TAC NO. MC6421

Responses to NRC Requests for Additional Information on WCAP-16208-P, Rev. 1, "NDE Inspection Length for CE Steam Generator Tubesheet Region Explosive Expansions" for Waterford Steam Electric Station Unit 3

March 2006

LTR-CDME-06-16-NP

Revision 0

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

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DEFINITIONS

ARC – Alternate repair criteria are approvals by NRC to utilize specific criteria for repair decisions based on detection of flaws.

AVT – All Volatile Treatment.

BET – Bottom of the explansion transition.

BTA – Bore Trepanning Association process for machine boring. A process improvement employed for tubesheet drilling. Not applicable to Waterford 3.

Collar - Tubesheet mockups were fabricated from tubesheet bar stock material SA-508, Class 3. The machined bar stock in which a tube was explosively expanded was referred to in this project as a collar.

C* - The CE design explansion joint inspection distance.

EDM - Electrical discharge machining.

EOC – End of the operating cycle.

Explansion – Explosive expansion of tubing into a Combustion Engineering steam generator tubesheet.

F* - The Westinghouse design rolled joint inspection distance.

[

] a,c,e

Joint – The tube and tubesheet contact surface area created by the explansion process.

H* - The Westinghouse design hydraulic expansion joint inspection distance.

Leakage criteria – The generic Combustion Engineering design technical specifications LCO for accident induced leakage value is 0.5 gpm per steam generator. The leak limit is [reduced to one-fifth (i.e. 0.1 gpm)] a,c,e to provide margin for leaks from other potential degradation types. The criterion conservatively assumes that the leakage is from 100% of the tubes in the steam generator that have throughwall circumferentially oriented flaws present at the threshold length below the hot leg BET (Bottom of the Explansion Transition).

LCO – Technical specifications limiting condition for operation.

Maximum load – The largest force encountered while pulling the tube out of the tubesheet.

MDM - Metal Disintegration Machining.

NODP – Normal operating differential pressure = RCS pressure minus SG pressure at normal full power operating conditions.

Pullout force - The force required to move the tube relative to the tubesheet.

[

] a,c,e

POD – Probability of detection based on the ability of an NDE technique to indicate the presence of a flaw.

RAI - Request for additional information.

Rough bore – The machined surface on the inside diameter of each laboratory specimen rough bore collar was drilled on a lathe to a surface roughness not greater than 250 micro-inches (AA) to mockup the gun-drilled tubesheet hole surface. Applicable to Waterford 3.

SLB or MSLB – The design basis event known as main steam line break.

STD – The Science and Technology Division of Westinghouse.

Smooth Bore - The machined surface on the inside diameter of each laboratory specimen smooth bore collar was drilled on a lathe to a surface roughness not greater than 250 micro-inches (AA) and then reamed to increase smoothness to mockup the BTA process tubesheet hole surface. Not applicable to Waterford 3.

Taper – The theoretically incomplete contact near the top of the joint just below the explansion transition. The W* topical report increased the threshold length to account for an approximately 0.7" taper.

Threshold length – The tube to tubesheet joint length below the BET that provides a sufficient contact force to preclude pullout at 3NODP and leakage at SLB pressures.

TTS – Top of the tubesheet.

W* - The Westinghouse design explosive expansion joint inspection distance.

1.0 INTRODUCTION

1.1 BACKGROUND

The Westinghouse Owner's Group C* ("C-Star") program provided recommended tubesheet region inspection lengths for plants with Combustion Engineering nuclear steam supply systems steam generators. This inspection length is commonly referred to as the C* length.

By letter dated March 15, 2005 (ML050770200), Entergy Operations, Inc. submitted an application to change Waterford 3 technical specifications (TS) related to steam generator (SG) tube inspection to define the depth of the required tube inspections and plugging criteria within the tubesheet, with the depth of inspection defined as "C*". The technical basis for these changes was initially documented in Westinghouse topical report WCAP-16208-P, Revision 0, "NDE (Non-destructive Examination) Inspection Length for CE (Combustion Engineering) Steam Generator Tubesheet Region Explosive Expansions," dated October 2004. In a letter dated December 16, 2004 (ML043510406), the U.S. Nuclear Regulatory Commission (NRC) staff requested additional information from Florida Power and Light (FPL) about their C* amendment application for St. Lucie Unit 2. FPL's response to this request was issued March 31, 2005 (ML050960517), and Revision 1 of WCAP-16208-P (Reference 1) was subsequently issued in May 2005 (ML051520420). Based on the NRC staff review of the license amendment application for Waterford 3, the staff requested additional information in their letter dated October 25, 2005 (TAC MC6421), Reference 2. This document provides the responses to RAIs 5, 7, and 8 to support and supplement the complete submittal to be provided by Entergy.

The bounding objective of WCAP-16208-P, Revision 1 was to establish a leakage based inspection depth to ensure that the total predicted leakage from the hot leg side of the tubesheet was no more than [ ],[a,c,e] assuming that all tubes in-service were severed at the C* length. For the Waterford 3 plant the number of tubes in service was conservatively taken to be 9,300 tubes. On a per tube basis, this translates to a leak rate of [ ][a,c,e] The primary to secondary leakage rate assumed in the current accident analyses for Waterford 3 is 0.375 gpm/SG (Reference 3). The leak rate criterion/tube can be used to predict the total leakage from the hot leg side of the tubesheet for a given SG based on the number of tubes in service.

Proprietary information in this document is bracketed and annotated by superscripts. The superscripts are defined in the Westinghouse proprietary information affidavit that will accompany this document.

1.2 SUMMARY

The responses presented in this document:

- Determine a new inspection depth to support the leak rate criterion of [ ].[a,c,e] This revised inspection depth uses the "first slip" rather than the "maximum load" pullout data.
- Clarify the use of pull out data.

- Clarify the use of leakage data.

The response to NRC staff RAI #5 (Reference 2) results in a change in the recommended inspection depth from 10.4 inches to 10.6 inches below the top of tubesheet or bottom of the expansion transition as appropriate for the Waterford 3 steam generators. The following 3 tables (the Executive Summary Table; Table 2-1; and Table 6-15) of WCAP-16208-P, Revision 1 are thus amended as follows:

Executive Summary Table

Plant	Leak Rate Based Inspection Length Corrected for Dilation and NDE (in.)
CD (Waterford 3)	10.4⇒ 10.6

Table 2-1: Leakage Based Inspection Length Including Tubesheet Deflection and NDE Corrections

Plant	Leak Rate Based Inspection Length Adjusted for TS Dilation (inches)	Leak Rate Based Inspection Length Adjusted for TS Dilation and NDE (inches)
CD (Waterford 3)	10.1 ⇒ 10.3	10.4 ⇒ 10.6

Table 6-15: Inspection Length Based on Leakage

Plant	Burst Based Inspection Length Corrected for Dilation and NDE (in.)	Uncorrected Joint Length that Meets Leakage Criteria (inches)	Interpolated Leak Rate Based Inspection Length Corrected for Dilation (in.)	Leak Rate Based Inspection Length Corrected for Dilation and NDE (in.)
CD (Waterford 3)	2.6	6.57	10.1⇒ 10.3	10.4⇒ 10.6

1.3 QUALITY ASSURANCE

The work that is presented in this document was completed and reviewed under the requirements of the Westinghouse Quality Assurance Program (Reference 4).

2.0 RESPONSES TO REQUESTS FOR ADDITIONAL INFORMATION

2.1 RAI #5

Please clarify whether the load at first slip was reported and plotted in Figures 5-1 through 5-3 of WCAP-16208-P, Revision 1, or whether the maximum load was plotted. If the load at first slip was not used in all cases, please discuss the effect on the required inspection distance if the load at first slip was used. In addition, if the load at first slip was not used in Table 6-8 of WCAP-16208-P, Revision 1 ("Burst Based Inspection Length"), please provide Table 6-8 values to confirm that the 10.4-inch proposed inspection distance is still bounded when the most limiting specimen is evaluated using load at first slip.

2.1.1 Response to RAI # 5

The data that is plotted in Figures 5-1 through 5-3 of WCAP-16208-P is based on the 'maximum load' encountered during each pullout test. The leakage-limited inspection depth provided in WCAP-16208-P, Revision 1 uses the pullout force to assess the contact pressure of the joint, which in turn is used to provide a tubesheet hole dilation adjustment to the depth at which the leak rate criteria is met. In response to the NRC staff RAI, the more conservative 'first slip' criterion was applied in place of the maximum load as the relevant pullout force for the tubesheet contact force adjustment.

The rough bore pullout data provided in Table 5-2 of WCAP-16208-P, Revision 1 was obtained directly from Tables 4-2 and 4-3 of Reference 5 (WCAP-15720). Re-examination of the Table 4-2 data showed that only those tests in which a leak test was performed were included in the table (compare with Reference 5, Table 3-3). Reference 5, Appendix D lists all the Boston Edison samples that were pullout tested.

In the response to this RAI, in addition to the use of the first slip, two other minor adjustments have been made in the plotting of pullout force data: 1. All of the Boston Edison pullout tests are considered, not just those that were leak tested as was the case in the previous work. 2. The actual measured joint lengths were used where in some cases in the previous work nominal lengths were used.

The Boston Edison steam generator pullout tests, as well as the Reference 5 Sample 20 and 21 collar samples, were performed with the load cell test rig shown in Reference 5, Figure 3.11. This rig was attached to the tube by means of a gripper. [

] a,c,e

Reference 6 (Braidwood) uses a definition that [

] a,c,e

The pullout tests conducted in Windsor used fittings that were welded to the sample. These fittings had threaded ends that fit into threaded receptacles on the tensile tester. Therefore, no

gripper slippage needed to be assumed or accounted for in the tests conducted at the Windsor facilities.

Table 1 provides all of the room temperature, ambient pressure pullout data from Reference 5, using the 'first slip' criteria. In all cases, 'first slip' forces were less than 'maximum load' forces. Four of the samples exceeded the yield strength of the tubing material at the 'first slip' point. Another three samples exceeded the yield strength of the tubing material before the 'first slip' point had been reached, but was below the yield strength of the tubing at the 'first slip' point.

Figure 1 presents a plot of the Table 1 data. Data that had exceeded the yield strength of the tube is plotted separately and was not included in the regression analysis. The lower 95% prediction bound is also included.

Table 2 presents the revised WCAP-16208-P, Revision 1, Table 6-9 to account for the Figure 1 lower bound.

The 'Uncorrected Joint Length that meets the leakage criteria' value of [

][a,c,e]) interpolates to a dilation-corrected inspection length of 10.3 inches. After correcting this value for NDE error, the inspection depth increases by 0.3 inch to 10.6 inches after the use of 'first slip' pullout data.

The responses to these RAIs do not change the conclusion provided in Section 6.3 of WCAP-16208-P, Revision 1, that the leak-based inspection lengths bound the burst-based inspection lengths.

2.2 RAI #7

In WCAP-16208-P, Revision 1, it is not clear whether all of the available data were used to support the analytical adjustment to account for the axial load resistance provided by internal pressure. For example, specimens 8 and 12 from the Task 1154 program were run at room temperature with internal pressure; however, an analysis of this data (similar to what was done for the elevated temperature data point) was not provided. Please evaluate all data in which internal pressure (above ambient pressure) was applied to support the basis for the analytical adjustments to account for the internal pressure. With respect to the analysis of the pressure effects provided in your response, please provide additional details on how the axial force resistance due to the internal pressure of 1435 pounds per square inch was calculated and discuss how the effect of the residual contact pressure was taken into account in your analysis. (The actual pullout force was nearly the same as the pullout resistance expected analytically from the internal pressure effects. As a result, if the residual contact pressure was not included in this assessment, it would appear that the analytical adjustments for internal pressure are too high).

This RAI is divided into parts A, B, and C for clarity of discussion.

A: For example, specimens 8 and 12 from the Task 1154 program were run at room temperature with internal pressure; however, an analysis of this data (similar to what was done for the elevated temperature data point) was not provided.

B: Please evaluate all data in which internal pressure (above ambient pressure) was applied to support the basis for the analytical adjustments to account for the internal pressure.

C: With respect to the analysis of the pressure effects provided in your response, please provide additional details on how the axial force resistance due to the internal pressure of 1435 pounds per square inch was calculated and discuss how the effect of the residual contact pressure was taken into account in your analysis. (The actual pullout force was nearly the same as the pullout resistance expected analytically from the internal pressure effects. As a result, if the residual contact pressure was not included in this assessment, it would appear that the analytical adjustments for internal pressure are too high).

2.2.1 Response to RAI #7 Part A

Specimens 8 and 12 from the Task 1154 program were both tested at room temperature and an internal pressure of 2575 psi. The load test results for specimens 8 and 12 were both in excess of the tube yield strength. Neither specimen was used in any analyses reported in WCAP-16208-P, Revision 1 because the load during the pullout test exceeded the tube yield. When the pull force exceeds the yield strength of the tube the data reflects the tube strength and not the joint strength. The data is then independent of the joint length and does not add meaningful or useful information.

2.2.2 Background for Responses to RAI #7, Parts B and C

The net contact pressure, P_C, between the tube and the tubesheet during operation or accident conditions is given by,

$$P_C = P_0 + P_P + P_T - P_B \qquad (1)$$

where P_B is the loss of contact pressure due to dilation of the tubesheet holes, P_0 is the installation preload, P_P is the pressure induced load, and P_T is the thermal induced contact load.

In the case of the laboratory samples tested at room temperature, both P_T and P_B are zero.

The pullout force that is attributable to any of these components, F_x of contact pressure is calculated by multiplying the applicable contact pressure, P_x, by the contact area, A, and the coefficient of friction, μ:

$$F_x = P_x A \mu \qquad (2)$$

When the inside of the tube is pressurized, P, some of the pressure is absorbed by the deformation of the tube within the tubesheet and some of the pressure is transmitted to the OD of

the tube, P_P, as a contact pressure with the ID of the tubesheet:

$$P_P = P\xi \tag{3}$$

In this equation, ξ is the transmittance factor. The magnitude of the transmittance factor is found by considering the relative flexibilities of the tube and the tubesheet. The following discussion of flexibilities was obtained from Reference 7.

Flexibility, f, is defined as the ratio of deflection relative to applied force. It is the inverse of stiffness that is commonly used to relate force to deformation. There are three flexibility terms associated with the radial deformation of a cylindrical member depending on the surface to which the loading is applied and the surface for which the deformation is being calculated (e.g., for transmitted internal pressure one is interested in the radial deformation of the OD of the tube and the ID of the tubesheet). The deformation of the OD of the tube in response to the external pressure provided by the contact pressure is also of interest. These flexibility terms are derived from equations for radial displacement in thick-walled cylinders (Reference 8).

The flexibility of the tubesheet, designated herein by the subscript c, in response to an internal pressure, P_{ci}, is found as,

a,c,e

[ ] Tubesheet (4)

where,

r_{ci} = inside radius of the tubesheet and outside radius of the tube,
r_{co} = outside radius of the tubesheet hole unit cell,
E_c = the elastic modulus of the carbon steel tubesheet material, and
ν = Poisson's ratio for the tubesheet material.

Here, the subscripts on the flexibility stand for the component, c for tubesheet (and later t of tube), the surface being considered, i for inside or o for outside, and the surface being loaded, again, i for inside and o for outside.

The flexibility of the tube in response to the application of an external pressure, P_{to}, e.g., the contact pressure within the tubesheet, is,

a,c,e

[ ] Tube (5)

where E_t is the elastic modulus of the tube material. Poisson's ratio is the same for the tube and the tubesheet.

Finally, the flexibility of the outside radius of the tube in response to an internal pressure, P_{ti}, is,

a,c,e

[ ] Tube (6)

where r_{ti} is the internal radius of the tube.

The transmittance factor in equation (3) is found by:

a,c,e

[ ] (7)

The denominator of the fraction is also referred to as the interaction coefficient between the tube and the tubesheet. The contact pressure does not increase by as much as the amount of internal pressure that is transmitted through the tube alone, because the tubesheet acts as a spring and the interface moves radially outward in response to the increase in pressure.

2.2.3 Response to RAI #7, Part B

There are three cases reported in WCAP-16208-P, Revision 1, Table 5-1, of tube movement during testing with pressure applied inside the tube. All pullout screening tests were conducted with internal pressure. Only Sample 3, with a 2 inch joint length, and Sample 4, with a three inch joint length, experienced tube displacement during a pullout screening test. The tube blowout (another form of tube displacement) of Sample 1, with a joint length of 1 inch, occurred during room temperature leak testing. Samples 1, 3 and 4, like all of the samples documented in WCAP-16208-P, Revision 1, were explosively expanded into the tubesheet mock-up.

The blowout of Sample 1 was an unintended (but was considered possible and was thus monitored) consequence of a room temperature leak test. Figure 2 presents a plot of the internal pressure versus a relative time scale. Prior to the blowout, Sample 1 held an average pressure of [

] a,c,e

Sample 1 used 48 mil wall tubing. Using the nominal dimensions of the tubesheet collar, the calculated values for the flexibility terms in equations (4), (5) and (6) are:

[

] a,c,e

2.2.4 Response to RAI #7, Part C

The Task 1154 dataset in WCAP-16208-P, Revision 1: Figures 5-1 through 5-3 were plotted to determine the incremental contact force for use in determining loads for various joint lengths. The additional data from tests conducted in the work reported in Reference 1 (Samples 1, 3 and 4) tested the internal pressure effect on a confirmatory basis. That is, the data were not intended to be quantitative but to confirm the previous testing. A more conservative "first move" criterion was used to reinforce the conservatism. The Reference 5 data used a "Maximum Load" criterion. The sample 1, 3, and 4 test results were not used in the regression analysis developed in WCAP-16208. Nevertheless, RAI #7 seeks to assess relevant information from these tests rather than a simple pass/fail value. To provide a thorough explanation, a review of the pullout screening test data is presented here.

The purpose of the pullout screening tests was to demonstrate that a given joint could withstand a 3NODP load without movement (see Section 5.0 of Reference 1). [

] a,c,e

The "First Slip" criteria, provided in the response to RAI #5 (see Page 2-1), is appropriate for the determination of contact pressure. [

] a,c,e

Table 5-1 of WCAP-16208-P, Revision 1 provides the "Axial Force from Internal Pressure". For Sample 1, this is based on the blowout pressure of [ ]. a,c,e For Samples 3 and 4, the values provided in Table 5-1 of WCAP-16208-P, Revision 1 are based on the nominal internal NODP pressure of [ ] a,c,e Figure 3 and Figure 4 show that the actual internal pressures were slightly less than nominal. Load and actual internal pressures, as well as the calculated values for Axial Force from Internal Pressure (using the [ ] a,c,e value from equation 8) and the Pullout Force (the sum of the External Applied Load and the Axial Force from Internal Pressure) are provided in Table 3.

Using the actual internal pressure and "First Slip" load, rather than the nominal internal pressure of [ ] a,c,e and "First Move" load, is appropriate for the evaluation of analytical adjustments to account for the internal pressure.

The Sample 3 Pullout Screening test had an internal pressure of [
] a,c,e The external load was applied after the internal pressure was applied, without movement.

Sample 3 used 42 mil wall tubing. Using the nominal dimensions of the tubesheet collar, the calculated values for the flexibility terms in equations (4), (5) and (6) are:

[

] a,c,e

Adjusting the data in Figure 5-1 through 5-3 for the "First Slip" criterion rather than the "Maximum Load" criterion that was used, would only lower the regression and lower bound curves, thus the evaluations provided above would remain valid.

2.3 RAI #8

It is the NRC staff's understanding that not all data was included in Appendix B of WCAP-16208-P, Revision 1(i.e., some data was not included since it was well outside the targeted temperatures and pressures). It is also the staff's understanding that some data in Appendix B was not included in Table 4-1[Table 4-2] of WCAP-16208-P, Revision 1 (which was used in determining the leak rate as a function of joint length). Please confirm the staff's understanding and discuss the basis for not including all of the Appendix B data in Table 4-1[Table 4-2]. For example, was data from Appendix B not included in Table 4-1[Table 4-2]when steady state was never reached although the temperatures and pressures were within the desired range?

2.3.1 Response to RAI #8

The NRC staff understanding is correct that not all elevated temperature test data was included in WCAP-16208-P, Revision 1, Appendix B. WCAP-16208-P, Revision 1, Appendix D lists about 7 tests, of the almost 40 elevated temperature tests conducted, that did not meet the test criteria. Of the test data in Appendix B, representative sets of data were selected and tabulated in Table 4-2 based on the notes in Table 4-2.

Section 4.4 of WCAP-16208-P, Revision 1 discusses Table 4-2. Section 4.4 states the following: "The data in Appendix B were reviewed to identify those data that had reached steady, or established, values under SLB conditions. Table 4-2 provides a summary of all the established elevated temperature leak rate values. The data in this table consists of valid leak rates that have demonstrated some degree of an established or steady value. A valid leak rate was obtained from a test in which [

] a,c,e Appendix D provides a list of test data that were determined not to be valid."

In addition, there are a set of notes on the page following Table 4-2 (see page 4-17 of WCAP-16208-P, Revision 1) that describes the basis for selecting the data in Table 4-2.

[

] a,c,e However, the established leak rates in Table 4-2 are only for those tests conducted at SLB pressure and 600°F.

- Leak rate data obtained from tests conducted at conditions other than the target pressure differential of 2560 psi and the target temperature of 600°F, was not included in Table 4-2 of Reference 1.

- The remaining leak rate data (all taken at 2560 psi, 600°F) was considered on a test set by test set basis to determine if an established or steady value was reached. Justification for each data point in Table 4-2 is provided on page 4-17 of WCAP-16208-P, Revision 1. Thus, the remaining leak rate data in Appendix B was considered in determining the established leak rate, for each unique set of tests.

Table 1: Rough Bore 'First Slip' Pullout Test Data

(Room Temperature, Ambient Internal Pressure)

Tube ID	Test Lab	As-Built Engaged Length(in.)	0.25" First Slip Load(lbf) (adj for grip slip)	Note

a,b,c

Table 2: WCAP-16208-P, Rev. 1, Table 6-9: Effect of Tubesheet Deflection for Waterford 3 Steam Generators: Revised for Use of First Slip Loads

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

a,b,c

Table 3: Loads and Forces at First Move, First Slip and Maximum Load

a,b,c

Criteria		Sample 1	Sample 3	Sample 4

a,c,e

Figure 1: First Slip Pullout Force for 48 mil Wall Rough Bore Tests

a,b,c

Figure 2: Sample 1 Blowout During Room Temperature Leak Test (1-Inch Joint Length)

a,b,c

Figure 3: Sample 3 Pullout Screening Test (2-Inch Joint Length)

a,b,c

[ ]

Figure 4: Sample 4 Pullout Screening Test (3-Inch Joint Length)

3.0 REFERENCES

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

2. NRC Letter form N. Kalyanam, NRC to J. E. Venable, Entergy Operations "Waterford Steam Electric Station, Unit 3 (Waterford 3)- Request for Additional Information Related to Proposed Technical Specification Change Regarding Tube Sheet Inspection Depth for Steam Generator Tube Inspections (TAC No. MC6421), October 2005.

3. Entergy Operations, Inc Letter W3F1-2005-0009, "License Amendment Request Proposed Technical Specification Change Regarding Tubesheet Inspection Depth for Steam Generator Tube Inspections Waterford Steam Electric Station, Unit 3", March 15, 2005

4. "Nuclear Services Policies & Procedures," Westinghouse Quality Management System - Level 2 Policies and Procedures, Effective 03/31/04.

5. Westinghouse Report WCAP-15720, Revision 0, "NDE Inspection Strategy for Tubesheet Regions in CE Designed Units," CEOG Task 1154, July 2001.

6. "Braidwood Station, Units 1 and 2 – Issuance of Exigent Amendments RE: Revision of Scope of Steam Generator Inspections for Unit 2 Refueling Outage 11 (TAC NOS. MC6686 and MC6687)," NRC Letter from G.F. Dick to C.M. Crane (Excelon), April 25, 2005.

7. Westinghouse Report LTR-CDME-05-180, Revision 2, "Steam Generator Tube Alternate Repair Criteria for the Portion of the Tube within the Tubesheet at Catawba 2," December 2005.

8. W. C. Young and R. G. Budynas, "Roark's Formulas for Stress and Strain," Seventh Edition, Mc-Graw-Hill, New York, New York, 2002.

Attachment 4
To
W3F1-2006-0008

Westinghouse Affidavit Regarding Proprietary Information

Westinghouse

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Our ref: CAW-06-2118

March 21, 2006

APPLICATION FOR WITHHOLDING PROPRIETARY
INFORMATION FROM PUBLIC DISCLOSURE

Subject: Responses to NRC Requests for Additional Information on WCAP-16208-P, Rev. 1, "NDE Inspection Length for CE Steam Generator Tubesheet Region Explosive Expansions," for Waterford Steam Electric Station Unit 3 (Proprietary)

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-06-2118 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying affidavit by Entergy Operations, Inc.

Correspondence with respect to the proprietary aspects of the application for withholding or the Westinghouse affidavit should reference this letter, CAW-06-2118 and should be addressed to the undersigned.

Very truly yours,

for B. F. Maurer, Acting Manager
Regulatory Compliance and Plant Licensing

Enclosures

cc: G. S. Shukla (NRC)

CAW-06-2118

bcc: B. F. Maurer (ECE 4-7A) 1L, 1A
R. Bastien, 1L, 1A (Nivelles, Belgium)
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CAW-06-2118

AFFIDAVIT

STAE OF CONNECTICUT:

ss

COUNTY OF HARTFORD:

Before me, the undersigned authority, personally appeared I. C. Rickard, 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:

I. C. Rickard, Licensing Project Manager
Systems and Safety Analysis, Nuclear Services
Westinghouse Electric Company, LLC

Sworn to and subscribed
before me this 21st day
of March, 2006

Notary Public

My Commission Expires
May 31, 2008

(1) I am Licensing Project Manager, Systems and Safety Analysis, 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 the Westinghouse Electric Company LLC.

(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 accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by the Westinghouse Electric Company LLC 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 constitutes Westinghouse policy and provides 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 "Responses to NRC Requests for Additional Information on WCAP-16208-P, Rev. 1, 'NDE Inspection Length for CE Steam Generator Tubesheet Region Explosive Expansions,' for Waterford Steam Electric Station Unit 3" (Proprietary) being transmitted by Entergy Operations, Inc. letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted for use by Westinghouse Electric Company LLC for Waterford Steam Electric Station Unit 3 enables Westinghouse to support utilities in identifying and applying a steam generator tubesheet inspection model and, in particular, to determining the tubesheet inspection length appropriate for the Waterford Unit 3 steam generators, including:

(a) The identification of important factors relevant to determining the recommended steam generator tubesheet inspection length, and

(b) Development of a generic methodology for applying the inspection length model to utilities with NSSS plants.

Further, this information has substantial commercial value as follows:

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

(b) Westinghouse can sell support and defense of the inspection model.

(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 inspection models and licensing defense services for commercial power reactors without incurring 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

Attachment 5
To
W3F1-2006-0008

Revised Markup of Corrected
TS Pages for Reference 1

4.4.4.4 Acceptance Criteria

a. As used in this Specification

1. Tubing or tube means that portion of the tube or sleeve which forms the primary system to secondary system pressure boundary.

2. Imperfection means an exception to the dimensions, finish or contour of a tube from that required by fabrication drawings or specifications. Eddy-current testing indications below 20% of the nominal tube wall thickness, if detectable, may be considered as imperfections.

3. Degradation means a service-induced cracking, wastage, wear, or general corrosion occurring on either inside or outside of a tube.

4. Degraded Tube means a tube containing imperfections greater than or equal to 20% of the nominal wall thickness caused by degradation.

5. % Degradation means the percentage of the tube wall thickness affected or removed by degradation.

6. Defect means an imperfection of such severity that it exceeds the plugging or repair limit. A tube containing a defect is defective.

7. Plugging or Repair Limit means the imperfection depth at or beyond which the tube shall be removed from service by plugging or repaired by sleeving because it may become unserviceable prior to the next inspection and is equal to 40% of the nominal tube wall thickness.

INSERT 1

8. Unserviceable describes the condition of a tube if it leaks or contains a defect large enough to affect its structural integrity in the event of an Operating Basis Earthquake, a loss-of-coolant accident, or a steam line or feedwater line break as specified in 4.4.4.3c., above.

9. Tube Inspection means an inspection of the steam generator tube from ~~the point of entry (hot leg side) completely around the U-bend to the top support of the cold leg~~.

INSERT 2

10. Preservice Inspection means an inspection of the full length of each tube in each steam generator performed by eddy current techniques prior to service to establish a baseline condition of the tubing. This inspection was performed prior to field hydrostatic test and prior to initial POWER OPERATION using the equipment and techniques expected to be used during subsequent inservice inspections.

Insert 1

This Plugging or Repair Limit is not applicable in the portion of the tube that is greater than 10.6 inches below the bottom of the expansion transition or top of the tubesheet, whichever is lower, to the tube end. Degradation detected between 10.6 inches below the bottom of the expansion transition or top of the tubesheet, whichever is lower, and the bottom of the expansion transition or top of the tubesheet, whichever is higher, shall be plugged on detection.

Insert 2

10.6 inches below the bottom of the hot leg expansion transition or top of the tubesheet, whichever is lower, completely around the U-bend to the top support of the cold leg.

Attachment 6
To
W3F1-2006-0008

Revised Markup of Corrected
TS Pages for References 2 and 3

Insert 7 (New SG Program)

6.5.9, STEAM GENERATOR (SG) PROGRAM

A Steam Generator Program shall be established and implemented to ensure that SG tube integrity is maintained. In addition, the Steam Generator Program shall include the following provisions:

a. Provisions for condition monitoring assessments. Condition monitoring assessment means an evaluation of the "as found" condition of the tubing with respect to the performance criteria for structural integrity and accident induced leakage. The "as found" condition refers to the condition of the tubing during an SG inspection outage, as determined from the inservice inspection results or by other means, prior to the plugging or repair of tubes. Condition monitoring assessments shall be conducted during each outage during which the SG tubes are inspected, plugged, or repaired to confirm that the performance criteria are being met.

b. Performance criteria for SG tube integrity. SG tube integrity shall be maintained by meeting the performance criteria for tube structural integrity, accident induced leakage, and operational leakage.

    1. Structural integrity performance criterion: 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, 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. Primary to secondary leakage is not to exceed 540 gpd through any one SG.

    3. The operational leakage performance criterion is specified in LCO 3.4.5.2, "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 or repaired. Plugging or Repair is not applicable in the portion of the tube that is greater than 10.6 inches below the bottom of the expansion transition or top of the tubesheet, whichever is lower, to the tube end. Degradation detected between 10.6 inches below the bottom of the expansion transition or top of the tubesheet, whichever is lower, and the bottom of the expansion transition or top of the tubesheet, whichever is higher, shall be plugged on detection.

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, 10.6 inches below the bottom of the hot leg expansion transition or top of the tubesheet, whichever is lower, completely around the U-bend to the top support of the cold leg 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 and d.2 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% [percent] 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.

e. Provisions for monitoring operational primary to secondary leakage.

f. Provisions for SG tube repair methods. Steam generator tube repair methods shall provide the means to reestablish the RCS pressure boundary integrity of SG tubes without removing the tube from service. For the purposes of these Specifications, tube plugging is not a repair. The following tube repair method is applicable:

Defective tubes may be repaired in accordance with CENS Report CEN-605-P, "Waterford 3 Steam Generator Tube Repair Using Leak Tight Sleeves," Revision 00-P, dated December 1992.

Attachment 7
To
W3F1-2006-0008

List of Regulatory Commitments

List of Regulatory Commitments

The following table identifies those actions committed to by Entergy in this document. Any other statements in this submittal are provided for information purposes and are not considered to be regulatory commitments.

COMMITMENT	TYPE (Check one)		SCHEDULED COMPLETION DATE (If Required)
	ONE-TIME ACTION	CONT COMPL	
If sleeves are installed, Entergy plans to inspect inservice sleeves over their full length plus 5 inches beyond the sleeve-to-tube rolled joint in the tube sheet in accordance with the requirements of the EPRI Guidelines using appropriate examination methodology. The tube shall be plugged upon detection of any service induced imperfection, degradation or defect in the sleeve or pressure boundary portion of the original tube wall in the sleeve-to-tube rolled joint. Entergy will periodically inspect sleeves as a minimum in accordance with the existing TS requirements		X	**Conditional - Following sleeve installation**