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January 4, 1990

Dr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Dresden Nuclear Power Station Unit 3
ABB-ATOM Control Rod Demonstration Program
NRC Docket No. 50-249

References (a): CECo letter J.A. Silady to T.E. Murley dated October 18, 1989, "Extension of ABB-ATOM Control Rod Demonstration Program".

(b): CECo letter B. Rybak to H. R. Denton dated July 18, 1983, "Proposed Amendments to Appendix A of the Technical Specifications to Operating License DPR-25 regarding use of ASEA-ATOM CRD Blades".

(c): Conference Call between CECo (J.A. Silady, D.R. O'Boyle, et al.) and NRC (B.L. Siegel, H.J. Richings, M.P. Huber et al.) on December 21, 1989.

(d): ABB-ATOM Letter Orjan Bernander to D. R. O'Boyle dated December 27, 1989, "EPRI/ABB Control Rod Program in Dresden-3: Technical Justification for Continued Operation of a Cracked Control Rod During Cycle 12" (See Attachment B).

Dr. Murley:

As discussed in our Reference (a) letter, Commonwealth Edison (CECo) is planning to extend the EPRI/ABB-ATOM control rod demonstration program at Dresden Unit 3 beyond the originally proposed three cycles of operation. This program involves the irradiation of eight lead test control rods, four all-B4C control rods and four with hafnium tips. Reinsertion of these control rods was

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dependent on the results of the Dresden Unit 3 End-of-Cycle 11 visual examination conducted at Dresden by ABB-ATOM. This visual examination identified minor crack indications in three of the eight control rods. As discussed in Attachments A and B Commonwealth Edison proposes to continue irradiation of the five unaffected control rods and one of the control rods with minor cracks. The remaining two control rods will be discharged.

The continued irradiation of these six ABB-ATOM control rods in Dresden 3 does not present an unreviewed safety question and will permit the objectives of the lead test control rod project to be met. CECo requests NRC concurrence with this proposal. Fuel reload is currently expected to begin January 9, 1990 with startup in the second week of February.

Please contact this office should further information be required.

Very truly yours,

J. A. Silady
Nuclear Licensing Administrator

Attachments

cc: A.B. Davis - Regional Administrator, RIII
B.L. Siegel - Project Manager, NRR
S.G. DuPont - Senior Resident Inspector, Dresden

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ATTACHMENT A

A visual examination of the ABB control rods was performed in the spent fuel pool using high resolution color video monitoring and recording equipment and included all eight surfaces of each of the eight control rods. Previous end-of-cycle examinations on these test control rods only included four of the control rods. The Dresden lead test control rods are the first ABB-ATOM rods to be examined in the U.S.; however, ABB-ATOM has performed examinations on approximately 300 control rods in Europe. The visual examination at Dresden was completed on December 17, 1989, with the initial onsite report showing minor crack indications on three of the eight control rods. The preliminary examination results were discussed with B.L.Siegel (NRR Project Manager for Dresden) and personnel from the Reactor Systems Branch during a conference call on December 21, 1989, Reference (c). The video tape recordings were examined by ABB engineers in Vasteras, Sweden, who have previous experience in evaluating control rod integrity, and a summary of the results and recommendations was provided to CECo in the Reference (d) letter which is enclosed as Attachment B.

The affected control rods included one all-B4C control rod (AA103) and two hafnium tipped control rods (AA106H and AA107H). Control rod AA103 had three minor crack indications which are discussed further in Attachment B. Preliminary reviews of the two hafnium tipped control rods showed four and eight crack indications on the two rods. Additional information on these control rods will be provided to the NRC as it becomes available to Edison from ABB-ATOM.

Commonwealth Edison proposes to discharge the two cracked hafnium tipped control rods, place the cracked all-B4C control rod and one of the non-cracked all-B4C control rods in non-control cell core locations, and place the remaining four non-cracked control rods (two all-B4C and two hafnium tipped) into symmetric control cell core locations. The two control rods in the non-control cell core positions will only accumulate significant fluence in the control rod tip.

ABB-ATOM has indicated that any potential loss of B4C in Rod AA103 is insignificant with respect to reactivity depletion, based on previous inspections of B4C loss using neutron radiography performed in Europe. ABB-ATOM has extensive experience in Swedish and Finnish reactors, with continued operation of rods with confirmed or expected cracking for one or two cycles in non-control cell core locations. This experience has shown that no degradation occurs to significantly reduce the shutdown margin or affect structural or mechanical integrity. Neutron radiograph examinations of these control rods with confirmed cracks has revealed that after one or two cycles of operation with cracks, additional B4C loss could generally not be detected.

As indicated in Reference (d), two of the cracks on control rod AA103 are located near the tip of one of the wings. If additional cracking were to occur, any B4C loss would likely be limited to the top 2 or 3 absorber-filled holes. Since there are 454 absorber holes per wing (1816 absorber holes per control rod) the potential loss of B4C in a few holes would have a neglible affect on reactivity worth. The third minor crack on Rod AA103 is near the middle of the control rod and therefore is not expected to propagate since the rod segment will accumulate essentially no neutron fluence in the fully withdrawn position during high power operation.

It should also be noted that these control rods were originally considered high worth control rods. In our Reference (a) letter, CECo indicated that the control rods are now considered matched worth control rods due to their exposure and therefore would not be specifically modeled. This continues to be true for the control rods to be placed in the control cell core locations. However, due to voiding differences, the control rods to be place in the non-control cell core locations will be slightly higher than matched worth at full power, while considered matched worth at cold clean conditions and at low powers. Since the cycle analyses were already performed assuming fully matched worth control rods, CECo has evaluated the effect of slightly higher worth rods on the cycle analyses and determined that the slightly higher worth will have minimal impact.

The higher worth control rods are a potential concern only with regard to positive reactivity insertion events involving control rods, i.e. the Rod Drop Accident (RDA) and the Rod Withdrawal Error (RWE). The higher worth rods will not affect the RDA analysis because the RDA is only a concern below 20% power where the control rods are essentially matched worth. In addition, the D3C11 RDA shows considerable margin to the RDA analysis limit. With regard to the RWE, in the initial Reference (b) submittal to the NRC concerning these test blades, CECo indicated that if the ABB-ATOM control rods were placed in non-control cell core locations that the higher worth of these rods would be explicitly factored into the limiting RWE analysis as appropriate. However, since the slightly high worth control rods have minimal impact on the RWE analysis, they will not be explicitly factored into the D3C12 cycle specific RWE analysis. The control rods in the two locations where the higher worth rods are to be placed were fully withdrawn in the limiting rod pattern for the D3C12 RWE analysis and therefore had no impact on the analysis. The non-control cell locations planned for the two higher worth rods by definition limit the situations when these are even partially inserted to lower power conditions. Based on discussions with CECo and ANF nuclear design engineers, rod worths and RWE results would be comparable even if one of these rods is assumed to be erroneously inserted and erroneously withdrawn at full power. In addition, the D3C12 RWE transient analysis limiting MCPR is bounded by the limiting pressurization transient with considerable margin (0.20 ΔCPR for RWE vs. 0.29 ΔCPR for Load Reject w/o Bypass).

Based on the above, Commonwealth Edison concludes that operation of Dresden Unit 3 Cycle 12, with four of the unaffected ABB-ATOM lead test control rods in control cell core locations and two of the ABB-ATOM lead test control rods (one unaffected and one with minor cracking) in non-control cell core locations, does not result in an unreviewed safety question. The conclusions of the CECo review of the reload per 10 CFR 50.59 are therefore not expected to change. Consistent with past practice, CECo will provide a courtesy notification letter prior to restart which documents the results of the reload review per 10 CFR 50.59. This letter will also transmit the final Core Operating Limits Report for D3C12.

ATTACHMENT B

Commonwealth Edison Co.
Att.: Dr Dennis O'Boyle
Core Materials Technology
P. O. Box 767
CHICAGO ILL 60690, U.S.A.

December 27, 1989

Subject: EPRI/ABB control rod program in Dresden-3: Technical justification for continued operation of a cracked control rod during cycle 12.

ABB Atom has proposed that, of the eight control rods, the four intact rods No. 101, 104, 105H, and 108H be reinserted into control cells for use in Single Rod Sequences during cycle 12 as in the previous operating cycles. These four rods then represent three design variants, namely, the use of both the early (No. 101) and the later steel qualities as well as rods with and without hafnium in the top six inches. Another two rods were proposed to be reinserted in non-control cell locations. One of these is intact (No. 102) while No. 103 has minor cracking. The remaining two rods have been suggested not to be reinserted.

The rods were visually inspected in the Dresden-3 spent fuel pool using high-resolution video monitoring and recording. All eight control rods also passed a gauge test, showing that no significant deformation of the blade wings had taken place. The tape recordings were later scrutinized by ABB engineers in Västerås, Sweden, who have previous experience in checking control rod integrity. The cracks found on three of the rods (No. 103, 106H, and 107H) have been divided into three categories, as demonstrated in the appended diagram. Rod No. 103 has revealed cracks, one each of type 1 and 2 at the top end of the boron carbide zone of one blade wing, and one type 3 crack near the middle of another. The judgement is that B4C loss is insignificant in this rod (as well as in the other two) with respect to reactivity depletion. This conclusion is based on earlier checking of B4C loss by neutron radiography.

The safe continued operation of rod No. 103 is supported by extensive experience in the 11 Swedish and Finnish reactors, where rods with confirmed or expected cracking are routinely operated for one or two additional (12-month) cycles in non-control cells beyond detection of cracking. No case of degradation, sufficient to significantly reduce the shutdown margin or otherwise affect mechanical integrity, is known to ABB Atom.

Neutron radiography of 28 ABB Atom control rods with confirmed cracks has revealed only minor or no loss of boron carbide. After one or two cycles of operation with cracks, additional loss could generally not be detected. In no case was the loss sufficient to affect the shut-down margin significantly. The important conclusion was that when the control rods continue to be used in non-control cell, there is little or no defect progression. It is probably significant that in such locations only the very tip of the rods experiences any substantial exposure increment (and even there rather much less than the tip of a partially inserted rod).

In the Dresden-3 case, as mentioned earlier, the cracks of type 1 and 2 are at the top end where there is an exposure peaking. If any further cracking were to occur, it is thus expected to be confined to the very top end of the rod, and therefore any loss of B4C would be limited to the top 2 or 3 absorber-filled holes and most likely to just one of the four blade wings. The depletion of reactivity worth is then negligible. Also, the observed type 3 crack is not expected to propagate since the pertinent rod segment will see essentially no neutron flux in the fully withdrawn position during high power operation and thus no further build-up of stresses.

In summary, ABB Atom concludes from the above that rod No. 103 can be safely operated as proposed for an additional 18-month cycle both with respect to mechanical integrity and to reactivity shutdown requirements.

Yours sincerely,

ABB Atom
Fuel division
Fuel engineering and development

Örjan Bernander
(General manager)

Crack morphology

Type 1: Appears like a conventional absorber swelling crack

Type 2: Originates at blade outer edge. Does not correlate to position of absorber channel. Sometimes branching. Probably not caused by absorber swelling.

Type 3: Originates at tab corner. Short cracks at an angle to channels. Not associated with absorber swelling