MAR 18 2009

L-2009-023
10CFR50.12
10CFR50.60 (b)

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555-0001

Re: Florida Power and Light Company
Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251

Update to NRC Reactor Vessel Integrity Database and
Exemption Request for Alternate Material Properties Bases
Per 10 CFR 50.12 and 10 CFR 50.60 (b)

Florida Power & Light has prepared an update to the NRC's Reactor Vessel Integrity Database to document the results of the most recent 10 CFR 50.61 Pressurized Thermal Shock (PTS) screening calculations and Nil Ductility Transition Reference Temperature (RT_{NDT}) values. The calculations utilize revised initial (unirradiated) RT_{NDT} values for Linde 80 weld materials based on Topical Report BAW-2308, Revisions 1-A and 2-A. The calculations assume fluence values applicable to the current 60-year license period that account for the previous (multiple cycle) use of PTS Absorbers in Turkey Point Units 3 and 4 as well as the projected fluence levels after the planned removal of the PTS Absorbers from Turkey Point Units 3 and 4 in 2009. 10 CFR 50.61 PTS screening criteria continue to be met for all Turkey Point Units 3 and 4 reactor vessel materials. The existing Reactor Coolant System (RCS) Pressure/Temperature (P/T) operating limits, Low Temperature Overpressure Protection System (LTOPS) setpoints, and LTOPS enabling temperature presently in the Turkey Point Units 3 and 4 Technical Specifications continue to be valid and conservative through their period of applicability (32 EFPY for Turkey Point Units 3 and 4).

Also, pursuant to 10 CFR 50.12 and 10 CFR 50.60(b), Florida Power & Light requests an exemption from the requirements of 10 CFR 50.61 and 10 CFR 50 Appendix G to revise certain Turkey Point reactor pressure vessel material initial (unirradiated) properties using Framatome ANP Topical Report BAW-2308, Revisions 1-A and 2-A. The Topical Report BAW-2308 Revision 2-A provides revised initial (unirradiated) reference temperatures for the Linde 80 weld materials present in the reactor pressure vessels of Turkey Point Units 3 and 4 and was approved by the NRC on March 24, 2008.

On July 29, 2008, Florida Power & Light participated in a teleconference with the NRC Materials Branch staff to discuss Florida Power & Light's pending exemption request and aspects of the NRC's review of Topical Report BAW-2308, Revisions 1-A and 2-A. Regarding the timing of the exemption request review, the NRC staff cited 10 CFR 50.61 (b)(3) and provided an interpretation that could be used to allow making significant core design changes while the exemption request was being reviewed by the

A001
NRR

NRC. The attached exemption request is submitted based on the interpretation that the schedule for implementing flux suppression measures can take into account the timing of the submittal, NRC review and approval of calculations that apply new analysis techniques. The Turkey Point core design changes related to Hafnium absorber removal are being made with the realistic expectation of obtaining NRC staff approval. This interpretation is reasonable, since the relevant effects of these changes on reactor vessel integrity are very long-term in nature, thus providing sufficient time for the necessary regulatory interactions. Furthermore, the NRC has already approved the new analysis techniques described in Topical Report BAW-2308, Revisions 1-A and 2-A. Additionally, the NRC has approved the exemption request by Surry which is in the same format presented in Attachments 1 and 2.

A discussion of the proposed changes to the reactor vessel materials evaluations for Turkey Point is provided in Attachment 1, and the request for exemption is included in Attachment 2. An update to the NRC Reactor Vessel Integrity Database (RVID) for Turkey Point is included as Attachment 3.

If you have any questions or require additional information regarding this submittal, please contact Robert Tomonto at 305-246-7327.

Very truly yours,

William Jefferson, Jr.
Vice President
Turkey Point Nuclear Plant

Attachments: 1. Proposed Changes to Reactor Vessel Materials Evaluations
2. Request for Exemption
3. Reactor Vessel Integrity Database Update

Cc: USNRC Project Manager, Turkey Point
USNRC Regional Administrator, Region II
USNRC Senior Resident Inspector, Turkey Point

Commitment Made in this Letter

1. Sections of the Turkey Point Units 3 and 4 Updated Final Safety Analysis Report (UFSAR) will be revised to reflect implementation of the revised design basis analyses described herein. Following NRC approval of the exemption request associated with this submittal, a UFSAR revision will be made in accordance with the requirements of 10 CFR 50.71(e).

Attachment 1

Proposed Changes to Reactor Vessel Materials Evaluations

1.0 Introduction

An update to the NRC's Reactor Vessel Integrity Database (RVID) has been prepared to document the results of Florida Power & Light's most recent 10 CFR 50.61 Pressurized Thermal Shock (PTS) screening calculations and Nil Ductility Transition Reference Temperature (RT_{NDT}) values for Turkey Point Units 3 and 4. The calculations utilize revised initial (unirradiated) RT_{NDT} values for Linde 80 weld materials based on Framatome ANP Topical Report BAW-2308, Revision 2-A, "Initial RT_{NDT} of Linde 80 Weld Materials".[1] The NRC approved Topical Report BAW-2308, Revision 2 in March 2008.[2] The RT_{NDT} calculations assume fluence values applicable to the current 60-year license period that account for the previous (multiple cycles) use of PTS Absorbers and the projected fluence levels after a planned permanent removal of the PTS Absorbers. Use of Topical Report BAW-2308, Revisions 1-A and 2-A noticeably reduces the projected end of life RT_{NDT}. A description of the PTS Absorber program is provided in Section 2.2.

An NRC letter to Florida Power & Light dated March 11, 1987 states that the PTS Rule "requires that the projected assessment of the RT_{PTS} must be updated whenever changes in core loadings, surveillance measurements or other information indicate a significant change in the projected values".[3] The permanent removal of the PTS Absorbers from Turkey Point Units 3 and 4 is considered a change in core loading which could result in a significant change in the projected RT_{PTS} values if no other changes are made.

10 CFR 50.61 PTS screening criteria continue to be met for all Turkey Point Units 3 and 4 reactor vessel materials. The existing RCS P-T limits, Low Temperature Overpressure Protection System (LTOPS) set points, and LTOPS enabling temperature presently in the Technical Specifications continue to be valid and conservative through their period of applicability (i.e., 32 effective full power years (EFPY)).

The use of Topical Report BAW-2308, Revision 2-A requires the submittal of an exemption request pursuant to 10 CFR 50.12 and 10 CFR 50.60(b) from the requirements of 10 CFR 50.61 and 10 CFR 50 Appendix G because it involves a change in the methodology of how the initial material properties are acquired. An exemption request for Turkey Point Units 3 and 4 is provided in Attachment 2. The plan to permanently remove the PTS Absorbers in Turkey Point Units 3 and 4 does not require the submittal of an exemption; it does require an update of the projected assessment of the RT_{PTS} because the removal of PTS Absorbers from Turkey Point Units 3 and 4 is considered to be a significant change in core loadings. The results of the updated projected RT_{PTS} values, ¼-T ART (Adjusted Reference Temperature) values and ¾-T ART values for Turkey Point Units 3 & 4 are provided in Attachment 3.

Florida Power & Light made a courtesy notification to the NRC via telecom on July 29, 2008 regarding intentions of permanently removing the PTS Absorbers from the Turkey Point Units 3 and 4 cores during their respective 2009 refueling outages. Although removal of the PTS Absorbers from Turkey Point Units 3 and 4 is planned for 2009,

removal of the PTS Absorbers for 3 cycles will not create a significant change in the projected end of life RT_{PTS} values. Additionally, PTS absorbers could once again be integrated into the Unit 3 and 4 reactor cores at the end of any cycle to ensure that the projected PTS screening criteria are not violated assuming the requirements of 10 CFR 50.61 and 10 CFR 50 Appendix G. The temporary removal of the PTS absorbers will be addressed in accordance with 10 CFR 50.59 and is not anticipated to require NRC approval or licensing actions.

2.0 Background

2.1 Integrated Surveillance Program

Turkey Point Units 3 and 4 reactor vessels are essentially identical for the purposes of the P-T limit curves and LTOP set points. Babcock and Wilcox (B&W) fabricated the Turkey Point Units 3 and 4 reactor vessels using ring forgings joined by submerged arc welds. Therefore, each vessel has only one beltline circumferential weld in the core mid-plane region. This weld is designated SA-1101 and was fabricated from Page weld wire heat number 71249 for both reactor vessels. Both units have the exact same limiting material circumferential beltline weld.[4] The method used to determine the most limiting material for both units is based on the material properties and projected cumulative fluence. These similarities resulted in developing one set of Pressure-Temperature (P-T) curves applicable for use on both units. Both Turkey Point Units 3 and 4 pressure-temperature limits have been evaluated for operation up to 32 EFPY. Units 3 and 4 are very similar in terms of design, operating hours and fluence. This case has been made in FPL letter L-85-66 to the NRC, the submittal for an integrated surveillance program[5] and the SER for an integrated surveillance program[6] in 1985. The integrated surveillance program for Turkey Point Units 3 and 4 is still valid as no significant changes have been made to cause Units 3 and 4 to become dissimilar. In addition, Units 3 and 4 have similar fuel loading patterns and they are within approximately ½ effective full power years of each other. Calculations assume that data from Units 3 and 4 are interchangeable.

2.2 PTS Absorbers

Beginning with Cycles 9 and 10 of Turkey Point Units 3 and 4, respectively, burnable absorber rods were placed into peripheral fuel assembly locations to reduce the neutron fluence at the limiting reactor pressure vessel (RPV) weld locations. The rods were changed to Hafnium absorber rods beginning with Cycles 10 and 11 of Turkey Point Units 3 and 4, respectively.[7,8] The Hafnium, or PTS Absorbers were implemented to ensure that the limiting beltline weld materials would continue to meet the applicable PTS screening criteria provided in 10 CFR 50.61. The NRC was notified of Florida Power & Light's plan to use PTS Absorbers in Turkey Point Units 3 and 4 in a letter dated March 25, 1983.[9]

The PTS Absorbers have a design lifetime of 10.5 EFPY and have already been replaced once. The replacement PTS Absorbers are qualified to remain in the Turkey

Point Unit 3 and 4 cores through the end of Cycle 24 for both units, at which time they would require replacement. Florida Power & Light has elected to remove the PTS Absorbers at the end of Cycle 23 for Turkey Point Unit 3 and end of Cycle 24 for Turkey Point Unit 4. The Turkey Point Unit 3 Cycle 24 core, which will begin operation in the spring of 2009, will not contain PTS Absorbers. Similarly, the Turkey Point Unit 4 Cycle 25 core, which will begin operation in the fall of 2009, will not contain PTS Absorbers. The removal of PTS Absorbers will preclude the need to procure at least three more sets of PTS Absorbers during the remaining life of each plant (including planned uprate), which will reduce lifetime radioactive waste. Also, PTS Absorber removal will reduce fuel handling requirements during refueling outages and disposal operations, thereby resulting in dose reductions.

The removal of PTS Absorbers from Turkey Point Units 3 and 4 will result in increased fast neutron fluence on reactor pressure vessel beltline materials, as discussed in Section 3.0 below.

2.3 Previously Reported RPV Fluence Projections

The Reactor Vessel Integrity Database (RVID) documents the last materials update for Turkey Point Units 3 and 4 as being in the year 2000. However, the most recent update to the Turkey Point Units 3 and 4 limiting vessel material fluence was provided to the NRC via Florida Power & Light letter dated April 1, 2006.[10] The reported end of life (EOL) vessel fluence value at the limiting weld was projected to be 3.93×10^{19} n/cm^2. EOL for Units 3 and 4 is at 60 years (approximated at 48 EFPY) based on the renewed license expiration dates of 2032 and 2033, respectively.

3.0 Proposed Changes to Previously Reported Values

3.1 New RPV Fluence Projections

New RPV fluence projections have been calculated with current data and consideration for the removal of the PTS absorbers during the Units 3 and 4 respective 2009 refueling outages. The starting point for this calculation was the Unit 3 Surveillance Capsule X analysis, which reported the most recent measured fluence[11] at the limiting material weld, 2.10×10^{19} n/cm^2 at 19.85 EFPY. This EFPY was at the end of cycle (EOC) 18 (9/29/2001). Calculations for Unit 3 were prepared from EOC 18 to the 2009 scheduled refueling outage using fluence projections[12] that considered the effect of the PTS absorbers. Calculations from 2009 through 32 and 48 EFPY were completed for Unit 3 using the fluence projections from the Surveillance Capsule X report, with no consideration of the effect of the PTS absorbers. The most recent fluence data from Unit 3 was utilized in all calculations. The fluence calculations from Unit 3 can be applied to Unit 4 due to the approved integrated surveillance program and similar operation, EFPY and fluence as discussed in section 2.1 of this document. Fluence projections were calculated for the intermediate and lower shell forgings, the intermediate to lower shell forging circumferential weld (limiting weld material) and the

upper shell forging and upper to intermediate shell forging circumferential weld. The values are reported in Attachment 3. The 60-year EOL (approximately 48 EFPY) vessel fluence at the limiting weld is now projected to be 5.17 x 10^{19} n/cm^2.

3.2 Linde 80 Weld Material Properties

Framatome ANP Topical Report BAW-2308, Revision 1-A[13] provides an alternate method for determining the unirradiated and adjusted RT_{NDT} for the Linde 80 weld materials present in the beltline region of the RPVs at Turkey Point Units 3 and 4. The NRC approved Topical Report BAW-2308, Revision 1 in August 2005.[14]

Framatome ANP Topical Report BAW-2308, Revision 2-A[1] provides revised initial (unirradiated) RT_{NDT} values and associated uncertainties for the materials used in the calculations. Revision 2-A used revised initial (unirradiated) RT_{NDT} values and was approved in March 2008.[2] Table 9 of Topical Report BAW-2308, Revision 2-A contains the revised initial reference temperature (IRT_{T0}) and initial margin (σ_I) values for Linde 80 weld materials that are approved by the NRC for the purpose of RPV material property determination. The approved values from Revision 2-A are shown below.

Table 3.1
NRC Staff-Accepted Initial RT_{T0} and σ_I Values for Linde 80 Weld Materials

Linde 80 Heat	Values Approved in BAW-2308, Rev. 1-A SER		With Proposed ASTM E1921 Loading Rate Adjustment	
	IRT_{To} (°F)	Initial Margin σ_I (°F)	IRT_{To} (°F)	Initial Margin σ_I (°F)
406L44	-94.9	11.0	-98.0	11.6
71249	-47.4	12.9	-53.5	12.8
72105	-32.7	11.8	-31.1	13.7
821T44	-80.2	9.3	-84.2	9.6
299L44	-81.8	11.6	-74.3[a]	12.8[a]
72442	-30.0	11.9	-33.2	12.2
72445	-72.5	12.3	-72.5	12.0
61782[b]	---	---	-58.5	15.4
Other Heats	-47.6	17.2	-48.6[a]	18.0[a]

[a] New Data Included
[b] New Heat

The following Linde 80 weld materials are contained in the Turkey Point Unit 3 reactor vessel: 71249 and 72442.

The following Linde 80 weld materials are contained in the Turkey Point Unit 4 reactor vessel: 71249, 72105 and 72442.

Note that for any Linde 80 material not specifically included in the table above, the inputs for "Other Heats (Generic Value)" are to be used.

3.3 Conditions and Limitations

Condition and Limitation (4) in the NRC's Safety Evaluation for Topical Report BAW-2308, Revision 1-A states the following:

> *"Any licensee who wants to utilize the methodology of TR BAW-2308, Revision 1 as outlined in items (1) through (3) above, must request an exemption, per 10 CFR 50.12, from the requirements of Appendix G to 10 CFR Part 50 and 10 CFR 50.61 to do so."*

In the above quotation, Condition and Limitation (1) pertains to NRC-accepted values of initial (unirradiated) reference temperature, IRT_{T0}, and the corresponding uncertainty term, σ_I, for Linde 80 weld materials. They are based on the Master Curve methodology using direct testing of fracture toughness in accordance with ASTM Standard Test Method E-1921 and ASME Code Case N-629. These values are provided in Table 3 of the NRC SER[14], and shown above in the first two data columns in Table 3.1.

Condition and Limitation (2) requires that a minimum chemistry factor of 167.0°F be applied when the methodology of RG 1.99, Revision 2, is used to assess the shift in initial properties due to irradiation.

Condition and Limitation (3) requires that a value of σ_Δ = 28.0°F be used in the determination of the margin term, as defined in Topical Report BAW-2308, Revision 1-A, and RG 1.99, Revision 2. As noted in the SER[14], the NRC staff has concluded that the use of σ_Δ = 28.0°F in conjunction with the IRT_{T0} and σ_I values based on Master Curve testing, and material property shifts based on the models in RG 1.99, Revision 2, with a minimum chemistry factor of 167°F, provides an acceptable basis for RPV Linde 80 weld assessment. The Conditions and Limitations specified in the SER[14] have been met for the 10 CFR 50.61 PTS assessment and Adjusted Reference Temperatures (ART) at $^1/_4$-T and $^3/_4$-T, for the Turkey Point Linde 80 weld materials addressed in this submittal. The $^1/_4$-T and $^3/_4$-T values show that the current Turkey Point Pressure-Temperature Limits and P-T Curves are still valid.

Topical Report BAW-2308, Revision 1-A, was published on August 4, 2005, with the NRC safety evaluation (SE) containing, among others, two NRC imposed conditions to reevaluate the conclusions of Revision 1-A, considering anticipated additional test data and using the most recent consensus approach in the American Society for Testing and Materials (ASTM) for reference temperature determination.

Topical Report BAW-2308, Revision 2 was submitted to comply with the two conditions of the SER for Topical Report BAW-2308, Revision 1-A. To satisfy the first condition specified in the SER, Revision 2 repeated the Topical Report BAW-2308, Revision 1-A analyses and recalculated the weld wire heat-specific IRT_{To} and σ_I values and the Linde 80 weld generic values considering new weld heat 61782 and weld heat 299L44 test data. To satisfy the second SER condition, Revision 2 used the proposed 2007 Edition of the ASTM Standard Test Method E 1921 (ASTM E 1921), "Standard Test Method for Determination of Reference Temperature, T_o, for Ferritic Steels in the Transition Range", in all relevant IRT_{To} and σ_I calculations. The recalculated IRT_{To} and σ_I values, along with those reported in Topical Report BAW-2308, Revision 1-A, were summarized for various heats of Linde 80 welds in Table 9 of Topical Report BAW-2308, Revision 2, and above in Table 3.1.

As indicated in Revision 2, the proposed 2007 Edition of ASTM E 1921 adopted a loading rate adjustment for T_o, which is different from that of Topical Report BAW-2308, Revision 1-A. Based on the summary results in Table 3.1 above, the Pressurized Water Reactor Owners Group (PWROG) concluded that when combining the σ_I values and the shift margin (σ_Δ) of 28° F with IRT_{To}, the approved IRT_{To} and σ_I values in Topical Report BAW-2308, Revision 1-A are conservative relative to the recalculated values presented in Revision 2, with the exception of the results for weld heat 72105 and weld heat 299L44. The results for weld heat 72105 are non-conservative relative to the approved value by 3.2°F, and the results for weld heat 299L44 are non-conservative relative to the approved value by 8.5°F in Revision 2. The σ_Δ of 28°F is specified for welds in Regulatory Guide 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials". Turkey Point Unit 4 contains weld material 72105, however this is not the limiting material in terms of margin to the PTS (10 CFR 50.61) screening limit due to the weld location and the fact the material only comprises the outer 33% of the weld. Even with the increase in IRT_{To}, ample margin remains in excess of 100°F at 32 EFPY.

In the NRC SER of Topical Report BAW-2308, Revision 2, the NRC concluded that the slightly modified initial RT_{NDT} methodology and the revised IRT_{To} and σ_I values in Revision 2 are acceptable for estimating the IRT_{To} and σ_I values for various heats of the Linde 80 welds in future RPV integrity evaluation applications. In addition, Topical Report BAW-2308, Revision 2, was found acceptable for referencing in licensing applications for Turkey Point Units 3 and 4 as delineated in Revision 2 and to the extent specified under Section 4.0, Limitations and Conditions, of the SER. Due to the limited objective of Revision 2, it is considered a supplement to, not a replacement of, Topical Report BAW-2308, Revision 1-A. Therefore, Items (1) to (4) listed under Section 5, "Conditions and Limitations," of the NRC staff's August 4, 2005, SER for Topical Report BAW-2308, Revision 1-A, must still be addressed in all future plant specific applications referencing Topical Report BAW-2308, Revision 1-A, and Revision 2.

Topical Report BAW-2308, Revision 2, was accepted by the NRC for referencing in licensing applications for PWRs with the following condition:

> *"Future plant-specific applications for RPVs containing weld heat 72105, and weld heat 299L44, of Linde 80 welds must use the revised IRT_{To} and σ_I values in BAW-2308, Revision 2."*

There are no changes being proposed in this submittal for the material properties of non-Linde 80 weld materials, which are the RPV forgings. Chemical composition, chemistry factors, uncertainty terms, and overall margin terms are unchanged for the forging materials and remain consistent with the information previously reported.[11]

A summary of the material property data relevant to this submittal is included as Attachment 3. This data is provided as an update to the NRC's Reactor Vessel Integrity Database (RVID).

3.4 Pressurized Thermal Shock Assessment

Florida Power & Light has performed a PTS assessment for all Turkey Point RPV beltline materials. The neutron fluence projections were calculated to the end of the current 60-year operating licenses (approximately 48 EFPY). The unirradiated RT_{NDT} values and associated uncertainties presented in Topical Report BAW-2308, Revision 2-A were used for the Linde 80 weld materials. Unirradiated RT_{NDT} initial values and associated uncertainties for non-Linde 80 materials are unchanged from those previously provided. The results of the PTS screening calculations are provided in Attachment 3.

For both Turkey Point Units 3 and 4, the limiting material in terms of absolute value of RT_{PTS} is the Intermediate to Lower Shell Circumferential Weld, SA-1101. The value of RT_{PTS} was calculated at the 60-year end of life (approximately 48 EFPY) assuming removal of PTS absorbers (Hf inserts) after Cycle 23 and 24, respectively for both Units 3 and 4. RT_{PTS} was calculated as 244.2°F versus the PTS screening criterion of 300°F for circumferential welds. This value represents a 55.8°F margin to the applicable PTS screening criterion for this material.

In summary, when the revised 60-year fluence projections are considered in conjunction with the alternate initial RT_{NDT} methodology as described in Topical Reports BAW-2308, Revisions 1-A and 2-A, Turkey Point Units 3 and 4 reactor vessel beltline materials meet the 10 CFR 50.61 PTS screening criteria through the end of the current 60-year operating license period.

3.5 10 CFR 50.61 Screening Calculations Without Use of Topical Report BAW-2308, Revisions 1-A and 2-A

Florida Power & Light has performed sensitivity calculations to determine when the 10 CFR 50.61 screening criteria would be reached by the Linde 80 weld materials without

Hf inserts after Cycle 23 and 24, respectively for both Units 3 and 4 and without employing the alternate methodology as described in Topical Report BAW-2308, Revisions 1-A and 2-A. The results of these sensitivity calculations show that the 10 CFR 50.61 PTS screening criterion of 300°F would be reached by Turkey Point Units 3 and 4 weld material SA-1101 at a fast neutron fluence of 4.85 $x10^{19}$ n/cm^2. This indicates a loss of approximately 3 EFPY for both units. Turkey Point Units 3 and 4 would be able to operate until approximately year 2029 and 2030, respectively without the use of Topical Report BAW-2308, Revisions 1-A and 2-A.

3.6 Upper Shelf Energy

The Turkey Point limiting girth weld material Charpy upper-shelf energy (USE) dropped below fifty foot pounds early in life, which is the minimum requirement by Appendix G of 10 CFR Part 50. The most recent equivalent margins analysis (EMA) was performed as a time limited aging analysis during license renewal in accordance with Appendix K of Section XI of the ASME Code. The existing USE analysis[15] included conservative margin relative to the reactor vessel weld fluence projections described in Section 3.1. The projected fluence for the limiting material at the 60-year EOL (approximated at 48 EFPY) was projected to be 5.5 x 10^{19} n/cm^2. The fluence at those limiting weld locations is now projected to be 5.17 x 10^{19} n/cm^2.

In summary, when the revised 60-year neutron fluence values are considered, Turkey Point Units 3 and 4 reactor vessel beltline materials meet the 10 CFR Part 50 Appendix G requirements by employing an Equivalent Margin Analysis that demonstrates acceptable margins of safety against fracture for projected low upper-shelf Charpy impact energy levels at 48 EFPY.

3.7 Technical Specification RCS Pressure-Temperature Limits/Upper Shelf Energy

The current 32 EFPY Turkey Point Units 3 and 4 Technical Specifications for RCS P-T limit curves and LTOPS set points are based on a limiting $^1/_4$-thickness ($^1/_4$-T) Adjusted Reference Temperature (ART) of 262°F and a limiting $^3/_4$-thickness ($^3/_4$-T) ART of 218°F[16] for the Turkey Point Units 3 and 4 Intermediate to Lower Shell Circumferential Weld material SA-1101. When the current Technical Specifications RCS P-T limits and LTOPS set points were developed, these values of ART were determined to bound both Turkey Point Units 3 and 4 reactor vessel beltline materials at end of the original 40-year license fluences corresponding to 32 EFPY.

The summary tables provided in Attachment 3 show the results for the $^1/_4$-T ART and the $^3/_4$-T ART values considering the revised fluence projections corresponding to 32 EFPY and the Linde 80 weld material properties per Topical Report BAW-2308, Revision 2-A. At fluence projections corresponding to 32 EFPY, the limiting $^1/_4$-T ART value is 207.03 °F and the limiting $^3/_4$-T RT_{NDT} value is 164.18°F for Turkey Point Units 3 and 4 Intermediate to Lower Shell Circumferential Weld material, SA-1101. As such, the current Turkey Point Units 3 and 4 Technical Specifications for RCS P-T limits and LTOPS setpoints remain conservative

Table 3.2 ART Value Comparisons for Limiting Weld SA-1101

Location	32 EFPY Tech Spec Limits	32 EFPY BAW-2308 Revs 1A & 2A
$^1/_4$-T (°F)	262	207.03
$^3/_4$-T (°F)	218	164.18

When the revised fluence projections at 32 EFPY are used with the revised Linde 80 weld initial RT_{NDT} values, the limiting $^1/_4$-T and $^3/_4$-T ART values remain less than those used in the development of the current P-T limits and LTOPS set points that have been established for 32 EFPY.

Therefore, the existing Turkey Point Technical Specifications RCS P-T limits, LTOPS set point, and LTOPS enabling temperature remain valid and conservative for their period of applicability, corresponding to 32 EFPY for Turkey Point Units 3 and 4.

3.8 RPV Material Surveillance Program per 10 CFR 50 Appendix H

Current reactor vessel material surveillance monitoring requirements for Turkey Point are based on the predicted shift in Charpy V-notch 30 ft-lb energy (ΔT_{30}). The alternate methodology described in Topical Report BAW-2308, Revisions 1-A and 2-A does not rely on obtaining direct fracture toughness measurements (i.e. in accordance with ASTM-1921) in the irradiated condition for the purposes of monitoring changes due to irradiation in the Linde 80 weld materials. Topical Report BAW-2308, Revisions 1-A and 2-A also confirmed that the irradiation-induced shift in Charpy V-notch 30 ft-lb energy (ΔT_{30}) conservatively over predicted the Master Curve ΔT_0 test data for Linde 80 weld materials. Therefore, the current reactor vessel material surveillance program at Turkey Point is not affected (i.e. current monitoring requirements are based on predicted shift in Charpy V-notch 30 ft-lb energy (ΔT_{30}) and the surveillance schedule remains unaffected.

4.0 Turkey Point Units 3 and 4 Technical Specifications

As noted in Section 3.7, the current Turkey Point Technical Specifications RCS P-T limits, LTOPS setpoint, and LTOPS enabling temperature (TS 3/4.4.9) are not affected by this submittal and remain valid and conservative for their period of applicability. Therefore, there are no changes to Turkey Point Technical Specifications proposed in this submittal.

Florida Power & Light expects to submit, at a later date, a Technical Specifications change request to provide revised RCS P-T Limits, LTOPS setpoint, and LTOPS

Enable Temperature basis that will be effective through the end of the Turkey Point Units 3 and 4, 60-year operating licenses.

5.0 Affected UFSAR Sections

Following NRC approval of the exemption request associated with this submittal, revisions will be made to the UFSAR and the Tech Spec Bases in accordance with the requirements of 10 CFR 50.71(e).

6.0 Reactor Vessel Integrity Database (RVID)

Attachment 3 of this submittal contains a RVID update based on the alternate material properties basis for Linde 80 weld materials as provided in Topical Report BAW-2308, Revision 2-A. The RVID update also includes the revised RPV neutron fluence values, which include the effects of previous (multiple cycle) use of PTS Absorbers in Turkey Point Units 3 and 4 and the projected fluence levels after the planned removal of the PTS Absorbers from Turkey Point Units 3 and 4. The revised fluence values support plant operation for 48 EFPY for Turkey Point Units 3 and 4, corresponding to the end of the current 60-year operating licenses.

7.0 Conclusions

Changes to the Turkey Point Units 3 and 4 PTS assessment per 10 CFR 50.61 and 10 CFR 50 Appendix G are proposed that are valid to the end of the current 60-year license period. The changes are a result of proposed implementation of Topical Report BAW-2308, Revisions 1-A and 2-A. The use of Topical Report BAW-2308, Revisions 1-A and 2-A will allow the permanent removal of PTS Absorbers from the Turkey Point Unit 3 and 4 cores while still remaining within the PTS limits through end of license.

As described in this assessment, the PTS screening criteria per 10 CFR 50.61 and 10 CFR 50 Appendix G are met for all Turkey Point Units 3 and 4 RPV beltline materials. The assessment employs alternate initial RT_{NDT} methodology for the Linde 80 weld materials as described in Topical Report BAW-2308, Revisions 1-A and 2-A. The assessment also employs revised RPV neutron fluence values that appropriately consider previous (multiple cycle) use and eventual removal of PTS Absorbers in Turkey Point Units 3 and 4.

The $^1/_4$-T and $^3/_4$-T ART values used in the development of the current Turkey Point Units 3 and 4 Technical Specifications P-T limits, LTOPS setpoint, and LTOPS enabling temperature remain valid and conservative for the period of applicability.

8.0 References

[1] Framatome ANP Topical Report BAW-2308, Revision 2-A, "Initial RT_{NDT} of Linde 80 Weld Materials," approved March 2008

[2] NRC letter from H. K. Nieh to G. Bischoff (Westinghouse), "Final Safety Evaluation for Pressurized Water Reactor Owners Group (PWROG) Topical Report (TR) BAW-2308, Revision 2, 'Initial RT_{NDT} of Linde 80 Weld Materials' (TAC No. MD4241)," dated March 24, 2008

[3] NRC letter from Daniel McDonald to C.O. Woody (Florida Power & Light), "Projected Values of Material Properties for Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events - Turkey Point Plant, Units 3 and 4", dated March 11, 1987

[4] FPL letter L-98-155 from R.J. Hovey (Florida Power & Light) to USNRC, "Response to RAI regarding Generic Letter 92-01, Revision 1, Supplement 1, Reactor Vessel Structural Integrity", dated July 13, 1998

[5] FPL letter L-85-66 from J.W. Williams (Florida Power & Light) to USNRC (Darrell Eisenhut), "Reactor Plant Surveillance Material Program", dated February 8, 1985

[6] NRC letter from Daniel McDonald to J.W. Williams (Florida Power & Light), "License amendments No. 112, DPR-31 (PTN Unit 3) and No. 106, DPR-41 (PTN Unit 4)", dated April 22, 1985

[7] WCAP-10836, "The Nuclear Design and Core Management of the Turkey Point Unit 3 Power Plant Cycle 10", May 1985, page 2-7

[8] WCAP-11027, "The Nuclear Design and Core Management of the Turkey Point Unit 4 Power Plant Cycle 11", March 1986, page 2-9

[9] FPL letter L-83-180 from Robert E. Uhrig (Florida Power & Light) to USNRC (Steven Varga), "Turkey Point Units 3 & 4, Docket Nos. 50-250, 50-251, Pressurized Thermal Shock", dated March 25, 1983

[10] FPL letter L-2006-037 from Terry O. Jones (Florida Power & Light Company) to USNRC, "Turkey Point Units 3 and 4, Docket Nos. 50-250 and 50-251, Reactor Vessel Surveillance Capsule Proposed Change in Withdrawal Schedule", dated April 1, 2006

[11] WCAP 15916, Revision 0, "Analysis of Capsule X from the Florida Power & Light Company Turkey Point Unit 3 Reactor Vessel Radiation Surveillance Program", Table 6-3, September 2002

[12] Westinghouse Letter 02-38, "Neutron Exposure Projections Based on Continued Use of Power Suppression Rods in Future Core Designs", dated October 16, 2002

[13] Framatome ANP Topical Report BAW-2308, Revision 1-A, "Initial RT_{NDT} of Linde 80 Weld Materials," approved August 2005

[14] Safety Evaluation by the Office of Nuclear Reactor Regulation for Topical Report (TR) BAW-2308, Revision 1, "Initial RT_{NDT} of Linde 80 Weld Materials", Babcock and Wilcox Owners Group Project No. 693, dated August 4, 2005

[15] Topical Report BAW-2312, Revision 1, "Low Upper Shelf Toughness Fracture Mechanics Analysis of Reactor Vessels of Turkey Point Units 3 and 4 for Extended Life Through 48 Effective Full Power Years", December 2000

[16] Turkey Point Nuclear Generating Unit No. 3, Renewed Facility Operating License No. DPR-31 and Turkey Point Nuclear Generating Unit No. 4, Renewed Facility Operating License No. DPR-41 Reactor Coolant System, Technical Specifications, Section 3/4.4.9, Pressure Temperature Limits, Reactor Coolant System, Limiting Condition for Operation, Pages 3/4 4-31 and 4-32

Attachment 2

Regulatory Basis and Request for Exemption

Request for Exemption

1.0 INTRODUCTION

In accordance with the provisions of 10 CFR 50.60(b) and 10 CFR 50.12, Florida Power & Light is submitting a request for exemption from certain requirements of 10 CFR 50.61, "Fracture Toughness Requirements for Protection Against Thermal Shock Events", and 10 CFR 50, Appendix G, "Fracture Toughness Requirements." The requested exemption would allow use of an alternate method, as described in Framatome ANP Topical Report BAW-2308, Revisions 1-A and 2-A (supplemental), for determining the adjusted RT_{NDT} (reference nil-ductility temperature) of the Linde 80 weld materials present in the beltline region of the Turkey Point Units 3 and 4 reactor pressure vessels.

2.0 BACKGROUND

10 CFR 50.61(a)(5) and 10 CFR 50, Appendix G (II)(D)(i), require that the pre-service or unirradiated condition RT_{NDT} be evaluated according to the procedures in the ASME Code, Section III, Paragraph NB-2331, from Charpy V-notch impact tests and drop weight tests.

Topical Report BAW-2308, Rev. 1-A provides an NRC-approved alternate method for determining the adjusted RT_{NDT} (reference nil-ductility temperature) of the Linde 80 weld materials present in the beltline region of the reactor pressure vessels at Turkey Point Units 3 and 4. Topical Report BAW-2308, Revision 2-A, provides revised initial (unirradiated) RT_{NDT} values for the Linde 80 weld materials present in the reactor pressure vessels of Turkey Point Units 3 and 4.

The following Condition and Limitation is stated in the NRC's Safety Evaluation for Topical Report BAW-2308, Rev. 1:

> *"Any licensee who wants to utilize the methodology of TR BAW-2308, Revision 1 as outlined in items (1) through (3) above, must request an exemption, per 10 CFR 50.12, from the requirements of Appendix G to 10 CFR Part 50 and 10 CFR 50.61 to do so."*

In the above quotation, Condition and Limitation (1) pertains to NRC-accepted values of initial (unirradiated) reference temperature, IRT_{T0}, and the corresponding uncertainty term, σ_I, for Linde 80 weld materials based on the Master Curve methodology using direct testing of fracture toughness in accordance with ASTM Standard Test Method E-1921.

Condition and Limitation (2) requires that a minimum chemistry factor of 167.0°F be applied when the methodology of Regulatory Guide 1.99, Revision 2, is used to assess the shift in nil-ductility transition temperature due to irradiation.

Condition and Limitation (3) requires that a value of σ_Δ = 28.0°F be used to determine the margin term, as defined in Topical Report BAW-2308, Revision 1-A, and Regulatory Guide 1.99, Revision 2.

Topical Report BAW-2308, Revision 2-A provides revised initial (unirradiated) RT_{NDT} values for the Linde 80 weld materials present in the reactor pressure vessels approved for use in evaluations for Turkey Point Units 3 and 4.

3.0 PROPOSED EXEMPTION

The exemption requested by Florida Power & Light addresses portions of the following regulations:

(1) Appendix G to 10 CFR Part 50, which sets forth fracture toughness requirements for ferritic materials of pressure-retaining components of the reactor coolant pressure boundary of light water nuclear power reactors to provide adequate margins of safety during any condition of normal operation, including anticipated operational occurrences and system hydrostatic tests, to which the system may be subjected over its service lifetime;

(2) 10 CFR 50.61, which sets forth fracture toughness requirements for protection against pressurized thermal shock (PTS).

The exemption from Appendix G to 10 CFR 50 is to replace the required use of the existing Charpy V-notch and drop-weight-based methodology with the use of an alternate methodology described in Topical Reports BAW-2308, Revisions 1-A and 2A that incorporates the use of fracture toughness test data for evaluating the integrity of the Linde 80 weld materials present in the Turkey Point Units 3 and 4 reactor pressure vessel beltline regions. The alternate methodology employs direct fracture toughness testing per the Master Curve methodology based on use of ASTM Standard Method E 1921 (1997 and 2002 editions), and ASME Code Case N-629. The exemption is required since Appendix G to 10 CFR 50 requires that for the pre-service or unirradiated condition, RT_{NDT} be evaluated by Charpy V-notch impact tests and drop weight tests according to the procedures in the ASME Code, Paragraph NB-2331.

The exemption from 10 CFR 50.61 is to use an alternate methodology described in Topical Reports BAW-2308, Revisions 1-A and 2-A to allow the use of direct fracture toughness test data for evaluating the integrity of the Linde 80 weld materials present in the Turkey Point Units 3 and 4 RPV beltline regions, based

on the use of ASTM E 1921 (1997 and 2002 editions) and ASME Code Case N-629. The exemption is required because the methodology for evaluating RPV material fracture toughness in 10 CFR 50.61 requires that the pre-service or unirradiated condition be evaluated using Charpy V-notch impact tests and drop weight tests according to the procedures in the ASME Code, Paragraph NB-2331.

The NRC's Safety Evaluation for Topical Report BAW-2308, Revision 1, concludes that an exemption is required to address issues related to 10 CFR 50.61 inasmuch as the methodology presented in Topical Report BAW-2308, Revision 1, as modified and approved by the NRC staff, represents a significant change to the methodology specified in 10 CFR 50.61 for determining the PTS reference temperature (RT_{PTS}) value for Linde 80 weld material. The changes in the methodology described in Topical Report BAW-2308, Revision 1-A, with respect to the methodology per 10 CFR 50.61, include the requirements for use of a minimum chemistry factor of 167°F and a value of σ_Δ = 28.0°F for Linde 80 weld materials.

Additionally, the NRC's Safety Evaluation for Topical Report BAW-2308, Revision 2 concludes that the revised PTS reference temperature (RT_{PTS}) values for Linde 80 weld materials are acceptable for referencing in licensing applications for Turkey Point Units 3 and 4 as delineated in Topical Report BAW-2308, Revision 2 and to the extent specified under Section 4.0, Limitations and Conditions, of the SE, which states:

> *"Future plant-specific applications for RPVs containing weld heat 72105, and weld heat 299L44, of Linde 80 welds must use the revised IRT_{To} and σ_I values in TR BAW-2308, Revision 2."*

10 CFR 50.12 states that the Commission may grant an exemption from requirements contained in 10 CFR 50 provided that: 1) the exemption is authorized by law, 2) the exemption will not result in an undue risk to public health and safety, 3) the exemption is consistent with the common defense and security, and 4) special circumstances, as defined in 10 CFR 50.12(a)(2) are present. The requested exemption to allow the use of Topical Report BAW-2308, Revisions 1-A and 2-A, as the basis for the Linde 80 weld material initial properties at Turkey Point Units 3 and 4 satisfy these requirements as described below.

1. <u>The requested exemption is authorized by law.</u>

   No law exists which precludes the activities covered by this exemption request. 10 CFR 50.60(b) allows the use of alternatives to 10 CFR 50, Appendix G when an exemption is granted by the Commission under 10 CFR 50.12.

In addition, 10 CFR 50.61 permits other methods for use in determining the initial material properties provided such methods are approved by the Director, Office of Nuclear Reactor Regulation.

2. The requested exemption does not present an undue risk to the public health and safety.

   The proposed material initial properties basis described in Topical Report BAW-2308 Revisions 1-A and 2-A represents an NRC-approved methodology for establishing weld wire specific and generic IRT_{T0} values for Linde 80 welds. Topical Report BAW-2308, Revisions 1-A and 2-A, includes appropriate conservatisms to ensure that use of the proposed initial material properties basis does not increase the probability of occurrence or the consequences of an accident at Turkey Point Units 3 or 4, and will not create the possibility for a new or different type of accident that could pose a risk to public health and safety.

   The use of this proposed approach ensures that the intent of the requirements specified in 10 CFR 50 Appendix G and 10 CFR 50.61 are satisfied.

   The requested exemption is consistent with the NRC staff requirements specified in the Safety Evaluation for the approved Topical Report BAW-2308, Revisions 1-A and 2-A; consequently, the exemption does not present an undue risk to the public health and safety.

3. The requested exemption will not endanger the common defense and security.

   The requested exemption is specifically concerned with RPV material properties and is consistent with NRC staff requirements specified in the Safety Evaluation for approved Topical Report BAW-2308, Revision 1-A and 2-A. Consequently, the requested exemption will not endanger the common defense and security.

4. Special circumstances are present which necessitate the request for an exemption to the regulations of 10 CFR 50.61 and 10 CFR 50 Appendix G.

   Pursuant to 10 CFR 50.12(a)(2), the NRC will not consider granting an exemption to the regulations unless special circumstances are present. The requested exemption meets the special circumstances of paragraph 10 CFR 50.12(a)(2)(ii) since application of these regulations in this particular circumstance is not necessary to achieve the underlying purpose of the regulations.

The underlying purpose of 10 CFR 50.61 and 10 CFR 50 Appendix G is to protect the integrity of the reactor coolant pressure boundary by ensuring that each reactor vessel material has adequate fracture toughness. Application of paragraph NB-2331 of ASME Section III in the determination of initial material properties was conservatively developed based on the level of knowledge existing in the early 1970s concerning reactor pressure vessel materials and the estimated effects of operation. Since the early 1970s, the level of knowledge concerning these topics has greatly expanded. This increased knowledge level permits alternatives to the requirements of ASME III NB-2331via application of Topical Report BAW-2308, Revisions 1-A and 2-A, while maintaining the underlying purpose of the ASME Code and NRC regulations to ensure an acceptable margin of safety is maintained.

This submittal presents the reactor vessel integrity assessments for Turkey Point Units 3 and 4 utilizing the methodology of Topical Report BAW-2308, Revision 1-A and 2-A for Linde 80 weld materials. The assessment documents the integrity of the reactor pressure vessel for Turkey Point Units 3 and 4 relative to the requirements and underlying purpose of 10 CFR 50.61 and 10 CFR 50 Appendix G.

Therefore, the intent of 10 CFR 50.61 and 10 CFR 50 Appendix G will continue to be satisfied for the proposed change in reactor vessel material initial properties basis, thus justifying the exemption request. Issuance of an exemption from the criteria of these regulations to permit the use of Topical Report BAW-2308, Revision 1-A and 2-A for Turkey Point Units 3 and 4 will not compromise the safe operation of the reactors, and will ensure that RPV integrity is maintained.

Attachment 3

REACTOR VESSEL MATERIALS DATA TABLES

FOR TURKEY POINT UNITS 3 AND UNIT 4

PTS Summary Based on 32 EFPY Fluences and Linde 80 Weld Material Properties per BAW-2308, Revisions 1-A and 2-A[1]

Facility: Turkey Point Unit 3 | Vessel Manufacturer: B&W | RPV Beltline Thickness 7.75 inches | Cladding Thickness 0.156 inches

RPV Weld Wire Heat or Material ID	Location	Best Estimate Cu (wt%)	Best Estimate Ni (wt%)	ID Fluence ($x10^{19}$)	Assigned Material Chemistry Factor	Method of Determining CF	RT_{NDT} (°F)	σ_o	σ_Δ	Margin	Inner Surface ΔRT_{NDT} (°F)	Inner Surface ART or RT_{PTS} (°F)	$^1/_4$-T ART[2] (°F)	3/4-T ART[3] (°F)
122S146VA1	Upper Shell Forging	0.11	0.68	0.30	75.2	Table	50.0	0	17.0	34.0	50.40	134.40	125.76	111.09
123P461VA1	Intermediate Shell Forging	0.06	0.70	4.03	14.6	Surveillance	40.0	0	8.5	17.0	19.82	76.82	75.24	71.59
123S266VA1	Lower Shell Forging	0.08	0.67	4.03	42.7	Surveillance	30.0	0	8.5	17.0	57.98	104.98	100.35	89.69
72442	Upper to Int. Shell Circ. Weld SA-1484	0.26	0.60	0.30	180.0	Table	-33.2	12.2	28.0	61.08	120.65	148.53	127.83	92.72
71249	Int. to Lower Shell Circ. Weld SA-1101	0.23	0.59	3.16	167.6	Table	-53.5	12.8	28.0	61.57	218.38	226.45	207.03	164.18

Facility: Turkey Point Unit 4 | Vessel Manufacturer: B&W | RPV Beltline Thickness 7.75 inches | Cladding Thickness 0.156 inches

RPV Weld Wire Heat or Material ID	Location	Best Estimate Cu (wt%)	Best Estimate Ni (wt%)	ID Fluence ($x10^{19}$)	Assigned Material Chemistry Factor	Method of Determining CF	RT_{NDT} (°F)	σ_o	σ_Δ	Margin	Inner Surface ΔRT_{NDT} (°F)	Inner Surface ART or RT_{PTS} (°F)	$^1/_4$-T ART[2] (°F)	3/4-T ART[3] (°F)
124S309VA1	Upper Shell Forging	0.11	0.70	0.30	75.5	Table	40.0	0	17.0	34.0	50.61	124.61	115.92	101.20
123P481VA1	Intermediate Shell Forging	0.05	0.68	4.03	31.0	Table	50.0	0	17.0	34.0	42.09	126.09	122.73	114.99
122S180VA1	Lower Shell Forging	0.06	0.74	4.03	5.4	Surveillance	40.0	0	Note 4	7.33	7.33	54.66	54.08	52.73
72442	Upper to Int. Shell Circ. Weld WF-67 (Inner 67%)	0.26	0.60	0.30	180.0	Table	-33.2	12.2	28.0	61.08	120.65	148.53	127.83	N/A
72105	Upper to Int. Shell Circ. Weld WF-70 (Outer 33%)	0.32	0.58	0.09	199.3	Table	-31.1	13.7	28.0	62.34	78.95	110.19	N/A	103.03
71249	Int. to Lower Shell Circ. Weld SA-1101	0.23	0.59	3.16	167.6	Table	-53.5	12.8	28.0	61.57	218.38	226.45	207.03	164.18

Source of Input Data:
RVID Referenced
BAW-2325, Revision 1
BAW-2308, Revision 2-A
BAW-2166

Note 1: Current Technical Specification PT limits are for 32 EFPY and limited at $^1/_4$-T ART and $^3/_4$-T ART of 262°F and 218°F, Respectively

Note 2: For Welds, $^1/_4$-T ART limiting weld value of 262°F was used in the determination of PT limits (32 EFPY Approved by NRC on 10/30/00)
For Forgings, $^1/_4$-T ART limiting forging value of 124°F was used in the determination of PT limits (32 EFPY Approved by NRC on 10/30/00)

Note 3: For Welds, $^3/_4$-T ART limiting weld value of 218°F was used in the determination of PT limits (32 EFPY Approved by NRC on 10/30/00)
For Forgings, $^3/_4$-T ART limiting forging value of 117°F was used in the determination of PT limits (32 EFPY Approved by NRC on 10/30/00)

Note 4: Unit 4 Lower Shell Forging σ_Δ value is determined by R.G. 1.99, Revision 2 since σ_Δ need not > $^1/_2(\Delta RT_{NDT})$, but was only implemented for the vessel inner surface

PTS Summary Based on 48 EFPY Fluences and Linde 80 Weld Material Properties per BAW-2308, Revisions 1-A and 2-A

Facility: Turkey Point Unit 3 Vessel Manufacturer: B&W RPV Beltline Thickness 7.75 inches Cladding Thickness 0.156 inches

RPV Weld Wire Heat or Material ID	Location	Best Estimate Cu (wt%)	Best Estimate Ni (wt%)	ID Fluence ($x10^{19}$)	Assigned Material Chemistry Factor	Method of Determining CF	RT_{NDT} (°F)	σ_o	σ_Δ	Margin	Inner Surface ΔRT_{NDT} (°F)	Inner Surface ART or RT_{PTS} (°F)
122S146VA1	Upper Shell Forging	0.11	0.68	0.43	75.2	Table	50.0	0	17.0	34.0	57.56	141.56
123P461VA1	Intermediate Shell Forging	0.06	0.70	6.14	14.6	Surveillance	40.0	0	8.5	17.0	21.03	78.03
123S266VA1	Lower Shell Forging	0.08	0.67	6.14	42.7	Surveillance	30.0	0	8.5	17.0	61.52	108.52
72442	Upper to Int. Shell Circ. Weld SA-1484	0.26	0.60	0.43	180.0	Table	-33.2	12.2	28.0	61.08	137.79	165.67
71249	Int. to Lower Shell Circ. Weld SA-1101	0.23	0.59	5.17	167.6	Table	-53.5	12.8	28.0	61.57	236.13	244.20

Facility: Turkey Point Unit 4 Vessel Manufacturer: B&W RPV Beltline Thickness 7.75 Cladding Thickness 0.156 inches

RPV Weld Wire Heat or Material ID	Location	Best Estimate Cu (wt%)	Best Estimate Ni (wt%)	ID Fluence ($x10^{19}$)	Assigned Material Chemistry Factor	Method of Determining CF	RT_{NDT} (°F)	σ_o	σ_Δ	Margin	Inner Surface ΔRT_{NDT} (°F)	Inner Surface ART or RT_{PTS} (°F)
124S309VA1	Upper Shell Forging	0.11	0.70	0.43	75.5	Table	40.0	0	17.0	34.0	57.79	131.79
123P481VA1	Intermediate Shell Forging	0.05	0.68	6.14	31.0	Table	50.0	0	17.0	34.0	44.66	128.66
122S180VA1	Lower Shell Forging	0.06	0.74	6.14	5.4	Surveillance	40.0	0	Note 1	7.78	7.78	55.56
72442	Upper to Int. Shell Circ. Weld WF-67 (Inner 67%)	0.26	0.60	0.43	180.0	Table	-33.2	12.2	28.0	61.08	137.79	165.67
72105	Upper to Int. Shell Circ. Weld WF-70 (Outer 33%)	0.32	0.58	0.12	199.3	Table	-31.1	13.7	28.0	62.34	90.55	121.79
71249	Int. to Lower Shell Circ. Weld SA-1101	0.23	0.59	5.17	167.6	Table	-53.5	12.8	28.0	61.57	236.13	244.20

Source of Input Data:

RVID Referenced
BAW-2325, Revision 1
BAW-2308, Revision 2-A
BAW-2166

Note 1: Unit 4 Lower Shell Forging σ_Δ value is determined by R.G. 1.99, Revision 2 since σ_Δ need not $> 1/2(\Delta RT_{NDT})$, but was only implemented for the vessel inner surface