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SUBJECT: Final response to NRC Bulletin 90-002, "Loss of Thermal  
Margin Caused by Channel Box Bow."

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September 28, 1990  
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Docket No. 50-397

U. S. Nuclear Regulatory Commission  
Attn: Document Control Desk  
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Gentlemen:

Subject: NUCLEAR PLANT NO. 2; OPERATING LICENSE NPF-21  
FINAL RESPONSE TO NRC BULLETIN NO. 90-02:  
LOSS OF THERMAL MARGIN CAUSED BY CHANNEL BOX BOW

- References:
1. NRC Bulletin No. 90-02, March 20, 1990, "Loss of Thermal Margin Caused by Channel Box Bow"
  2. G02-90-075, April 13, 1990, GC Sorensen; Manager, Regulatory Programs to USNRC, "Nuclear Plant No. 2; Operating License NPF-21; Modification to the WNP-2 Cycle 6 Reload Submittal and Response to NRC Bulletin No. 90-02: Loss of Thermal Margin Caused by Channel Box Bow"
  3. Nuclear Technology; DP Chan and DL Larkin; March 1987; "Finite Element Analysis of Boiling Water Reactor Fuel Channel Bulge and Bow"
  4. UK 90-498; August 17, 1990; "WNP-2 Channel Bow and Channel Reuse"; ABB Atom Inc.
  5. BK-89-20; June 19, 1989; "Oskarsham 2 Fuel Failures"; ABB Atom Inc.
  6. XN-ANF-524, Rev. 2; Suppl. 1; November 1989; "Advanced Nuclear Fuels Corporation Critical Power Methodology for Boiling Water Reactors Methodology for Analysis of Assembly Channel Bowing Effects"
  7. Letter; August 8, 1990; AC Thadoni; NRC to RA Copeland; ANF; "Acceptance for Referencing of Topical Report ANF-524(P); Revision 2; ANF Critical Power Methodology for Boiling Water Reactors"

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8. Letter, May 3, 1990; RA Copeland, ANF to RC Jones, NRC; "Transmittal of Additional Information on Topical Report ANF-524(P); Revision 2"

The purpose of this letter is to provide the NRC with further information regarding the requirements of NRC Bulletin No. 90-02; "Loss of Thermal Margin Caused by Channel Box Bow" (Reference 1). In Reference 2; the Supply System provided a response to NRC Bulletin No. 90-02 which was relevant to WNP-2 Cycles 5 and 6. In the referenced response the Supply System committed to supply additional information addressing subsequent fuel cycles by October 1, 1990. This letter fulfills that commitment.

We will begin by reiterating some points stated in Reference 2. The Supply System does not intend to use channel boxes in WNP-2 for two bundle lifetimes. The Supply System is sensitive to the potential problems of excessive channel box bow. The Supply System has, in the past, re-inserted channels but began a program about one and one half years ago to transition away from channel re-use.

At the beginning of Cycle 6 (the 1990-1991 fuel cycle in WNP-2); three hundred fifty two (352) channels have been re-inserted in the WNP-2 core. Channels which are re-inserted in WNP-2 are first subject to inspection and physical measurement. Channels are found to be acceptable if their physical dimensions and associated neutron induced distortions are measured to be within a pre-determined acceptance criteria. Approximately 80% of the discharged channels inspected have been qualified for reuse. The acceptance criteria are developed based on an analytical model that predicts channel distortion with irradiation (Reference 3).

Channels re-inserted in WNP-2 were channels discharged from WNP-2 Cycles 1, 2; 3 and 4. Three hundred thirty two (332) are initial core GE channels. Twenty (20) are CARTECH channels inserted in Cycle 2 to replace GE channels fabricated from mismatched halves and subsequently discharged at the end of Cycle 2. There are no longer channels in the WNP-2 core manufactured from mismatched halves.

The Supply System will transition under our channel management program to use channels for only a single bundle lifetime, which is currently 33,000 MWD/MTU; and with the introduction of a new fuel design, will be extended to 42,000 MWD/MTU. Current projections conclude that while no channel will be used for two bundle lifetimes (66,000 MWD/MTU); it is estimated that subsequent to Cycle 6 operation, some channels could enter the 50-60 GWD/MTU burnup range of concern identified in Reference 1.



During the transition the Supply System will discharge channels predicted to achieve a target burnup of approximately 50,000 MWD/MTU or perform analyses to justify continued use. This action could necessitate the discharge of approximately 81 fuel channels at the end of Cycle 7, 47 fuel channels at the end of Cycle 8, and two channels at the end of Cycle 9. Discharged channels will be replaced with re-qualified channels that will not exceed approximately 50,000 MWD/MTU. If analyses are used to justify continued use, the analyses will be performed with an NRC approved methodology to determine appropriate CPR limits for fuel associated with channels that have a predicted exposure greater than approximately 50,000 MWD/MTU.

The burnup target of 50,000 MWD/MTU was selected based upon the following considerations:

- The lower limit of the range of concern as identified in Reference 1 is 50,000 MWD/MTU.
- ABB Atom states that channel bow follows from elongation. The elongation tends to accelerate at exposures corresponding to a burnup of around 50,000 MWD/MTU. For reused channels, ABB Atom proposes that channels that surpass an equivalent burnup of 55,000 MWD/MTU be measured for bow and the channel replaced if bow exceeds a chosen value (References 4 and 5).
- The Supply System has performed internal evaluations which indicate that at channel exposures up to 50,000 MDU/MTU, the expected channel growth in reinserted channels is within acceptable limits for channel distortion. This analysis was performed using the Supply System Channel Growth Model (Reference 3), which is also used to qualify the reinserted channels.
- For the current reload contract, the Advanced Nuclear Fuels (ANF) methodology (Reference 6) that will be employed to analyze reload cores in WNP-2 has been approved by the NRC (Reference 7). The ANF data base available for use in the analysis covers channels manufactured by GE, CARTECH and ABB Atom, and includes data to 70,000 MWD/MTU (Reference 8). This methodology and data base provides an approved basis for determining thermal limits, including any impact of channel box bow in WNP-2 channel boxes.


Future reload designs (i.e. Cycle 7 and beyond) will be analyzed with NRC approved methodologies which account for the effects on thermal limits of channel box bow. If thermal limits penalties associated with excessive channel bow are identified by these cycle specific analyses, these penalties will be applied to the WNP-2 thermal limits.

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FINAL RESPONSE TO NRC BULLETIN NO. 90-02

The Supply System does not expect excessive channel box bow to occur in WNP-2. All re-inserted channels are measured and accepted based on pre-determined criteria prior to re-insertion. The acceptance criteria, developed by a bounding analytical model (Reference 3), limits channel bow values to well below those which would be expected to create a problem with channel box bow.

Very truly yours,

  
for G. C. Sorensen, Manager  
Regulatory Programs

WCW:bw

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