ACCELERATED DISTRIBUTION DEMONSTRATION SYSTEM

REGULATORY INFORMATION DISTRIBUTION SYSTEM (RIDS)

ACCESSION NBR:9103040382 DOC.DATE: 91/02/25 NOTARIZED: NO DOCKET #
FACIL:50-397 WPPSS Nuclear Project, Unit 2, Washington Public Powe 05000397
AUTH.NAME AUTHOR AFFILIATION
SORENSEN,G.C. Washington Public Power Supply System
RECIP.NAME RECIPIENT AFFILIATION
Document Control Branch (Document Control Desk)

SUBJECT: Suppls 900413 & 0928 responses to NRC Bulletin 90-002, "Loss of Thermal Margin Caused by Channel Box Bow," per NRC 901224 request.

DISTRIBUTION CODE: IE38D COPIES RECEIVED:LTR 1 ENCL 1 SIZE: 13
TITLE: NRC Bulletin 90-002, Loss of Thermal Margin Caused by Channel Box Bow

NOTES:

	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL	RECIPIENT ID CODE/NAME	COPIES LTTR	COPIES ENCL
	PD5 LA	1	0	PD5 PD	1	1
INTERNAL:	AEOD/DOA	1	1	AEOD/DSP/TPAB	1	1
	NRR FIENO,D	1	1	NRR LONG,W PD31	1	1
	NRR/DET/EMEB 7E	1	1	NRR/DOEA/OEAB11	1	1
	NRR/DOEA/OGCB11	1	1	NRR/DREP/PEPB9D	1	1
	NRR/DST/ 8E2	1	1	NRR/PMAS/ILRB12	1	1
	PM	1	1	REG FILE 02	1	1
	RES/DSIR/EIB	1	1	RGN5 FILE 01	1	1
EXTERNAL:	NRC PDR	1	1	NSIC	1	1

NOTE TO ALL "RIDS" RECIPIENTS:

PLEASE HELP US TO REDUCE WASTE! CONTACT THE DOCUMENT CONTROL DESK, ROOM P1-37 (EXT. 20079) TO ELIMINATE YOUR NAME FROM DISTRIBUTION LISTS FOR DOCUMENTS YOU DON'T NEED!

TOTAL NUMBER OF COPIES REQUIRED: LTTR 18 ENCL 17

RIDS/ADDS

RIDS/ADDS

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

P.O. Box 968 • 3000 George Washington Way • Richland, Washington 99352

February 25, 1991
G02-91-037

Docket No. 50-397

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

Gentlemen:

Subject: **NUCLEAR PLANT NO. 2, OPERATING LICENSE NPF-21
REQUEST FOR ADDITIONAL INFORMATION REGARDING NRC BULLETIN 90-02,
"LOSS OF THERMAL MARGIN CAUSED BY CHANNEL BOX BOW" (TAC NO. 76354)**

Reference:
1. G02-90-075, April 13, 1990, GC Sorensen (Supply System) 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"

2. G02-90-162, September 28, 1990, GC Sorenson (Supply System) to USNRC, "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"

3. Letter and Attachments, December 24, 1990, P.L. Eng (NRC) to G.C. Sorensen (Supply System), same subject

Attached is the Supply System response to the request (Reference 3) for additional information, on channel box bow in WNP-2.

Very truly yours,

GC Sorensen

G. C. Sorensen, Manager
Regulatory Programs

WCW:bw
Attachment: Response

cc: JB Martin - NRC RV
NS Reynolds - Winston & Strawn
PL Eng - NRC
DL Williams - BPA/399
NRC Site Inspector - 901A

9103040382 910225
PDR ADOCK 05000397
Q PDR

IE38
1/1

REQUESTED INFORMATION REGARDING WNP-2 CYCLE 7 OPERATION WITH REUSED CHANNELS

1. **The number of channels scheduled to be reused in Cycle 7.**

   The number of reused channels scheduled for Cycle 7 is 349. Of the 352 reused channels in Cycle 6, three will be discharged at EOC6.

2. **Please provide the following for each channel scheduled for reuse in Cycle 7:**

   a. **Planned location coordinates for Cycle 7 for each channel.**

   The planned location coordinates for Cycle 7 for each reused channel are given in Table 1 attached. The location of each reused channel is also indicated on the attached Cycle 7 core map (Figure 1) by assembly number. The appropriate channel number for each assembly number can be determined from Table 1.

   b. **Whether any of the channels scheduled to be reused in Cycle 7 will be located adjacent to new fuel assemblies.**

   One-hundred-sixty-four of the reused channels will be located face adjacent to new fuel assemblies.

   c. **Whether any of the reused channels will be adjacent to a limiting bundle during Cycle 7.**

   Given the number of reused channels, it is likely that a reused channel will be adjacent to a limiting assembly during Cycle 7. The precise location of limiting assemblies during Cycle 7 will be dependent upon the actual operating experience of (and control rod patterns used for) Cycle 7 operation. However, experience has shown that limiting assemblies are almost always once burned assemblies and, potentially at the end of a long cycle, fresh assemblies can become limiting. There are many instances of reused channels being adjacent to once burned and fresh assemblies in the Cycle 7 core. As an example, at the beginning of Cycle 7 assembly UD5104 in location 22,22 is the limiting assembly. This assembly is face adjacent to reused channel 73227 (location 21,22), reused channel 63947 (location 22,21), and reused channel 63940 (location 22,23). At the end of Cycle 7, limiting assembly UD6074 (location 17,19) is face adjacent to channel 71990 (location 17,18), channel 73405 (location 16,19), and channel 70106 (location 18,19). It is therefore likely that a reused channel could be adjacent to a limiting assembly at some time during Cycle 7. This probability is recognized and taken into account in calculation of the Safety Limit Minimum Critical Power Ratio, SLMCPR, as discussed in the response to 3.b given below.

d. Discuss the estimated exposure and maximum calculated channel bow for each channel reused in Cycle 7 (using the Supply System Analytical Model).

Channel distortion (bow + bulge) magnitude and direction is directly dependent upon the location history of the channels. The channel that will have the largest estimated maximum exposure at EOC 7 is channel 71927. This channel will reside in core location 2,15 (xy coordinates from the upper left corner as shown in Figure 1) in WNP-2 during Cycle 7. The operational history of this channel is:

CYCLE NO.	LOCATION (x,y)	CYCLE EXPOSURE (MWD/MTU)	ACCUMULATED EXPOSURE (MWD/MTU)
1	23,6	9169	9169
2	16,10	5860	15029
3	17,5	5644	20673
4	Spent Fuel Pool	0	20673
5	11,11	8590	29263
6	3,10	8400*	37663
7	2,15	7800*	45463

* Estimated

The Supply System analytical model predicts a maximum calculated channel bow for this channel to be equal to or less than 58 mils. The model predicts a maximum calculated channel bulge to be less than or equal to 45 mils for this channel. The total predicted distortion is less than or equal to 103 mils. Exposures for the other reused channels in WNP-2 are shown in Table 1. The calculated total distortion of these channels can generally be expected to be less than this value.

We would like to reaffirm that the Supply System model is used to re-qualify channels. It is not used to estimate SLMCPR effects. This process is described in 3.b below, and is based on a measured channel distortion data base. The Supply System has measured channels out to exposures of 30,655 MWD/MTU. Their measured maximum distortion was compared, on a selected basis, to the Supply System model. Calculated values were found to be conservative relative to measurements, except at very low exposures. (Reference: EANF-90-0434, November 13, 1990, WC Wolkenhauer to DL Whitcomb, "Comparison of Supply System Channel Distortions Model to Experimental Data).

3. Discuss how the anticipated maximum channel bow will affect the following parameters during Cycle 7:

a. MCPR Operating Limit

The anticipated effect of maximum channel bow is accounted for in the MCPR operating limit by modification to the SLMCPR which is a part of the MCPR operating limit. A discussion of the method for inclusion of channel bow affects in the SLMCPR is given below in 3.b.

b. MCPR Safety Limit

The WNP-2 MCPR safety limit, SLMCPR, 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 fuel channel bow. Topical Report XN-NF-524(P)(A), Revision 2 and Supplements, "Advanced Nuclear Fuels Critical Power Methodology for Boiling Water Reactors", discusses ANF MCPR safety limit methodology and describes in detail how channel bow effects are incorporated into the MCPR safety limit. The effects of channel bow are included in the WNP-2 Cycle 7 safety limit. Without channel bow the WNP-2 Cycle 7 MCPR safety limit would be reduced by about 0.03.

FIGURE 1
CYCLE 7 LOAD PATTERN SHOWING ASSEMBLIES WITH REINSERTED CHANNELS

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1									XN2013	LJT197*	LJT273*	LJT393*	LJT342*	LJT171*	LJT202*
2								LJT277*	AN3092*	UD5125	UD4045	UD5066*	UD4054	UD5122	UD4146
3						XN2124	XN2132	UD4018	UD4051	AN3074*	AN3043*	XN2025	UD6001	UD4034*	AN3064*
4						XN2121	WA6003	UD6700	UD5069*	UD6003	AN3035*	XN2087*	XN2115	UD6004	AN3068*
5					XN1060	UD4052	UD6007	XN2006	UD5064*	UD4112	UD5062	AN3070*	UD5124	UD4046	UD5132
6			XN2027*	XN1065	UD4118	XN2018	UD5070*	UD6009	XN2127	UD6010	UD4115*	UD6011	UD4048	UD6012	XN1039
7			XN2026*	UD5111	UD6017	UD5135	AN3032*	AN3051*	UD5131	UD4100	AN3100*	XN2046*	UD5072*	UD4053	XN2091*
8		LJT188*	UD4111	UD6702	XN2130	UD6019	AN3099*	XN2120	UD4114	UD6020	AN3040*	XN2106*	XN2045	UD6021	XN2129
9	XN1160*	AN3104*	UD4088	UD5087	LYV153	XN2004	UD5123	UD4017	UD5058	AN3075*	UD5057	UD4099	UD5093	UD4107	UD5128
10	LJT339*	UD5065*	AN3053*	UD6025	UD4061	UD6026	UD4043	UD6027	AN3076*	UD6028	XN1150	UD6029	XN2114	UD6030	XN2134
11	LJT311*	UD4128	AN3031*	AN3041*	UD5055	UD4024*	AN3042*	AN3038*	UD5056	XN1154	AN3052*	AN3039*	UD5071*	UD4082	XN1074
12	LJT325*	UD5127	XN2024	XN2084*	AN3079*	UD6037	XN1135	XN2085*	UD4104	UD6038	AN3069*	AN3067*	UD4108	UD6039	XN2125
13	LJT187*	UD4032*	UD6043	XN2047*	UD5121	UD4047	UD5061	XN2023*	UD5054	XN2007	UD5129	UD4117	UD5126	AN3054*	UD4025*
14	LJT328*	UD5030*	UD4122	UD6045	UD4044	UD6046	UD4103	UD6047	UD4113	UD6048	UD4062	UD6049	AN3066*	UD6050	AN3036*
15	LJT282*	AN3133*	AN3046	AN3034*	UD5063*	XN1100	XN2086*	XN1146	UD5130	XN2126	XN2003	XN2022*	UD4121	AN3080*	AN3033*
16	LJT240*	AN3102*	AN3037*	AN3011*	UD5084	XN1066	XN2056*	XN2123*	UD5040*	XN2102*	XN1137	XN2040*	UD4072	AN3002*	AN3132*
17	LJT235*	UD5042	UD4071	UD6057	UD4098	UD6058	UD4040*	UD6059	UD4144*	UD6060	UD4016*	UD6061	AN3114*	UD6062	AN3014*
18	LJT270*	UD4006*	UD6069	XN2118	UD5085	UD4005*	UD5008*	XN2116	UD5075	XN2105*	UD5078	UD4033*	UD5094	AN3058*	UD4087
19	LJT272*	UD5080	XN2071	XN2066*	AN3128*	UD6071	XN2048*	XN2055*	UD4012*	UD6072	AN3010	AN3072*	UD4026*	UD6073	XN2050*
20	LJT271*	UD4131	AN3044*	AN3020*	UD5039*	UD4076	AN3127*	AN3009	UD5036*	XN2058*	AN3019*	AN3055*	UD5020*	UD4028*	XN2075*
21	LJT193*	UD5095	AN3057*	UD6077	UD4143*	UD6078	UD4101	UD6079	AN3073*	UD6080	XN2005*	UD6081	XN2110*	UD6082	XN2111*
22	XN2037*	AN3050*	UD4021*	UD5134	LYV156	XN2062*	UD5010*	UD4077	UD5009*	AN3071*	UD5016*	UD4039*	UD5120	UD4027*	UD5077
23		LJT308*	UD4042*	UD6704	XN2104*	UD6089	AN3101*	XN2113	UD4137*	UD6090	AN3118	XN2098*	XN2072*	UD6091	XN2028*
24			XN2061*	UD5086	UD6095	UD5102	AN3123*	AN3013*	UD5004*	UD4041*	AN3086*	XN2119	UD5011*	UD4095	XN2081*
25			XN2041*	XN2122*	UD4116*	XN2012	UD5017*	UD6097	XN2089*	UD6098	UD4011*	UD6099	UD4015*	UD6100	XN1124
26					XN1117	UD4091	UD6105	XN1153	UD5076	UD4138*	UD5014*	AN3131*	UD5081	UD4102	UD5103
27						XN2112	WA6001	UD6706	UD5028*	UD6107	AN3056*	XN2065*	XN2088*	UD6108	AN3113*
28						XN2049*	XN2103*	UD4078	UD4092	AN3087*	AN3012*	XN2073*	UD6111	UD4094	AN3018*
29								LJT312*	AN3088*	UD5079	UD4038*	UD5082	UD4097	UD5018*	UD4145
30									XN2131	LJT160*	LJT340*	LJT384*	LJT231*	LJT387*	LJT250*

	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
1	LJT205*	LJT184*	LJT331*	LJT176*	LJT286*	LJT213*	XN1159								
2	UD4147	UD5116	UD4069	UD5115	UD4020	UD5108	AN3089*	LJT341*							
3	AN3028*	UD4059	UD6002	XN2108*	AN3083*	AN3090*	UD4065	UD4058	XN1140	XN2034					
4	AN3096*	UD6005	XN1110	XN2095*	AN3007*	UD6006	UD5112	UD6701	WA6004	XN1092					
5	UD5119	UD4057	UD5052	AN3027*	UD5045	UD4109	UD5073	XN2031	UD6008	UD4029*	XN1061				
6	XN1037	UD6013	UD4010	UD6014	UD4105	UD6015	XN1144	UD6016	UD5050	XN1156	UD4126	XN2032	XN2010		
7	XN2099*	UD4070	UD5091	XN2009	AN3049*	UD4001	UD5117	AN3119*	AN3030*	UD5046	UD6018	UD5133	XN2035		
8	XN1106	UD6022	XN2097*	XN2080*	AN3126*	UD6023	UD4127	XN1093	AN3045*	UD6024	XN1162	UD6703	UD4110	LJT288*	
9	UD5068	UD4129	UD5083	UD4120	UD5041	AN3107*	UD5109	UD4066	UD5051	XN2021	LYV155	UD5013*	UD4125	AN3085*	XN2033
10	XN1143	UD6031	XN1161	UD6032	XN2015	UD6033	AN3097*	UD6034	UD4064	UD6035	UD4009	UD6036	AN3103*	UD5067	LJT162*
11	XN2016	UD4093	UD5043	AN3125*	AN3120*	XN2044	UD5074	AN3130*	AN3025*	UD4022*	UD5053	AN3026*	AN3029*	UD4130	LJT323*
12	XN2020	UD6040	UD4124	AN3098*	AN3081*	UD6041	UD4106	XN2101*	XN2017	UD6042	AN3084*	XN2067*	XN1090	UD5113	LJT369*
13	UD4073	AN3082*	UD5118	UD4123	UD5048	XN2117	UD5110	XN2109*	UD5044	UD4019	UD5047	XN1158	UD6044	UD4055	LJT241*
14	AN3008*	UD6051	AN3095*	UD6052	UD4056	UD6053	UD4050	UD6054	UD4119	UD6055	UD4063	UD6056	UD4096	UD5035*	LJT337*
15	AN3021*	AN3001*	UD4031*	XN2096*	XN2030	XN1138	UD5114	XN1155	XN2094*	XN1101	UD5049	AN3022*	AN3124*	AN3134*	LJT214*
16	AN3024*	AN3122*	UD4075	XN2136	XN1151	XN2038*	UD5101	XN2054*	XN2068*	XN1081	UD5001	AN3061*	AN3129*	AN3065*	LJT179*
17	AN3015*	UD6063	AN3106*	UD6064	UD4139*	UD6065	UD4142*	UD6066	UD4035*	UD6067	UD4080	UD6068	UD4089	UD5060	LJT237*
18	UD4090	AN3112*	UD5033*	UD4023*	UD5029*	XN2039*	UD5026*	XN2008	UD5096	UD4014*	UD5023*	XN1020	UD6070	UD4002	LJT216*
19	XN2076*	UD6074	UD4037*	AN3110*	AN3023*	UD6075	UD4134*	XN2051*	XN1152	UD6076	AN3016*	XN2100*	XN1141	UD5105	LJT247*
20	XN2057*	UD4049	UD5098	AN3077*	AN3063*	XN2074*	UD5022*	AN3006*	AN3062*	UD4060	UD5031*	AN3060*	AN3047*	UD4133	LJT295*
21	XN2093*	UD6083	XN2042*	UD6084	XN2135	UD6085	AN3116*	UD6086	UD4079	UD6087	UD4140*	UD6088	AN3111*	UD5021*	LJT376*
22	UD5038*	UD4008*	UD5059	UD4007*	UD5037*	AN3115*	UD5104	UD4086	UD5024*	XN2063*	LYV154	UD5136	UD4003*	AN3093*	XN2083*
23	XN2036*	UD6092	XN2059*	XN2090*	AN3017*	UD6093	UD4141*	XN1103	AN3108*	UD6094	XN2092*	UD6705	UD4135*	LJT218*	
24	XN2078*	UD4068	UD5089	XN2011	AN3091*	UD4036*	UD5106	AN3005*	AN3048*	UD5088	UD6096	UD5092	XN2064*		
25	XN1125	UD6101	UD4013*	UD6102	UD4132*	UD6103	XN2069*	UD6104	UD5099	XN1070	UD4004*	XN2082*	XN2133		
26	UD5090	UD4084	UD5032*	AN3121*	UD5100	UD4136*	UD5097	XN1142	UD6106	UD4081	XN1111				
27	AN3109*	UD6109	XN2107*	XN2052*	AN3078*	UD6110	UD5025*	UD6707	WA6002	XN1157					
28	AN3117	UD4074	UD6112	XN2060*	AN3059*	AN3105*	UD4030*	UD4085	XN2043*	XN2001*					
29	UD4148	UD5002	UD4067	UD5034*	UD4083*	UD5107	AN3094*	LJT227*							
30	LJT335*	LJT165*	LJT226*	LJT180*	LJT253*	LJT167*	XN1102								

* ASSEMBLY WITH REINSERTED CHANNEL

TABLE 1

REINSERTED CHANNELS, ASSEMBLIES, AND PROJECTED EOC 7 EXPOSURE

Y	X	CURRENT ASSEMBLY	CHANNEL ID	PROJ. EOC 7 EXPOSURE
1	10	LJT197	73437	37291.
1	11	LJT273	70171	42181.
1	12	LJT393	71815	37859.
1	13	LJT342	73418	37410.
1	14	LJT171	73169	37681.
1	15	LJT202	60835	42389.
1	16	LJT205	71832	42047.
1	17	LJT184	71996	37674.
1	18	LJT331	71462	41790.
1	19	LJT176	73113	37838.
1	20	LJT286	71329	41624.
1	21	LJT213	73363	37034.
2	8	LJT277	60903	41318.
2	9	AN3092	63572	42000.
2	12	UD5066	71780	36087.
2	22	AN3089	62513	42087.
2	23	LJT341	60827	41996.
3	10	AN3074	73425	43942.
3	11	AN3043	6450D	36086.
3	14	UD4034	72009	36550.
3	15	AN3064	72035	40944.
3	16	AN3028	72474	40760.
3	19	XN2108	73379	40520.
3	20	AN3083	71809	44760.
3	21	AN3090	73390	44018.
4	9	UD5069	63492	37599.
4	11	AN3035	71986	40193.
4	12	XN2087	71965	37611.
4	15	AN3068	70287	41846.
4	16	AN3096	70257	41548.
4	19	XN2095	70104	37735.
4	20	AN3007	5960D	31472.
5	9	UD5064	71198	37048.
5	12	AN3070	5881D	31839.
5	19	AN3027	71437	40198.
5	25	UD4029	73090	44725.
6	3	XN2027	73412	37572.
6	7	UD5070	71945	37374.
6	11	UD4115	71785	42967.
7	3	XN2026	73375	43416.
7	7	AN3032	71942	41281.
7	8	AN3051	63949	44000.
7	11	AN3100	73120	43638.
7	12	XN2046	71370	34071.
7	13	UD5072	70238	37375.

TABLE 1 (CONT.)

Y	X	CURRENT ASSEMBLY	CHANNEL ID	PROJ. EOC 7 EXPOSURE
7	15	XN2091	71387	32832.
7	16	XN2099	61638	39340.
7	20	AN3049	72024	43636.
7	23	AN3119	63442	44045.
7	24	AN3030	71443	41420.
8	2	LJT188	73225	38183.
8	7	AN3099	71956	44006.
8	11	AN3040	73367	42178.
8	12	XN2106	73168	33080.
8	18	XN2097	62446	41169.
8	19	XN2080	72003	33058.
8	20	AN3126	71933	44604.
8	24	AN3045	71914	44501.
8	29	LJT288	72019	41459.
9	1	XN1160	72475	42631.
9	2	AN3104	72039	44759.
9	10	AN3075	73079	44723.
9	21	AN3107	71808	41961.
9	27	UD5013	70110	37045.
9	29	AN3085	73394	44054.
10	1	LJT339	71889	37565.
10	2	UD5065	61550	34444.
10	3	AN3053	5898D	35484.
10	9	AN3076	5809D	36217.
10	22	AN3097	71400	44878.
10	28	AN3103	73154	35474.
10	30	LJT162	70262	37290.
11	1	LJT311	71480	38181.
11	3	AN3031	71389	45069.
11	4	AN3041	73108	39430.
11	6	UD4024	62926	43058.
11	7	AN3042	71970	44217.
11	8	AN3038	71756	44389.
11	11	AN3052	71958	43211.
11	12	AN3039	71789	39495.
11	13	UD5071	71938	30622.
11	19	AN3125	71755	39350.
11	20	AN3120	73226	43678.
11	23	AN3130	6012D	32858.
11	24	AN3025	63257	44119.
11	25	UD4022	73386	31704.
11	27	AN3026	72001	39889.
11	28	AN3029	72439	44530.
11	30	LJT323	72000	41422.
12	1	LJT325	73443	37900.
12	4	XN2084	71936	37690.
12	5	AN3079	63445	40382.

TABLE 1 (CONT.)

Y	X	CURRENT ASSEMBLY	CHANNEL ID	PROJ. EOC 7 EXPOSURE
12	8	XN2085	71762	32634.
12	11	AN3069	73116	40169.
12	12	AN3067	61769	43971.
12	19	AN3098	5900D	35207.
12	20	AN3081	73111	31215.
12	23	XN2101	73438	32193.
12	26	AN3084	71391	40621.
12	27	XN2067	73582	38280.
12	30	LJT369	71364	37854.
13	1	LJT187	73136	37900.
13	2	UD4032	72010	45037.
13	4	XN2047	73584	43813.
13	8	XN2023	73401	34739.
13	14	AN3054	63427	44417.
13	15	UD4025	70279	36086.
13	17	AN3082	71447	32846.
13	23	XN2109	73424	41991.
13	30	LJT241	71441	38180.
14	1	LJT328	70161	37360.
14	2	UD5030	71848	37270.
14	13	AN3066	73366	42317.
14	15	AN3036	63602	41983.
14	16	AN3008	71758	41921.
14	18	AN3095	5938D	35801.
14	29	UD5035	71983	36876.
14	30	LJT337	73119	37291.
15	1	LJT282	71378	37417.
15	2	AN3133	71927	45463.
15	4	AN3034	71757	41747.
15	5	UD5063	71817	37160.
15	7	XN2086	71300	33124.
15	12	XN2022	71461	33800.
15	14	AN3080	5866D	33684.
15	15	AN3033	73130	44189.
15	16	AN3021	71458	44185.
15	17	AN3001	71790	42628.
15	18	UD4031	72038	36872.
15	19	XN2096	71472	33764.
15	24	XN2094	71761	32563.
15	27	AN3022	72027	43751.
15	28	AN3124	71376	40867.
15	29	AN3134	73384	44677.
15	30	LJT214	72028	41313.
16	1	LJT240	70105	37418.
16	2	AN3102	71753	36410.
16	3	AN3037	72037	40774.
16	4	AN3011	60890	44585.

TABLE 1 (CONT.)

Y	X	CURRENT ASSEMBLY	CHANNEL ID	PROJ. EOC 7 EXPOSURE
16	7	XN2056	72023	38801.
16	8	XN2123	71465	36181.
16	9	UD5040	62522	37057.
16	10	XN2102	62711	42634.
16	12	XN2040	71302	33801.
16	14	AN3002	62283	33766.
16	15	AN3132	71981	44327.
16	16	AN3024	71445	44481.
16	17	AN3122	71928	39683.
16	21	XN2038	71371	36167.
16	23	XN2054	71767	35906.
16	24	XN2068	61682	39391.
16	27	AN3061	73399	44383.
16	28	AN3129	71442	40558.
16	29	AN3065	71976	39162.
16	30	LJT179	63945	42075.
17	1	LJT235	70244	37322.
17	7	UD4040	71786	26545.
17	9	UD4144	62335	44127.
17	11	UD4016	71904	26333.
17	13	AN3114	5805D	33100.
17	15	AN3014	71985	42042.
17	16	AN3015	72014	42136.
17	18	AN3106	5932D	35929.
17	20	UD4139	61794	44507.
17	22	UD4142	6028D	29027.
17	24	UD4035	71957	42133.
17	30	LJT237	72011	37294.
18	1	LJT270	71920	38181.
18	2	UD4006	71954	27007.
18	6	UD4005	73089	26904.
18	7	UD5008	71377	37647.
18	10	XN2105	61650	35058.
18	12	UD4033	72007	45129.
18	14	AN3058	73388	44300.
18	17	AN3112	71990	43978.
18	18	UD5033	70158	37376.
18	19	UD4023	73614	33368.
18	20	UD5029	61773	37363.
18	21	XN2039	71194	35509.
18	22	UD5026	61750	37563.
18	25	UD4014	71853	44757.
18	26	UD5023	73069	37161.
18	30	LJT216	73404	37058.
19	1	LJT272	70080	37961.
19	4	XN2066	61972	31487.
19	5	AN3128	72021	40571.

TABLE 1 (CONT.)

Y	X	CURRENT ASSEMBLY	CHANNEL ID	PROJ. EOC 7 EXPOSURE
19	7	XN2048	5924D	31187.
19	8	XN2055	71134	32886.
19	9	UD4012	71950	26433.
19	12	AN3072	71788	43811.
19	13	UD4026	71467	44365.
19	15	XN2050	71934	33144.
19	16	XN2076	73405	33354.
19	18	UD4037	70106	42801.
19	19	AN3110	71773	43660.
19	20	AN3023	5850D	31198.
19	22	UD4134	71903	44412.
19	23	XN2051	70280	39107.
19	26	AN3016	71448	40081.
19	27	XN2100	71959	31566.
19	30	LJT247	71931	37681.
20	1	LJT271	73585	37903.
20	3	AN3044	73422	45064.
20	4	AN3020	63956	40297.
20	5	UD5039	70011	37160.
20	7	AN3127	70102	44118.
20	9	UD5036	73238	36967.
20	10	XN2058	73076	42570.
20	11	AN3019	71852	44051.
20	12	AN3055	73171	39853.
20	13	UD5020	71791	37031.
20	14	UD4028	73110	44990.
20	15	XN2075	71886	43287.
20	16	XN2057	71909	35093.
20	19	AN3077	71812	39435.
20	20	AN3063	62937	43842.
20	21	XN2074	71949	36174.
20	22	UD5022	70252	37107.
20	23	AN3006	71912	44509.
20	24	AN3062	71890	44111.
20	26	UD5031	73415	37268.
20	27	AN3060	71268	40133.
20	28	AN3047	73133	42421.
20	30	LJT295	70236	37193.
21	1	LJT193	62609	37320.
21	3	AN3057	5802D	35475.
21	5	UD4143	72042	26505.
21	9	AN3073	72036	44878.
21	11	XN2005	71495	36326.
21	13	XN2110	73588	34720.
21	15	XN2111	63951	42650.
21	16	XN2093	72040	35965.
21	18	XN2042	61727	34468.

TABLE 1 (CONT.)

Y	X	CURRENT ASSEMBLY	CHANNEL ID	PROJ. EOC 7 EXPOSURE
21	22	AN3116	63947	44849.
21	26	UD4140	73083	44370.
21	28	AN3111	73135	44031.
21	29	UD5021	71799	36971.
21	30	LJT376	71362	37194.
22	1	XN2037	71170	37435.
22	2	AN3050	71449	33271.
22	3	UD4021	73232	42137.
22	6	XN2062	71410	36317.
22	7	UD5010	72034	37193.
22	9	UD5009	71913	37653.
22	10	AN3071	73131	33018.
22	11	UD5016	71356	37100.
22	12	UD4039	71835	25931.
22	14	UD4027	70233	43941.
22	16	UD5038	71960	37562.
22	17	UD4008	73148	44235.
22	19	UD4007	62647	42447.
22	20	UD5037	71830	37272.
22	21	AN3115	73227	44622.
22	24	UD5024	61529	36968.
22	25	XN2063	71897	36809.
22	28	UD4003	63953	42136.
22	29	AN3093	73420	44750.
22	30	XN2083	71843	37284.
23	2	LJT308	71955	42622.
23	3	UD4042	71943	44834.
23	5	XN2104	71146	43851.
23	7	AN3101	61523	44334.
23	9	UD4137	70221	44973.
23	12	XN2098	73364	39960.
23	13	XN2072	73440	33577.
23	15	XN2028	73383	41860.
23	16	XN2036	61541	42581.
23	18	XN2059	71765	41291.
23	19	XN2090	62699	33788.
23	20	AN3017	73139	44616.
23	22	UD4141	63940	44898.
23	24	AN3108	71994	44200.
23	26	XN2092	71810	37028.
23	28	UD4135	71975	42323.
23	29	LJT218	71398	37199.
24	3	XN2061	71456	36990.
24	7	AN3123	71991	43382.
24	8	AN3013	71838	43973.
24	9	UD5004	71908	37836.
24	10	UD4041	71923	26129.

TABLE 1 (CONT.)

Y	X	CURRENT ASSEMBLY	CHANNEL ID	PROJ. EOC 7 EXPOSURE
24	11	AN3086	70047	41188.
24	13	UD5011	71930	37098.
24	15	XN2081	71390	32833.
24	16	XN2078	61673	39034.
24	20	AN3091	73112	43635.
24	21	UD4036	73441	26631.
24	23	AN3005	73153	43908.
24	24	AN3048	70272	41281.
24	28	XN2064	73239	37011.
25	3	XN2041	73392	44465.
25	4	XN2122	71280	38537.
25	5	UD4116	71764	44882.
25	7	UD5017	63943	37359.
25	9	XN2089	73376	35736.
25	11	UD4011	71792	24391.
25	13	UD4015	5912D	27317.
25	18	UD4013	71289	45234.
25	20	UD4132	73167	42969.
25	22	XN2069	71905	36627.
25	26	UD4004	73444	33932.
25	27	XN2082	71893	37812.
26	10	UD4138	71485	45221.
26	11	UD5014	71759	37587.
26	12	AN3131	72041	40537.
26	18	UD5032	70243	37268.
26	19	AN3121	71444	40793.
26	21	UD4136	62412	45092.
27	9	UD5028	71962	36967.
27	11	AN3056	61741	40347.
27	12	XN2065	71921	31248.
27	13	XN2088	72476	36455.
27	15	AN3113	HA5422	43584.
27	16	AN3109	73121	44005.
27	18	XN2107	73224	42796.
27	19	XN2052	61526	31227.
27	20	AN3078	71967	40534.
27	22	UD5025	71141	37646.
28	6	XN2049	71857	37407.
28	7	XN2103	71331	37571.
28	10	AN3087	61578	43699.
28	11	AN3012	5999D	36057.
28	12	XN2073	71964	40520.
28	15	AN3018	71431	40535.
28	19	XN2060	73416	33571.
28	20	AN3059	5868D	33397.
28	21	AN3105	70206	43474.
28	22	UD4030	71308	42105.

TABLE 1 (CONT.)

Y	X	CURRENT ASSEMBLY	CHANNEL ID	PROJ. EOC 7 EXPOSURE
28	24	XN2043	71910	36813.
28	25	XN2001	72012	37379.
29	8	LJT312	70293	41433.
29	9	AN3088	5905D	33246.
29	11	UD4038	73403	26010.
29	14	UD5018	61538	37028.
29	19	UD5034	71771	37032.
29	20	UD4083	72017	44038.
29	22	AN3094	5852D	35967.
29	23	LJT227	73067	41079.
30	10	LJT160	62542	37680.
30	11	LJT340	71211	42466.
30	12	LJT384	71499	37100.
30	13	LJT231	70216	42075.
30	14	LJT387	73609	37318.
30	15	LJT250	71997	41424.
30	16	LJT335	70291	37234.
30	17	LJT165	71457	37027.
30	18	LJT226	70060	37234.
30	19	LJT180	71438	37035.
30	20	LJT253	63636	37233.
30	21	LJT167	71911	37677.

April 22, 1991

Docket No. 50-397

Mr. G. C. Sorensen, Manager
Regulatory Programs
Washington Public Power Supply System
3000 George Washington Way
P.O. Box 968
Richland, Washington 99352

Dear Mr. Sorensen:

SUBJECT: EVALUATION OF RESPONSE TO NRC BULLETIN NO. 90-02, "LOSS OF THERMAL MARGIN CAUSED BY CHANNEL BOX BOW" (TAC NO. 76354)

On March 20, 1990, the NRC issued Bulletin No. 90-02, "Loss of Thermal Margin Caused By Channel Box Bow." The bulletin contained reporting requirements applicable to boiling water reactor facilities using fuel channel boxes for a second bundle lifetime. You responded to the bulletin in letters dated April 13, 1990 (G02-90-075) and September 28, 1990 (G02-90-162). You provided additional information by letter dated February 25, 1991 (G02-91-037) in response to the staff's request.

In each letter, you indicated that 349 channel boxes were to be reused in the upcoming cycle (cycle 7). Your responses described the number and disposition of the affected channel boxes and the actions taken to assure compliance with the technical specification for thermal limits.

We have completed our review of your responses and find that it satisfactorily resolves the issues discussed in NRC Bulletin 90-02 for cycle 7 and that its application to any future channel reuse must be evaluated on a cycle specific basis. A copy of our safety evaluation is enclosed.

This completes our efforts under TAC No. 76354. If you have any questions regarding this issue, please contact me.

Sincerely,

Original signed by

Patricia L. Eng, Project Manager
Project Directorate V
Division of Reactor Projects III/IV/V
Office of Nuclear Reactor Regulation

cc w/enclosure:
See next page

DISTRIBUTION

Docket File	NRC & LPDRs	PD5 r/f	BBoger	MVirgilio	DFoster
PEng	OGC	EJordan	PD5 p/f	ACRS (10)	RZimmerman, RV
AAttard	RJones				

NRC FILE CENTER COPY

OFC	:LA/PD5/DRPW	:PM/PD5/DRPW	:D/PD5/DRPW	:	:
NAME	:DFoster	:PEng:sg	:JMyer	:	:
DATE	:4/18/91	:4/22/91	:4/22/91	:	:

OFFICIAL RECORD COPY Document Name: WNP2 76354

Mr. G. C. Sorensen
Washington Public Power Supply System

WPPSS Nuclear Project No. 2
(WNP-2)

cc:

Mr. J. W. Baker
WNP-2 Plant Manager
Washington Public Power Supply System
P.O. Box 968, MD 927M
Richland, Washington 99352

Regional Administrator, Region V
U.S. Nuclear Regulatory Commission
1450 Maria Lane, Suite 210
Walnut Creek, California 94596

G. E. C. Doupe, Esq.
Washington Public Power Supply System
3000 George Washington Way
P. O. Box 968
Richland, Washington 99532

Chairman
Benton County Board of Commissioners
P. O. Box 190
Prosser, Washington 99350-0190

Mr. R. G. Waldo, Chairman
Energy Facility Site Evaluation Council
Mail Stop PY-11
Olympia, Washington 98504

Mr. R. C. Sorensen
U. S. Nuclear Regulatory Commission
P. O. Box 69
Richland, Washington 99352

Mr. Alan G. Hosler, Licensing Manager
Washington Public Power Supply System
P. O. Box 968, MD 956B
Richland, Washington 99352

Nicholas S. Reynolds, Esq.
Winston & Strawn
1400 L Street, N.W.
Washington, D.C. 20005-3502

Mr. A. Lee Oxsen, Acting
Managing Director for Operations
Washington Public Power Supply System
P. O. Box 968, MD 1023
Richland, Washington 99352

Mr. Gary D. Bouchey, Director
Licensing and Assurance
Washington Public Power Supply System
P. O. Box 968, MD 280
Richland, Washington 99352

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

SAFETY EVALUATION BY THE OFFICE OF NUCLEAR REACTOR REGULATION

RELATING TO EVALUATION RESPONSE TO NRC BULLETIN NO. 90-02

WASHINGTON PUBLIC POWER SUPPLY SYSTEM

WASHINGTON NUCLEAR POWER UNIT 2

DOCKET NO. 50-397

1.0 BACKGROUND

WNP-2 is a C-lattice BWR and, as such, is less susceptible than a D-Lattice core to the phenomena of and effects from channel box bow. Washington Public Power Supply System (WPPSS) is aware of the potential problems associated with channel box bow, and for that reason WPPSS had embarked on a channel management program since initial operation. This channel management program consists of data collection on channel operating history and actual measurement of channel distortion as a function of channel operation. The licensee's ultimate goal is to make the transition away from channel box reuse.

Beginning with the upcoming cycle, cycle 7, the effects of channel box bow will be addressed in WNP-2 reload design using the approved ANF methodology for determining the Safety Limit Critical Power Ratio (SLCPR). The ANF data incorporated in the ANF methodology has been reviewed previously by the NRC and included WNP-2 measured data (Reactor D in this data base). Analysis of the data indicated that WNP-2 is observing less channel box bow because WNP-2 is a C-lattice. This data extends to an exposure of 50 GWD/MTU.

This safety evaluation covers the staff review of the Washington Public Power Supply System strategy for reuse of channel boxes in the upcoming cycle.

2.0 EVALUATION

2.1 Channel Box Characterization

Channel boxes are selected for reuse by WNP-2 by establishing an accept/reject criteria based on "Distortion Allowance." Discharged channel boxes are measured in the WNP-2 channel box measuring machine and the total maximum distortion (bow plus bulge) due to reactor operation is determined. The licensee showed that total channel box distortion will vary along the channel with the maximum distortion value usually located near the middle of the channel.

The Distortion Allowance was developed based on the following relation:

Distortion Allowance = Nominal Design Clearance - Calculated Future Distortion.

Used channel boxes are qualified for reuse if their measured distortion (from nominal) is less than the Distortion Allowance as developed from the above relationship.

The licensee defines the Nominal Design Clearance as the nominal clearance between the channel box and the potential interference (in this case the control blade and/or Local Power Range Monitor (LPRM) as defined by the design drawings of the reactor core.

The Calculated Future Distortion is defined as the total distortion (bow plus bulge) as determined by the WNP-2 channel box model. The model is based upon the expected future irradiation path of the fuel assembly upon which the channel box will be placed. The licensee pointed out that typically, the future irradiation path is assumed to be five cycles at the interior of the core and one cycle on the periphery. The amount of channel box bulge for the interior and the periphery is determined from the channel box bow model, assuming operation at 100% power. The model sums the results of the five cycles at the interior and one at the periphery to obtain a total expected bulge.

Similarly, channel box bow data is obtained from figures/plots generated by the channel box model for both the interior and periphery locations and again at assumed 100% power. The total expected channel box bow and bulge are then summed to obtain the total expected channel box distortion.

With the Nominal Design Clearance known from design drawings and Calculated Future Distortion determined from the WNP-2 channel box bow model, the licensee is able to determine a Distortion Allowance value(s) for clearance of both the control blade and the LPRM for any given cycle. Channel boxes with measured total distortion less than the control blade and the LPRM Distortion Allowances are qualified for reuse.

2.2 Estimated Exposure and Maximum Calculated Channel Box Bow

In their February 25 submittal, the licensee pointed out that the magnitude and direction of channel box distortion (bow plus bulge), is directly dependent upon the location history of the channel boxes. The channel box that will have the largest estimated maximum at the end of cycle 7 is channel box designated 71927. During cycle 7, this channel box is expected to be exposed to approximately 7.8 GWD/MTU with a total accumulated exposure at the end of cycle 7 of approximately 45 GWD/MTU.

The Supply System analytical model predicts a maximum calculated channel box bow for this channel to be equal to or less than 58 mils. The model also predicts a maximum calculated channel bulge of 45 mils or less. Consequently, the total predicted channel box distortion for this channel is less than or equal to 103 mils. The exposures and channel box distortion for the remaining reused channels in WNP-2 are less (in some cases much less) than the values stated above.

2.3 Channel Box Measurement

The Supply System has measured bow data on channel boxes out to exposures of approximately 31 GWD/MTU. Their measured (maximum) data was compared to calculated data generated by the channel box distortion model. The calculated values were found to be conservative relative to measured data (Reference 4).

2.4 Channel Box Bow Effects on the MCPR Limits

The licensee indicated that it will take into account the channel box bow effects on the MCPR operating limit by modifying (recalculating) the SLMCPR, maintaining the same delta CPR. The WNP-2 SLMCPR was established through statistical considerations of measurement and calculations uncertainties, associated with the thermal hydraulics state of the reactor using design basis radial, axial and local power distributions and considering fuel channel box bow (Reference 5). The effects of the channel box bow are included in the WNP-2 cycle 7 safety limit adjustment.

3.0 CONCLUSION

Based on the above evaluation, the NRC staff has concluded that the licensee's cycle 7 reload design with reused channel boxes and the methods used to account for the channel box impact on the core operating limits is acceptable. The data and methodology used provide reasonable assurance that the thermal margin to the MCPR safety limit is maintained.

If in future cycles channel box reuse is continued, further review and prior approval by the NRC staff will be required.

Principal Contributor: A. Attard

Date: April 22, 1991

4.0 REFERENCES

1. GO2-90-162, September 28, 1990, G.C. Sorensen (Supply System) to USNRC, "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".

2. Supply System Interoffice Memorandum, from W.C. Wolkenhauer, Principal Engineer, to D.L. Whitcomb, Manager, Nuclear Fuel, November 13, 1990.

3. GO2-91-037, February 25, 1991, G.C. Sorensen to USNRC, "Nuclear Plant No. 2, Operating License NPF-21, Request for additional information regarding NRC Bulletin No. 90-02, "Loss of Thermal Margin Caused by Channel Box Bow".

4. EANF-90-0434, November 13, 1990.

5. Letter, August 8, 1990, A.C. Thadani, NRC to R.A. Copeland, ANF, "Acceptance for Referencing of Topical Report ANF-524 (p), Revision 2, ANF Critical Power Methodology for Boiling Water Reactor".