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1CAN061401

June 26, 2014

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
11555 Rockville Pike
Rockville, MD 20852

SUBJECT: Response to Request for Additional Information Regarding Proposed Exemption for Alternative Initial Reference Temperature Values
Arkansas Nuclear One – Unit 1
Docket No. 50-313
License No. DPR-51

REFERENCES:
1. Entergy letter dated March 20, 2014, “Request for Exemption from Certain 10 CFR 50.61 and 10 CFR 50, Appendix G Requirements” (1CAN031403) (ML14083A640)
2. NRC letter dated June 4, 2014, “Arkansas Nuclear One, Unit 1 – Request for Additional Information Regarding Proposed Exemption for Alternative Initial Reference Temperature Values” (TAC No. MF3700) (ML14148A382)

Dear Sir or Madam:

By letter dated March 20, 2014 (Reference 1), Entergy Operations, Inc. (Entergy) submitted an exemption request for Arkansas Nuclear One, Unit 1 (ANO-1). The exemption request is from certain requirements in 10 CFR 50.61, "Fracture toughness requirements for protection against pressurized thermal shock events," and 10 CFR 50, Appendix G, "Fracture Toughness Requirements," for the proposed use of alternative initial reference temperature values for Linde 80 welds used in fabricating the ANO-1 reactor vessel.

The NRC has reviewed the submittal and has determined that in order for the staff to complete its review of the exemption, additional information is required. The purpose of this submittal is to provide the requested response. The response is attached.

This letter contains no new regulatory commitments.

If you have any questions or require additional information, please contact me.

Sincerely,

ORIGINAL SIGNED BY DAVID B. BICE FOR STEPHENIE S. PYLE

SLP/rwc

Attachment: Response to Request for Additional Information Exemption Request Regarding Alternative Initial Reference Temperature Values for Certain Welds

cc: Mr. Marc L. Dapas
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U. S. Nuclear Regulatory Commission
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Attachment to

1CAN061401

Response to Request for Additional Information
Exemption Request Regarding Alternative Initial
Reference Temperature Values for Certain Welds

**Response to Request for Additional Information
Exemption Request Regarding Alternative Initial
Reference Temperature Values for Certain Welds**

By letter dated March 20, 2014 (Agencywide Documents Access and Management System Accession No. ML14083A640), Entergy Operations, Inc., submitted an exemption request for Arkansas Nuclear One, Unit 1 (ANO-1). The exemption is relating to use of alternative initial reference temperature values for Linde 80 welds used in fabricating the ANO-1 reactor vessel. In order for the U.S. Nuclear Regulatory Commission (NRC) staff to complete its review of the exemption, a response to the following request for additional information is requested.

1. **The request dated March 20, 2014, does not explain values of chemistry factor which are used to calculate the reference temperature (RT_{NDT}). The NRC needs this information to ensure that the ΔRT_{NDT} calculation is in accordance with the conditions and limitations in Topical Report BAW-2308, Revision 1-A and 2-A, "Initial ΔRT_{NDT} of Linde 80 Weld Materials," regarding chemistry factors. Please provide the values of chemistry factor used along with the detailed calculation for ΔRT_{NDT}.**

   Entergy Response:

   The following information is related to the pressurized thermal shock calculation (i.e., the fluence is calculated at the clad / base metal interface. The only difference between the determination of the ΔRT_{NDT} for the adjusted reference temperature and the PTS value is where the fluence is determined. The chemistry factor is not impacted by the fluence factor.

   The chemistry factor and the determination of ΔRT_{NDT} are provided in this attachment for all of the ANO-1 reactor vessel material for completeness. The forgings and plates are not impacted by the request for the exemption to use BAW-2308.

   The determination of ΔRT_{NDT} is provided below.

   ΔRT_{NDT} is the mean value of the adjustment in reference temperature caused by irradiation and is calculated per 10 CFR 50.61 or Regulatory Guide (RG) 1.99, Revision 2 (same methodology) as follows:

   $$\Delta RT_{NDT} = (CF) \times (FF) \quad (1)$$

   where *CF* is the Chemistry Factor and *FF* is the fluence factor.

   The *CF* is a function of the material's copper (Cu) and nickel (Ni) content (Cu weight percent (wt%) and Ni wt%, respectively). When determining the *CF*, the Cu wt% and Ni wt% are best estimate values for the material, which are normally the mean of the measured values for the material when available.

The Cu and Ni contents for the ANO-1 reactor vessel (RV) beltline materials are reported in BAW-2313. The Cu wt% and Ni wt% values for the forgings and plates are from measured data reported on the ANO-1 RV material's certified material test reports (CMTRs). The Cu wt% and Ni w% values for the Linde 80 welds are statistically determined best estimates for each weld wire heat.

The *CF* is determined from Table 1 (for weld metals) and Table 2 (for base metals) in 10 CFR 50.61. Linear interpolation is permitted. Using Linde 80 weld metal initial RT_{NDT} from BAW-2308 requires a minimum *CF* of 167.0.

Table 1 lists the chemistry factors for the ANO-1 RV beltline materials.

Table 1: 10 CFR 50.61 Chemistry Factors for the ANO-1 RV Materials

Beltline Materials	Material Identification (ID)/Acceptance No.	Cu wt% *[Note A]*	Ni wt% *[Note A]*	Chemistry Factor *[Note B]*
Lower Nozzle Belt Forging	AYN 131	0.03	0.70	20.0
Upper Shell Plate 1	C5120-2	0.17	0.55	122.75
Upper Shell Plate 2	C5114-2	0.15	0.52	105.6
Lower Shell Plate 1	C5120-1	0.17	0.55	122.75
Lower Shell Plate 2	C5114-1	0.15	0.52	105.6
LNBF to US Circ. Weld	WF-182-1	0.24	0.63	177.95
US 1 to US 2 Axial Welds (2)	WF-18	0.19	0.57	167.0
US to LS Circ. Weld	WF-112	0.27	0.59	182.55
LS 1 to LS 2 Axial Welds (2)	WF-18	0.19	0.57	167.0

US = Upper Shell
LS = Lower Shell
LNBF = Lower Nozzle Belt Forging
Circ. = Circumferential

Notes:

A. The reported Cu wt% and Ni wt% values for beltline forgings and plates are from measured data; the reported Cu wt% and Ni wt% values for beltline welds are weld-wire heat best estimates.

B. The Chemistry Factor is calculated per 10 CFR 50.61 or RG 1.99, Revision 2 Tables 1 and 2 (linear interpolation allowed) with a minimum of 167.0 for Linde 80 weld metals per BAW-2308.

In accordance with 10 CR 50.61, the *FF* is determined as follows:

$$FF = f^{(0.28 - 0.10 \log f)} \quad (2)$$

where f (10^{19} n/cm^2, E > 1.0 MeV) is the projected peak fluence at the clad / base metal interface.

The projected peak fluence value was determined using the methodology provided in BAW-2241-P-A..

Table 2 lists the *FFs* for the ANO-1 RV beltline materials at 54 Effective Full Power Years (EFPY).

Table 2: Fluence Factors at 54 EFPY for the ANO-1 RV Materials

Beltline Materials	Material ID	54 EFPY Peak Fluence (10^{19} n/cm^2)	Fluence Factor
Lower Nozzle Belt Forging (start of 12" thickness)	AYN 131	0.113	0.442
Lower Nozzle Belt Forging (start of 8.44" thickness)	AYN 131	0.142	0.491
Lower Nozzle Belt Forging (at LNBF to US Weld)	AYN 131	1.21	1.053
Upper Shell Plate 1	C5120-2	1.34	1.081
Upper Shell Plate 2	C5114-2	1.34	1.081
Lower Shell Plate 1 (8.44" thickness)	C5120-1	1.32	1.077
Lower Shell Plate 2 (8.44" thickness)	C5114-1	1.32	1.077
LNBF to Upper Shell Circumferential Weld	WF-182-1	1.21	1.053
US 1 to US 2 Axial Welds (2)	WF-18	1.06	1.016
Upper Shell to Lower Shell Circumferential Weld	WF-112	1.28	1.069
LS 1 to LS 2 Axial Welds (2)	WF-18	1.14	1.037

LNBF = Lower Nozzle Belt Forging
US = Upper Shell
LS = Lower Shell

The ΔRT_{NDT} values are calculated by multiplying the chemistry factors and fluence factors. The 54 EFPY ΔRT_{NDT} values for the ANO-1 RV beltline materials are presented in Table 3.

Table 3: ΔRTNDT Values for the ANO-1 RV Materials at 54 EFPY

Beltline Materials	Material ID	*CF*	*FF*	ΔRT_{NDT} (°F)
Lower Nozzle Belt Forging (start of 12" thickness)	AYN 131	20.0	0.442	8.8
Lower Nozzle Belt Forging (start of 8.44" thickness)	AYN 131	20.0	0.491	9.8
Lower Nozzle Belt Forging (at LNBF to US Weld)	AYN 131	20.0	1.053	21.1
Upper Shell Plate 1	C5120-2	122.75	1.081	132.7
Upper Shell Plate 2	C5114-2	105.6	1.081	114.2
Lower Shell Plate 1 (8.44" thickness)	C5120-1	122.75	1.077	132.2
Lower Shell Plate 2 (8.44" thickness)	C5114-1	105.6	1.077	113.8
LNBF to Upper Shell Circumferential Weld	WF-182-1	177.95	1.053	187.4
US 1 to US 2 Axial Welds (2)	WF-18	167.0	1.016	169.7
Upper Shell to Lower Shell Circumferential Weld	WF-112	182.55	1.069	195.1
LS 1 to LS 2 Axial Welds (2)	WF-18	167.0	1.037	173.1

LNBF = Lower Nozzle Belt Forging
US = Upper Shell
LS = Lower Shell
°F = degrees Fahrenheit