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SUBJECT: Responds to RAI re W WCAP-13587,rev 1,"Reactor Vessel Upper Shelf Energy Bounding Evaluation For W Pressurized Water Reactors, & GL-92-01,rev 1, "Reactor Vessel Structural Integrity."

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Indiana Michigan
Power Company
P.O. Box 16631
Columbus, OH 43216

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Donald C. Cook Nuclear Plant Units 1 and 2
Docket Nos. 50-315 and 50-316
License Nos. DPR-58 and DPR-74
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
FOR GENERIC LETTER 92-01, REV. 1
(TAC NOS. M83453 AND M83454)

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555

Attn: T. E. Murley

January 24, 1994

Dear Dr. Murley:

This letter and its attachment are being submitted in response to a verbal request for additional information from your staff regarding Westinghouse WCAP-13587, Revision 1, "Reactor Vessel Upper Shelf Energy Bounding Evaluation for Westinghouse Pressurized Water Reactors," and our response to Generic Letter 92-01, Revision 1, "Reactor Vessel Structural Integrity," as applicable to Donald C. Cook Nuclear Plant, Units 1 and 2.

The attachment to this letter provides the additional information on the upper shelf energy for the upper shell course plates for the Unit 2 reactor vessel. This information was sent to your staff on December 21, 1993, on a draft basis. This letter finalizes and provides additional clarifications on the matter.

Sincerely,

E E Fitzpatrick

E. E. Fitzpatrick
Vice President

cad

Attachment

A028
1/1

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PDR ADOCK 05000315
P PDR

cc: A. A. Blind - Bridgman
G. Charnoff
J. B. Martin - Region III
NFEM Section Chief
NRC Resident Inspector - Bridgman
J. R. Padgett

bc: S. J. Brewer
D. H. Malin/J. B. Kingseed/T. R. Satyan-Sharma
M. L. Horvath - Bridgman - w/o attachment
J. D. Benes
J. B. Shinnock - w/o attachment
W. G. Smith, Jr.
J. B. Hickman, NRC - Washington, D.C.
AEP:NRC:1173B
DC-N-6015.1 - w/o attachment

ATTACHMENT TO AEP:NRC:1173B

AMERICAN ELECTRIC POWER SERVICE CORPORATION

DONALD C. COOK NUCLEAR PLANT UNIT 2

UPPER SHELF CHARPY VALUES

American Electric Power Service Corporation
Donald C. Cook Nuclear Plant Unit 2 Upper Shelf Charpy Values

Per the definition for "beltline region of the reactor vessel", given in 10 CFR 50 Appendix G, "Fracture Toughness Requirements", seven plates from the Donald C. Cook Nuclear Plant Unit 2 reactor pressure vessel are considered to be in the beltline region. The location in the reactor pressure vessel and the identification as to heat number are given in Table 1. As part of the reactor pressure vessel material acceptance criteria, the manufacturer of the vessel, Chicago Bridge & Iron (CBI) Company contracted Lukens Steel Company to perform charpy impact testing on material from the seven plates. The Westinghouse Electric Corporation Vessel Equipment Specification (E-Spec) required that a value of 30 ft-lbs be obtained at 10°F. The Donald C. Cook Nuclear Plant Unit 2 reactor pressure vessel was fabricated prior to the ASME Section III Code and 10 CFR Part 50 Appendix G requirement that the charpy V-notch impact specimens be oriented in the transverse or "weak" direction to meet the RT_{NDT} or upper shelf requirements. When Lukens Steel Company performed the testing on the Donald C. Cook Nuclear Plant Unit 2 reactor pressure vessel materials the specimens were oriented in the longitudinal or "strong" direction. Further, Lukens Steel Company provided partial (i.e. not to 100% shear) Charpy curves for specimens in the longitudinal direction.

As part of the reactor pressure vessel materials radiation surveillance program, Westinghouse performed charpy V-notch impact testing in the transverse direction on the two intermediate and two lower shell plates. Testing of the four plates showed that they meet 10 CFR Part 50 Appendix G requirements of having a minimum of 75 ft-lbs at the start of plant life. The remaining three plates from the upper shell course location were not tested as part of the surveillance program because they were not evaluated to be limiting. The upper shell plates have similar chemistry as the intermediate and lower shell plates, however they are located nineteen (19) inches above the active core and will experience a significantly lower fluence than the intermediate and lower shell plates as shown in Table 2. The original Lukens Steel Company material testing of the three upper shell course plates, heat numbers C5518-1, C5518-2 and C5521-1 exhibited a maximum of 84 ft-lbs at 70% shear, 75 ft-lbs at 50% shear; and 63 ft-lbs at 40% shear, respectively. Lukens Steel Company obtained the above results from specimens oriented in the longitudinal direction. That is, the long axis of the charpy V-notch impact specimen was parallel to the major working direction of the plates. U. S. Nuclear Regulatory Commission, Standard Review Plan, NUREG-0800, Revision 1 dated July 1981 states that if tests were only made on longitudinal specimens, the values should be reduced to 65% of the longitudinal values to estimate the transverse properties. The 65% criteria was developed from data obtained by the Pressure Vessel Research Committee (PVRC) and the Metals Properties Council (MPC) in the mid to late nineteen sixties and early nineteen seventies. Based on the partial longitudinal Charpy curves provided by the Lukens Steel Company and the 65% multiplication factor in NUREG-0800, Revision 1, the calculated transverse Charpy V-notch energies (ft-lbs) for plates C5518-1, C5518-2, and C5521-2 would be 54 (0.65 x 84), 48 (0.65 x 75), and 41 (0.65 x 63), respectively.

Table 2 presents the weight percent copper, the end-of-life (EOL, 32 EFPY) fluence at the 1/4-thickness and the resulting percentage decrease in upper shelf energy per Regulatory Guide 1.99, Revision 2. In order to meet the 10 CFR Part 50 Appendix G requirement that the reactor vessel exhibit a minimum of 50 ft-lbs in the transverse direction during the plant's operating life, plates C5518-1, C5518-2 and C5521-1 would have to have a minimum initial

upper shelf impact energy of 56 ft-lbs, 56 ft-lbs and 57 ft-lbs, respectively. Plates C5518-1 and C5518-2 are from the same heat of steel. The designation of 1 and 2 refer to the plate number as they were cut off during the hot rolling. From the partial energy versus temperature curve given in Figures 1 and 2 for C5518-1 and C5518-2 one would expect the upper shelf energy would plateau above that shown on the abbreviated curve such that the initial transverse energy (0.65 x longitudinal) would be above 56 ft-lbs, ensuring that the 50 ft-lb EOL energy requirement is exceeded. The partial Charpy impact energy versus temperature curve for plate C5521-1 is shown in Figure 3. Similarly, one would expect the upper shelf energy of plate C5521-1 to plateau above that shown in Figure 3. This can be confirmed from the transverse Charpy impact data for intermediate shell plate C5521-2, Figure 4. Plate C5521-2 charpy V-notch impact energy versus temperature curve for specimens oriented in the transverse direction (axis of the specimen perpendicular to the major working direction) is shown in Figure 4 and shows an upper shelf energy of 86 ft-lbs. Based on the projected EOL fluence, copper content (see Table 2), Regulatory Guide 1.99, Revision 2 methodology results in a predicted decrease of 11.5% in upper shelf energy at EOL for upper shell course plate C5521-1 resulting in a EOL upper shelf energy of 76 ft-lbs (0.885 x 86 ft-lbs).

Therefore, it can be concluded that the three upper shell plates, C5518-1, C5518-2, and C5521-1 will exceed the minimum required Charpy impact energy of 50 ft-lbs in the transverse direction during the plant's operating life.

TABLE 1
DONALD C. COOK NUCLEAR PLANT UNIT 2 BELTLINE REGION PLATES

Location	Identification
Upper Shell Course	C5518-1
Upper Shell Course	C5518-2
Upper Shell Course	C5521-1
Intermediate Shell Course	C5521-2
Intermediate Shell Course	C5556-2
Lower Shell Course	C5540-2
Lower Shell Course	C5592-1

TABLE 2
END-OF-LIFE UPPER SHELF ENERGY

Material Description	Copper (wt. %)	EOL 1/4-t Fluence (n/cm^2)	R. G. 1.99, Rev. 2 (% Decrease)	Minimum Initial USE (Ft-lbs)
C5518-1	0.12	4.85 E+17	10.5	56
C5518-2	0.12	4.85 E+17	10.5	56
C5521-1	0.14	4.85 E+17	11.5	57
C5521-2	0.14	1.03 E+19	23.0	62
C5556-2	0.15	1.03 E+19	24.0	62
C5540-2	0.11	1.03 E+19	20.0	60
C5592-1	0.14	1.03 E+19	23.0	62

FIGURE 1

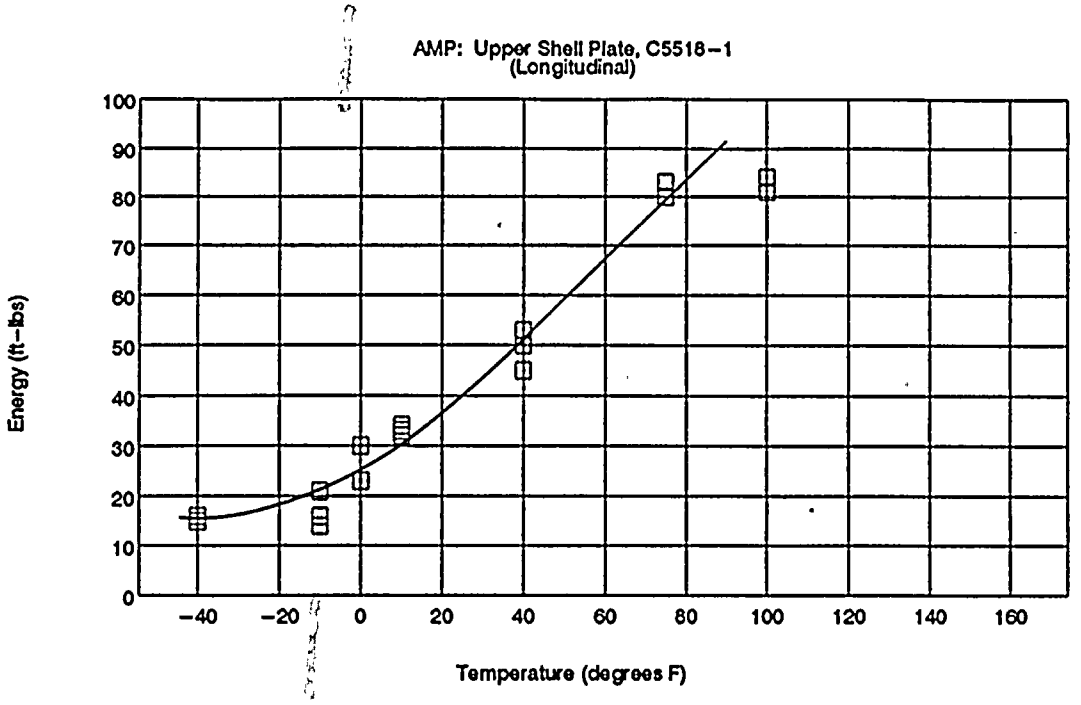

FIGURE 2

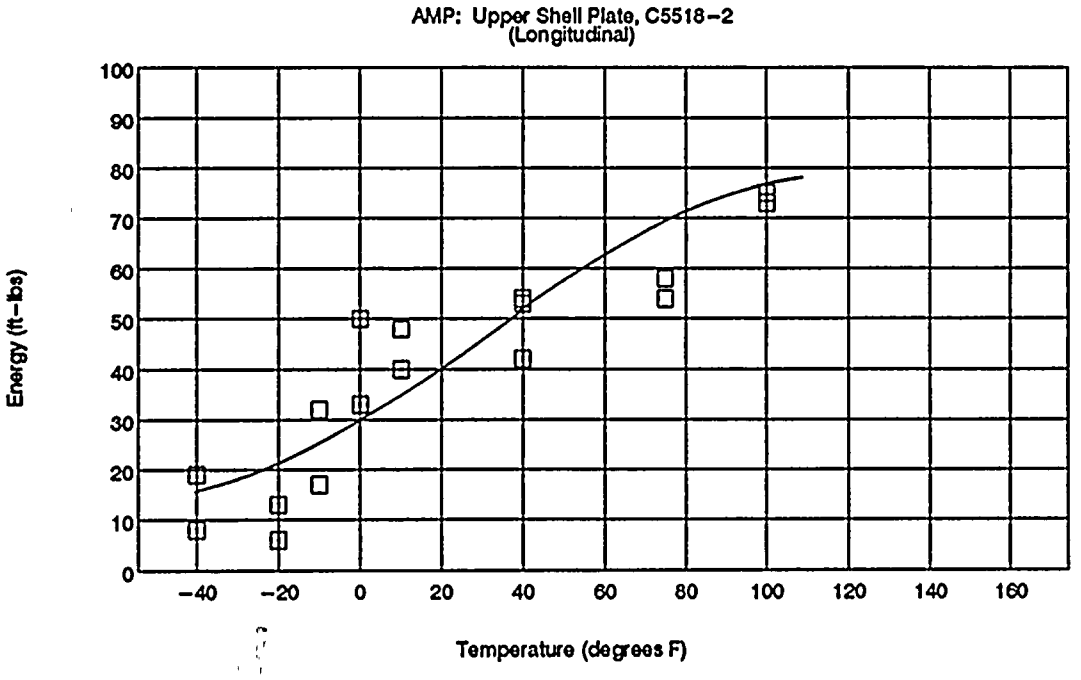

FIGURE 3

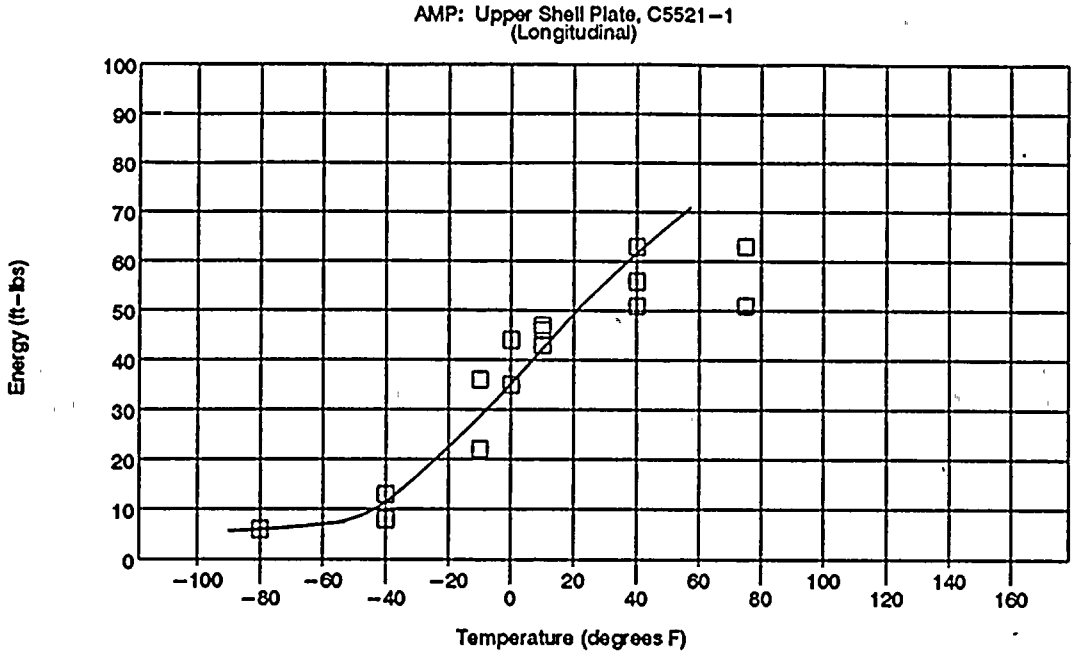

FIGURE 4