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October 19, 1981

NUCLEAR PRODUCTION DEPARTMENT

U.S. Nuclear Regulatory Commission
Office of Nuclear Reactor Regulation
Washington, D.C. 20555

Attention: Mr. Harold R. Denton, Director

Dear Mr. Denton:

SUBJECT: Grand Gulf Nuclear Station
Units 1 and 2
Docket Nos. 50-416 and 50-417
File 0260/0862/L-340.0
Results of ODYN Transient Event
Analyses (NRC Q211.145)
AECM-81/400

The ODYN model analyses for certain transient events as requested by the Reactor Systems Branch have been completed. The results of these analyses will be incorporated into the FSAR text and submitted in the next available amendment. Summary results for these event analyses and the input parameters are provided as attachments through revised Tables 15.0-1 and 15.0-2.

The ODYN transient analyses are provided for the following FSAR Chapter 15 events: 1) Feedwater Controller Failure, Maximum Demand; 2) Pressure Controller Down Scale Failure; 3) Generator Load Rejection, Bypass-On; 4) Generator Load Rejection, Bypass-Off; 5) Turbine Trip, Bypass-Off, and 6) Inadvertent MSIV Closure. An ODYN analysis was also performed for the Inadvertent MSIV Closure with Flux Scram for FSAR Chapter 5.

The Inadvertent MSIV closure with Flux Scram event analysis assumes the failure of the MSIV position scram. The ODYN analysis of this event yielded a maximum pressure of 1260 psig. This transient represents an overpressure condition (in excess of vessel design pressure of 1250 psig) for approximately one second. This maximum pressure is significantly below the limit of 1375 psig as computed in accordance with Article NB-7000 of the ASME Boiler & Pressure Vessel Code. Additional information (figures and revised FSAR text) on this analysis will be provided later as part of revisions to FSAR Chapter 5.

The above analyses were performed using a revised operating minimum critical power ratio (MCPR) of 1.18 as allowed by the plant specific ECCS analysis provided in FSAR Section 6.3.3. The lowest MCPR using ODYN resulted in 1.08 for the Feedwater Controller Failure, Maximum Demand. The revision of MCPR values for other transient events was made due to the lowered operating MCPR of 1.18. Consistent with this, the MCPR for the Loss of Feedwater Heater event (Manual Flow Control) was reduced to 1.06. See the attached revised FSAR Table 15.01.

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This information is provided in response to NRC Question 211.145 (FSAR Chapter 15) and the outstanding issue on this subject as described in the Grand Gulf Safety Evaluation Report Section 1.9(7).

Yours truly,

John Richardson for

L. F. Dale
Manager of Nuclear Services

SAB/JGC/JDR:lm

Attachments: FSAR Tables 15.0-1 and 15.0-2

cc: Mr. N. L. Stampley (w/a)
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U. S. Nuclear Regulatory Commission
Washington, D.C. 20555

TABLE 15.0-1

RESULTS SUMMARY OF TRANSIENT EVENTS APPLICABLE TO BWRs

Subsection I.D.	Figure I.D.	Description	Maximum Neutron Flux % NBR	Maximum Dome Pressure psig	Maximum Vessel Pressure psig	Maximum Steam Line Pressure psig	Maximum Core Average Surface Heat Flux % of Initial	Minimum CPR -	Frequency Category*	Duration of Blowdown: No. of Valves 1st Blowdown	Duration of Blowdown: Duration of Blowdown sec	
15.1		DECREASE IN CORE COOLANT TEMPERATURE										
15.1.1	15.1-2	Loss of Feedwater Heater, Manual Flow Control	122	1060	1072	1042	114	1.06 ~~1.08~~	a	0	0	
15.1.2	15.1-3	Feedwater Cntl Failure, Max Demand ****	113 ~~159~~	1168 ~~1161~~	1196 ~~1169~~	1165 ~~1153~~	105 ~~106~~	1.08 ~~1.14~~	a	20	6	211.83
15.1.3	15.1-4	Pressure Controller Fail - Open	104	1127	1130	1127	100	>1.13 ~~1.12~~	a	11	3	
15.1.4	15.1-5 15.1-6	Inadvertent Opening of Safety or Relief Valve	See Text									
15.1.6		RHR Shutdown Cooling Malfunction Decreasing Temp	See Text									
15.2		INCREASE IN REACTOR PRESSURE	See Text									
15.2.1	15.2-1	Pressure Controller Downscale Failure ****	144 ~~158~~	1195 ~~1183~~	1229 ~~1192~~	1190 ~~1177~~	102 ~~104~~	1.10 ~~1.13~~	a	20	9 ~~7~~	211.83
15.2.2	15.2-2	Generator Load Rejection, Bypass-On, ****	105 ~~134~~	1165 ~~1156~~	1193 ~~1165~~	1163 ~~1149~~	100 ~~100~~	>1.13 ~~1.12~~	a	20	5	211.136
15.2.2	15.2-3	Generator Load Rejection, Bypass-Off, ****	112 ~~249~~	1203 ~~1195~~	1234 ~~1204~~	1207 ~~1188~~	100 ~~104~~	1.13 ~~1.12~~	a ~~b~~	20	6 ~~18~~	211.83
15.2.3	15.2-4	Turbine Trip, Bypass-On	111	1154	1161	1148	100	>1.13 ~~>1.12~~	a	20	5	211.136
15.2.3	15.2-5	Turbine Trip Bypass-Off ****	105 ~~192~~	1202 ~~1192~~	1233 ~~1201~~	1207 ~~1185~~	100 ~~101~~	>1.13 ~~1.15~~	a ~~b~~	20	6 ~~18~~	
15.2.4	15.2-6	Inadvertent MSIV Closure ****	105 ~~104~~	1180 ~~1173~~	1213 ~~1181~~	1179 ~~1171~~	100	>1.13 ~~>1.12~~	a	20	5.6 ~~11~~	
15.2.5	15.2-7	Loss of Condenser Vacuum	127	1172	1179	1165	100	>1.13 ~~>1.12~~	a	20	15	211.136
15.2.6	15.2-8	Loss of Auxiliary Power Transformer	104	1134	1147	1131	100	>1.13 ~~>1.12~~	a	11	4	
15.2.6	15.2-9	Loss of All Grid Connections	121	1156	1163	1149	100	>1.13 ~~>1.12~~	a	20	5	
15.2.7	15.2-10	Loss of All Feedwater Flow	104	1045	1056	1029	100	>1.13 ~~>1.12~~	a	0	5	
15.2.8	-	Feedwater Piping Break	See Table 15.0-1A, event 15.6.6									
15.2.9	15.2-13	Failure of RHR Shutdown Cooling	See Text									

* Frequency definition is discussed in subsection 15.0.3.1.

**See subsection 15.0.3.3.1.

a Moderate frequency

b Infrequent

**** Transients Simulated Using ODYN Code

TABLE 15.0-1 (Cont.)

Sub-section I.D.	Figure I.D.	Description	Maximum Neutron Flux, % NBR	Maximum Dome Pressure psig	Maximum Vessel Pressure psig	Maximum Steam Line Pressure psig	Maximum Core Average Surface Heat Flux % of Initial	Minimum CPR -	Frequency Category*	Duration of Blowdown: No. of Valves 1st Blow-down	Duration of Blowdown: Dura-tion of Blow-down sec
15.3		DECREASE IN REACTOR COOLANT SYSTEM FLOW RATE									
15.3.1	15.3-1	Trip of One Recirculation Pump Motor	104	1045	1056	1029	100	1.13 ~~1.12~~	a	0	0
15.3.1	15.3-2	Trip of Both Recirculation Pump Motors	104	1167	1171	1162	100	1.13 ~~1.12~~	a	20	7
15.3.2	15.3-3	Fast Closure of One Main Recirc. Valve	104	1045	1056	1029	100	1.13 ~~1.12~~	a	0	0
15.3.2	15.3-4	Fast Closure of Two Main Recirc. Valves	104	1167	1170	1161	100	1.13 ~~1.12~~	a	20	7
15.3.3	15.3-5	Seizure of One Recirculation Pump	104	1149	1152	1143	100	1.13 ~~1.12~~	c	20	8
15.3.4		Recirc. Pump Shaft Break	See Subsection 15.3.3								
15.4		REACTIVITY AND POWER DISTRIBUTION ANOMALIES									
15.4.1.1		RWE - Refueling	See Text						b		
15.4.1.2		RWE - Startup	See Text						b		
15.4.2		RWE - At Power	See Text						a		
15.4.3		Control Rod Misoperation	See Subsections 15.4.1 and 15.4.2								
15.4.4	15.4-3	Abnormal Startup of Idle Recirculation Loop	86	985	988	978	135	1.13 ~~1.12~~	a	0	0
15.4.5	15.4-4	Fast Opening of One Main Recirc. Valve	316	976	994	971	135	1.13 ~~1.12~~	a	0	0
15.4.5	15.4-5	Fast Opening of Both Main Recirc Valves	256	974	994	969	133	1.13 ~~1.12~~	a	0	0
15.4.7		Misplaced Bundle Accident	See Text					1.08 ~~1.10~~	b		
15.5		INCREASE IN REACTOR COOLANT INVENTORY									
15.5.1	15.5-1	Inadvertent HPCS Pump Start	104	1045	1056	1029	100	1.13 ~~1.12~~	a	0	0
15.5.3		BWR Transients	See appropriate Events in Sections 15.1 and 15.2								

211.136

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* Frequency definition is discussed in subsection 15.0.3.1.
** See subsection 15.0.3.3.1.
***Transients initiated from low power
a Moderate frequency
b Infrequent
c Unexpected

Amend. 47 4/81

TABLE 15.0-2

INPUT PARAMETERS AND INITIAL CONDITIONS FOR TRANSIENTS

1.	Thermal power level, MWt		
	Warranted value	3833	
	Analysis value	3993	
2.	Steam flow, lbs per hr		
	Warranted value (NBR)	16.488×10^6	
	Analysis value	17.312×10^6	
3.	Core flow, lbs per hr	113.5×10^6	
4.	Feedwater flow rate, lb per sec		
	Warranted value (NBR)	4618	
	Analysis value	4809	
5.	Feedwater temperature, F	425	
6.	Vessel dome pressure, psig	1045	
7.	Vessel core pressure, psig	1056	
8.	Turbine bypass capacity, % NBR	35	
9.	Core coolant inlet enthalpy, Btu per lb	530.2	
10.	Turbine inlet pressure, psig	960	
11.	Fuel lattice	P 8 x 8 R	
12.	Core average gap conductance, Btu/sec-ft^2-F	~~600~~ 0.1891	
13.	Core leakage flow, %	10.65	
14.	Required MCPR operating limit		211.83
	First core ***	~~1.20~~ 1.18	
	~~Reload core~~	~~1.20~~	
15.	MCPR safety limit for incidents of moderate frequency		
	First core	1.06	
	~~Reload core~~	~~1.07~~	
16.	Doppler coefficient (-) ¢/F		232.12
	Analysis data **	0.132	
17.	Void coefficient (-) ¢/% rated voids		
	Analysis data for power Increase events**	14.0	
	Analysis data for power Decrease events **	4.0	
18.	Core average rated void Fraction, % **	41.9	
19.	Scram reactivity, $ k		
	Analysis data **	Figure 15.0-2	
20.	Control rod drive speed, position versus time	Figure 15.0-3	
21.	Jet pump ratio, M	2.32	
22.	Safety/relief valve capacity, % NBR		
	@ ~~1125 psig~~ 1145 psig	~~100.6~~ 102.4	
	Manufacturer	Dikker	
	Quantity installed	20	

TABLE 15.0-2 (Cont.)

23.	Relief function delay, seconds	0.4
24.	Relief function response time constant, seconds	0.1
25.	Set points for safety/relief valves	1185 1205
	Safety function, psig	1175, ^ 1195, ^ 1215
	Relief function, psig	~~1125, 1135, 1145, 1155~~ 1145, 1155, 1165, 1175
26.	Number of valve groupings simulated	
	Safety function, No.	~~3~~ 5
	Relief function, No.	~~3~~ 4
27.	High flux trip, % NBR	
	Analysis set point (122 x 1.042), % NBR	127.2
28.	High-pressure scram set point, psig	1,095
29.	Vessel level trips, feet above dryer skirt bottom	
	Level 8 - (L8), feet	5.88
	Level 4 - (L4), feet	4.03
	Level 3 - (L3), feet	2.16
	Level 2 - (L2), feet	~~(-)2.26~~ (-)2.182
30.	APRM thermal trip	
	Set point, % NBR	118.8
31.	Recirculation pump trip delay, Seconds	~~0.10~~ 0.14
32.	Recirculation pump trip inertia time constant for analysis, sec*	5
33.	High Pressure Recirculation pump trip	
	Pressure Set point - psig (nominal)	1135
	Time Delay - Sec.	0.3
34.	Total Steamline Volume, ft.^{3}	4358

211.96

211.200

211.95

* The inertia time constant is defined by the expression:

$$t = \frac{2 \pi J_o n}{g T_o}$$

, where t = inertia time constant (sec)

J_o = pump motor inertia (lb-ft^2)

n = rated pump speed (rps)

g = gravitational constant (ft/sec^2)

T_o = pump shaft torque (ft-lb)

**Parameters used in REDY analysis only.
ODYN values are calculated within the code for the end of cycle 1 condition.

***The 1.18 operating limit MCPR is based on the limiting transient, loss of feedwater heater, manual flow control described in Section 15.1.1 and also satisfies the initial MCPR used in ECCS analysis (Table 6.3-2).