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EXTENDED LOAD LINE LIMIT ANALYSIS MILLSTONE POINT NUCLEAR POWER STATION UNIT 1

GENERAL ELECTRIC

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GENERAL ELECTRIC BOILING WATER REACTOR EXTENDED LOAD LINE LIMIT ANALYSIS FOR MILLSTONE POINT NUCLEAR POWER STATION, UNIT 1

NUCLEAR POWER SYSTEMS DIVISION • GENERAL ELECTRIC COMPANY
SAN JOSE, CALIFORNIA 95125

GENERAL ELECTRIC

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TABLES

ILLUSTRATIONS

1. SUMMARY

This report justifies the expansion of the operating region of the power/flow map for Millstone Point Nuclear Power Station Unit 1. The underlying technical analysis is referred to as the Extended Load Line Limit Analysis (ELLLA).

Previous analyses of this type, the Load Line Limit Analyses (LLLA), were more restrictive in scope for most BWR/3s. Specifically, BWR/3 operation at rated power and less than rated flow was not analyzed. However, LLLA for BWR/4s routinely included analyses at rated power and minimum flows of 91 to 94% of rated. In early 1981, an ELLLA was performed for a typical BWR/3 to support operation at rated power with flow as low as 87%. This work draws on the previous analyses to develop a set of restricted generic conclusions regarding applicability of the license basis safety analyses to operation within this expanded domain (Figure 2-1). It is further shown that MPNPS-1, Cycle 8 meets the conditions of validity of the generic conclusions, and hence that for MPNPS-1, Cycle 8, the consequences of events initiated from within the extended domain are bounded by the consequences of the same events initiated from the license basis condition.

These analyses show that ascension to full power may proceed along a modified power/flow line bounded by the 108% rod block* line up to the 100% power/87% flow point as shown in Figure 2-1.

The discussion and analyses presented show that all safety bases normally applied to Millstone Point Nuclear Power Station Unit 1 are satisfied throughout Cycle 8 for operation within this envelope.

*RB = 0.58 W_D + 50, where W_D is drive flow in percent of rated.

2. INTRODUCTION

Two factors which restrict the flexibility of a BWR during power ascension in proceeding from the low-power/low-core-flow condition to the high-power/high-core-flow condition are: (1) the FSAR power/flow curve, and (2) Preconditioning Interim Operating Management Recommendations (PCIOMRs).

If the rated load line control rod pattern is maintained as core flow is increased, changing equilibrium xenon concentrations will result in less than rated power at rated core flow. In addition, fuel pellet-cladding interaction considerations inhibit withdrawal of control rods at high power levels. The combination of these two factors can result in the inability to attain rated core power directly.

Recent analyses (References 1 and 2) justify the modification of the operating envelope defined by the power/flow curve while remaining within previously established operating limits and the PCIOMRs. The operating envelope is modified to include the extended operating region bounded by the 108% APRM rod block line, the rod block intercept line, the rated power line, and the rated load line.

This report provides the analytical basis for Millstone Point Nuclear Power Station, Unit 1 operation during Cycle 8 under a modified operating envelope to permit the direct ascension to full power within the design bases previously applied.

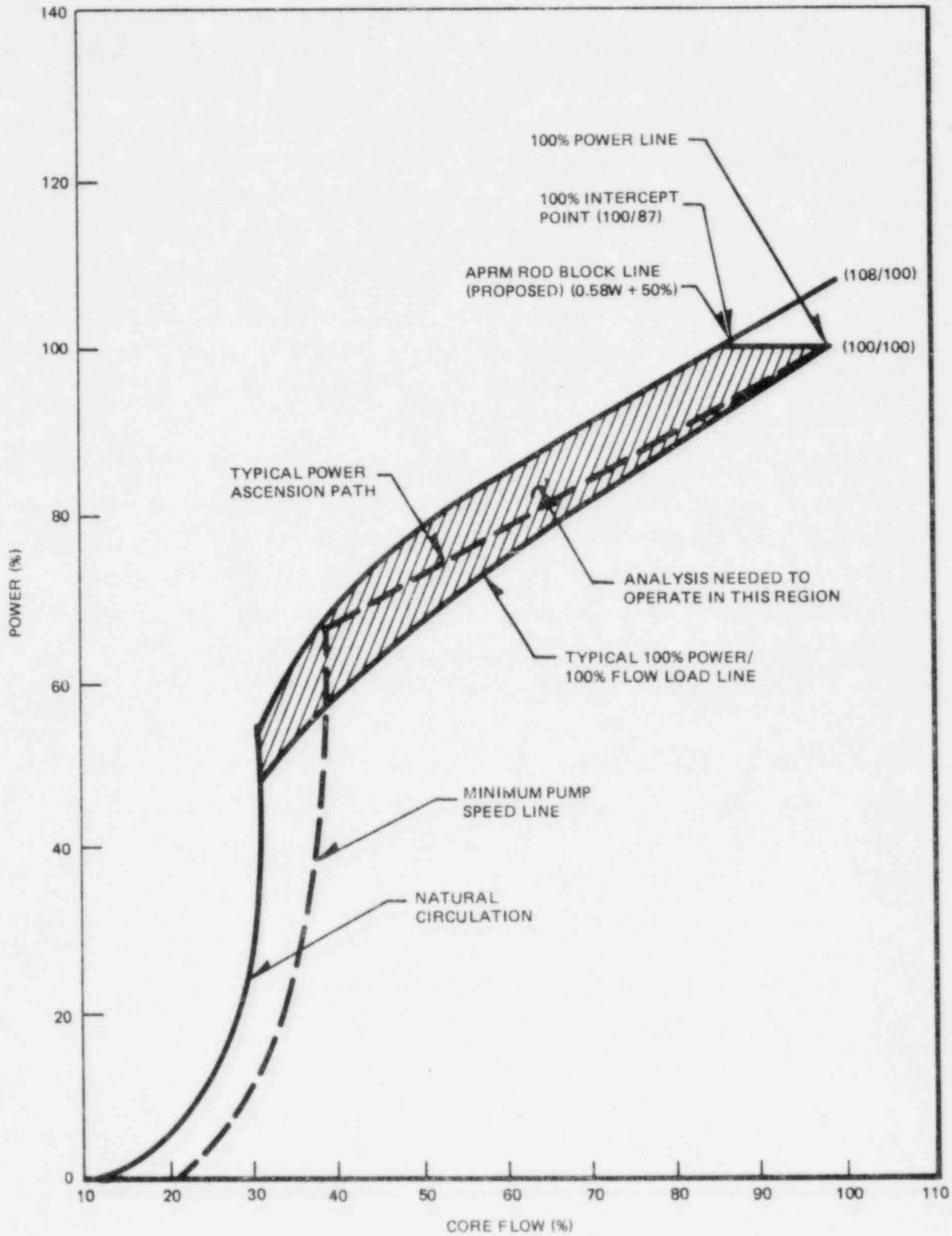

Figure 2-1. Power/Flow Map

3. DISCUSSION

3.1 BACKGROUND

Operation of the Millstone Point Nuclear Power Station, Unit 1 utilizing the power/flow map is described in Section III of the FSAR (Reference 3). This section of the FSAR describes the basic operating envelope (Figure III-2.3) within which normal reactor operations are conducted and provides the basic philosophy behind the power/flow curve. FSAR Figure III-2.3 is reproduced as Figure 3-1 of this document.

The MPNPS-1 operating domain was expanded with the issuance of Reference 1. This analysis further expands the operating domain to allow power ascension along the 108% APRM rod block* line to 100% power at 87% flow. Rated power operation at any flow between 87% and 100% is acceptable.

Certain terminology from the previous Load Line Limit Analyses is retained herein:

Rod Block Intercept Point - 85% power/61% flow.

100% Intercept Point - lowest flow point of which rated power operation is acceptable. (87% flow for MPNPS-1)

Rod Intercept Line - a straight line between the Rod Block Intercept Point and the 100% Intercept Point. Because the latter point lies on the APRM Rod Block line, no Rod Intercept Line exists for MPNPS-1.

3.2 ANALYTICAL BASIS

To provide relief from the operating restrictions inherently imposed during ascension to power by the existing power/flow curve and PCIOMRs, a modified power/flow curve has been derived. In deriving this operating curve, five design basis objectives were specified:

*PB = 0.58 Wp+50 where Wp is line flow in percent of rated.

1. For those transients and accidents that are sensitive to variations in power and flow, the 100% power/100% flow point must be shown to be a more limiting condition than any condition within the expanded operating region (i.e., the shaded region of Figure 2-1).

2. In no instance shall the ratio of power to flow intentionally exceed the ratio defined by the rod block line.

3. The slope of the rod block intercept line between the rod block intercept point and the 100% intercept point must be such that flow increases are capable of compensating for xenon buildup while increasing reactor power.

4. The consequences of all accidents and transients analyzed in the FSAR and subsequent amendments and the license submittals must remain within the limits normally specified for such events.

5. Reactor power ascension from minimum recirculation pump speed to full power shall be directly attainable through combined control rod movement and recirculation flow increase without violation of either the power/flow line or PCIOMRs.

To meet these objectives, analyses were performed for typical BWRs and conclusions were drawn concerning the safety consequences of operation in the extended operating region (shaded area of Figure 2-1). It was shown that these conclusions were applicable to MPNPS-1, Cycle 8.

3.3 ANALYSIS AND RESULTS

3.3.1 Stability

3.3.1.1 Channel Hydrodynamic Conformance to the Ultimate Performance Criterion

The channel performance calculation for MPNPS-1, Cycle 8, was presented in Reference 5. The decay ratios are reproduced below:

Channel Hydrodynamic Performance	Extrapolated Rod Block Line* - Natural Circulation Power
Channel Type	Decay Ratio
P8x8R Channel	0.20
8x8 Channel	0.26

At this most responsive condition, the most responsive channels are clearly within the bounds of the ultimate performance criteria of ≤1.0 decay ratio at all attainable operating conditions.

3.3.1.2 Reactor Conformance to Ultimate Performance Criterion

The decay ratios determined from the limiting reactor core stability conditions are presented in Reference 5. The most responsive case for this analysis is the extrapolated rod block line* - natural circulation condition.

Reactor Core Stability	Extrapolated Rod Block Line* - Natural Circulation Power
Decay Ratio, X_2/X_o	0.61

These calculations show the reactor to be in compliance with the ultimate performance criteria, including the most responsive condition.

3.3.2 Loss-of-Coolant Accident

A discussion of low-flow effects on LOCA analyses for all operating plants (Reference 6) has been presented to and was approved by the NRC (Reference 7). The LOCA analysis for MPNPS-1 (Reference 9) is applicable in the power flow domain discussed in this report.

3.3.3 Pressurization Transients

As shown in Reference 5, the most limiting transient for MPNPS-1, Cycle 8 is the Load Rejection without bypass. By examining the results of numerous

*RB ≤ 0.58 W_D + 50, where W_D is drive flow in % of rated.

transient evaluations (Tables 3-1 through 3-8) at various power/flow conditions, it is possible to demonstrate that, for MPNPS Cycle 8, transients originated from within the extended operating domain are less severe than the limiting transient at license basis condition.

3.3.3.1 Changes in Nuclear Characteristics

The end-of-cycle (EOC) conditions for the various plants and power/flow conditions were calculated in different ways depending on the plant cycle operating plan. For Plant H (see Tables 3-1 - 3-9), the 100/100 EOC point was determined by assuming rated operation (100/100), and by a Haling power shape throughout the cycle (normal practice). The reduced flow points were determined by using the same exposure point and simply reducing the flow. In this case, the exposures for all three points (100/100, 100/92, and 100/87) were identical, only the power shape changed. For other plants, different combinations of Haling "burns" were assumed resulting in unique exposures for each power/flow combination. For Plant F, the 100/100 EOC was determined using the normal Haling assumptions. The 100/111 EOC was then determined by using a 100/111 Haling starting from the 100/100 EOC. On the other hand, the Plant C and L EOCs were determined by using Haling assumptions throughout the cycle, i.e., 100/100 and 100/105 over entire cycle to define the two distinct EOC conditions.

From a transient viewpoint, the important nuclear characteristics which are affected when changing from a high to low flow condition (100/100 to 100/87 or 100/111 to 100/100, etc.) are the scram and void reactivities.

The scram response improves (more negative reactivity) when the flow is reduced. This results because as the flow is reduced, the boiling boundary moves lower in the core, thus causing the axial power shape to peak more toward the bottom (Figures 3-2 and 3-3). This, in turn, results in a stronger scram response because the control rods become "effective" earlier during insertion.

The impact on void reactivity, of changing between high and low flow conditions, is primarily affected by exposure. Since the high and low flow conditions represent only a slight change in exposure, it is expected that the void reactivity characteristics should be very similar. This trend can be observed by comparing Figures 3-4 and 3-5.

In comparing the various Haling assumptions, both the "F" and "G/L" assumptions define unique EOC nuclear conditions (exposure and power shape) while that applied to H resulted in only a change to the power shape. Since the calculated exposure differences are rather small, all three of these calculational methods yield similar results.

3.3.3.2 Evaluation of Transient Results

This section provides transient result comparisons between high and low flow initial conditions for various plants, and justification for extending the conclusions reached to MPNPS-1, Cycle 8.

The transient results of primary importance for this study are ΔCPR and peak vessel pressure. Either of these have the potential to impact operation. To ensure that the reduced flow condition (100/87) is bounded by the reference licensing condition, (100/100) it is necessary to consider ΔCPR and the peak vessel pressures.

The Plant H results for 100/100, 100/92 and 100/87, show a clear trend of decreasing ΔCPR with decreasing flow for both LRw/oBP and FWCF. The peak vessel pressure for the MSIV flux scram event was unchanged between 100/100 and 100/92 (the 100/87 condition was not evaluated).

The Plant F results also clearly show ΔCPR improvement for the transient originated from the lower flow condition. The Plant F analysis is somewhat unusual because it assumes that 1/2 of the turbine bypass functions and the scram signal is delayed 0.20 sec after start of turbine stop valve closure.

The net effect is that the TTw/1/2BP for Plant F is less sensitive to the scram than other plants would be and thus the improvement due to the enhanced scram is understated.

The evaluations for Plants G and L are for smaller flow differences (5%) than for H (13%) and F (11%). These plants also differ in that they have RPT. The transient results show that the higher flow condition (104/105) still yields ΔCPRs which either bound or are equivalent to the reduced flow condition (105/100). The peak vessel pressures are essentially constant for both flow conditions.

The evaluations for Plants M and K are for a smaller flow difference (6%). They were done at slightly different initial power levels (104/100 and 100/94). The results show that the higher flow condition (104/100) results in larger ΔCPRs and smaller peak vessel pressures than transients originated from the reduced flow condition (100/94).

3.3.4 Rod Withdrawal Error

The effective RBM setpoint is a function of power and flow. Above the rated rod line, the rod block will occur with less rod withdrawal. Thus the evaluation at rated is conservative for operation above the rated load line.

Table 3-1

PLANT CHARACTERISTICS

	Plant											
	A	B	C	D	E	F	G	H	K	L	M	MPNPS-1 Cycle 8
Number of Fuel Bundles	560	764	560	764	368	240	560	484	548	560	560	580
Rated Thermal Power (MWt)	2436	3293	2436	3293	1593	997	2436	1670	2381	2436	2436	2011
Rated Core Flow (Mlb/hr)	77.0	102.5	77.0	102.5	49.0	29.7	77.0	57.6	73.5	78.5	77.0	69.0
Relief Valve Setpoint (psig)	1090	1105	1105	1105	1090	1065	1090	1108	1080	1080	1090	1095
Relief Valve Capacity (No./%NBR)	11/85.7	11/66.0	11/87.4	11/66.0	6/72.0	4/79.0	11/89.6	7/83.0	7/57.1	11/85.7	11/85.7	6/61.4
Safety Valve Setpoint (psig)	—	1250	--	1230	1240	1210	--	--	1240	--	--	--
Safety Valve Capacity (No./%NBR)	—	2/14.8	—	2/13.6	2/18.9	6/122.4	--	--	3/19.8	--	--	--
Control Rod Drive Specification	67B	67B	67B	67B	67B	67B & MST*	67B	67B	67B	67B	67B	67B

*T (% insertion) = 0.375 (5), 0.776 (20), 1.57 (50), 2.75 (90), + 200 msec interrogation delay.

Table 3-2a

TRANSIENT INPUT DATA AND OPERATING CONDITIONS FOR LICENSE BASIS POINT

	Plant											
	A	B	C	D	E	F	G	H	K	L	M	MPNPS Cycle 8
Thermal Power (MWt/%)	2533/104	3441/104	2533/104	3440/104	1657/104	997/100	2536/104	1670/100	2482/104	2537/104	2535/104	2011/100
Steam Flow (Mlb/hr/%)	10.96/105	14.10/105	10.99/105	14.0/105	7.18/105	4.07/100	11.0/105	6.78/100	9.56/105	10.5/105	10.96/105	7.94/100
Core Flow (Mlb/hr/%)	77.0/100	102.5/100	77.0/100	102.5/100	49.0/100	29.7/100	77.0/100	57.6/100	73.5/100	78.5/100	77.0/100	69.0/100
Dome Pressure (psig)	1019	1020	1020	1019	1020	1005	1020	1025	1020	1020	1019	1035
Turbine Pressure (psig)	958	960	960	959	960	960	960	978	960	960	959	980
NDP Void Coefficient (¢/%Rg)	-8.76	-6.66	-8.10	-8.32	-9.35	-8.93	-7.68	-6.57			--	-6.17
TAP Void Coefficient (¢/%Rg)	-10.93	-8.32	-10.13	-10.40	-11.69	-11.16	-10.00	-8.22			--	-7.72
NDP Doppler Coefficient (¢/°F)	-0.1955	-0.2283	-0.1938	-0.2318	-0.2302	-0.222	-0.225	-0.223			--	-0.2166
TAP Doppler Coefficient (¢/°F)	-0.1886	-0.2169	-0.1841	-0.2202	-0.2187	-0.211	-0.214	-0.212			--	-0.2058
Average Fuel Temperature (°F)	1519	1337	1538	1360	1359	1377	1357	1171			--	1217
NDP Scram Worth ($)	-39.09	-39.28	-38.85	-36.75	-39.17	-46.31	-38.36	-37.05			--	-37.79
TAP Scram Worth ($)	-31.27	-31.42	-31.08	-29.40	-31.34	-37.05	-30.69	-29.64			--	-30.22

Table 3-2b

TRANSIENT INPUT DATA AND OPERATING CONDITIONS FOR 100% INTERCEPT POINT

	Plant									
	A	B	C	D	E	F	G	H*	K	L
Thermal Power (MWt/%)	2436/100	3293/100	2436/100	3293/100	1593/100	N/A	2436/100	1670/100	2381/100	2436/100
Steam Flow (Mlb/hr/%)	10.47/100	13.42/100	10.47/100	13.38/100	6.84/100		10.47/100	6.77/100	9.57/100	10.03/100
Core Flow (Mlb/hr/%)	72.4/94	93.3/94	72.4/94	93.3/94	45.2/92.2		72.3/94	53.0/92	73.5/94	73.8/94
Dome Pressure (psig)	1012	1013	1014	1013	1014		1021	1022	1014	1013
Turbine Pressure (psig)	957	978	959	958	960		967	977	959	958
NDP Void Coefficient (¢/%Rg)	-9.16	-6.95	-8.65	-8.90	-9.98		-7.65		--	
TAP Void Coefficient (¢/%Rg)	-11.45	-8.69	-10.81	-11.12	-12.47		-10.49			
NDP Doppler Coefficient (¢/°F)	-0.2278	-0.2281	-0.2219	-0.2305	-0.2283		-0.225			
TAP Doppler Coefficient (¢/°F)	-0.2164	-0.2167	-0.2108	-0.2190	-0.2169		-0.214			
Average Fuel Temperature (°F)	1472	1295	1490	1317	1321		1357			
NDP Scram Worth ($)	-39.39	-39.41	-38.81	-36.84	-39.29		-38.46			
TAP Scram Worth ($)	-31.51	-31.53	-31.05	-29.47	-31.43		-30.77			

N/A - Not Analyzed
*Plant H analyzed at 92 & 87% flow.

Table 3-2c

TRANSIENT INPUT DATA AND OPERATING CONDITIONS FOR ROD BLOCK INTERCEPT POINT

	Plant										
	A	B	C	D	E	F	C	H	K	L	M
Thermal Power (MWt/%)	2071/85	2799/85	2071/85	2799/85	1354/85	N/A	2071/85	1420/85	N/A	2071/85	N/A
Steam Flow (Mlb/hr/%)	8.72/83.3	11.18/83.3	8.72/83.3	11.13/83.2	5.70/83.3		8.72/83.3	5.64/83.3		8.35/83.3	
Core Flow (Mlb/hr/%)	46.97/61	62.53/61	46.97/61	62.53/61	29.9/61		47.0/61	35.1/61		47.9/61	
Dome Pressure (psig)	992	992	993	992	993		1078	1004		992	
Turbine Pressure (psig)	954	953	955	954	956		988	972		953	
NDP Void Coefficient (¢/%Rg)	-10.27	-7.95	-9.60	-10.42	-11.26		-8.97				
TAP Void Coefficient (¢/%Rg)	-12.84	-9.94	-12.00	-13.02	-14.08		-11.31				
NDP Doppler Coefficient (¢/°F)	-0.2275	-0.2269	-0.2217	-0.2283	-0.2258		-0.2277				
TAP Doppler Coefficient (¢/°F)	-0.2161	-0.2155	-0.2106	-0.2169	-0.2145		-0.2163				
Average Fuel Temperature (°F)	1303	1163	1317	1180	1183		1357				
NDP Scram Worth ($)	-39.64	-40.69	-38.71	-36.60	-39.13		-38.63				
TAP Scram Worth ($)	-31.71	-32.55	-30.97	-29.28	-31.30		-30.90				

N/A - Not Analyzed

Table 3-2d

TRANSIENT INPUT DATA AND OPERATING CONDITIONS
FOR INCREASED FLOW POINTS

	Plant							
	A-E	F	F[a]	G	H	K	L	M
Thermal Power (MWt/%)	N/A	997/100	997/100	2540/104	N/A	N/A	2543/104	N/A
Steam Flow (Mlb/hr/%)		4.07/100	4.07/100	10.99/105			10.53/105	
Core Flow (Mlb/hr/%)		33.0/111	33.0/111	80.9/105			82.4/105	
Dome Pressure (psig)		1004	1004	1019			1020	
Turbine Pressure (psig)		958	958	959			959	
NDP Void Coefficient (¢/%Rg)		-8.15	-7.08					
TAP Void Coefficient (¢/%Rg)		-10.19	-8.85					
NDP Doppler Coefficient (¢/°F)		-0.222	-0.222					
TAP Doppler Coefficient (¢/°F)		-0.211	-0.210					
Average Fuel Temperature (°F)		1377	1377					
NDP Scram Worth ($)								
TAP Scram Worth ($)								

N/A - Not Analyzed

[a]Feedwater temperature reduction

Table 3-3a

GETAB ANALYSIS INITIAL CONDITIONS FOR LICENSE BASIS POINT

	Plant											
	A	B	C	D	E	F	G	H	K	L	M	MPNPS-1 Cycle 8
Core Power (MWt)	2436	3293	2436	3293	1593	947	2436	1670	2381	2436	2436	2011
Core Flow (Mlb/hr)	77.0	102.5	77.0	102.5	49.0	29.7	77.0	57.6	73.5	78.5	77.0	69.0
Reactor Pressure (psia)	1035	1035	1035	1035	1035	1035	1035	1038	1035	1035	1035	1065
Inlet Enthalpy (Btu/lb)	526.9	521.5	526.9	521.5	526.3	520.7	526.9	524.3	520.4	523.7	526.9	526.0
Nonfuel Power Fraction	0.04	0.04	0.04	0.04	0.04	0.035	0.04	0.035	0.04	0.04	0.04	0.035
Axial Peaking Factor	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40	1.40
7x7 Fuel												
Local peaking factor	1.24		1.24	1.24	1.24				1.24	1.24		
Radial peaking factor	1.17		1.23	1.37	1.22				1.21	1.33		
R-factor	1.100		1.100	1.080	1.100				1.100	1.100		
Bundle power (MWt)	5.012		5.267	5.794	5.173				5.489	5.651		
Bundle flow (10^3lb/hr)	127.2		125.8	122.5	126.2				122.6	125.5		
8x8 Fuel												
Local peaking factor	1.22		1.22		1.22			1.22			1.22	1.22
Radial peaking factor	1.24		1.32		1.29			1.52			1.35	1.73
R-factor	1.098		1.098		1.098			1.098			1.098	1.094
Bundle power (MWt)	5.306		5.306		5.466			5.131			5.753	5.880
Bundle flow (10^3lb/hr)	118.3		116.2		116.0			104.2			115.0	98.1
8x8R Fuel												
Local peaking factor	1.22	1.26	1.20	1.20			1.20	1.20	1.20	1.20	1.20	1.20
Radial peaking factor	1.39	1.61	1.46	1.56			1.52	1.67	1.54	1.60	1.50	1.85
R-factor	1.051	1.051	1.051	1.058			1.051	1.052	1.051	1.052	1.051	1.051
Bundle power (MWt)	5.966	6.9[illegible]5	6.220	6.529			6.489	5.618	6.553	6.815	6.397	6.280
Bundle flow (10^3lb/hr)	118.2	109.3	117.0	110.6			112.1	97.2	110.4	112.2	115.2	96.3
P8x8R Fuel												
Local peaking factor							1.20	1.20		1.[illegible]0	1.20	1.20
Radial peaking factor							1.52	1.63		1.[illegible]	1.48	1.85
R-factor							1.051	1.052		1.052	1.051	1.051
Bundle power (MWt)							6.472	5.496		6.828	6.397	6.279
Bundle flow (10^3lb/hr)							112.4	97.9		113.0	115.2	96.3

Table 3-3b

GETAB ANALYSIS INITIAL CONDITIONS FOR 100% INTERCEPT POINT

	Plant											
	A	B	C	D	E	F	G	H*	H*	K	L	M
Core Power (MWt)	2436	3293	2436	3293	1593	N/A	2436	1620	1670	2381	2436	2436
Core Flow (Mlb/hr)	72.4	96.4	72.4	93.3	45.2		72.4	53.0	50.4	69.1	73.8	72.4
Reactor Pressure (psia)	1034	1034	1033	1033	1034		1034	1037	1036	1034	1034	1034
Inlet Enthalpy (Btu/lb)	525.5	519.9	525.6	518.8	524.5		525.5	522.1	520.8	518.5	522.2	525.5
Nonfuel Power Fraction	0.04	0.04	0.04	0.04	0.04		0.04	0.035	0.035	0.04	0.04	0.04
Axial Peaking Factor	1.40	1.40	1.40	1.40	1.40		1.40	1.40	1.40	1.40	1.40	1.40
7x7 Fuel												
Local peaking factor	1.24		1.24	1.24	1.24					1.24	1.24	1.22
Radial peaking factor	1.19		1.25	1.36	1.22					1.24	1.36	1.36
R-factor	1.100		1.100	1.080	1.100					1.100	1.100	1.098
Bundle power (MWt)	5.058		5.336	5.749	5.179					5.466	5.798	5.784
Bundle flow (10^3lb/hr)	119.2		117.5	104.0	116.1					115.1	125.5	107.2
8x8 Fuel												
Local peaking factor	1.22		1.22	1.22	1.22			1.22	1.22	1.22		
Radial peaking factor	1.27		1.35	1.40	1.30			1.52	1.52	1.52		
R-factor	1.098		1.098	1.096	1.098			1.098	1.098	1.098		
Bundle power (MWt)	5.402		5.736	5.912	5.515			5.143	5.100	6.454		
Bundle flow (10^3lb/hr)	110.1		108.1	93.7	106.1			95.2	90.2	98.8		
8x8R Fuel												
Local peaking factor	1.20	1.24	1.22	1.20			1.20	1.20	1.20	1.20	1.20	1.20
Radial peaking factor	1.40	1.58	1.48	1.53			1.51	1.67	1.67	1.53	1.62	1.50
R-factor	1.051	1.051	1.051	1.058			1.051	1.052	1.052	1.051	1.052	1.051
Bundle power (MWt)	5.942	6.637	6.310	6.401			6.389	5.612	5.600	6.551	6.879	6.402
Bundle flow (10^3lb/hr)	110.1	94.8	108.9	92.4			105.6	88.8	87.8	102.1	112.9	107.7
P8x8R Fuel												
Local peaking factor							1.20	1.20	1.20	1.20	1.20	1.20
Radial peaking factor							1.49	1.63	1.63	1.52	1.61	1.47
R-factor							1.051	1.052	1.052	1.051	1.052	1.051
Bundle power (MWt)							6.389	5.494	5.500	6.472	6.858	6.280
Bundle flow (10^3lb/hr)							105.6	89.5	87.8	103.3	114.0	108.4

*Plant H analyzed at 92 and 87% flow

N/A - Not Analyzed

Table 3-3c

GETAB ANALYSIS INITIAL CONDITIONS FOR ROD BLOCK INTERCEPT POINT

	Plant										
	A	B	C	D	E	F	G	H	K	L	M
Core Power (MWt)	2071	2799	2071	2799	1354	N/A	2071	1420	N/A	2071	N/A
Core Flow (Mlb/hr)	47.0	62.5	47.0	62.5	29.9		47.0	35.1		47.9	
Reactor Pressure (psia)	1008	1007	1007	1007	1007		1008	1010		1008	
Inlet Enthalpy (Btu/lb)	513.2	506.7	513.3	506.4	512.4		513.2	510.2		509.4	
Nonfuel Power Fraction	0.04	0.04	0.04	0.04	0.04		0.04	0.035		0.04	
Axial Peaking Factor	1.40	1.40	1.40	1.40	1.40		1.40	1.40		1.40	
7x7 Fuel											
Local peaking factor	1.23		1.24	1.24	1.24					1.24	
Radial peaking factor	1.32		1.32	1.38	1.28					1.44	
R-factor	1.100		1.100	1.080	1.100					1.100	
Bundle power (MWt)	4.761		4.793	4.952	4.610						
Bundle flow (10^3lb/hr)	75.3		75.2	74.2	76.2						
8x8 Fuel											
Local peaking factor	1.22		1.22	1.22	1.22			1.22			
Radial peaking factor	1.44		1.47	1.44	1.41			1.65			
R-factor	1.098		1.098	1.096	1.098			1.098			
Bundle power (MWt)	5.205		5.320	5.140	5.074			4.729			
Bundle flow (10^3lb/hr)	68.2		67.6	66.0	68.2			61.1			
8x8R Fuel											
Local peaking factor	1.20	1.24	1.22	1.20			1.20	1.20		1.20	
Radial peaking factor	1.57	1.54	1.59	1.55			1.61	1.79		1.65	
R-factor	1.051	1.051	1.051	1.058			1.051	1.052		1.052	
Bundle power (MWt)	5.684	5.503	5.756	5.504			5.75	5.109			
Bundle flow (10^3lb/hr)	68.2	61.8	68.5	66.9			60.8	57.7			
P8x8R Fuel											
Local peaking factor							1.20	1.20		1.20	
Radial peaking factor							1.59	1.76		1.60	
R-factor							1.051	1.052		1.052	
Bundle power (MWt)							5.75	5.041			
Bundle flow (10^3lb/hr)							66.5	58.0			

N/A - Not Analyzed

Table 3-3d

GETAB ANALYSIS INITIAL CONDITIONS FOR INCREASED FLOW POINTS

	Plant						
	A-E	F	G	H	K	L	M
Core Power (MWt)	N/A	997	2541	N/A	N/A		N/A
Core Flow (Mlb/hr)		33.0	80.9				
Reactor Pressure (psia)		1037	1043				
Inlet Enthalpy (Btu/lb)		523.4	528.4				
Nonfuel Power Fraction		0.04	0.04				
Axial Peaking Factor		1.40	1.40				
7x7 Fuel							
Local peaking factor							
Radial peaking factor							
R-factor							
Bundle power (MWt)							
Bundle flow (10^3lb/hr)							
8x8 Fuel							
Local peaking factor							
Radial peaking factor							
R-factor							
Bundle power (MWt)							
Bundle flow (10^3lb/hr)							
8x8R Fuel							
Local peaking factor		1.20	1.20				
Radial peaking factor		1.56	1.51				
R-factor		1.052	1.051				
Bundle power (MWt)		6.354	6.693				
Bundle flow (10^3lb/hr)		114.3	118.3				
P8x8R Fuel							
Local peaking factor		1.20	1.20				
Radial peaking factor		1.53	1.49				
R-factor		1.052	1.051				
Bundle power (MWt)		6.231	6.617				
Bundle flow (10^3lb/hr)		115.2	119.0				

N/A - Not Analyzed

Table 3-4

ASME PRESSURE VESSEL CODE COMPLIANCE: MSIV CLOSURE, FLUX SCRAM

Plant	Initial Power/Flow	Peak Neutron Flux Ø (% initial)	Peak Heat Flux Q/A (% initial)	Peak Steamline Pressure P_{sl} (psig)	Peak Vessel Pressure P_v (psig)
	(104P, 100F)	849	127	1217	1264
A	(100P, 94F)	1005	128	1211	1254
	(85P, 61F)	834	126	1186	1211
	(104P, 100F)	491	122	1242	1277
B	(100P, 94F)	521	122	1226	1260
	(85P, 61F)	504	120	1192	1217
	(104P, 100F)	741	125	1218	1263
C	(100P, 94F)	860	131	1211	1252
	(85P, 61F)	706	131	1189	1214
	(104P, 100F)	783	125	1266	1295
D	(100P, 91F)	797	130	1251	1280
	(85P, 61F)	405	124	1193	1217
	(104P, 100F)	770	126	1245	1287
E	(100P, 92.2F)	939	126	1247	1271
	(85P, 61F)	897	124	1196	1217
F	(100P, 111F)	617	129	1260	1303
	(104P, 100F)	677*	122	1203	1234
	(100P, 94F)	632*	122	1201	1231
G	(91P, 75F)	507*	123	1180	1205
	(85P, 61F)	405*	123	1182	1199
	(104P, 105F)	702*	122	1202	1235

Table 3-4

ASME PRESSURE VESSEL CODE COMPLIANCE: MSIV CLOSURE, FLUX SCRAM
(Continued)

Plant	Initial Power/Flow	Peak Neutron Flux Ø (% initial)	Peak Heat Flux Q/A (% initial)	Peak Steamline Pressure P_{sl} (psig)	Peak Vessel Pressure P_v (psig)
	(100P, 100F)	658*	128	1222	1244
	(100P, 92F)	662*	127	1223	1243
H	(100P, 87F)	635*	127		
	(92P, 75F)	525*	128	1207	1228
	(85P, 61F)	444*	128	1187	1207
K	(104P, 100F)	446*	124	1243	1270
	(100P, 94F)	440*	122	1234	1261
	(104P, 100F)	568*	120	1199	1232
L	(100P, 94F)	538*	122	1192	1224
	(91P, 75F)	421*	120	1169	1195
	(85P, 61F)	348*	120	1164	1183
	(104P, 105F)	576*	120	1199	1233
M	(104P, 100F)	693*	124	1236	1275
	(100P, 94F)	616*	124	1229	1266
MPNPS-1 Cycle 8	(100P, 100F)	---	---	1244	1276

*% Nominal Rated

Table 3-5

TRANSIENT SUMMARY--TURBINE TRIP WITHOUT BYPASS

Plant	Analysis	Initial Power (% NBR)	Initial Flow (% NBR)	$\hat{\phi}$ (% initial)	$\hat{Q}/A$ (% initial)	$\hat{P}_{sl}$ (psig)	P_v (psig)	ΔCPR 7x7	ΔCPR 8x8	ΔCPR 8x8R	ΔCPR P8x8R
A	R	104	100	353	114	1177	1220	0.22	0.30	0.29	--
A	R	100	94	354	114	1172	1215	0.22	0.29	0.29	--
A	R	85	61	247	106	1158	1182	0.09	0.13	0.13	--
B	R	104	100	183	102	1198	1225	--	0.12	0.12	--
B	R	100	94	173	102	1185	1211	--	0.12	0.12	--
B	R	85	61	150	100	1160	1180	--	0.06	0.06	--
C	R	104	100	260	110	1171	1217	0.16	0.23	0.22	--
C	R	100	94	254	113	1167	1209	0.15	0.21	0.21	--
C	R	85	61	169	105	1155	1178	0.04	0.07	0.07	--
D	R	104	100	249	109	1186	1228	0.13	0.18	0.18	--
D	R	100	91	249	108	1176	1214	0.12	0.17	0.17	--
D	R	85	61	162	105	1152	1175	0.01	0.02	0.03	--
E	R	104	100	333	115	1207	--	0.20	0.28	--	--
E	R	100	92	325	113	1187	--	0.18	0.26	--	--
E	R	85	61	181	101	1149	--	0.04	0.06	--	--
F[b,c]	Ø	100	100	889	121	1110	1139	--	--	0.25	0.29
F[b,c]	Ø	100	111	924	121	1109	1143	--	--	0.28	0.32
F[a,b,c]	Ø	100	111	849	120	1109	1143	--	--	0.26	0.30
F[b,c,d]	Ø	100	111	924	121	1108	1141	--	--	0.28	0.32
F[b,d,e]	Ø	100	100	628	116	1103	1129	--	--		
F[b,d,e]	Ø	100	111	723	118	1103	1134	--	--	0.22	0.26
MPNPS-1 Cycle 8	R	100	100	260[f]	109	1213	1227	-0.18	0.18	0.20	--

[a] Feedwater temperature reduction

[b] 1/2 bypass failure

[c] No position scram

[d] Measured scram time

[e] Position scram with 200 msec delay

[f] % nominal rated

R - REDY, Ø-ODYN

Table 3-6

TRANSIENT SUMMARY--LOAD REJECTION WITHOUT BYPASS

Plant	Analysis	Initial Power (% NBR)	Initial Flow (% NBR)	$\hat{\phi}$ (% initial)	$\dot{Q}/A$ (% initial)	$\hat{P}_{sl}$ (psig)	$\hat{P}_v$ (psig)	ΔCPR 7x7	ΔCPR 8x8	ΔCPR 8x8R	ΔCPR P8x8R
A	R	104	100	376	115	1178	1225	0.23	0.31	0.30	--
A	R	100	94	360	115	1173	1216	0.22	0.29	0.29	--
A	R	85	61	251	107	1157	1182	0.09	0.13	0.13	--
B	R	104	100	201	104	1203	1229	--	0.14	0.14	--
B	R	100	94	191	103	1189	1215	--	0.16	0.14	--
B	R	85	61	167	102	1162	1183	--	0.09	0.09	--
C	R	104	100	302	111	1172	1219	0.18	0.25	0.25	--
C	R	100	94	284	114	1168	1210	0.16	0.22	0.22	--
C	R	85	61	168	106	1154	1177	0.04	0.07	0.07	--
D	R	104	100	277	111	1189	1233	0.15	0.21	0.21	--
D	R	100	91	267	115	1180	1219	0.14	0.19	0.19	--
D	R	85	61	176	107	1153	1177	0.03	0.05	0.06	--
E	R	104	100	367	116	1209	--	0.22	0.30	--	--
E	R	100	92	348	114	1188	--	0.19	0.27	--	--
E	R	85	61	179	101	1149	--	0.04	0.07	--	--
F	NOT ANALYZED										
G	Ø	104	100	507[b]	114	1186	1208	--	--	0.17	0.17
G	Ø	100	94	489[b]	114	1180	1202	--	--	--	--
G	Ø	91	75	424[b]	113	1175	1194	--	--	--	--
G	Ø	85	61	332[b]	111	1165	1183	--	--	--	--
G	Ø	104	105	501[b]	113	1184	1207	--	--	0.17	0.18
G[a]	Ø	105	100	503[b]	115	1178	1200	--	--	0.18	0.18
G[a]	Ø	105	105	481[b]	114	1184	1206	--	--	0.18	0.18
H	Ø	100	100	679[b]	124	1206	1230	--	0.35	0.35	0.39
H	Ø	100	92	631[b]	122	1206	1228	--	0.31	0.31	0.34
H	Ø	92	75	396[b]	120	1183	1202	--	0.25	0.25	0.28
H	Ø	85	61	329[b]	122	1195	1208	--	0.23	0.24	0.26
H	Ø	100	87	576[b]	121	1205	1227	--	0.30	0.30	0.33
K	Ø	104	100	502[b]	117	1179	1213	0.14	0.19	0.19	0.19
K	Ø	100	94	469[b]	117	1174	1206	0.13	0.17	0.17	0.19
L	Ø	104	100	338[b]	108	1166	1189	--	--	--	--
L	Ø	100	94	320[b]	108	1160	1182	--	--	--	--
L	Ø	91	75	267[b]	108	1145	1168	--	--	--	--
L	Ø	85	61	216[b]	106	1145	1160	--	--	--	--
L	Ø	104	105	333[b]	108	1167	1191	0.07	--	0.11	0.11
L[a]	Ø	105	105	336[b]	108	1165	1188	0.08	--	0.11	0.11
L[a]	Ø	105	100	346[b]	109	1166	1187	0.08	--	0.11	0.11
M	Ø	104	100	653	120	1208	1246	--	0.22	0.22	0.24
M	Ø	100	94	596	120	1197	1231	--	0.20	0.20	0.23
MPNPS-1 Cycle 8	R	100	100	305	116	1193	1226	--	0.30	0.30	0.32

[a]Feedwater temperature reduction

[b]% nominal rated

Table 3-7

TRANSIENT SUMMARY--LOSS OF FEEDWATER HEATING

Plant	Analysis	Initial Power (% NBR)	Initial Flow (% NBR)	$\hat{\phi}$ (% initial)	$\hat{Q}/A$ (% initial)	$\hat{P}_{sl}$ (psig)	$\hat{P}_{v}$ (psig)	ΔCPR			
								7x7	8x8	8x8R	P8x8R
A	R	104	100	116	114	1018	1068	0.11	0.13	0.13	--
A	R	100	94	116	114	1012	1057	0.11	0.13	0.13	--
A	R	85	61	117	117	994	1020	0.13	0.15	0.15	--
B	R	104	100	116	115	1008	1064	--	0.13	0.13	--
B	R	100	94	116	116	1002	1053	--	0.13	0.13	--
B	R	85	61	121	121	988	1019	--	0.19	0.19	--
C	R	104	100	118	116	1019	1068	0.11	0.13	0.13	--
C	R	100	94	116	114	1013	1057	0.12	0.14	0.14	--
C	R	85	61	111	111	992	1017	0.13	0.15	0.15	--
D	R	104	100	117	117	1012	1068	0.15	0.16	0.16	--
D	R	100	91	118	117	1004	1053	0.13	0.14	0.14	--
D	R	85	61	123	128	990	1022	0.18	0.19	0.20	--
E	R	104	100	121	119	1023	--	0.14	0.16	--	--
E	R	100	92	121	120	1016	--	0.14	0.17	--	--
E	R	85	61	125	124	999	--	0.19	0.21	--	--
F	R	100	100	112	111	1002	1043	--	--	0.14	0.14
F	R	100	111	116	113	1041	1083	--	--	0.14	0.14
F[a]	R	100	111	110	110	1023	1073	--	--	0.14	0.14
MPNPS-1 Cycle 8	R	100	100	118	117	1033	1072	--	0.15	0.15	0.15

[a]MST

Table 3-8

TRANSIENT SUMMARY--FEEDWATER CONTROLLER FAILURE

Plant	Analysis	Initial Power (% NBR)	Initial Flow (% NBR)	$\hat{\phi}$ (% initial)	$\hat{Q}/A$ (% initial)	$\hat{P}_{sl}$ (psig)	$\hat{P}_v$ (psig)	ΔCPR 7x7	ΔCPR 8x8	ΔCPR 8x8R	ΔCPR P8x8R
A	R	104	100	243	114	1152	1200	0.18	0.25	0.25	--
A	R	100	94	241	115	1150	1193	0.19	0.26	0.26	--
A	R	85	61	184	111	1138	1160	0.13	0.17	0.17	--
B	R	104	100	144	106	1153	1187	--	0.09	0.09	--
B	R	100	94	134	107	1148	1179	--	0.09	0.10	--
B	R	85	61	136	109	1137	1156	--	0.13	0.13	--
C	R	104	100	109	105	1028	1076	0.05	0.06	0.06	--
C	R	100	94	112	110	1022	1067	0.06	0.07	0.08	--
C	R	85	61	117	111	996	1021	0.09	0.10	0.11	--
D	R	104	100	185	111	1147	1193	0.11	0.16	0.16	--
D	R	100	91	174	115	1142	1181	0.09	0.13	0.13	--
D	R	85	61	176	116	1127	1149	0.10	0.12	0.12	--
E	R	104	100	211	111	1146	--	0.14	0.21	--	--
E	R	100	92	188	106	1142	--	0.11	0.17	--	--
E	R	85	61	133	109	1127	--	0.09	0.11	--	--
F	Ø	100	100	214	105	1031	1062	--	--	--	--
F	Ø	100	111	181	104	1021	1062	--	--	--	--
F[a]	Ø	100	111	180	105	1021	1063	--	--	--	--
G	Ø	104	100	293[b]	114	1151	1182	--	--	0.15	0.16
G	Ø	100	94	274[b]	114	1139	1172	--	--	0.15	0.17
G	Ø	91	75	256[b]	114	1133	1160	--	--	0.15	0.16
G	Ø	85	61	207[b]	113	1128	1145	--	--	0.13	0.14
G	Ø	104	105	286[b]	114	1143	1177	--	--	0.16	0.17
G[a]	Ø	105	100	317[b]	119	1148	1177	--	--	0.17	0.18
G[a]	Ø	105	105	125[b]	112	1111	1134	--	--	0.08	0.08
G[a]	Ø	95	105	311[b]	121	1129	1158	--	--	0.21	0.23
H	Ø	100	100	518[b]	124	1169	1201	--	0.33	0.34	0.37
H	Ø	100	92	488[b]	123	1169	1197	--	0.30	0.30	0.33
H	Ø	100	87	465[b]	122	1170	1194	--	0.29	0.30	0.32
H	Ø	92	75	345[b]	118	1166	1184	--	0.23	0.24	0.26
H	Ø	85	61	230[b]	116	1147	1170	--	0.17	0.19	0.21
K	Ø	104	100	314[b]	114	1135	1172	0.09	0.13	0.14	0.16
K	Ø	100	94	282[b]	116	1131	1165	0.13	0.17	0.17	0.19
L	Ø	104	100	147[b]	108	1137	1161	0.08	--	0.11	0.11
L	Ø	100	94	191[b]	110	1128	1158	0.07	--	0.11	0.12
L	Ø	91	75	188[b]	110	1124	1144	0.07	--	0.11	0.12
L	Ø	85	61	146[b]	109	1119	1138	0.06	--	--	--
'	Ø	104	105	198[b]	110	1136	1166	0.07	--	0.11	0.12
L[a]	Ø	105	105	234[b]	115	1131	1163	0.11	--	0.15	0.16
L[a]	Ø	105	100	126[b]	111	1107	1128	0.06	--	0.08	0.08
M	Ø	104	100	362*	118	1173	1216	--	0.17	0.17	0.19
M	Ø	100	94	332*	118	1170	1210	--	0.16	0.17	0.18
MPNPS Cycle 8	R	100	100	111	106	1033	1072	--	0.06	0.07	0.07

[a]Feedwater temperature reduction

[b]% nominal rated

Table 3-9

ODYN TRANSIENT RESULTS FOR OFF-RATED CORE FLOW CONDITIONS

	Power/ Flow	$\hat{\phi}$ (%)	$\hat{Q}$/A (%)	Peak Pressure (psig) Steamline	Peak Pressure (psig) Vessel	ΔCPR
H						
LR w/o BP						
	100/100	689.3	123.9	1206	--	0.39
	100/92	630.7	121.8	1206	--	0.34
	100/87	576.0	120.6	1205	--	0.33
FWCF	100/100	547.4	123.9	1169	--	0.37
	100/92	487.7	123.3	1169	--	0.33
	100/87	464.7	122.1	1170	--	0.32
MSIV FS						
	100/100	657.9	127.3	--	1243	--
	100/92	651.8	126.5	--	1243	--
F						
TT w/1/2 BP						
	100/111	723.0	117.5	1103	--	0.26
	100/100	628.0	115.5	1103	--	0.22
G (w/RPT)						
LR w/o BP						
	104/105	501.0	113.3	1184	--	0.18
	104/100	507.0	113.6	1186	--	0.17
FWCF	104/105	286.0	114.5	1143	--	0.17
	104/100	293.0	114.1	1151	--	0.16
MSIV FS						
	104/105	702.0	121.8	--	1235	--
	104/100	677.0	121.6	--	1234	--

Table 3-9

ODYN TRANSIENT RESULTS FOR OFF-RATED CORE FLOW CONDITIONS (Continued)

	Power/ Flow	$\hat{\phi}$ (%)	$\hat{Q}$/A (%)	Peak Pressure (psig) Steamline	Vessel	ΔCPR
L (w/RPT)						
LR w/o BP	104/105	333.0	108.1	1166	--	0.11
	104/100	337.9	108.4	1166	--	0.11
FWCF	104/105	198.0	110.2	1136	--	0.12
	104/100	146.8	107.5	1137	--	0.11
MSIV FS	104/105	576.0	119.6	--	1233	--
	104/100	567.5	120.0	--	1232	--
M						
LR w/o BP	104/100	653.0	120.4	1208	--	0.24
	100/94	596.0	119.8	1197	--	0.23
FWCF	104/100	362.0	117.5	1173	--	0.19
	100/94	332.0	117.5	1170	--	0.18
MSIV FS	104/100	693.0	124.3	--	1275	--
	100/94	616.0	123.8	--	1266	--
K						
LR w/o BP	104/100	501.5	117.3	1179	--	0.21
	100/94	468.5	116.6	1174	--	0.19
FWCF	104/100	314.4	114.1	1135	--	
	100/94	281.9	116.1	1131	--	0.15
MSIV FS	104/100	445.5	123.7	--	1270	--
	100/94	440.1	122.1	--	1261	--

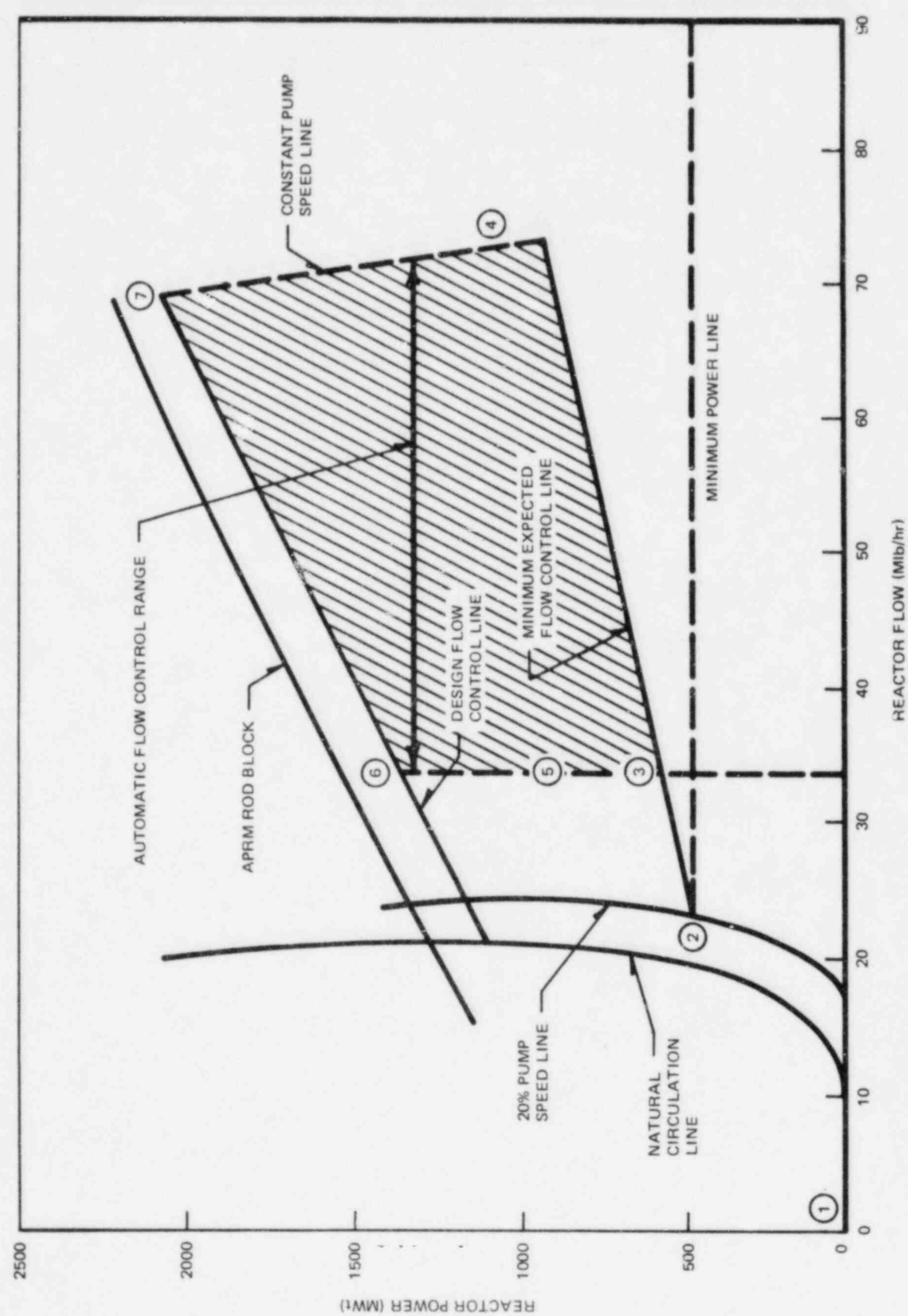

Figure 3-1. Millstone Operating Power Flow Map

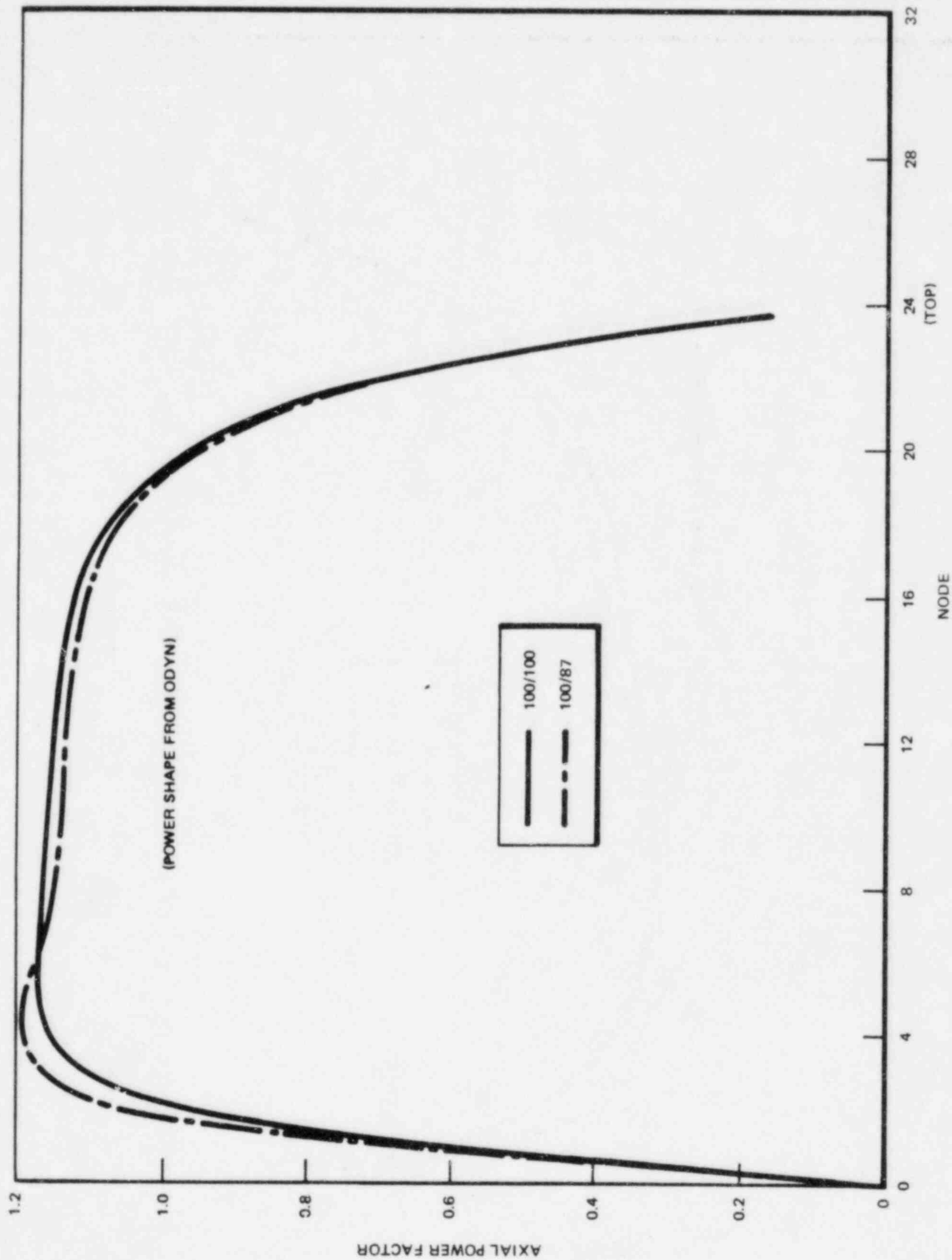

Figure 3-2. Plant H Axial Power Shape for 100% and 87% Core Flow

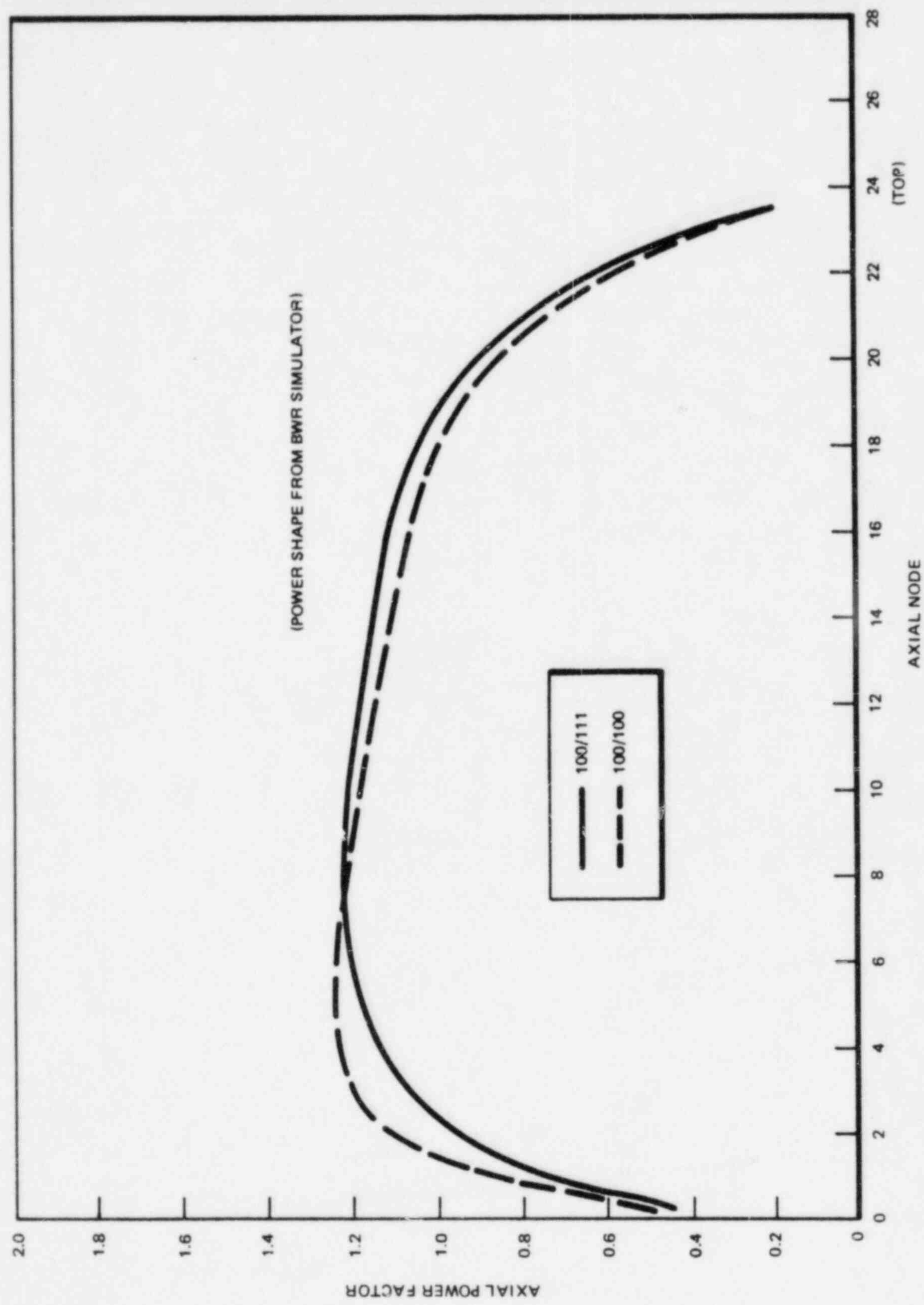

Figure 3-3. Axial Power Shape for 100% and 111% Rated Core Flow, Plant F

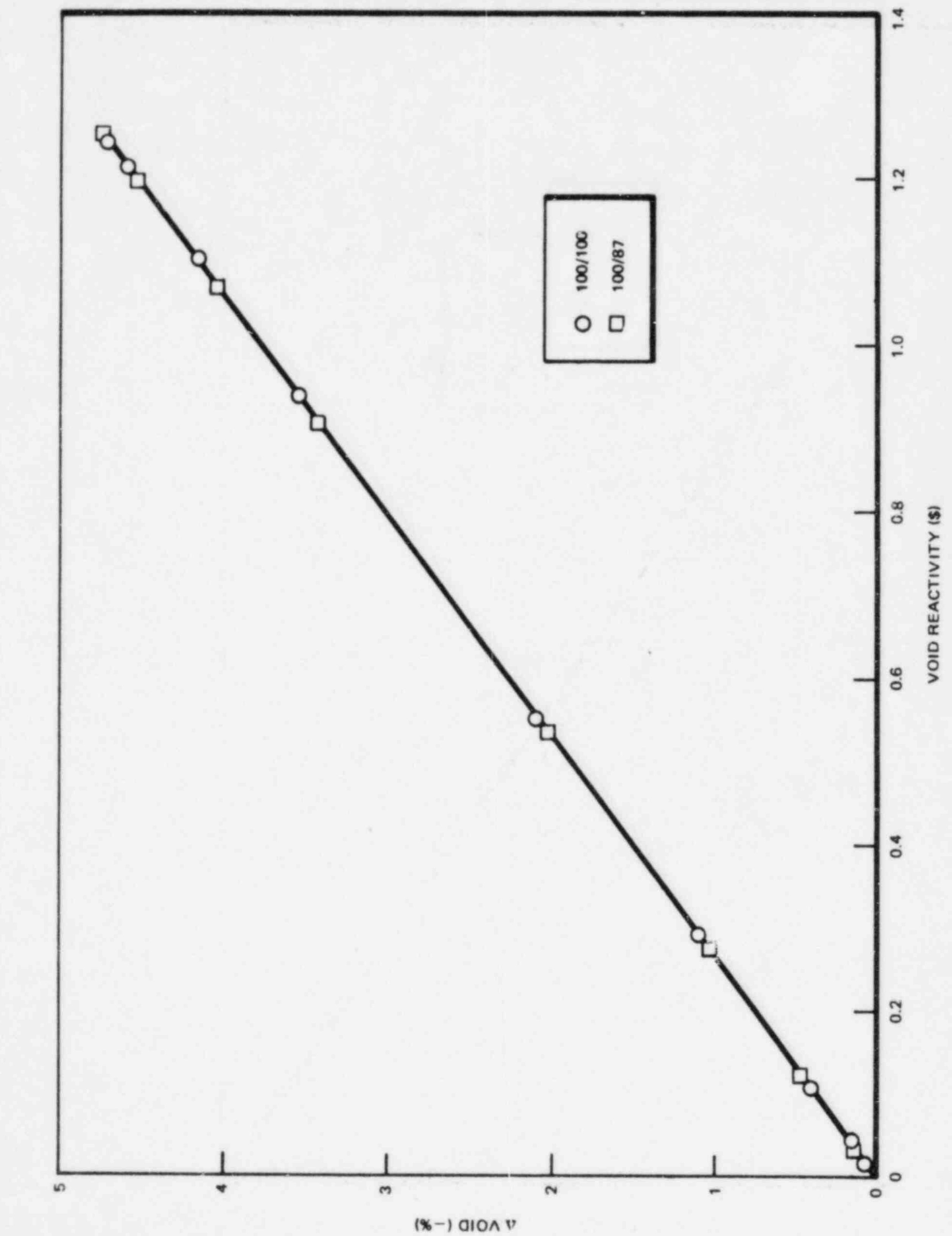

Figure 3-4. Void Reactivity vs Delta Void for LRW/OBP at 100/100 and 100/87, Plant H

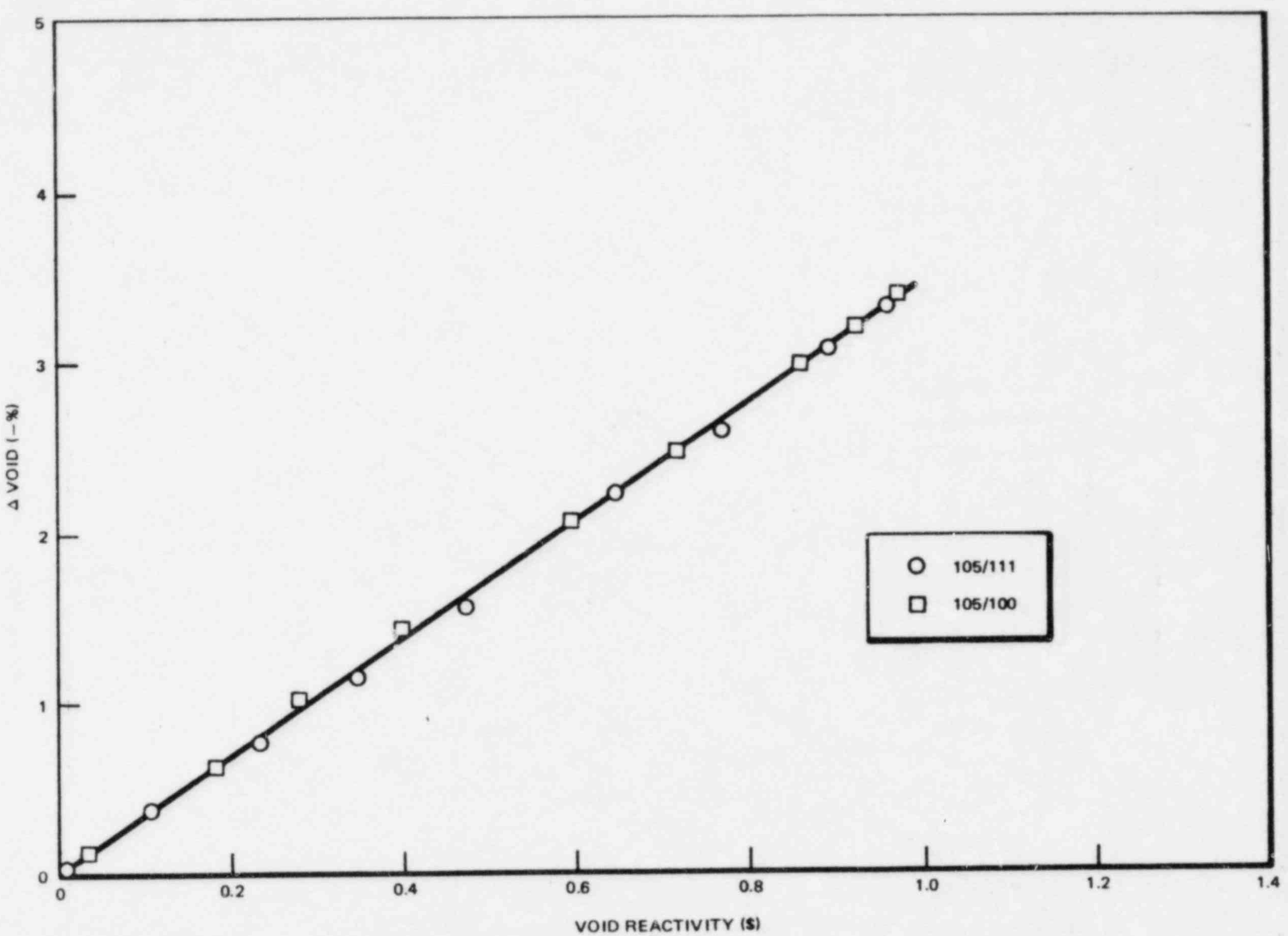

Figure 3-5. Void Reactivity vs Delta Void for TTW1/2BP at 100/111 and 100/100, Plant F

4. APPLICATION

The method of analyses described in this report in support of operation along the modified power/flow line are of a bounding type that can be applied to evaluate all BWR/3 and BWR4 plants whose operation is guided by a power/flow curve.

The rod block intercept point of 100% power/87% flow lies along the APRM flow-biased rod block line having a slope represented by the equation:

$$0.58W + 50\%$$

where

W = recirculation flow rate in percent of rated

The relationship between core flow and recirculation flow is shown in Figure 4-1.

Currently, most BWRs operate on the basis of a power/flow curve approximated by the equation:

$$0.65W + 35\%^{*}$$

with the APRM flow-biased rod block represented by the equation,

$$0.66W + 42\%^{*}$$

The less restrictive equation (0.58W + 50%) was approved by the United States Nuclear Regulatory Commission (Reference 8) and the analyses for this report were performed with this line as the upper bound of the proposed operating envelope.

Operation utilizing the current MPNPS-1 technical specification rod block line (0.66W + 42%) can be effected in the same manner as using the proposed

*Several plants vary a few percent from these values.

rod block line, except the intersection with the rod block intercept line would occur at slightly higher power and flow (Figure 2-1). This is within the analyzed envelope and, therefore, conforms with the bases and conclusions of this report.

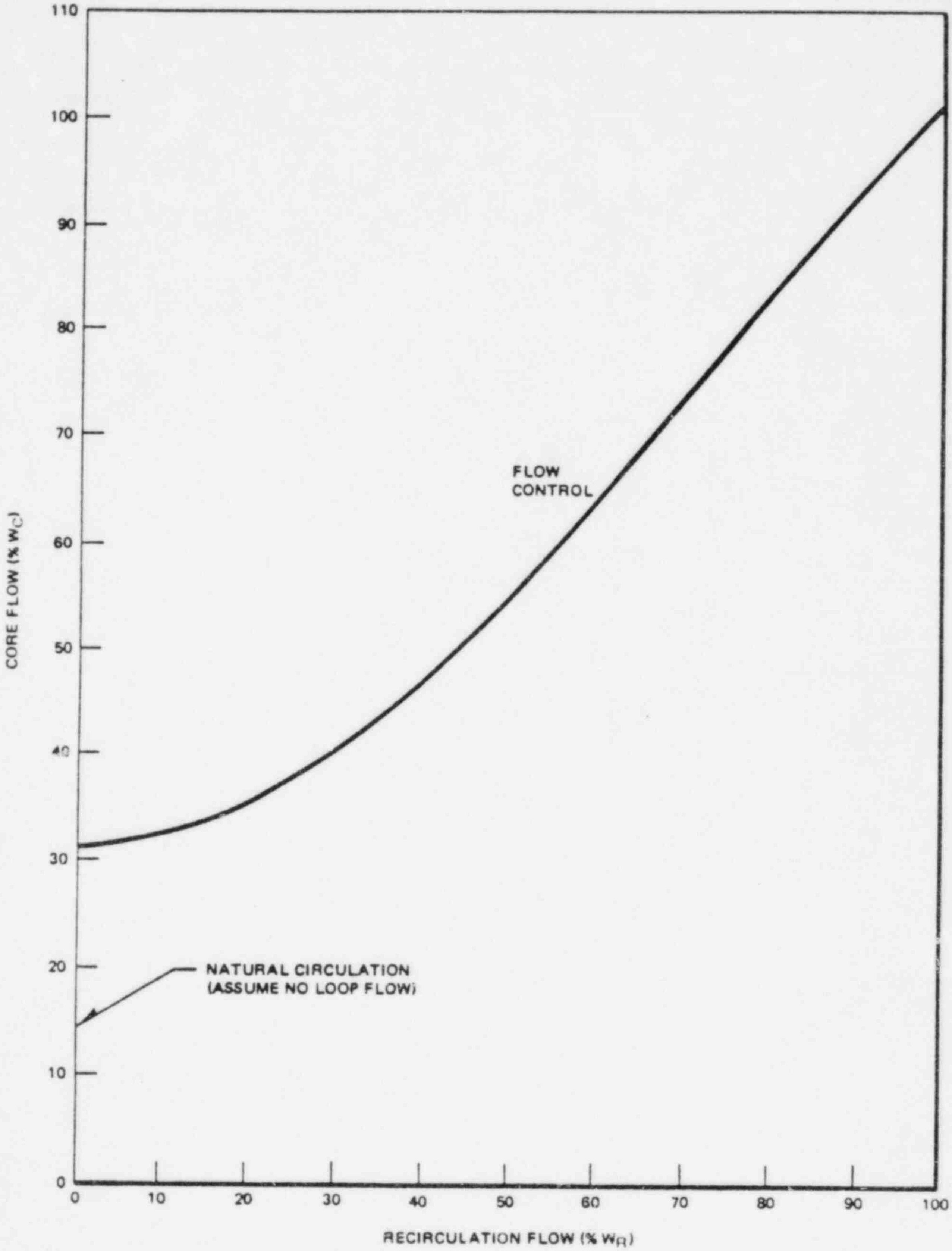

Figure 4-1. Core Flow-Recirculation Flow Relationship for Jet-Pump Plants

5. REFERENCES

1. "Millstone Unit 1, Load Line Limit Analysis," Rev. 1, November 1977 (NEDO-21285-1).

2. Northeast Nuclear Energy Co., "Safety Evaluation by the Office of Nuclear Reactor Regulation Supporting Amendment No. 52 to Provisional Operating License No. DPR-21," Millstone Nuclear Power Station Unit 1, Docket No. 50-245, July 1978.

3. "Final Safety Analysis Report, Millstone Point Nuclear Power Station."

4. "One-Dimensional Core Transient Model," October 1978 (NEDE-24154P).

5. "Supplemental Reload Licensing Submittal for Millstone Unit 1 Reload 7," June 1980 (Y1003J01A09).

6. Gridley, R. L., Letter to D. G. Eisenhut (NRC), "Review of Low-Core Flow Effects on LOCA Analysis for Operating BWRs," May 8, 1978.

7. Eisenhut, D. G., (NRC) Letter to R. L. Gridley, enclosing "Safety Evaluation Report Revision of Previously Imposed MAPLHGR (ECCS-LOCA) Restrictions for BWRs at Less Than Rated Flow," May 19, 1978.

8. Safety Evaluation by the Office of Nuclear Reactor Regulation Supporting Amendment No. 59 to Provisional Operating License No. DPR-19, Amendment No. 52 to Facility Operating License No. DPR-25, Amendment No. 70 to Facility Operating License No. DPR-29, and Amendment No. 64 to Facility Operating License No. DPR-30, Commonwealth Edison Company and Iowa-Illinois Gas and Electric Company, Dresden Station Unit Nos. 2 and 3, Quad Cities Station Unit Nos. 1 and 2, Docket Nos. 50-237, 50-249, 50-254, and 50-265.

9. "Loss-of-Coolant Accident Analysis Report for Millstone Unit 1 Nuclear Power Station," Rev. 1, July 1980, (NEDO-24085-1).

Docket No. 50-245

Attachment No. 4

"Supplement 1 to Extended Load Line

Limit Analysis Millstone Point

Nuclear Power Station Unit 1

(Reverification for Cycle 9)"

NEDO-24366-1, dated June 1982

October 1982