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PWROG
PWR Owners Group

(4)

Program Management Office
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Windsor, Connecticut 06095

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USNRC

December 18, 2007 (9:59am)

OFFICE OF SECRETARY
RULEMAKINGS AND
ADJUDICATIONS STAFF

OG-07-536

Secretary
Attn: Rulemakings and Adjudications Staff
U. S. Nuclear Regulatory Commission
Washington, DC 20555-0001

Subject: PWR Owners Group
Transmittal of PWROG Comments on the NRC "Proposed Rule on Alternate Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events", RIN 3150-AI01, PA-MSC-0232

The purpose of this letter is to transmit PWROG comments on the NRC "Proposed Rule on Alternate Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events". The enclosed Excel file (Enclosure 1) provides the final set of comments on the PTS Rule that was developed by the PWROG. Enclosures 2 and 3 are Word files that are referenced in the attached Excel file and provide additional information on the comments in Enclosure 1. The PWROG would like to highlight three comments:

1. The rule should be changed to require plants exercising this option to use an NRC approved methodology for predicting DT30. There is not currently a consensus for using equations in the proposed Rule for best estimate values in operating plants. When a consensus methodology is established, it should be the basis for Revision of USNRC Regulatory Guide 1.99.

2. Surveillance capsule data should not be used to adjust DT30 predictions. The prediction based on analysis of an extensive surveillance capsule database and on the best estimate chemical composition for the heat of the material is more reliable than a prediction based on a single set of surveillance measurements.

3. There are a number of technical concerns with the embedded flaw limits for welds and plates in Tables 2 and 3, respectively, in the Voluntary PTS Rule 10CFR50.61a that was proposed by the NRC. It is suggested that The NRC have a dialogue about these technical concerns with the industry and resolve them before the final version of the Voluntary PTS Rule is published for use.

Template = SECY-067

SECY-02

For technical questions regarding the enclosed PWROG comments, please contact Ted Meyer (Westinghouse) at (412) 374-4226 or Cheryl Boggess (Westinghouse) at (412) 374-4692. If you have any additional questions or comments on the enclosed information, feel free to contact Jim Molkenthin in the PWROG office at (860) 731-6727 or me at (704) 382-8619.

Sincerely,

J. Molkenthin approving for M. Arey

Melvin L. Arey, Jr., Duke Energy Corporation
MSC Chairman
PWR Owners Group

MLA:JPM:las

Enclosures: (3) – PWROG Comments to New NRC PTS Rule

cc: PWROG Management Committee Participants in PA-MSC-0375
PWROG Materials Subcommittee Participants in PA-MSC-0375
PWROG PMO
B. Gray, AREVA NP
B. Hall, AREVA NP
R. Lott, W
C. Boggess, W
S. Peters, USNRC (3 copies)
S. Rosenberg, USNRC
N. Palm, W
B. Bishop, W
S. Byrne, W
C. Brinkman, W
D. Forsyth, W
J. Fasnacht, W

NRC PTS Rule-Making: MRP-PWROG Comments Fall 2007

Enclosure 1

Overall #	Comment Location: Page #	Sub-Section #	Line #	Table #	Comment	Proposed Change	Comment Resolution
1	General				Given the significant amount of resources required to reevaluate the vessel in accordance with the requirements in 10 CFR 50.61a and that some plants have already made a significant investment determining RT using an alternative method (i.e., Master Curve), would NRC be receptive to licensees pursuing an exemption request to 10 CFR 50.61?	Continue to allow exemptions in the future for determining RTPTS using the current PTS Rule, e.g., use the Master curve approach to determine RTPTS.	
2	56280				industry bodies should be used to establish a single consensus embrittlement trend curve (ETC) that is acceptable for use in 10CFR50.61 and other NRC Regulations. The consensus ETC should allow evaluation based on reasonably available data and provide accurate predictions of the transition temperature for individual plants. Although the ETC defined in Equations 5 through 7 and described in Section f provides a reasonable description of generic behavior for use in the probabilistic studies, there is no consensus for use of this equation in providing best estimate predictions for transition temperature shifts in individual plants. Presentations at recent ASTM E10.02 Subcommittee meetings indicate that both industry and NRC Research are currently working on improved ETCs that are expected to eventually become the basis for revisions to ASTM E900 and NRC Regulatory Guide 1.99. If these revised ETCs are adopted as industry consensus curves, there is a strong possibility that NRC Regulations will include three distinctly different equations for calculating the same parameter (DT30).	Revise Section (f) to remove all reference to equations 5-7 and require calculation of DT30 values based on an NRC approved methodology. Alternative text is suggested in the Attachment 2, "Section f". These suggested revisions include elimination of Table 5 and the requirement to revise predictions based individual surveillance measurements. The basis for these additional changes are outlined in a separate comment.	
					This optional section of 10CFR50.61 will only apply to a handful of plants. This confusion in the Regulation could be avoided if the optional portion of the Regulation required use of an NRC approved methodology rather than the specific trend curve.		
3		(a)(7) & (8)			50.61a(a)(7) & (8): These paragraphs define flux and fluence to be determined using paragraph (g) of that section. The question is: if the flux and/or fluence are calculated does the method used to determine these values have to comply with RG 1.190?	No proposed change to the rule.	
4		(a)(10)			There is little added value in the requirement to go back and assess surveillance data as a part of this rule because variability in data has already been accounted for in the derivation of the embrittlement correlation. Furthermore, there is no viable methodology for adjusting the projected DT30 for the vessel based on the surveillance data. Any effort to make this adjustment is likely to introduce additional error into the prediction. (Note that the embrittlement correlation described in the basis for the revised PTS rule (NUREG-1874) was derived using all of the currently available industry-wide surveillance data.) In the event that the surveillance data does not match the DT30 value predicted by the embrittlement correlation, the best estimate value for the pressure vessel material remains to be that derived using the embrittlement correlation. The likely source of the discrepancy is an error in the characterization of the surveillance material or of the irradiation environment. Therefore, unless the discrepancy can be resolved, obtaining the DT30 prediction based on the best estimate chemical composition for the heat of the material is more reliable than a prediction based on a single set of surveillance measurements.	Remove the requirement to go back and assess surveillance data as a part of this rule because variability in data was already incorporated into the embrittlement correlation. Furthermore, there is no viable methodology for adjusting the projected DT30 for the vessel based on the surveillance data. Any effort to make this adjustment is likely to introduce additional error into the prediction. (Note that the embrittlement correlation described in the basis for the revised PTS rule (NUREG-1874) was derived using all of the currently available industry-wide surveillance data.) In the event that the surveillance data does not match the DT30 value predicted by the embrittlement correlation, the best estimate value for the pressure vessel material remains to be that derived using the embrittlement correlation. The likely source of the discrepancy is an error in the characterization of the surveillance material or of the irradiation environment. Therefore, unless the discrepancy can be resolved, obtaining the DT30 prediction based on the best estimate chemical composition for the heat of the material is more reliable than a prediction based on a single set of surveillance measurements.	
5		b			This document is only applicable to the existing fleet of PWRs. The characteristics of advanced PWR designs were not considered in the analysis.	Add statement to state that this rule is applicable to the current PWR fleet and not the new plant designs.	
6	56283	(c)(2)			10 CFR 50.61a (c) states "The information required by paragraphs (c)(1), (c)(2), and (c)(3) of this section must be submitted for review and approval by the Director at least three years before the limiting RT_{PTS} value calculated under 10 CFR 50.61 is projected to exceed the PTS screening criteria in 10 CFR 50.61 for plants licensed under 10 CFR Part 50 or 10 CFR Part 52." In the case of Palisades, this information is required to be submitted by December 31, 2010. Palisades has two refueling outages scheduled prior to that date (spring 2009 and fall 2010). Given the fall 2010 outage is close to the required submittal date, the spring 2009 outage is the preferred date for performing the inspection. Performing an in-service inspection on such short notice is certainly an enormous and unexpected misuse of resources. Unlike NRC, most organizations attempt to operate using at least a five year planning horizon.	Revise to read "The information required by paragraphs (c)(1) and (c)(3) of this section must be submitted for review and approval by the Director at least three years before the limiting RT_{PTS} value calculated under 10 CFR 50.61 is projected to exceed the PTS screening criteria in 10 CFR 50.61 for plants licensed under 10 CFR Part 50 or 10 CFR Part 52. A schedule to provide the information required by paragraph (c)(2) of this section shall be submitted at the same time."	
7		(c)(2)			Is the beltline area to be examined per this paragraph limited to the "limiting materials" or does this require the entire beltline under an owner's ISI program to be evaluated? Also does this paragraph impose a stand-alone special examination, or may the most recent ASME Section XI examination be used to satisfy this paragraph?	Please provide clarification	
8	56283	(d)(1)			The proposed rule states "Whenever there is a significant change in projected values of RT_{MAX-X}..." What defines a "significant" change?	Suggest revising the proposed rule to define a significant change as one where there is an increase in projected fluence greater than 20%. A 20% increase is equivalent to the uncertainty allowed in RG 1.190 and also equivalent to 2 standard deviations on the global fluence that is input to the FAVOR evaluations in NUREG-1874.	
9		d(2)			Licensees shall determine impact of flaw assessments required by (e).......120 days	The 120 days applies only for subsequent applications of the PTS rule, i.e., after the initial application of the voluntary PTS Rule.	

	Comment Location						
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10		d(2) & e(4)			These sections imply that failure to meet the flaw distribution requirements in Tables and 3 would require a probabilistic analysis within one year to allow continued operation. This means that observation of a single large flaw could trigger a major analysis program. The technical basis for this Table is not obvious and the implications could be onerous.	Suggest that Tables 2 and 3 be provided as guidance, but not a strict requirement.	
11		(e)			It would be helpful if NRC would clarify that the Edition and Addenda of Section XI to be used is the one that the licensee is currently working to in their ISI Program. If some other Edition or Addenda is intended, it should be made clear what the NRC intends for a licensee to use and the basis for requiring a different Edition/Addenda to that the owner is currently using.	Please provide clarification	
12	56284	(e)(1)			The proposed rule refers to an "ASME flaw size increment". "ASME flaw size increment" is not a term defined in ASME Section XI. Section XI, IWA-3200(a) states "All observed or calculated values of dimensions of component thickness and of flaws detected by non-destructive examination to be used for comparison with the evaluation standards of IWB-3000...whether obtained as decimals or fractions, shall be expressed to the nearest 0.1 in for values 1 in. and greater, and to the nearest 0.05 in. for values less than 1 in." This does not preclude the inservice inspector from recording the indication dimensions to a greater accuracy. IWA-3200(a) enables the person evaluating the inservice inspection results to round-off the indication sizes and make a comparison to the IWB-3500 acceptance criteria without having to interpolate between the acceptance criteria table values. Therefore, there is no need to manipulate the flaw denisty data to fit the flaw sizes in bins of 0.05 in.	The reference to "ASME flaw size increment" should be removed.	
13		(e)(1)(iii)			Does the fluence map described in this paragraph have to be generated with a fluence methodology compliant with RG 1.190?	Please provide clarification	
14	56284	(e)(1)(iii)			The proposed rule states that the licensee shall document "the orientation of the indication relative to the axial direction,.." However, there is no provision for the use of this information relative to Tables 2 and 3.	The proposed rule should be revised to require that only axially oriented flaws be evaluated per Tables 2 and 3.	
15	56284	(e)(1)(iii)			The proposed rule states that the licensees shall document a fluence map that "allows the determination of the neutron fluence at the location of the detected indications." If the indications that are detected are acceptable per Tables 2 and 3, what is the benefit of the recording and submittal of this information? It seems that this information should only be required if the indications are outside the limits of Tables 2 and 3.	The proposed rule should only require the documentation of fluence information for flaws that are beyond the limits in Tables 2 and 3.	
16	56284	(e)(2)			The proposed rule states that licensees shall verify that if indications are detected in the clad-to-base metal interface, "The licensee shall verify that such indications do not open to the vessel inside surface using a qualified surface or visual examination." A number of forging plants have been identified (as noted in NUREG-1874) as having relatively large areas of underclad cracking. These areas have been inspected repeatedly and have shown no evidence of growth. Furthermore, evaluations have been performed, and approved by the NRC Staff (WCAP-15338-A), that have shown that the growth of these underclad cracks is not likely. Is it the intention of the proposed rule that these plants would be required to perform the proposed surface or visual examinations over these areas during each inservice inpsection? If indications are detected in the clad-to-base metal interface and surface or visual examinations confirm that these indications are not ID connected, is it necessary to repeat the surface or visual examinations after subsequent volumetric examinations here the same indications are detected in the clad-to-base metal interface?	Flaws (the proposed rule should delete the term "indications" and replace it with "flaws") in the clad-to-base metal interface that have been identified in previous inspections should be exempt from the surface or visual examinations of the proposed rule.	
18		f(2)			Focus on fluence at the weld fusion line may add confusion and a degree of difficulty with regard to defining maximum fluence at a location that is not normally singled out. The fusion line is not defined unambiguously for reactor pressure vessel axial or circumferential welds. It is suggested that the text refer to maximum fluence at the "weld" to avoid confusion.	Focus on fluence at the weld fusion line may add confusion and a degree of difficulty with regard to defining maximum fluence at a location that is not normally singled out. The fusion line is not defined unambiguously for reactor pressure vessel axial or circumferential welds. It is suggested that the text refer to maximum fluence at the "weld" to avoid confusion. Suggested re-phrasing for section f is provided in Attachment 2.	
19	56285	(f)(2)			The proposed rule states that "The ΔT30 value for each plate calculated as specified in Equation 1 of this section must be calculated for the maximum fluence (φFL). The proposed rule also states that "The ΔT_{30} value for each plate calculated as specified in Equation 1 of this section must be calculated for tFL....".	"(φFL)" and "tFL" should be "(φt_{FL})". Suggested rephrasing is provided in separate document to clarify in Section (f)(2) what fluence value (e.g., φtFL) is to be used to assess which ΔT30 value for each of equations 1 through 4.	
20	56285	(g)			NUREG/CR-6551 had a table with the data used in the correlation. Is the data for the new correlation available? Basically, if a plant is to compare to data from other surveillance programs, it is preferred the data (e.g., ΔT_{30}) be determined consistently (e.g., the same tanh curve shaping method).	Make the technical basis document for the proposed correlation available to the public.	
21		g			The original documentation for this equation had limits of validity for all of the major variables (fluence, temperature, Cu, Ni ....). Those limits should be included here. Suggest that even with the maximum allowable values, the shifts and predicted RTMax-X values will be below limit.	Include limits on application unless Equations 5, 6, and 7 are removed.	
22	56286	(g)			Equation 8 states "Residual ® =...".	Equation 8 should be "Residual (r) =...."	
23	56286			1	Table 1 of the proposed rule provides different PTS Screening Criteria for "Forging without under clad cracks" and "Forging with under clad cracks". NUREG-1874 provides clarification that reactor vessels that have been fabricated in accordance with Regulatory Guide 1.43 can be considered to not be susceptible to under clad cracking. No guidance or criteria is provided in the proposed rule for determining whether or not the forging material is susceptible to under clad cracking.	The proposed rule should be revised to include clarification that "Forging with under clad cracks" applies to forgings that have detected under clad cracking or were not fabricated in accordance with Regulatory Guide 1.43. The "Forging without under clad cracks" applies to forgings for which no under clad cracks have been detected and were fabricated in accordance with Regulatory Guide 1.43.	

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24	56283	(c)(3)			The proposed rule states that "Each licensee shall compare the projected RT_{MAX-X} values for plates, forgings, axial welds, and circumferential welds to the PTS screening criteria for the purpose..."	It is suggested that "in Table 1 of this section" be added following "screening criteria".	
25	56283	(c)(3)			The proposed rule states that "Each licensee shall compare the projected RT_{MAX-X} values for plates, forgings, axial welds, and circumferential welds to the PTS screening criteria..." However, Table 1 also includes a screening criterion for a combination of RT_{MAX-AW} and RT_{MAX-PL} that may be more restrictive than the separate RT_{MAX-AW} and RT_{MAX-PL} criteria. It should be clarified in section (c)(3) that for reactor vessels with plates and axial welds, the screening criteria of the RT_{MAX-AW}, RT_{MAX-PL}, and combination must be met.	Suggest revising the sentence saying "If any of the projected RT_{MAX-X} values are greater than the PTS screening criteria..." to read " If any of the projected RT_{MAX-X} values or combination of RT_{MAX-AW} and RT_{MAX-PL} values are greater than the PTS screening criteria..."	
26	56276		Col. 3		Revision 1 of R. G. 1.174 (ADAMS Accession Number ML023240437) is identified as the basis for the risk limit of $1x10^{-6}$ events/year for large early release frequency in the proposed rule. Section 2.2.5.5 of this guide states that the acceptance of risk results relative to the limits is to be evaluated using mean values. However, the RT_{MAX} limits in the proposed rule and NUREG-1874 are based upon the 95th percentile values, which are much higher than the mean values of TWCF as shown in Table 3.1 of NUREG-1874. If technical basis calculations need to be redone for any reason, use mean values of TWCF instead of 95% upper bounds.	Remove citation to R.G. 1.174, Revision 1, as basis for TWCF acceptance criteria or explain the differences.	
27	56277		Col. 3		It is stated that surface breaking flaws that penetrate through the cladding were not included in the technical basis. This is not true because the possibility of having flaws of this type were in fact considered in the pilot plant (Oconee Unit 1) for the B&W plant designs in NUREG-1806 and NUREG-1874. They were included because their existence cannot be excluded in single pass cladding.	State that surface breaking flaws were considered. Their existence cannot be excluded in single pass cladding and was included in the evaluation of the pilot plants.	
28	56277 56278		Col. 3 Col. 1		The technical basis for the embedded flaw density and size limits given in Tables 2 and 3 of the proposed rule is briefly described. A review of the cited NRC staff document (ADAMS Accession Number ML070950392) indicates that it failed to account for the effects of the uncertainties included in the 1000 embedded flaw distributions input to FAVOR, which of the simulated flaws contributed to TWCF and which of those flaws could be detected during inspection of the beltline region adjacent to the reactor core per the requirements of ASME Section XI, Appendix VIII.	An individual utility should not be required to perform the evaluation of the effect of potentially new flaw distributions for the fleet. The fleet concerns should be addressed by the NRC. The plant specific concerns should be addressed by considering options for alternative methods that do not require the approval of the NRR.	
29	56283	(c)(3) and (d)(3)	Col's. 2 and 3		If the screening limits for RT_{max} in Table 1 are not satisfied, then the same compensatory measures identified in the existing PTS Rule, 10 CFR 50.61 (flux reduction through thermal annealing) must be submitted with the requests for review and approval by the Director of NRR and implemented prior to when the limits are projected to be violated. Note that the option of calculating the TWCF using the maximum RT_{max} values for each type of belt-line material (axial or circ. weld, plate or forging) with the curve-fit equations 3-5 in Section 3.3.1.3 of NUREG-1874 and showing that it is less than the risk limit of 1x10-6 events/year is not included.	In section (d)(3), include the option of first calculating the TWCF using the maximum RT_{max} values for each type of belt-line material (axial or circ. weld, plate or forging) with the curve-fit equations 3-5 in Section 3.3.1.3 of NUREG-1874 and showing that it is less than the risk limit of 1x10-6 events/year. If this is not successful, then the remaining options in section (d)(3) would be invoked. This option should also be offered to alleviate confusion in the approximately 20 PWR plants that have both plates and forgings in the belt-line region.	
30	56284	(e)(1)		2 and 3	The technical basis for the embedded flaw density and size limits given in Tables 2 and 3 of the proposed rule is briefly described. A review of the cited NRC staff document (ADAMS Accession Number ML070950392) indicates that it failed to account for the effects of the uncertainties included in the 1000 embedded flaw distributions input to FAVOR, which of the simulated flaws contributed to TWCF and which of those flaws could be detected during inspection of the beltline region adjacent to the reactor core per the requirements of ASME Section XI, Appendix VIII.	An individual utility should not be required to perform the evaluation of the effect of potentially new flaw distributions on the fleet. This should be performed by the NRC. Options for alternative methods to do this should be considered. For subsection (iii), only the appropriate value of RT-max needs to be reported for flaws exceeding the limits in Tables 2 and/or 3. This information is already available (i.e. no new paperwork requirements) and is needed for evaluation of TWCF.	
31	56284	(e)(1)		2 and 3	The embedded flaw limits for 1 vessel ISI Vol. in Tables 2 and 3 correspond to an upper 3-sigma bound on the 1000 distributions input to FAVOR. The mean (average) limits for the 69 vessels in the U.S. PWR plants are consistent with the average values reported in the FAVOR output for thousands of simulated vessels. Therefore, if the accumulated number of vessel ISI Vol. indications starts to become significantly different than the limits would indicate, an evaluation of the effects of these differences could be performed by NRC.	An individual utility should not be required to perform the evaluation of the effect of potentially new flaw distributions for the US PWR fleet. This should be performed by the NRC. Options for alternative methods to do this should be considered. One proposed option would include an appropriate revision of the input flaw distributions per NUREG/CR-6817 and a sensitivity study with the latest version of the FAVOR Code for their effect on TWCF and the PTS screening limits of Table 1.	
32				2 and 3	There are a number of technical concerns with the embedded flaw limits for welds and plates in Tables 2 and 3, respectively, in the Voluntary PTS Rule 10CFR50.61a that was proposed by the NRC.	It is suggested that The NRC have a dialogue about these technical concerns with the industry and resolve them before the Voluntary PTS Rule is finalized. See Attachment 3, Table 2 and 3 Comment, for additional information.	
33	56284	(e)(4)(i) and (e)(4)(ii)			Per the requirements of sections (c)(2) and (d)(2), the effect of exceeding the embedded flaw limits of Tables 2 and 3 on TWCF needs to be evaluated relative to the TWCF exceeding the limit of 1E-06/year and submitted to the NRC Director for review and approval.	The PTS Rule should provide direction for performing this evaluation. Alternative methods for adressing the plant specific concerns, which do not require the approval of the NRR Director, should be considered.	
34	56284	(e)(2) and (e)(4)(iii)			Surface breaking flaws that penetrate through the cladding were included in the technical basis (Oconee Unit 1 for the B&W plant designs in NUREG-1806 and NUREG-1874). It has also been shown that even if they were to occur in single pass cladding and even grow by fatigue, they would not contribute to TWCF because of their circumferential orientation.	Remove these sections from the PTS Rule since they provide no additional information of any value per the Paperwork Reduction Requirements of Section VIII.	

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35	56284	(e)(3) and (e)(4)(iv)			Embedded flaws that violate the size requirements of ASME-XI Table 3510-1 are reportable and evaluated per the requirements of IWB-3610 of ASME Section XI. This information is already contained in the vessel inspection summary reports that are being sent to NRC. For PTS concerns, the limits on number of embedded flaws by size in Tables 2 and 3 are controlling.	Remove these sections from the PTS Rule since they provide no additional information of any value per the Paperwork Reduction Requirements of Section VIII.	
36	56285	(f)(3)		4	The default limits on Manganese (Mn) in Table 4 look high, especially for welds and forgings, relative to their stated intent (mean plus one sigma) and the actual data in NUREG-1874.	The default Mn values in Table 4 should be consistent with the mean values in Tables 3.3 and 3.4 and the RMS value of global and local standard deviations in Appendix a Task 1.6 in NUREG-1874.	
37	56285	(f)(6)		5	The requirements on evaluation of surveillance or other data relative to the trend curve perfections of the T30 shift with irradiation should only apply to new data that was not already included in the development of the trend curve used in section (g). The proposed statistical evaluation per equations 8 through 10 are not consistent with how the standard deviations in Table 5 were calculated.	Eliminate section (f)(6) and Table 5.	
38				1	There are no operating PWRs in column 2 of Table 1.	Please provide clarification	
39	56284	e(1)iii			Appendix VIII does not provide the examination volume for in-service Inspections.	Delete Appendix VIII, Supplement 4 and replace with IWB-2000	
40	56284	e(1)			The footnote to the Supplement 4 inspection volume defines the volume as the weld volume and not the normal examination volume, which is the weld plus 1/2 t. This paragraph requires the inner 1 inch/10% from the clad interface to be examined or analyzed. This conflicts with e(1)ii which implies the plates and forgings are inspected. It's not clear if the examination volume is the inner 1 inch/10% or inner 3/8 not including the cladding. The definition means the plate and forging do not have to be inspected.	Clarify that the intended examination volume is the normal examination volume, which includes the weld plus ½ t from the clad-to-base metal interface to three-eights of the reactor vessel thickness from the interior surface.	
41	56284	e(3)			The volume between the cladding interface and the interior surface of the RPV are not included in the examination volume and Appendix VIII does not qualify UT procedures for this volume. See figure IWB-2500-1 and -2	Clarify that the intended examination volume is the normal examination volume, which includes the weld plus ½ t from the clad-to-base metal interface to three-eights of the reactor vessel thickness from the interior surface.	
42	56284			2	The smallest flaw depth qualified by appendix VIII is .075" so this may require smaller flaw sizes to be reported using a procedure that is not qualified to such a shallow depth.	The smallest flaw depth qualified by appendix VIII is .075". Therefore start Table 2 at .075".	
43	37	(f)(2)			When RT_{MAX-AW} is determined using Equation 1, should the $[RT_{NDT(u)}+\Delta T_{30\text{-}plate}(\varphi t_{FL})]$ be determined for each of the plates that is adjacent to the axial weld of interest? It seems like the RT_{MAX-AW} should be the maximum RT_{NDT} for the weld metal and all the plates joined by the weld. It seems like (f)(2) is trying to say this, but it is not clear.	Clarify wording in f(2) to state that RT_{MAX-AW} and RT_{MAX-CW} is the maximum RT_{NDT} for the weld metal and all the plates joined by the weld.	
44	40	(g)			Equations 1-4: In the terms $\Delta T_{30\text{-}plate}(\varphi t_{FL})$, $\Delta T_{30\text{-}axialweld}(\varphi t_{FL})$, etc. it appears that the ΔT_{30} shift is being multiplied by the φt_{FL} (flux x time or fluence term). This cannot be correct because the units of RT_{MAX-X} is temperature. I believe the (φt_{FL}) term should be part of the subscript denoting the ΔT_{30} based on the maximum fluence for the material of interest.	Clarify wording in Equations 1-4 to show ΔT_{30} and fluence are evaluative factors and not algebraic.	
45					Use of φt_{FL} for welds and φt_{MAX} for other product forms is confusing. Should just use φt_{MAX} and define it as the max fluence for either the weld of interest or other material of interest. Why does Equation 4 for $RT_{MAX\text{-}CW}$ not use φt_{FL} if Equation 1 does?	Should just use φtMAX and define it as the max fluence for either the weld of interest or other material of interest. Other option is to define fluence as φtPL, φtAW, φtFO, or φtCW to clearly indicate which fluence should be used.	

(f) *Calculation* of RT_{MAX-X} values. Each licensee shall calculate RT_{MAX-X} values for each reactor vessel beltline material using φt. φt must be calculated using an NRC-approved methodology.

(1) The values of RT_{MAX-AW}, RT_{MAX-PL}, RT_{MAX-FO}, and RT_{MAX-CW} must be determined using Equations 1 through 4 of this section.

(2) The values of ΔT_{30} must be determined using an embrittlement trend curve acceptable to the NRC (e.g., the embrittlement trend curves included in Section 50.61 of this Rule and those addressed in the Technical Basis Documents for Section 50.61a of this Rule) for each axial weld fusion line, plate, and circumferential weld fusion line, unless the conditions specified in paragraph (f)(6)(iv) of this section are met. The ΔT_{30} value for each axial weld fusion line calculated as specified by Equation 1 of this section must be calculated for the maximum fluence (φt_{FL}) occurring along a particular axial weld The ΔT_{30} value for each plate calculated as specified by Equation 1 of this section must be calculated for φt_{FL} occurring along a particular axial weld. The ΔT_{30} value for each plate or forging calculated as specified by Equations 2 and 3 of this section are calculated for the maximum fluence (φt_{MAX}) occurring at the clad-to-base metal interface of each plate or forging. In Equation 4, the φt_{FL} value used for calculating the plate, forging, and circumferential weld RT_{MAX-CW} value is the maximum φt occurring for each material along the circumferential weld.

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[2] Table 2 for the weld flaws is limited to flaw sizes that are expected to occur and were modeled from the technical basis supporting this rule. Similarly, Table 3 for the plate and forging flaws stops at the maximum flaw size modeled for these materials in the technical basis supporting this rule.

[3] Because flaws greater than three-eights of the vessel wall thickness from the inside surface do not contribute to TWCF, flaws greater than three-eights of the vessel wall thickness from the inside surface need not be analyzed for their contribution to PTS.

(3) The values of Cu and Ni (as well as for other applicable elements) in calculation of ΔT_{30} (e.g., the embrittlement trend curves included in Section 50.61 of this Rule and those addressed in the Technical Basis Documents for Section 50.61a of this Rule) must represent the best estimate values for the material weight percentages. For a plate or forging, the best estimate value is normally the mean of the measured values for that plate or forging. For a weld, the best estimate value is normally the mean of the measured values for a weld deposit made using the same weld wire heat number as the critical vessel weld. If these values are not available, either the upper limiting values given in the material specifications to which the vessel material was fabricated, or conservative estimates (mean plus one standard deviation) based on generic data[4] as shown in Table 4 of this section for P and Mn, must be used.

(4) The values of RT_{NDTu}. must be evaluated according to the procedures in the ASME Code, Section III, paragraph NB–2331. If any other method is used for this evaluation, the licensee shall submit the proposed method for review and approval by the Director along with the calculation of RT_{MAX-X} values required in paragraph (c)(1) of this section.

(i) If a measured value of RT_{NDTu}. is not available, a generic mean value of RT_{NDTu}.for the class[5] of material must be used if there are sufficient test results to establish a mean.

(ii) The following generic mean values of RT_{NDTu} must be used unless justification for different values is provided: 0 °F for welds made with Linde 80 weld flux; and -

56 °F for welds made with Linde 0091, 1092, and 124 and ARCOS B–5 weld fluxes.

(5) The value of T_c in the ΔT_{30} determination must represent the weighted time average of the reactor cold leg temperature under normal operating full power conditions from the beginning of full power operation through the end of licensed operation.

(6) The Licensee shall report any information to the Director that significantly improves or detracts from the reliability of the RTmax-x predictions. The use of any alteration of the RTmax-x predictions is subject to the approval of the Director. The methodology employed shall be consistent with ASTM Standards E185 and E2215 or other NRC-approved methodology. The licensee shall verify that an appropriate RT_{MAX-X} value has been calculated for each reactor vessel beltline material. The licensee shall consider plant-specific information that could affect the determination of a material's ΔT_{30} value.

(i) The licensee shall evaluate the results from a plant-specific or integrated surveillance program if the surveillance data has been deemed consistent as judged by the following criteria:

(A) The surveillance material must be a heat-specific match for one or more of the materials for which RT_{MAX-X} is being calculated. The 30-foot-pound transition temperature must be determined as specified by the requirements of 10 CFR 50 Appendix H.

(B) If three or more surveillance data points exist for a specific material, the surveillance data must be evaluated for consistency as specified by paragraph (f)(6)(ii) of this section. If fewer than three surveillance data points exist for a

[4] Data from the reactor vessels fabricated to the same material specification in the same shop as the vessel in question and in the same time period is an example of "generic data."

[5] The class of material for estimating $RT_{NDT(u)}$ must be determined by the type of welding flux (Linde 80, or other) for welds or by the material specification for base metal.

specific material, then it is not necessary to perform the consistency check following paragraph (f)(6)(ii).

(ii) The licensee shall estimate the mean deviation from the model (using an embrittlement trend curve acceptable to the NRC) for the specific data set (i.e., a group of surveillance data points representative of a given material). The mean deviation from the model for a given data set must be calculated using Equations 8 and 9 of this section. The mean deviation for the data set must be compared to the maximum heat-average residual given in Table 5 or Equation 10 of this section and based on the material group into which the surveillance material falls and the number of available data points. The licensee shall determine, based on this comparison, if the surveillance data show a significantly different trend than the model predicts. The surveillance data analysis must follow the criteria in paragraphs (f)(6)(iii) through (f)(6)(iv) of this section. For surveillance data sets with greater than 8 shift points, the maximum credible heat-average residual must be calculated using Equation 10 of this section. The value of σ used in Equation 10 of this section must comply with Table 5 of this section.

(iii) If the mean deviation from the model for the data set is equal to or less than the value in Table 5 or the value using Equation 10 of this section, then the ΔT_{30} value must be determined using using an embrittlement trend curve acceptable to the NRC.

(iv) If the mean deviation from the model for the data set is greater than the value in Table 5 or the value using Equation 10 of this section, the ΔT_{30} value must be determined using the surveillance data. If the mean deviation from the model for the data set is outside the limits specified in Equation 10 of this section or in Table 5 of this section, the licensee shall review the data base for that heat in detail, including all parameters in the embrittlement trend curve and the data used to determine the baseline Charpy V-notch curve for the material in an unirradiated condition. The licensee shall submit an evaluation of the surveillance data and its ΔT_{30} and RT_{MAX-X} values for review and approval by the Director no later than one year after the surveillance capsule is withdrawn from the reactor vessel.

(7) The licensee shall report any information that significantly improves the accuracy of the RT_{MAX-X} value to the Director. Any value of RT_{MAX-X} that has been modified as specified in paragraph (f)(6)(iv) of this section is subject to the approval of the Director when used as provided in this section.

(g) *Equations and variables used in this section.*

Equation 1: $RT_{MAX-AW} = MAX \{[RT_{NDT(u)-plate} + \Delta T_{30-plate}(\varphi t_{FL})], [RT_{NDT(u)-axialweld} + \Delta T_{30-axialweld}(\varphi t_{FL})]\}$

Equation 2: $RT_{MAX-PL} = RT_{NDT(u)-plate} + \Delta T_{30-plate}(\varphi t_{MAX})$

Equation 3: $RT_{MAX-FO} = RT_{NDT(u)-forging} + \Delta T_{30-forging}(\varphi t_{MAX})$

Equation 4: $RT_{MAX-CW} = MAX \{[RT_{NDT(u)-plate} + \Delta T_{30-plate}(\varphi t_{MAX})], [RT_{NDT(u)-circweld} + \Delta T_{30-circweld}(\varphi t_{MAX})], [RT_{NDT(u)-forging} + \Delta T_{30-forging}(\varphi t_{MAX})]\}$

Equation 8: Residual (ρ) = measured ΔT_{30} - predicted ΔT_{30} (by Equations 5, 6, and 7)

Equation 9: Mean deviation for a data set of n data points $= \sum_{i=1}^{n} r_i / n$

Enclosure 3

There are a number of technical concerns with the embedded flaw limits for welds and plates in Tables 2 and 3, respectively, in the Voluntary PTS Rule 10CFR50.61a that was proposed by the NRC. It is suggested that the NRC have a dialogue about these technical concerns with the industry and resolve them before the final version of the Voluntary PTS Rule is published for use.

These technical concerns are stated and briefly summarized below.

1. Minimum Flaw Size

The minimum flaw size is inconsistent with ASME Code inspection requirements and therefore can not be practically implemented.

For embedded flaws, the size in the depth direction is characterized by through-wall extent (TWE). The minimum value of TWE, below which there is no limit on the number of flaws in Tables 2 and 3 is different than that used in Section 2.10.2.2 on Probability of Detection and Figure 2.8 in NUREG-1874.

2. Flaw Size Increment

The flaw size increments in the proposed tables are inconsistent with those used in the representative plant analyses in NUREG-1874.

The embedded flaw size (TWE) increment in revised Tables 2 and 3 is less than one percent of the vessel wall thickness. However, an increment of one percent was used to generate the 1000 weld and plate flaw distributions that are input into FAVOR as described in Sections 9.4 and 9.5, respectively, of Revision 1 of NUREG/CR-6817, *A Generalized Procedure for Generating Flaw-Related Inputs for the FAVOR Code.* Moreover, for the probabilistic fracture mechanics (PFM) calculations, FAVOR uses only the largest flaw size for the range of sizes in each increment of one percent of the vessel wall thickness.

3. Flaw Contribution to TWCF

The flaw limits should be based on only those embedded flaws that contribute to vessel failure.

The limits on embedded flaws in Tables 2 and 3 are based upon the flaws simulated by FAVOR, not just those flaws that that could fail due to PTS. The following simulated flaws have minimal contribution to failure and TWCF: embedded flaws up to one foot above and below the beltline region adjacent to the reactor core, flaws with a TWE from 12.5% to 37.5% of the vessel wall thickness and all embedded flaws that are oriented in a circumferential direction

4. Allowable Number of Flaws

The flaw limits are applicable to a large number of vessels, not a single vessel, since they are based on average values of the thousands of simulations used in the representative plant probabilistic analyses.

The allowable number of flaws in Tables 2 and 3 is based upon the average number of flaws in a given size (TWE) range for thousands of vessel simulations by FAVOR without any consideration of the variability among the 1000 flaw distributions input to FAVOR for both welds and plates. It is expected that the number of embedded flaws in 50% of the vessels would be greater than this average value.

5. Maximum Flaw Size

The maximum flaw size limits are unrealistic because they do not represent the range of values used in the representative plant analyses.

The maximum embedded flaw size (TWE) for welds in Tables 2 and 3 are set so that on average only one flaw would be expected to occur in each vessel simulated by FAVOR. It appears there is no consideration of the maximum embedded flaw size (TWE) in the 1000 distributions input to FAVOR, which are based upon the truncation limits in Revision 1 of NUREG/CR-6817.

6. Limits for Plate Flaws

The plate embedded flaw limits are unrealistic as they are primarily based upon failures in simulated axial weld flaws.

It appears that the embedded flaw limits for plates in Table 3 are based upon FAVOR output for plate failures, not plate flaws. FAVOR results used for NUREG-1874 show that the majority of plate failures are due to simulated axial weld flaws for Beaver Valley Unit 1. Also it is not clear if the limits in Table 3 apply to all of the plate material or just the beltline material inspected with the welds per the requirements in Section XI of the ASME Code.

7. Forging Limitations

The plate limits should have restrictions regarding their application to forgings susceptible to underclad cracking.

There is no guidance on whether the plate embedded flaw limits in Table 3 can be applied for forgings. It appears that the limits of Table 3 can be applied to forgings if they are not susceptible to underclad cracking or the susceptible forging material is below the appropriate PTS screening limit in Table 1 of the Voluntary PTS Rule (e.g. 246 °F for vessel wall $\leq$ 9.5 inch).

8. Evaluation if Flaw Limits Are Exceeded

An acceptable evaluation method is required since neither of the options suggested in Section II of the proposed rule can be practically implemented.

If the number of embedded flaws exceeds the limits for total number of flaws in Tables 2 and/or 3 for welds and plates, respectively, then an evaluation of the effects of exceeding these limits would be required to be submitted to the Director of NRR for review and approval. It appears that a simple evaluation procedure could be developed based upon the fact that probability of vessel failure (through-wall crack) during a postulated PTS transient depends on the number of embedded axial flaws in the vessel. The adjusted TWCF contribution of the axial welds and/or plates could then be calculated using the correlations with the $RT_{MAX\text{-}X}$ per equations 3-5 and 3-6 in NUREG-1874 and evaluated relative to the risk limit of $1x10^{-6}$/year without the approval of the Director of NRR being required..

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