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SUBJECT: Forwards response to NRC Bulletin 90-002, "Loss of Thermal Margin Caused by Channel Box Bow," effect on Cycle 11 Operation.

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December 1, 1994
GO2-94-267

Docket No. 50-397

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

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 11 OPERATION**

References:
1. NRC Bulletin No. 90-02, dated March 20, 1990, "Loss of Thermal Margin Caused by Channel Box Bow"
2. Letter G02-90-162, dated September 28, 1990, GC Sorensen (SS) 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 (SS), "Evaluation of Response to NRC Bulletin No. 90-02: Loss of Thermal Margin Caused by Channel Box Bow (TAC NO. 76354)"

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. Reference 2 provided the Supply System's initial response to NRC Bulletin 90-02.

JE11 1/

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), stated that the reuse of channel boxes in future cycles be evaluated on a cycle specific basis. Correspondingly, the Cycle 11 evaluation is provided below. A summary of the WNP-2 reused channel management program is provided in Attachment 1.

The Cycle 11 MCPR Safety Limit is currently being determined. The effect of channel bow is expected to contribute about 0.02 to the MCPR Safety Limit. The Cycle 11 core will contain 38 reused channels. At the end of Cycle 11, the peak reused channel exposure is predicted to be 47.5 GWd/MTU. The exposure distribution for the reused channels is given in the following table:

Reused Channel Exposure Distribution at EOC 11

EXPOSURE RANGE GWd/MTU	QUANTITY
16 - 33	8
33 - 41	28
41 - 47.5	2

Eight channels will be replaced at the end of Cycle 10 because their exposures at the end of Cycle 11 are projected to exceed 50 GWd/MTU. These channels will be replaced with exposed channels which have been measured and meet the criteria established in Reference 2 for allowable distortion. 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. Two Cycle 11 reused channels will experience a second cycle of irradiation on the core edge. These channels and their respective assemblies and core locations are identified in the following table:

Channels with Two Cycles of Irradiation on the Core Edge

CHANNEL	ASSEMBLY	CORE LOCATION (Attachment 3: row,column)
71392	UD4116	30,11
73444	UD4004	30,20

The two 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 core during Cycle 11 is therefore deemed acceptable. The two channels are scheduled for discharge after Cycle 11.

A reused channel could be located face adjacent to a limiting assembly. As stated before, 38 reused channels will reside in the WNP-2 core during Cycle 11. The planned core location for each reused channel is given in Attachment 2. The location of each reused channel is also indicated in Attachment 3 by assembly number. The appropriate channel number for each assembly number can be determined from Attachment 2. Six (6) 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 11 operation. The possibility of a reused channel being face adjacent to a limiting assembly is taken into account in the calculation of the MCPR Safety Limit. The MCPR Safety Limit is calculated in accordance with the Siemens Power Corporation (SPC) methodology for determining the WNP-2 Safety and Operating Limits (Reference 5 of Attachment 4).

MAXIMUM DISTORTION

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 11 are channels 71938 and 73444. These channels will reside in core locations 2,8 and 30,20 respectively (row and column coordinates from the upper left corner as shown in Attachment 3). The maximum EOC 11 distortion for the 38 reused channels is predicted to be less than 105 mills. Of all the reused channels in the core, channel 72030 is predicted to have the largest distortion (98 mils) at EOC 11. The Supply System analytical channel bow model predicts the maximum, calculated total distortion for all reused channels in the Cycle 11 core to be small enough to avoid interference with both control blades and in-core instrumentation.

CONCLUSION

In accordance with NRC Bulletin 90-02 and Reference 3, the Supply System requests NRC approval of this plan for the reuse of channel boxes during Cycle 11. The Supply System will continue to conduct the channel management program as outlined in Attachment 1. 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.

The reused channels are scheduled to be loaded into the core during the spring 1995 refueling outage, scheduled to end May 23, 1995. Therefore, NRC approval of this submittal prior to May 23, 1995 is requested. If you have any questions or desire additional information, please contact me or D. A. Swank at (509) 377-4563.

Sincerely,

J. V. Parrish (1023)
Assistant Managing Director for Operations

DAS/slc

Attachments:
1. Summary of Reused Channel Management Program
2. Assemblies, Reused Channels, And Projected Exposure
3. Cycle 11 Load Pattern Showing Assemblies with Reused Channels
4. Channel Box Bow Chronology

cc: LJ Callan - NRC RIV
JW Clifford - NRC
KE Perkins, Jr. - NRC RIV Walnut Creek Field Office
NRC Senior Resident Inspector - 927N
NS Reynolds - Winston & Strawn
DL Williams - BPA/399

ATTACHMENT 1

SUMMARY OF REUSED CHANNEL MANAGEMENT PROGRAM

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, however, a program was initiated in 1992 to transition away from channel reuse.

As discussed in the FSAR, the current Supply System channel management goal is to use 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 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 were required to meet a predetermined acceptance criteria. Reference 2 of the Attachment 4 Chronology 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 of the Attachment 4 Chronology). Reference 5 discusses SPC's Safety Limit methodology and describes in detail how channel bow effects are incorporated into the Safety Limit. 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. 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 13 of the Attachment 4 Chronology list the updates, through Cycle 10, to the reused channel management program.

ATTACHMENT 2

ASSEMBLIES, REUSED CHANNELS, AND PROJECTED EOC 11 EXPOSURES

Row	Column	Current Assembly	Channel ID	Proj EOC 11 Exposure
1	14	UD5066	71492	29614
2	8	UD5071	71938	47509
5	5	UD5069	73223	34301
8	3	UD5030	71979	30929
8	28	UD5035	72004	30929
12	1	UD5065	71858	29632
13	1	UD4034	73151	35760
15	30	UD5013	73228	32285
17	27	UD5026	73231	27674
19	4	UD5010	73150	37351
19	27	UD5024	73109	37464
19	30	UD5021	71459	34964
20	26	UD5023	70108	33774
21	1	UD4021	73423	31937
21	30	UD4003	72030	32287
22	1	UD5040	73149	33964
23	29	UD5029	73138	34561
24	3	UD4042	71989	32524
24	28	UD4135	72477	29432
25	3	UD5039	73362	33420
25	4	UD5036	71946	35083
25	27	UD5022	71987	35128
25	28	UD5031	70202	33435
26	5	UD5028	73053	34426
26	20	UD5032	73128	33787
26	26	UD5025	73378	32655
27	6	UD5016	71204	35034
27	12	UD5004	70159	37212
27	25	UD5037	73170	35052
28	6	UD5014	73369	33292
28	8	UD5018	73589	34508
29	8	UD5020	71939	34532
30	11	UD4116	71392	36443
30	15	UD5008	70209	32036
30	17	UD5034	63510	33287
30	20	UD4004	73444	44133
30	21	UD4030	71854	32067
30	22	UD5038	71972	33631

ATTACHMENT 3

CYCLE 11 LOAD PATTERN SHOWING ASSEMBLIES WITH REUSED CHANNELS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1									UD5128	UD4051	UD4118	UD5125	UD4122	UD5066*	UD5061
2								UD5071*	UD7093	UD9014	UD9082	UD7092	UD8004	UD9059	UD9116
3						UD5062	UD4018	UD5122	UD9027	wp10	UD9130	wp10	UD9062	wp10	UD8083
4						UD5057	UD9031	UD9136	wp10	WA6003	UD8096	UD5131	wp10	UD5093	UD7075
5					UD5069*	UD7064	UD6013	wp10	UD9067	wp10	UD5124	wp10	UD7030	wp10	UD6057
6			UD5055	UD5056	UD7090	UD8078	wp10	UD9066	UD8036	UD6026	UD8080	UD7087	UD9015	UD5005	UD9016
7			UD4111	UD9064	UD6060	wp10	UD8003	UD6075	UD9150	wp10	UD6054	UD8050	UD7009	wp10	UD7071
8		UD5129	UD5030*	UD9020	wp10	UD9004	UD6053	UD8002	UD8064	UD6108	UD7059	UD8001	UD9114	UD6061	UD8034
9	UD5130	UD7023	UD9098	wp10	UD9075	UD8017	UD9050	UD8077	UD8016	wp9	UD6036	wp10	UD6087	wp10	UD6039
10	UD4088	UD9113	wp10	UD5111	wp10	UD6094	wp10	UD6103	wp9	UD6041	wp10	UD6120	UD9103	UD8069	UD9085
11	UD4128	UD9077	UD9093	UD8099	UD5121	UD8087	UD6056	UD7042	UD6028	wp10	UD7095	UD7006	UD6113	wp10	UD7078
12	UD5065*	UD7008	wp10	UD5123	wp10	UD7020	UD8067	UD8057	wp10	UD6112	UD7044	UD7005	wp10	UD6059	UD6038
13	UD4034*	UD8008	UD9092	wp10	UD7068	UD9133	UD7085	UD9051	UD6037	UD9028	UD6058	wp10	UD6068	wp10	UD9127
14	UD5127	UD9003	wp10	UD5054	wp10	UD5007	wp10	UD6062	wp10	UD8055	wp10	UD6114	wp10	UD7079	UD7021
15	UD5087	UD9071	UD8066	UD7019	UD6069	UD9104	UD7086	UD8043	UD6115	UD9149	UD7024	UD6052	UD9072	UD7089	UD8023
16	UD5134	UD9070	UD8071	UD7011	UD6070	UD9126	UD7061	UD8040	UD6002	UD9122	UD7065	UD6079	UD9048	UD7046	UD8026
17	UD5080	UD9128	wp10	UD5075	wp10	UD5019	wp10	UD6021	wp10	UD8088	wp10	UD6012	wp10	UD7063	UD7060
18	UD4094	UD8047	UD9034	wp10	UD7053	UD9054	UD7045	UD9068	UD6100	UD9029	UD6077	wp10	UD6055	wp10	UD9030
19	UD5095	UD7029	wp10	UD5010*	wp10	UD7062	UD8070	UD8053	wp10	UD6001	UD7076	UD7031	wp10	UD6076	UD6014
20	UD4131	UD9057	UD9074	UD8039	UD5085	UD8085	UD6072	UD7007	UD6035	wp10	UD7054	UD7028	UD6073	wp10	UD7080
21	UD4021*	UD9002	wp10	UD5086	wp10	UD6117	wp10	UD6022	wp9	UD6015	wp10	UD6017	UD9012	UD8081	UD9073
22	UD5040*	UD7047	UD9129	wp10	UD9069	UD8007	UD9094	UD8048	UD8074	wp9	UD6034	wp10	UD6105	wp10	UD6018
23		UD5078	UD5042	UD9123	wp10	UD9013	UD6110	UD8009	UD8049	UD6016	UD7014	UD8073	UD9060	UD6029	UD8022
24			UD4042*	UD9032	UD6080	wp10	UD8024	UD6111	UD9081	wp10	UD6067	UD8090	UD7002	wp10	UD7069
25			UD5039*	UD5036*	UD7072	UD8097	wp10	UD9063	UD8028	UD6102	UD8079	UD7010	UD9076	UD5003	UD9124
26					UD5028*	UD7083	UD6071	wp10	UD9061	wp10	UD5081	wp10	UD7013	wp10	UD6078
27						UD5016*	UD9049	UD9041	wp10	WA6001	UD8015	UD5004*	wp10	UD5120	UD7004
28						UD5014*	UD4078	UD5018*	UD9036	wp10	UD9005	wp10	UD9021	wp10	UD8041
29								UD5020*	UD7001	UD9035	UD9151	UD7101	UD8005	UD9119	UD9080
30									UD5077	UD4092	UD4116*	UD5079	UD4071	UD5082	UD5008*

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	UD5044	UD5115	UD4096	UD5108	UD4126	UD4065	UD5068								
2	UD9090	UD9011	UD8014	UD7049	UD9088	UD9106	UD7105	UD5043							
3	UD8021	wp10	UD9044	wp10	UD9102	wp10	UD9010	UD5116	UD4058	UD5045					
4	UD7103	UD5083	wp10	UD5117	UD8019	WA6004	wp10	UD9089	UD9024	UD5041					
5	UD6025	wp10	UD7027	wp10	UD5052	wp10	UD9125	wp10	UD6047	UD7077	UD5112				
6	UD9115	UD5015	UD9091	UD7091	UD8084	UD6020	UD8012	UD9026	wp10	UD8086	UD7022	UD5074	UD5053		
7	UD7051	wp10	UD7107	UD8033	UD6046	wp10	UD9045	UD6096	UD8037	wp10	UD6045	UD9107	UD4110		
8	UD8013	UD6064	UD9047	UD8032	UD7074	UD6042	UD8072	UD8030	UD6097	UD9007	wp10	UD9101	UD5035*	UD5048	
9	UD6066	wp10	UD6010	wp10	UD6104	wp9	UD8054	UD8051	UD9043	UD8006	UD9023	wp10	UD9083	UD7032	UD5114
10	UD9046	UD8044	UD9033	UD6101	wp10	UD6048	wp9	UD6107	wp10	UD6074	wp10	UD5133	wp10	UD9065	UD4125
11	UD7082	wp10	UD6119	UD7041	UD7067	wp10	UD6049	UD7017	UD6040	UD8059	UD5047	UD8091	UD9152	UD9037	UD4130
12	UD6065	UD6050	wp10	UD7040	UD7015	UD6099	wp10	UD8010	UD8061	UD7099	wp10	UD5051	wp10	UD7037	UD5067
13	UD9017	wp10	UD6019	wp10	UD6109	UD9118	UD6011	UD9135	UD7070	UD9040	UD7094	wp10	UD9112	UD8031	UD4059
14	UD7043	UD7033	wp10	UD6106	wp10	UD8035	wp10	UD6044	wp10	UD5012	wp10	UD5110	wp10	UD9108	UD5113
15	UD8011	UD7025	UD9117	UD6043	UD7018	UD9086	UD6098	UD8029	UD7048	UD9052	UD6063	UD7102	UD8060	UD9131	UD5013*
16	UD8018	UD7096	UD9084	UD6092	UD7058	UD9142	UD6030	UD8038	UD7038	UD9141	UD6033	UD7066	UD8098	UD9053	UD5136
17	UD7055	UD7088	wp10	UD6008	wp10	UD8025	wp10	UD6032	wp10	UD5027	wp10	UD5026*	wp10	UD9095	UD5105
18	UD9042	wp10	UD6090	wp10	UD6089	UD9087	UD6118	UD9134	UD7036	UD9137	UD7057	wp10	UD9001	UD8058	UD4074
19	UD6004	UD6091	wp10	UD7106	UD7012	UD6003	wp10	UD8042	UD8068	UD7056	wp10	UD5024*	wp10	UD7108	UD5021*
20	UD7026	wp10	UD6095	UD7003	UD7052	wp10	UD6005	UD7039	UD6084	UD8082	UD5023*	UD8075	UD9022	UD9006	UD4133
21	UD9146	UD8094	UD9009	UD6007	wp10	UD6085	wp9	UD6027	wp10	UD6081	wp10	UD5092	wp10	UD9096	UD4003*
22	UD6031	wp10	UD6082	wp10	UD6006	wp9	UD8065	UD8052	UD9143	UD8027	UD9138	wp10	UD9132	UD7100	UD5101
23	UD8062	UD6023	UD9018	UD8045	UD7034	UD6009	UD8056	UD8046	UD6086	UD9140	wp10	UD9105	UD5060	UD5029*	
24	UD7104	wp10	UD7098	UD8100	UD6083	wp10	UD9100	UD6051	UD8076	wp10	UD6093	UD9110	UD4135*		
25	UD9111	UD5006	UD9099	UD7097	UD8095	UD6116	UD8020	UD9097	wp10	UD8089	UD7016	UD5022*	UD5031*		
26	UD6088	wp10	UD7035	wp10	UD5032*	wp10	UD9038	wp10	UD6024	UD7050	UD5025*				
27	UD7081	UD5059	wp10	UD5106	UD8092	WA6002	wp10	UD9079	UD9058	UD5037*					
28	UD8093	wp10	UD9056	wp10	UD9019	wp10	UD9025	UD5002	UD4085	UD5100					
29	UD9109	UD9055	UD8063	UD7073	UD9120	UD9121	UD7084	UD5098							
30	UD5096	UD5034*	UD4089	UD5107	UD4004*	UD4030*	UD5038*								

wp10 are fresh 9x9-9X assemblies loaded in Cycle 11

* are assemblies with Reused Channels

ATTACHMENT 4

CHANNEL BOX BOW CHRONOLOGY

References:

1. NRC Bulletin No. 90-02, dated March 20, 1990, "Loss of Thermal Margin Caused by Channel Box Bow"
2. Letter G02-90-162, dated September 28, 1990, GC Sorensen (SS) 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 (SS), "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 (SS) 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 (SS) to USNRC, "Request for Additional Information Regarding NRC Bulletin 90-02, Loss of Thermal Margin Caused by Channel Box Bow"
7. Letter G02-92-048, dated February 25, 1992, GC Sorensen (SS) 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 (SS), "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 (SS), "Reused Channel Boxes for Cycle 9 (TAC M85924)"
10. Letter G02-94-074, dated March 19, 1994, JV Parrish (SS) to USNRC, "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"
11. Letter G02-94-123, dated May 20, 1994, JV Parrish (SS) to USNRC, "WNP-2, Operating License NPF-21 Response to NRC Bulletin 90-02: 'Loss of Thermal Margin Caused by Channel Box Bow', Response to Questions on Cycle 10 Operation"
12. Letter G02-94-142, dated June 20, 1994, JV Parrish (SS) to USNRC, "WNP-2, Operating License NPF-21, Response to NRC Bulletin 90-02: "Loss of Thermal Margin Caused by Channel Box Bow," Correction to Cycle 10 Operations"
13. Letter dated July 12,1994, JW Clifford (NRC) to JV Parrish (SS), "Washington Public Power Supply System Nuclear Project No. 2 Response to NRC Bulletin No. 90-02 (TAC NO. M89124)"