leakage criterion. Therefore, the leakage criterion defines the required cold leg tube-to-tubesheet joint length and bounds the inspection length for the cold leg side pullout criterion.

The C* generically applied limiting conditions for the leak rate criterion were based on a conservative assessment of conditions during a main steam line break (MSLB) event. Leak rate data in the C* analysis was evaluated at a pressure of 2560 psid and 600°F for the development of the hot leg inspection length. The pressure value of 2560 psid corresponds to the pressurizer safety valve setpoint plus 3 percent for valve accumulation less atmospheric pressure in the secondary side of the faulted steam generator. This pressure differential represents the pressure that would be obtained during a main steam line break due to total depressurization of the faulted steam generator with reactor coolant pressure rising to the setpoint of the reactor coolant system safety valves assuming no operator action to modulate or terminate safety injection. This pressure differential represents the limiting pressure that would create the most limiting leak rate.

As in the C* development for the hot leg side of the tubesheet, the accident-induced leak rate criterion for the Palisades Nuclear Plant is the plant-specific allowable value of 0.3 gpm per steam generator. In the C* generic topical work, Reference 1, the criterion was conservatively limited to 0.1 gpm per steam generator for this single type of flaw (tubesheet region cracking) representing all hot leg joints. The plant-specific threshold length for leakage is determined from the single joint leak rate as a function of the postulated flaw depth below the bottom of the expansion transition. The single joint leak rate must be less than or equal to the leak rate criterion of 0.1 gpm divided by the number of tubes assumed to be defective. The hot leg C* work determined an inspection length for the hot leg joints based on the assumption that all 7846 hot leg joints were leaking at the leak rate derived from the C* testing that would cumulatively equal 0.1 gpm. The allowable leak rate on this basis is 1.27E-05 gpm per hot leg joint. Note that the active tube count of 7846 tubes in the limiting SG is based on the active tube count at the time of the hot leg C* submittal. The current limiting active tube count is 7826 tubes in Steam Generator B.

The leak rate criterion for the sum of the cold leg joints and the hot leg joints if all are assumed to be leaking based on the method and reference transient used in Reference 1 is 0.2 gpm or two times the 0.1 gpm used in Reference 1. This criterion for leakage retains margin against the Palisades Nuclear Plant accident-induced leakage limit of 0.3 gpm/steam generator.

The following constraints guided the analysis for the development of the cold leg inspection length:

1. The acceptance criterion is the NDE inspection length in the cold leg tube-to-tubesheet joint that meets a total cold leg joint leak rate of 0.1 gpm per steam generator for the generic (Reference 1) MSLB case.

   Therefore, the total leak rate is 0.2 gpm per steam generator in the faulted loop which is two times the Reference 1 leak rate criterion of 0.1 gpm based on doubling the number of leaking joints by adding the cold leg joints to the hot leg joint count in the effected steam generator.

2. The inspection length must include consideration of the effect on leakage from:
   - Reactor coolant system (RCS) pressure and temperature adjustments to the leak rate test data,
   - Tube-to-tubesheet joint contact force adjustment resulting from the internal pressure and the RCS temperature, and
   - The tubesheet hole dilation caused by tubesheet deflection under primary-to-secondary pressure differential.

3.0 CALCULATION METHODOLOGY

3.1 BACKGROUND

Reference 1 provided the general methodology to determine the joint length that meets the leakage criteria. The applicable sections from this reference are as follows:

- Section 4.6 of Reference 1 describes how temperature affects the leak rate.
- Section 4.8 of Reference 1 describes how the leak rate data is evaluated to provide the joint length at which the leak rate criteria are met (prior to adjustments for NDE error and tubesheet hole dilation).

LTR-CDME-06-80-P, Revision 1 (Reference 3) and LTR-CDME-07-22-P (Reference 7) provide revised joint lengths for the hot leg under a "first slip" pullout load criteria and a lower temperature (583°F applicable to Palisades hot leg tubesheet joints). A similar methodology is employed in this report. The applicable inputs from these references are as follows:

- Figure 2 of Reference 7 provides the 95% lower bound prediction of first slip pullout force for 42 mil wall smooth bore tests. This figure is taken directly from the RAI response to RAI # 6 in Reference 7.
- Table 6-11 of Reference 1 provides the dilation axial force due to tubesheet bending. The bending on the cold leg side of the tubesheet is conservatively considered to be the same as the hot leg side of the tubesheet.
- The required engagement length of less than 5.25 inches to resist the three times the normal operation differential pressure (3NODP) pullout load of [ ]^a,c,e^ lb_f from Reference 3 is conservative for the cold leg because the value of "RCS Pressure and Diff Thermal Axial Force" of [ ]^a,c,e^ lb_f used in the calculation in Reference 3 is less than the value [ ]^a,c,e^ lb_f calculated at 532°F in Section 3.4. This is consistent with the discussion in the response to RAI # 5 in Reference 7.

3.2 TEMPERATURE CORRECTION FOR UNDILATED JOINT LENGTH

The effect of temperature on the leak rate from a tubesheet joint without tubesheet hole dilation was experimentally quantified in Reference 1. The effect of temperature on tubesheet hole dilation is accounted for analytically.

Section 4.6 of Reference 1 provides the experimentally determined relationship that describes how temperature affects the leak rate. This equation is used to adjust the leak rate data in Table 4-7 of Reference 1. The analysis that is described in Section 4.8 of Reference 1 is performed using the temperature-adjusted data to obtain the joint length that would meet the leakage criteria for an undilated tubesheet hole.

Reference 1 used a generic hot leg temperature of 600°F to determine the leakage-limited inspection distance. The Palisades cold leg temperature is 532°F (Reference 5). Section 2.3 of

Reference 3 demonstrated how the leak rate adjustment was applied for a hot leg temperature of 583°F applicable to Palisades. When a similar adjustment is made for a cold leg temperature of 532°F, then [

]^{a,c,e}

Table 1: WCAP-16208-P, Table 4-7: Transformed Leak Rate Data: Revised for Change of Temperature from 600°F to 532°F

a,c,e

		Temperature Corrected Data		Transformed	
Index	Sample	**L** Joint Length (inches)	**Q** Leak Rate at 532°F (gpm)	**$L-L_{avg}$** Joint Length (inches)	**$Q-Q_{avg}$** Leak Rate (gpm)

Calculations of the "Uncorrected Joint Length that Meets Leakage Criteria," then follow the methodology provided in Section 4.8 of Reference 1. The result is a minor revision to Figure 4-4 of Reference 1, as is shown in Figure 1. Using the leakage criteria as the y-axis leak rate value and reading the corresponding joint length off of the 95% confidence interval curve yields the "Uncorrected Joint Length that Meets Leakage Criteria."

a,b,c

[ ]

Figure 1: WCAP-16208-P, Figure 4-4: Leak Rate vs. Joint Length at 532°F, ΔP=SLB, (Revised)

The result is that the "Uncorrected Joint Length that Meets Leakage Criteria," that was provided in Tables 4-9 and 6-15 of Reference 1 (at the assumed leak criterion of 0.1 gpm/SG), becomes [ ][a,c,e] inches when using the cold leg temperature of 532°F and the number of actual in-service tubes (7826 tubes/SG[1] – Reference 6).

3.3 FIRST SLIP PULLOUT FORCE

The first slip pullout force values are taken from Figure 2 of Reference 7. This figure shows the 95% lower prediction bound for the first slip pullout force as a function of joint length. The

1 The number of tubes considered here is the largest number of tubes in operation in either SG after the 2009 inspection.

"Axial Force" column of Table 2 contains these values of axial force from Table 1 (Column 2) of Reference 7.

3.4 RCS PRESSURE AND DIFFERENTIAL TEMPERATURE AXIAL FORCE

The impact on flow resistance of the tubesheet hole at the cold leg temperature is computed in a similar manner as was done in Reference 3. This calculation considers the temperature and the corresponding temperature dependent material properties to compute the interface force between the tube and tubesheet. Table 6-11 of Reference 1 uses a conservative value of [

]a,c,e

3.5 DILATATION AXIAL FORCE

Table 6-11 of Reference 1 provides the dilation axial force due to tubesheet bending. The original design reports assume symmetry of the tubesheet for both hot and cold leg sides. Since the bending is due to the differential pressure across the tubesheet and the primary pressure on the cold leg side is slightly smaller than the primary pressure on the hot leg side, the magnitude of the tubesheet deflection from differential pressure is likely to be slightly smaller on the cold leg. In the current evaluation, the bending of the cold leg side is conservatively considered to be the same as the hot leg side of the tubesheet.

3.6 CALCULATION OF INSPECTION DISTANCE

Incorporating the "first slip" 95% lower bound prediction of Reference 7 and the 532°F value for the "RCS Pressure and Diff Thermal Axial Force" into Table 6-11 of Reference 1 yields a mechanism to adjust the "Uncorrected Joint Length that Meets Leakage Criteria" for tubesheet hole dilation.

Table 2 presents a revision to Table 6-11 of Reference 1 that accounts for "first slip" pullout data and a 532°F cold leg as described in the previous sections. The first column in this table is the depth measured from the expansion transition near the top of the tubesheet. The second column is the axial force from the expansion described in Section 3.3. The third column represents the axial force resulting from the internal pressure in the tube and the differential thermal expansion between the tube and the tubesheet corresponding to the cold leg temperature as described in Section 3.4. The fourth column is the sum of Columns 2 and 3. The fifth column shows the dilation force resulting from the tubesheet deflection described in Section 3.5. The sixth column shows the algebraic sum of Columns 4 and 5. Since a negative axial force is not possible (when there is no radial contact force between the tube and the tubesheet), negative values are truncated to 0. The subsequent columns follow the computation as described in Reference 1.

Section 2.3 presented "Uncorrected Joint Length that Meets Leakage Criteria" length of [ ]^{a,c,e} inches for leakage criteria of 0.1 gpm/SG for 7826 tubes/SG. Looking up each "Uncorrected Joint Length that Meets Leakage Criteria" in the rightmost column of Table 2, and interpolating to find the result in the leftmost column of the table, produces "Joint Length that Meets Leakage Criteria" value of [ ]^{a,c,e} inches. Adding NDE axial position uncertainty of [ ]^{a,c,e} inch to both values yields a leakage-based inspection length of 12.50 inches. This combination of the computed C* value and the axial position uncertainty is consistent with the discussion of RAI #8 in Reference 7. Note that this length is measured from the bottom of the expansion transition, not the top of the tubesheet. This C* value for the cold leg of 12.5 inches is the same as the C* value for the hot leg.

3.7 COMPARISON WITH INSPECTION DISTANCE FOR HOT LEG

The C* inspection distance for the hot leg at Palisades Nuclear Plant was computed in References 3 and 7. Variations in the way the uncertainties were treated made only a slight difference in the results. One of the conservatisms in the computation of the hot leg C* was the use of the generic value of [ ]^{a,c,e} lb_f for RCS Pressure and Diff. Thermal Axial Force which was discussed in Reference 7. If the plant-specific value of [ ]^{a,c,e} lb_f is used in the computation, the value of hot leg C* would be reduced. The appropriate plant-specific value for the cold leg conditions [ ]^{a,c,e} lb_f is used for the calculation of the cold leg C*. The increase in the C* length due to the increased leak rate at the lower temperature coincidentally is within round-off of the increase in the hot leg C* due to the use of the conservative Axial Force value. Therefore the C* value of 12.5 inches for the cold leg is the same as the C* value for the hot leg because of the additional conservatism of the hot leg calculation.

Table 2: WCAP-16208-P, Table 6-11: Effect of Tubesheet Deflection for Palisades Steam Generators: Revised for Use of First Slip Loads and 532°F Cold Leg

Depth in Tubesheet (in)	Axial Force (lb_f)	RCS Pressure and Diff. Thermal Axial Force (lb_f)	Initial Axial Force (lb_f)	Dilation Axial Force (lb_f)	Net Axial Force (lb_f)	Net / Initial Ratio	Equiv. No-Dilate Length (inch)	Cum. No-Dilate Length (inch)

a,b,c

4.0 REFERENCES

1. Westinghouse Report WCAP-16208-P, Revision 1, "NDE Inspection Length for CE Steam Generator Tubesheet Region Explosive Expansions," May 2005.

2. Westinghouse Letter LTR-CDME-06-40-P, Revision 1, "Comments on the Application of WCAP-16208-P Revision 1, 'NDE Inspection Length for CE Steam Generator Tubesheet Region Explosive Expansions' to the Palisades Nuclear Power Plant," May 2006.

3. Westinghouse Letter LTR-CDME-06-80, Revision 1, "Palisades Tubesheet Inspection Depth," May 2006.

4. "Westinghouse Level II Policies and Procedures," Rev. 0, Effective August 3, 2009.

5. Westinghouse Letter LTR-CDME-07-124, "Entergy Input to Palisades REFOUT 19 Degradation Assessment," June 8, 2007.

6. Westinghouse Report SG-SGMP-09-3, "Palisades Nuclear Plant 1R20 Outage Steam Generator Condition Monitoring Report," April 2009.

7. Westinghouse Letter LTR-CDME-07-22-P, "Responses to NRC Requests for Additional Information Regarding the Application of WCAP-16208-P, Revision 1, 'NDE Inspection Length for CE Steam Generator Tubesheet Region Explosive Expansions' to the Palisades Nuclear Power Plant," February 2007.

8. NEI 97-06, Revision 1, "Steam Generator Program Guidelines," Nuclear Energy Institute, Washington, DC, January 2001.