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SUBJECT: Responds to NRC Bulletin 90-002, "Loss of Thermal Margin
 Caused by Channel Box Bow," effect on Cycle 10 operations.

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March 29, 1994
G02-94-074

Docket No. 50-397

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
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Subject: **WNP-2, OPERATING LICENSE NPF-21 -- RESPONSE TO NRC BULLETIN 90-02: "LOSS OF THERMAL MARGIN CAUSED BY CHANNEL BOX BOW", EFFECT ON CYCLE 10 OPERATION**

- References:
1. NRC Bulletin No. 90-02, March 20, 1990, "Loss of Thermal Margin Caused by Channel Box Bow"
 2. Letter G02-90-162, dated September 28, 1990, GC Sorensen to USNRC, "Final Response to NRC Bulletin No. 90-02: Loss of Thermal Margin Caused by Channel Box Bow"
 3. Letter, dated April 22, 1991, PL Eng (NRC) to GC Sorensen, "Evaluation of Response to NRC Bulletin No. 90-02: Loss of Thermal Margin Caused by Channel Box Bow (TAC NO. 76354)"
 4. Letter G02-93-024, dated February 2, 1993, GC Sorensen to USNRC, "Response to NRC Bulletin No. 90-02: Loss of Thermal Margin Caused by Channel Box Bow, Effect on Cycle 9 Operation (TAC No. M82920)"
 5. ANF-524(P)(A), Rev. 2, Supplements 1 and 2, dated November 1990, "Advanced Nuclear Fuels Corporation Critical Power Methodology for Boiling Water Reactors"
 6. Letter G02-91-037, dated February 25, 1991, GC Sorensen to USNRC, "Request for Additional Information Regarding NRC Bulletin 90-02, Loss of Thermal Margin Caused by Channel Box Bow"

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**Response to NRC Bulletin 90-02: "Loss of Thermal Margin
Caused by Channel Box Bow", Effect on Cycle 10 Operation**

7. Letter G02-92-048, dated February 25, 1992, GC Sorensen to USNRC, "Response to NRC Bulletin No. 90-02: Loss of Thermal Margin Caused by Channel Box Bow, Effect on Cycle 8 Operation"
8. Letter, dated June 15, 1992, WM Dean (NRC) to GC Sorensen, "Evaluation of Response to NRC Bulletin No. 90-02: Loss of Thermal Margin Caused by Channel Box Bow (TAC No. M82920)"
9. Letter, dated May 11, 1993, JW Clifford (NRC) to GC Sorensen, "Reused Channel Boxes for Cycle 9 (TAC M85924)"

INTRODUCTION

NRC Bulletin (NRCB) 90-02 (Reference 1) requested that licensees reusing channel boxes verify that current Minimum Critical Power Ratio (MCPR) Technical Specification operating and safety limits are met. All affected licensees were also requested to advise the NRC of the number and location of reused channel boxes and to describe the methods and associated data base used to account for the effects of channel box bow during reuse of channel boxes to ensure conformance with the CPR limits. This letter updates the Supply System response to NRCB 90-02: "Loss of Thermal Margin Caused by Channel Box Bow," as requested.

The Supply System originally responded to NRCB 90-02 in Reference 2. The NRC Safety Evaluation Report (SER), "Evaluation of Response to NRC Bulletin No. 90-02: Loss of Thermal Margin Caused by Channel Box Bow (TAC NO. 76354)" (Reference 3), required that the reuse of channel boxes in future cycles be evaluated on a cycle specific basis. The Cycle 10 update for the Supply System's response to NRCB 90-02 is provided below along with a correction to the Cycle 9 update (Reference 4). The Cycle 10 update begins with a summary of reused channel management at WNP-2.

SUMMARY OF REUSED CHANNEL MANAGEMENT

The Supply System is aware of the potential problems associated with channel box bow. WNP-2, a C-lattice BWR, is less susceptible than a D-lattice BWR to the phenomena of and effects from channel box bow. The Supply System has had a channel management program in place since initial operation of WNP-2. The Supply System channel management program is described in the WNP-2 Final Safety Analysis Report (FSAR), Section 4.2.4.4, Amendment 43. The channel management program consists of data collection on channel operating history and actual measurement of channel distortion as a function of channel operation. The Supply System has in the past installed re-qualified irradiated channels on new fuel but has since begun a program to transition away from channel reuse.

As discussed in the FSAR, the current Supply System channel management goal is use of a channel box for a single assembly lifetime. To achieve this goal, the Supply System is installing only new channels on new fuel. Reuse of channels is needed to complete the transition to using channels for one assembly lifetime. During the transition, the Supply System will discharge channels predicted

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to achieve a target exposure of approximately 50 GWd/MTU in a cycle or perform an analysis to justify continued use. All reused channels have been measured prior to reuse and required to meet a predetermined acceptance criteria. Reference 2 discusses the basis for the selection of the exposure target and the analytical methodology used to establish the acceptance criteria for channel reuse. Having measured all of the channels intended for reuse at WNP-2, the Supply System has discontinued channel measurement. Data on channel operating history will continue to be collected until all reused channels have been discharged. These actions are consistent with the Supply System's channel management goal of transitioning away from channel reuse.

Beginning with Cycle 7, the effects of channel box bow have been addressed in the WNP-2 reload design using the NRC approved Siemens Power Corporation (SPC) methodology for determining the WNP-2 MCPR Safety and Operating Limits (Reference 5). The Safety Limit is established through statistical consideration of measurement and calculational uncertainties associated with the thermal hydraulic state of the reactor using design basis radial, axial and local power distributions and considering channel box bow. Reference 5 discusses SPC's Safety Limit methodology and describes in detail how channel bow effects are incorporated into the Safety Limit. SPC channel bow data (including WNP-2 measured data) have been included in the Safety Limit methodology and reviewed and approved by the NRC (Reference 5). The anticipated effect of maximum channel bow is accounted for in the MCPR operating limit through the Safety Limit, which is a part of the operating limit.

References 4 and 6 through 9 list the updates to References 2 and 3 through Cycle 9.

CYCLE 9 CORRECTION

Reference 4 reported that Cycle 9 contained 232 reused channels. During the preparation of the reused channels data for Cycle 10, it was discovered that Cycle 9 contained 233 reused channels. Reused channel HA5422 on assembly AN3113 was inadvertently excluded from the list of reused channels in Reference 4. Figure 1 (Attachment 1) shows that assembly AN3113 was located at position 29,8 (row and column coordinates from the upper left corner of the figure). Its projected End of Cycle (EOC) 9 exposure was 46,831 MWd/MTU. Channel HA5422 was not listed as reused in Reference 4 because of an error in the computer program which transcribed the data from the channel management database to Reference 4. The computer program has been modified to prevent recurrence of this problem. There was no risk of operating Cycle 9 with a reused channel whose exposure exceeded 50 GWd/MTU. The methods in place at the time would have detected an over exposed channel and flagged it for discharge, independent of the programming error that affected Reference 4. In summary, there was an error in preparing the information reported in Reference 4, but commitments relating to channel exposure or distortion were met.

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CYCLE 10 DISCUSSION

Thirty-nine channels will be replaced at the end of Cycle 9 because their exposures at the end of Cycle 10 would have exceeded 50 GWd/MTU. These channels will be replaced with less exposed channels which have been measured and meet the criteria established for allowable distortion. The Cycle 10 core will contain 104 reused channels. At the end of Cycle 10, the peak reused channel exposure is predicted to be 49.3 GWd/MTU. The exposure distribution for the reused channels is given in the following table:

Reused Channel Exposure Distribution at EOC 10

EXPOSURE RANGE GWd/MTU	QUANTITY
16 - 33	38
33 - 41	33
41 - 49.3	33

The typical irradiation path for channels at WNP-2 is five cycles in the core interior and one on the core edge. The Supply System evaluates atypical irradiation histories and justifies continued reuse of affected channels on a case specific basis. Four reused channels in Cycle 10 will experience a second cycle of irradiation on the core edge. These channels and their respective assemblies and core locations are given in the following table:

Channels with Two Cycles of Irradiation on the Core Edge

CHANNEL	ASSEMBLY	CORE LOCATION (Figure 2: row,column)
72014	AN3015	30,17
71985	AN3014	30,14
71758	AN3008	1,17
71965	XN2087	1,15

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The four listed channels have been evaluated and meet the applicable acceptance criteria for channel reuse as determined by the methodology discussed in Reference 2. Irradiating these channels on the edge of the Cycle 10 core is, therefore, deemed acceptable. The four channels are scheduled for discharge after Cycle 10.

The probability of a reused channel being face adjacent to a limiting bundle is recognized and taken into account in the calculation of the MCPR Safety Limit using the SPC methodology. As stated before, 104 reused channels will reside in the WNP-2 Cycle 10 core. The planned core location for each reused channel is given in Table 1 (Attachment 2). The location of each reused channel is also indicated in Figure 2 (Attachment 3) by assembly number. The appropriate channel number for each assembly number can be determined from Table 1. Fifty of the reused channels will be located face adjacent to new fuel assemblies. Experience has shown that, although limiting assemblies are typically once burned, fresh assemblies could potentially be limiting at the end of a long cycle. However, the precise location of limiting assemblies during the cycle depends upon the actual operating experience. A reused channel could, therefore, be adjacent to a limiting assembly at some time during Cycle 10 operation.

Channel distortion (bow + bulge), magnitude and direction, is directly dependent upon the location history of the channels. The channels that will have the largest estimated exposure at the end of Cycle 10 are channels 71848 and 61550. These channels will reside in core locations 8,3 and 15,14 respectively (row and column coordinates from the upper left corner as shown in Figure 2). The Supply System analytical channel bow model predicts the maximum, calculated total distortion for these and all other reused channels in the Cycle 10 core to be small enough to avoid interference with both control blades and in-core instrumentation.

CONCLUSION

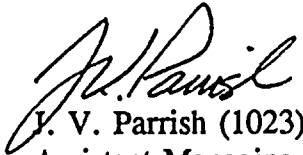
In accordance with NRCB 90-02 and Reference 3, the Supply System requests NRC approval of this plan for the reuse of channel boxes during Cycle 10. The Supply System will continue to conduct the channel management program as outlined in this letter and the references. Only measured channel boxes will be reused. The Supply System's channel bow methodology (Reference 2) will continue to be used to assure that reused channels will not interfere with control blades or in-core instrumentation. The Supply System will continue the transition to using channels for one assembly lifetime. NRC approved methods for accounting for channel bow effects in the MCPR Safety and Operating Limits will continue to be used.

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The reused channels are scheduled to be loaded into the core during the spring 1994 refueling outage, scheduled to end June 26, 1994. Therefore, NRC approval of this submittal prior to June 26, 1994 is requested. If you have any questions or desire additional information, please contact me or H. E. Kook at (509) 377-4278.

Sincerely,



J. V. Parrish (1023)

Assistant Managing Director for Operations

JDF/slc

- Attachments: 1. Figure 1; Cycle 9 Load Pattern Showing Assemblies with Reused Channels
2. Table 1; Reused Channels, Assemblies And Projected Exposure
3. Figure 2; Cycle 10 Load Pattern Showing Assemblies with Reused Channels

cc: JW Clifford - NRC
KE Perkins, Jr. - NRC RV
NRC Site Inspector - 927N
NS Reynolds - Winston & Strawn
DL Williams - BPA/399

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)
COUNTY OF BENTON)

Subject: Response to IEB 90-02
Channel Box Bow

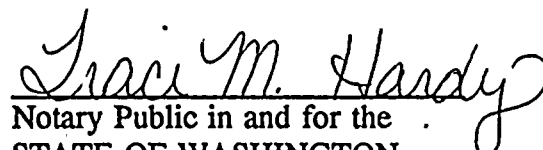
I, J. V. PARRISH, being duly sworn, subscribe to and say that I am the Assistant Managing Director, Operations for the WASHINGTON PUBLIC POWER SUPPLY SYSTEM, the applicant herein; that I have the full authority to execute this oath; that I have reviewed the foregoing; and that to the best of my knowledge, information, and belief the statements made in it are true.

DATE 29 March, 1993


J. V. Parrish, Assistant Managing Director
Operations

On this date personally appeared before me J. V. PARRISH, to me known to be the individual who executed the foregoing instrument, and acknowledged that he signed the same as his free act and deed for the uses and purposes herein mentioned.

GIVEN under my hand and seal this 29th day of March ⁴ 1993.


Notary Public in and for the
STATE OF WASHINGTON

Residing at Kennewick, Washington

My Commission Expires August 9, 1995