Section 1

LaSalle Unit 2 Cycle 9

Core Operating Limits Report

August 2002

Issuance of Changes Summary

Affected Section	Affected Pages	Summary of Changes	Date
All	All	Original Issue (Cycle 9)	11/00
References; 6	iii; 6-1	Revised Requirements for Use of SUBTIP Methodology	12/00
All	All	ITS changes, RBM trip setpoint and allowable value changes, TIP symmetry Chi-Squared testing, incorporated results of revised thermal limits with correct thermal conductivities, and other necessary administrative changes	5/01
Table of Contents, References, 2	ii, v, 2-3	Incorporate revised MCPR operating limits for ATRIUM-9B fuel due to schedule changes and changes in the target rod patterns.	8/01
References, Section 2.2, Table 2-1, Table 2-2, Table 3-1, Section 2, Table of Contents, Attachment 7.	v, 2-1, 2-2, 2-3, 2-4, 2-5, 3-5.	Defined nominal scram speed (NSS) requirements and added EOOS operating limits for NSS. Added Attachment 7.	2/02
References, Section 2.2, Table 2-1, Table 2-2, Section 3.2.2, Section 5	iii, iv, v, 2-1, 2-3, 2-4, 2-5, 2-6, 2-7, 3-1, 3-2, 3-6, 5-1	Incorporate revised MCPR operating limits and revised LHGR limits due to changes in target rod patterns. Incorporate revised MCPR operating limits and revised LHGR limits for operation between core average exposures of 30,266.2 MWd/MTU and 31,242.7 MWd/MTU. Removed Nominal Scram Speed MCPR operating limits. Other necessary administrative changes.	8/02

Table of Contents

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1. Average Planar Linear Heat Generation Rate (APLHGR) (3.2.1)

1.1 Tech Spec Reference:

Tech Spec 3.2.1

1.2 Description:

For operation without a full TIP set from BOC to 500 MWd/MT a penalty of 11.01% must be applied to all APLHGR limits.

1.2.1 GE Fuel

The MAPLHGR Limit is determined using the applicable Lattice-Type MAPLHGR limits from Tables 1.2-1 and 1.2-2. For Single Reactor Recirculation Loop Operation, the MAPLHGR limits in Tables 1.2-1 and 1.2-2 are multiplied by the MAPFAC multipliers provided in Figures 1.2-1 and 1.2-2.

1.2.2 SPC Fuel

The MAPLHGR Limit is the Lattice-Type MAPLHGR Limit. The Lattice-Type MAPLHGR limits are determined from the table given below:

Fuel Type	Cycle First Inserted
SPCA9-381B-13GZ7-80M	8
SPCA9-384B-11GZ6-80M	8
SPC-A9-391B-14G8.0-100M	9
SPC-A9-410B-19G8.0-100M	9
SPC-A9-383B-16G8.0-100M	9
SPC-A9-396B-12GZ-100M	9

(References 2 and 3)

Planar Average Exposure (GWd/MTU)	MAPLHGR (kW/ft) (all Siemens fuel types)
0.0	13.5
20.0	13.5
61.1	9.39

(References 3 and 6)

For single loop operation, the MAPLHGR limits from the table above are multiplied by the MAPLHGR multiplier. The MAPLHGR multiplier for SPC fuel is 0.90. (References 3, 5 and 6)

Table 1.2-1
Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)
vs.
Average Planar Exposure for Fuel Type
GE9B-P8CWB322-11GZ-100M-150-CECO

(Reference 9 and 19)

Exposure (MWD/ST)	Exposure (MWD/MT)	Lattice-Type MAPLHGR (kW/ft)					
		P8CWL071 NOG	P8CWL345 5G5.0/4G4.0	P8CWL362 9G4.0	P8CWL362 2G5.0/9G4.0	P8CWL345 9G4.0	P8CWL071 11GE
0	0	12.74	12.09	11.65	11.25	12.11	12.74
200	220.5	12.67	12.13	11.70	11.32	12.15	12.67
1000	1102.3	12.48	12.22	11.83	11.46	12.25	12.48
2000	2204.6	12.42	12.35	12.00	11.61	12.39	12.42
3000	3306.9	12.41	12.48	12.14	11.77	12.54	12.41
4000	4409.2	12.44	12.62	12.28	11.94	12.70	12.44
5000	5511.6	12.46	12.77	12.43	12.11	12.86	12.46
6000	6613.9	12.49	12.90	12.58	12.29	13.02	12.49
7000	7716.2	12.51	13.03	12.73	12.46	13.19	12.51
8000	8818.5	12.54	13.16	12.88	12.64	13.33	12.54
9000	9920.8	12.55	13.30	13.01	12.82	13.43	12.55
10000	11023.1	12.57	13.42	13.12	12.98	13.44	12.57
12500	13778.9	12.41	13.41	13.08	13.04	13.40	12.41
15000	16534.7	12.04	13.05	12.78	12.77	13.06	12.04
20000	22046.2	11.27	12.38	12.16	12.16	12.40	11.27
25000	27557.8	10.49	11.74	11.51	11.51	11.76	10.49
27215.6	30000	12.314	12.314	12.314	12.314	12.314	12.314
48080.8	53000	10.800	10.800	10.800	10 800	10.800	10.800
58967.1	65000	6 000	6.000	6.000	6.000	6.000	6.000
	Lattice No.	733	1817	1818	1819	1820	1821

Table 1.2-2
Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) vs. Average Planar Exposure for Fuel Type GE9B-P8CWB320-9GZ3-100M-150-CECO

(Reference 9 and 19)

Exposure (MWD/ST)	Exposure (MWD/MT)	Lattice-Type MAPLHGR (kW/ft)					
		P8CWL071 NOG	P8CWL346 4G5.0/3G4.0	P8CWL358 7G4.0	P8CWL358 2G5.0/7G4.0	P8CWL346 7G4.0	P8CWL071 9GE2
0	0	12.74	12.05	11.62	11.10	12.09	12.74
200	220.5	12.67	12.09	11.64	11.15	12.14	12.67
1000	1102.3	12.48	12.19	11.73	11.27	12.25	12.48
2000	2204.6	12.42	12.32	11.86	11.44	12.39	12.42
3000	3306.9	12.41	12.44	11.99	11.62	12.53	12.41
4000	4409.2	12.44	12.57	12.13	11.80	12.67	12.44
5000	5511.6	12.46	12.70	12.27	11.96	12.81	12.46
6000	6613.9	12.49	12.83	12.42	12.09	12.89	12.49
7000	7716.2	12.51	12.97	12.54	12.23	12.98	12.51
8000	8818.5	12.54	13.07	12.62	12.37	13.07	12.54
9000	9920.8	12.55	13.15	12.70	12.51	13.15	12.55
10000	11023.1	12.57	13.20	12.77	12.66	13.22	12.57
12500	13778.9	12.41	13.19	12.70	12.67	13.20	12.41
15000	16534.7	12.04	12.89	12.40	12.40	12.90	12.04
20000	22046.2	11.27	12.29	11.82	11.82	12.30	11.27
25000	27557.8	10.49	11.69	11.25	11.25	11.70	10.49
27215.6	30000	12.314	12.314	12.314	12.314	12.314	12.314
48080.8	53000	10.800	10.800	10.800	10.800	10.800	10.800
58967.1	65000	6.000	6.000	6.000	6.000	6.000	6.000
	Lattice No.	733	1812	1813	1814	1815	1816

Figure 1.2-1 Power-Dependent SLO MAPLHGR Multipliers for GE Fuel (MAPFAC $_P$)
(References 8 and 19)

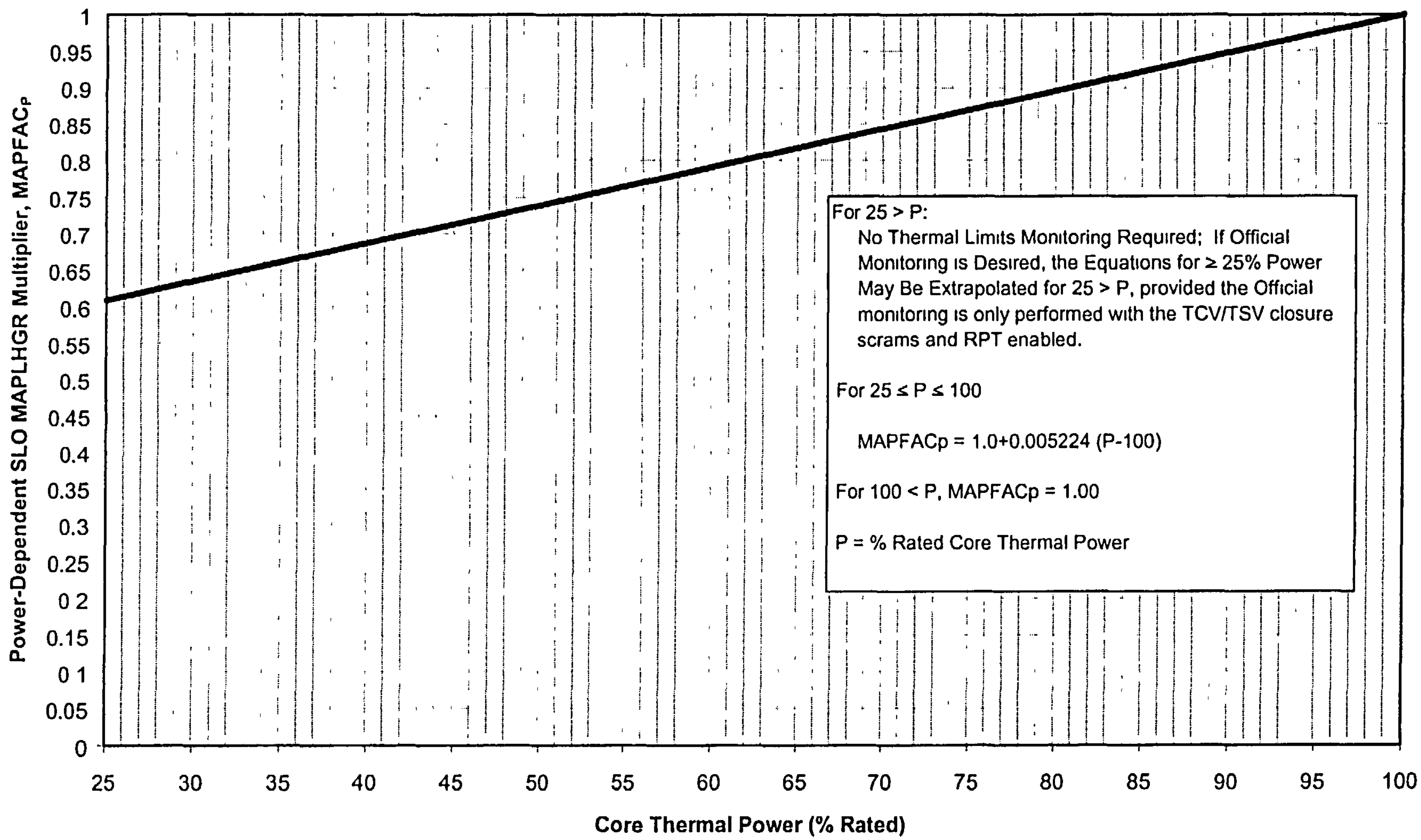
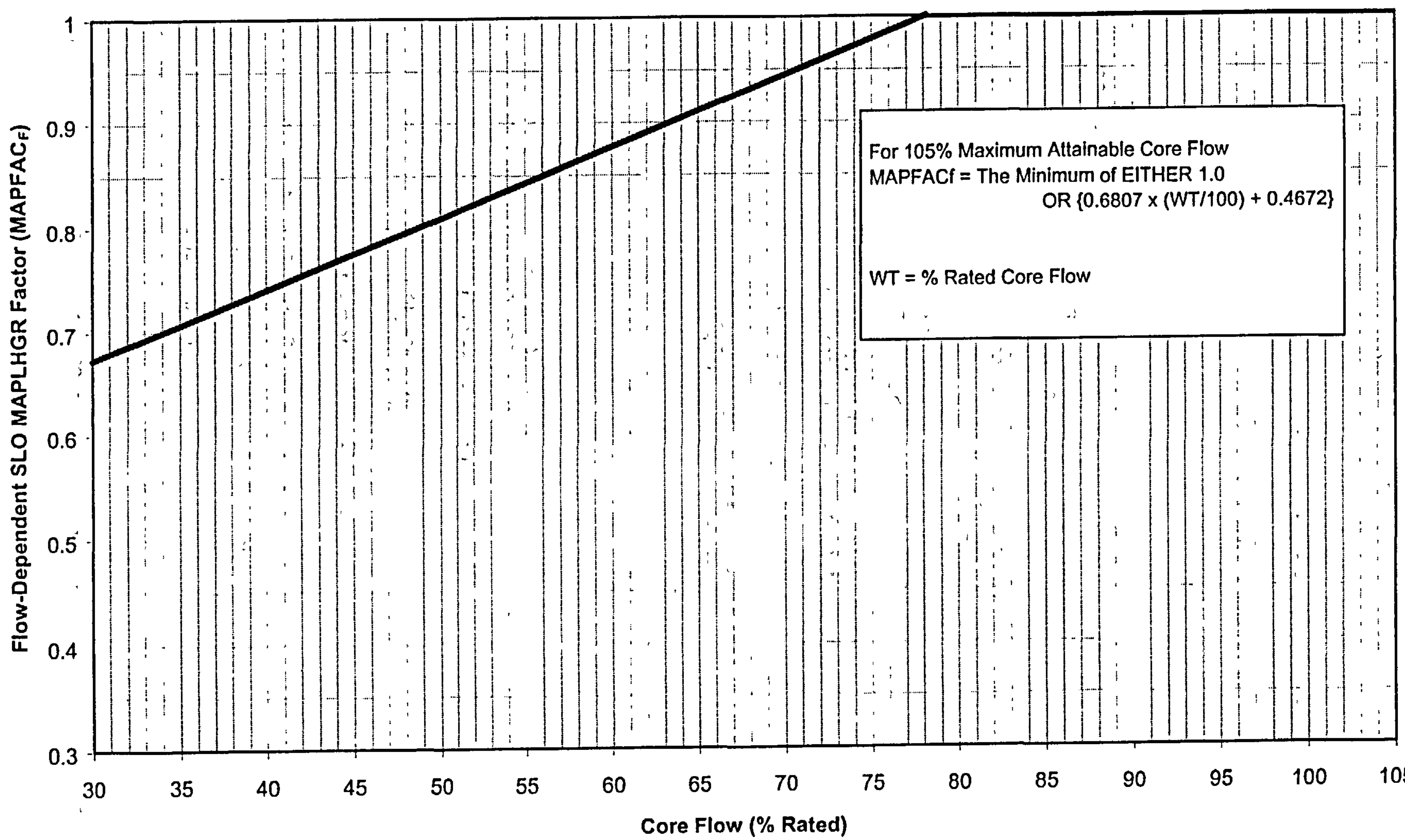


Figure 1.2-2 Flow-Dependent SLO MAPLHGR Multiplier ($MAPFAC_F$) for GE Fuel
(References 8, 18, and 19)



2. Minimum Critical Power Ratio (3.2.2)

2.1 Tech Spec Reference:

Tech Spec 3.2.2.

2.2 Description:

Prior to initial scram time testing for an operating cycle, the MCPR operating limit is based on the Technical Specification Scram Times. For Technical Specification requirements refer to Technical Specification table 3.1.4-1.

TIP Symmetry Chi-squared testing shall be performed prior to reaching 500 MWd/MTU to validate the MCPR calculation.

MCPR limits from BOC to Coastdown are applicable up to a core average exposure of 30,266.2 MWd/MTU (which is the licensing basis exposure used by SPC). (Reference 3)

MCPR limits for Coastdown are applicable from a core average exposure of 30,266.2 MWd/MTU to a core average exposure of 31,242.7 MWd/MTU (Reference 57).

2.2.1 Manual Flow Control MCPR Limits

The Governing MCPR Operating Limit while in Manual Flow Control is either determined from 2.2.1.1 or 2.2.1.2, whichever is greater at any given power, flow condition.

2.2.1.1 Power-Dependent MCPR ($MCPR_P$)*

2.2.1.1.1 GE Fuel

Table 2-1 gives the $MCPR_P$ limit as a function of core thermal power for Technical Specifications Scram Speed (TSSS).

2.2.1.1.2 Siemens Fuel

Table 2-2 gives the $MCPR_P$ limit as a function of core thermal power for Technical Specifications Scram Speed (TSSS).

2.2.1.2 Flow-Dependent MCPR ($MCPR_F$)

Table 2-3 gives the $MCPR_F$ limit as a function of flow.

2.2.2 Automatic Flow Control MCPR Limits

Automatic Flow Control is not supported for L2C9.

* For thermal limit monitoring at greater than 100%P, the 100% power MCPRp limits should be applied.

2.2.3 Nominal Scram Speeds

Nominal Scram Speeds (NSS) are not supported for L2C9.

Table 2-1
MCPRp for GE Fuel
(References 2, 3, 51, 56, and 57)

	Percent Core Thermal Power[1]						
EOOS Combination	0	25	25	60	80	80	100
No EOOS with TSSS (BOC to Last Sequence Exchange[2])	2.70	2.20	2.01	1.53			1.51
Single RR Loop only with TSSS (BOC to Last Sequence Exchange[2])	2.71	2.21	2.02	1 54			1.52
EOOS[4] with TSSS (BOC to Last Sequence Exchange[2])	2.85	2 35	2.24		1.96	1 86	1.63
EOOS[4]/Single RR Loop with TSSS (BOC to Last Sequence Exchange[2])	2 86	2.36	2.25		1.97	1.87	1.64
No EOOS with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.70	2.20	2 01	1.53			1.51
Single RR Loop only with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.71	2.21	2 02	1.54			1.52
EOOS[4] with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.85	2.35	2 24		1.96	1 86	1 63
EOOS[4]/Single RR Loop with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2 86	2.36	2.25		1 97	1.87	1.64
No EOOS with TSSS (Coastdown[3])	2.70	2.20	2.01	1.53			1.52
Single RR Loop only with TSSS (Coastdown[3])	2.71	2.21	2 02	1 54			1.53
Feedwater Heaters OOS with TSSS (Coastdown[3])	2 74	2.24	2.24	1.57			1 52
Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	2.75	2.25	2.25	1.58			1 53
Feedwater Heaters OOS/Turbine Bypass Valves OOS with TSSS (Coastdown[3])	2.74	2.24	2.24	1.64			1.53
Feedwater Heaters OOS/Turbine Bypass Valves OOS/Single RR Loop with TSSS (Coastdown[3])	2.75	2.25	2.25	1.65			1.54
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS with TSSS (Coastdown[3])	2.74	2.24	2 24		1.96	1.86	1.73
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	2 75	2.25	2.25		1.97	1.87	1.74

[1] Values are interpolated between relevant power levels. For operation at exactly 25% or 80% CTP, the more limiting value is used. 3489 MWt is rated power.

[2] 'Last Sequence Exchange' is defined as the A1 to A2 sequence exchange that occurs at approximately 15,600 MWd/MTU cycle exposure.

[3] Coastdown is defined as occurring at a core average exposure of 30,266.2 MWd/MTU. The coastdown thermal limits are to be applied for core average exposures between 30,266.2 MWd/MTU and 31,242.7 MWd/MTU. Limits are not provided in the COLR for cycle exposures beyond 31,242.7 MWd/MTU.

[4] Allowable EOOS conditions are listed in Section 5.

Table 2-2
MCPRp for Siemens Fuel

(References 2, 3, 21, 51, 53, 54, 55, 56, and 57)

For all Siemens fuel <u>EXCEPT</u> Fuel Type 18 in 10B cell locations and Fuel Types 16, 17, and 18 in A1 (7A, 7B, 7C, 8A, and 8B) cell locations

	Percent Core Thermal Power[1]						
EOOS Combination	0	25	25	60	80	80	100
No EOOS with TSSS (BOC to Last Sequence Exchange[2])	2.70	2.20	1.93	1.48			1.41
Single RR Loop only with TSSS (BOC to Last Sequence Exchange[2])	2.71	2.21	1.94	1.49			1.42
EOOS[4] with TSSS (BOC to Last Sequence Exchange[2])	2.85	2.35	2.17		1.70	1.62	1.53
EOOS[4]/Single RR Loop with TSSS (BOC to Last Sequence Exchange[2])	2.86	2.36	2.18		1.71	1.63	1.54
No EOOS with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.70	2.20	1.93	1.48			1.41
Single RR Loop only with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.71	2.21	1.94	1.49			1.42
EOOS[4] with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.85	2.35	2.17		1.70	1.62	1.53
EOOS[4]/Single RR Loop with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.86	2.36	2.18		1.71	1.63	1.54
No EOOS with TSSS (Coastdown[3])	2.70	2.20	1.93	1.48			1.44
Single RR Loop only with TSSS (Coastdown[3])	2.71	2.21	1.94	1.49			1.45
Feedwater Heaters OOS with TSSS (Coastdown[3])	2.70	2.20	2.17	1.54			1.44
Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	2.71	2.21	2.18	1.55			1.45
Feedwater Heaters OOS/Turbine Bypass Valves OOS with TSSS (Coastdown[3])	2.70	2.20	2.17	1.60			1.46
Feedwater Heaters OOS/Turbine Bypass Valves OOS/Single RR Loop with TSSS (Coastdown[3])	2.71	2.21	2.18	1.61			1.47
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS with TSSS (Coastdown[3])	2.70	2.20	2.17		1.70	1.62	1.60
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	2.71	2.21	2.18		1.71	1.63	1.61

Table continues on next page.

Table 2-2
(Continued)
MCPR$_P$ for Siemens Fuel

For <u>ONLY</u> Siemens Fuel Type 18 in 10B cell locations

	Percent Core Thermal Power[1]					
EOOS Combination	0	25	25	60	80	80	100
No EOOS with TSSS (BOC to Last Sequence Exchange[2])	2.74	2.24	1.97	1.52			1.45
Single RR Loop only with TSSS (BOC to Last Sequence Exchange[2])	2.75	2.25	1.98	1.53			1.46
EOOS[4] with TSSS (BOC to Last Sequence Exchange[2])	2.89	2.39	2.21		1.74	1.66	1.57
EOOS[4]/Single RR Loop with TSSS (BOC to Last Sequence Exchange[2])	2.90	2.40	2.22		1.75	1.67	1.58
No EOOS with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.70	2.20	1.93	1.48			1.41
Single RR Loop only with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.71	2.21	1.94	1.49			1.42
EOOS[4] with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.85	2.35	2.17		1.70	1.62	1.53
EOOS[4]/Single RR Loop with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.86	2.36	2.18		1.71	1.63	1.54
No EOOS with TSSS (Coastdown[3])	2.70	2.20	1.93	1.48			1.44
Single RR Loop only with TSSS (Coastdown[3])	2.71	2.21	1.94	1.49			1.45
Feedwater Heaters OOS with TSSS (Coastdown[3])	2.70	2.20	2.17	1.54			1.44
Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	2.71	2.21	2.18	1.55			1.45
Feedwater Heaters OOS/Turbine Bypass Valves OOS with TSSS (Coastdown[3])	2.70	2.20	2.17	1.60			1.46
Feedwater Heaters OOS/Turbine Bypass Valves OOS/Single RR Loop with TSSS (Coastdown[3])	2.71	2.21	2.18	1.61			1.47
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS with TSSS (Coastdown[3])	2.70	2.20	2.17		1.70	1.62	1.60
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	2.71	2.21	2.18		1.71	1.63	1.61

Table continues on next page.

Table 2-2
(Continued)
MCPR$_P$ for Siemens Fuel

For <u>ONLY</u> Siemens Fuel Type 16 and 17 in A1 (7A, 7C, and 8B) cell locations

Percent Core Thermal Power[1]

EOOS Combination	0	25	25	60	80	80	100
No EOOS with TSSS (BOC to Last Sequence Exchange[2])	2.73	2.23	1.96	1.51			1.44
Single RR Loop only with TSSS (BOC to Last Sequence Exchange[2])	2.74	2 24	1.97	1.52			1.45
EOOS[4] with TSSS (BOC to Last Sequence Exchange[2])	2.88	2.38	2.20		1.73	1.65	1.56
EOOS[4]/Single RR Loop with TSSS (BOC to Last Sequence Exchange[2])	2.89	2.39	2.21		1.74	1.66	1.57
No EOOS with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2 70	2.20	1.93	1.48			1.41
Single RR Loop only with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.71	2.21	1.94	1.49			1.42
EOOS[4] with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.85	2.35	2.17		1.70	1.62	1.53
EOOS[4]/Single RR Loop with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.86	2.36	2.18		1.71	1.63	1.54
No EOOS with TSSS (Coastdown[3])	2.70	2.20	1.93	1 48			1.44
Single RR Loop only with TSSS (Coastdown[3])	2.71	2.21	1.94	1.49			1.45
Feedwater Heaters OOS with TSSS (Coastdown[3])	2.70	2.20	2.17	1.54			1.44
Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	2.71	2.21	2.18	1.55			1.45
Feedwater Heaters OOS/Turbine Bypass Valves OOS with TSSS (Coastdown[3])	2 70	2.20	2.17	1.60			1.46
Feedwater Heaters OOS/Turbine Bypass Valves OOS/Single RR Loop with TSSS (Coastdown[3])	2.71	2.21	2.18	1.61			1.47
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS with TSSS (Coastdown[3])	2.70	2.20	2.17		1.70	1.62	1.60
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	2.71	2.21	2.18		1.71	1.63	1.61

Table continues on next page.

Table 2-2
(Continued)
$MCPR_P$ for Siemens Fuel

For ONLY Siemens Fuel Type 18 in A1 (7A, 7B, and 8A) cell locations

	Percent Core Thermal Power[1]						
EOOS Combination	0	25	25	60	80	80	100
No EOOS with TSSS (BOC to Last Sequence Exchange[2])	2.73	2.23	1.96	1.51			1.44
Single RR Loop only with TSSS (BOC to Last Sequence Exchange[2])	2.74	2.24	1.97	1.52			1.45
EOOS[4] with TSSS (BOC to Last Sequence Exchange[2])	2.88	2.38	2.20		1.73	1.65	1.56
EOOS[4]/Single RR Loop with TSSS (BOC to Last Sequence Exchange[2])	2.89	2.39	2.21		1.74	1.66	1.57
No EOOS with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.72	2.22	1.95	1.50			1.43
Single RR Loop only with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.73	2.23	1.96	1.51			1.44
EOOS[4] with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.87	2.37	2.19		1.72	1.64	1.55
EOOS[4]/Single RR Loop with TSSS (Last Sequence Exchange[2] to Coastdown[3])	2.88	2.38	2.20		1.73	1.65	1.56
No EOOS with TSSS (Coastdown[3])	2.72	2.22	1.95	1.50			1.46
Single RR Loop only with TSSS (Coastdown[3])	2.73	2.23	1.96	1.51			1.47
Feedwater Heaters OOS with TSSS (Coastdown[3])	2.72	2.22	2.19	1.56			1.46
Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	2.73	2.23	2.20	1.57			1.47
Feedwater Heaters OOS/Turbine Bypass Valves OOS with TSSS (Coastdown[3])	2.72	2.22	2.19	1.62			1.48
Feedwater Heaters OOS/Turbine Bypass Valves OOS/Single RR Loop with TSSS (Coastdown[3])	2.73	2.23	2.20	1.63			1.49
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS with TSSS (Coastdown[3])	2.72	2.22	2.19		1.72	1.64	1.62
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	2.73	2.23	2.20		1.73	1.65	1.63

[1] Values are interpolated between relevant power levels. For operation at exactly 25% or 80% CTP, the more limiting value is used. 3489 MWt is rated power.

[2] 'Last Sequence Exchange' is defined as the A1 to A2 sequence exchange that occurs at approximately 15,600 MWd/MTU cycle exposure.

[3] Coastdown is defined as occurring at a core average exposure of 30,266.2 MWd/MTU. The coastdown thermal limits are to be applied for core average exposures between 30,266.2 MWd/MTU and 31,242.7 MWd/MTU. Limits are not provided in the COLR for cycle exposures beyond 31,242.7 MWd/MTU.

[4] Allowable EOOS conditions are listed in Section 5.

Table 2-3
$MCPR_F$ for GE and Siemens Fuel
(Reference 3)

$MCPR_F$ limits for 105% Maximum Attainable Core Flow

Flow (% rated)	$MCPR_F$ ATRIUM-9B	$MCPR_F$ GE9
0	1.60	1.66
30	1.60	1.66
105	1.11	1.11

The $MCPR_F$ limits are applicable from BOC through coastdown and in all EOOS scenarios.

3. Linear Heat Generation Rate (3.2.3)

3.1 Tech Spec Reference:

Tech Spec 3.2.3.

3.2 Description:

For operation without a full TIP set from BOC to 500 MWd/MT a penalty of 11 01% must be applied to all LHGR limits.

3.2.1 GE Fuel

The LHGR Limit is the product of the LHGR Limit in the following tables and the minimum of either the power dependent LHGR Factor*, $LHGRFAC_P$, or the flow dependent LHGR Factor, $LHGRFAC_F$. The LHGR Factors ($LHGRFAC_P$ and $LHGRFAC_F$) for the GE fuel are determined from Figures 3.2-1 through 3.2-3 The following GE LHGR limits apply for the entire cycle exposure range: (References 2, 8, 10 and 19)

1. GE9B-P8CWB322-11GZ-100M-150-CECO (bundle 3861 in Reference 2)

Nodal Exposure (GWd/MT)	LHGR Limit (KW/ft)
0	13.75
13.06	13.75
27.80	11.75
50.31	10.31
60.89	6.00

2. GE9B-P8CWB320-9GZ-100M-150-CECO (bundle 3860 in Reference 2)

Nodal Exposure (GWd/MT)	LHGR Limit (KW/ft)
0.00	14.25
12.14	14.25
26 19	12.18
48.16	10.80
59.93	6.00

3.2.2 Siemens Fuel

The LHGR Limit is the product of the Steady-State LHGR Limit (given below) and the minimum of either the power dependent LHGR Factor*, $LHGRFAC_P$, or the flow dependent LHGR Factor, $LHGRFAC_F$. $LHGRFAC_P$ is determined from Table 3-1. $LHGRFAC_F$ is determined from Table 3-2. SPC LHGRFAC multipliers from BOC to Coastdown are applicable up to a core average exposure of 30,266.2 MWd/MTU (which is the licensing basis exposure used by SPC) (Reference 3) SPC LHGRFAC multipliers for Coastdown are applicable for core average exposures between 30,266.2 MWd/MTU and 31,242.7 MWd/MTU (Reference 57).

For All Siemens Fuel EXCEPT Fuel Type 18 in A1 (7A, 7B, and 8A) cell locations
(Reference 3)

Planar Average Exposure (GWd/MTU)	LHGR limit (kW/ft)
0.0	14.4
15.0	14.4
61.1	8.32

* For thermal limit monitoring at greater than 100%P, the 100% power LHGRFACp limits should be applied.

For ONLY Siemens Fuel Type 18 in A1 (7A, 7B, and 8A) cell locations
Prior to the Last Sequence Exchange at ~15,600 MWd/MTU cycle exposure
(Reference 3)

Planar Average Exposure (GWd/MTU)	LHGR limit (kW/ft)
0.0	14.4
15.0	14.4
61.1	8.32

For ONLY Siemens Fuel Type 18 in A1 (7A, 7B, and 8A) cell locations
Following the Last Sequence Exchange at ~15,600 MWd/MTU cycle exposure
(Reference 56)

Planar Average Exposure (GWd/MTU)	LHGR limit (kW/ft)
0.0	14.2
15.0	14.2
61.1	8.12

Figure 3.2-1 Power-Dependent LHGR Multipliers for GE Fuel (Formerly $MAPFAC_P$)
(References 8 and 19)

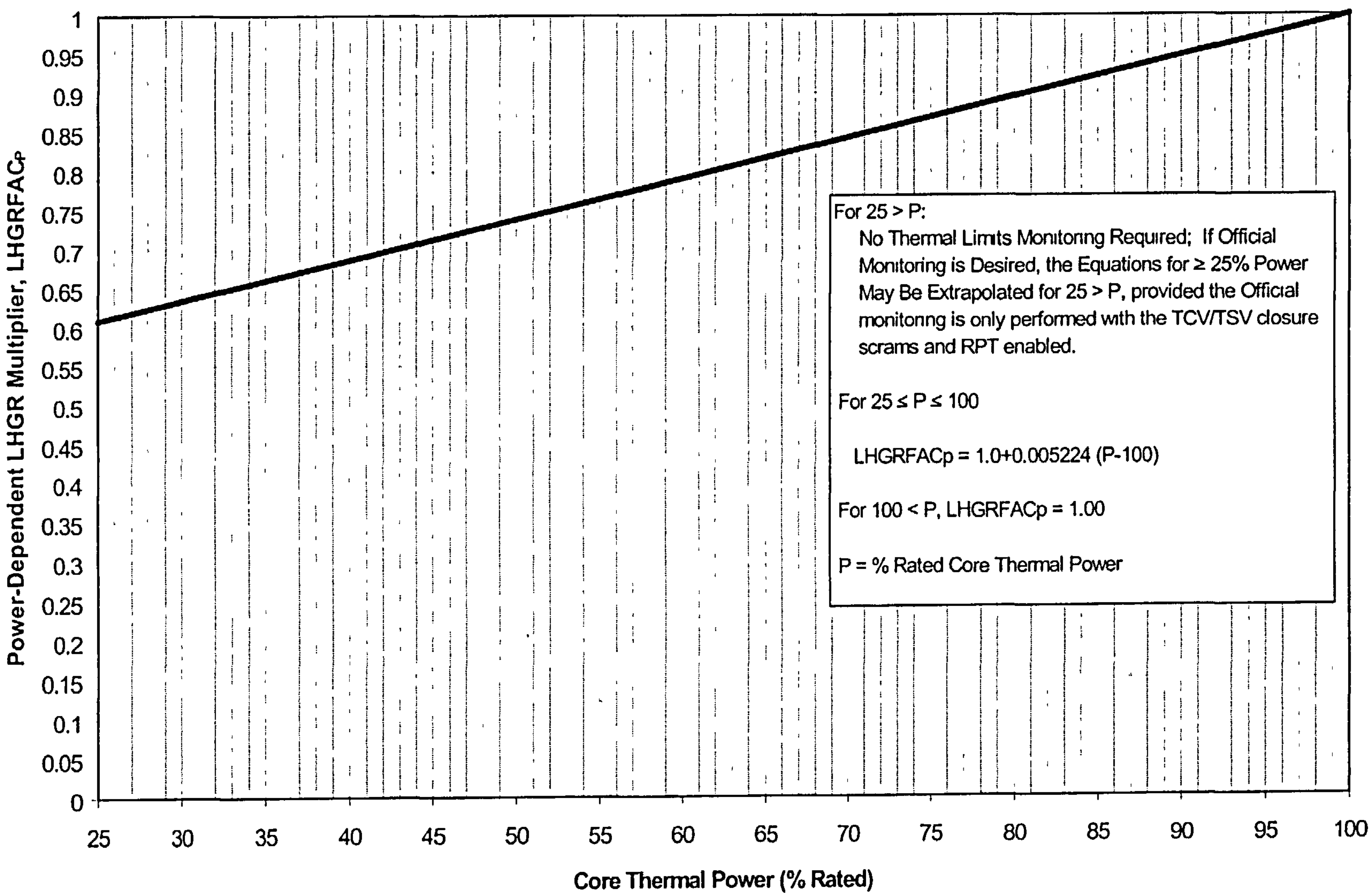


Figure 3.2-2 Power-Dependent LHGR Multiplier for GE Fuel (TCV(s) Slow Closure) (formerly $MAPFAC_P$)

(References 11 and 19)

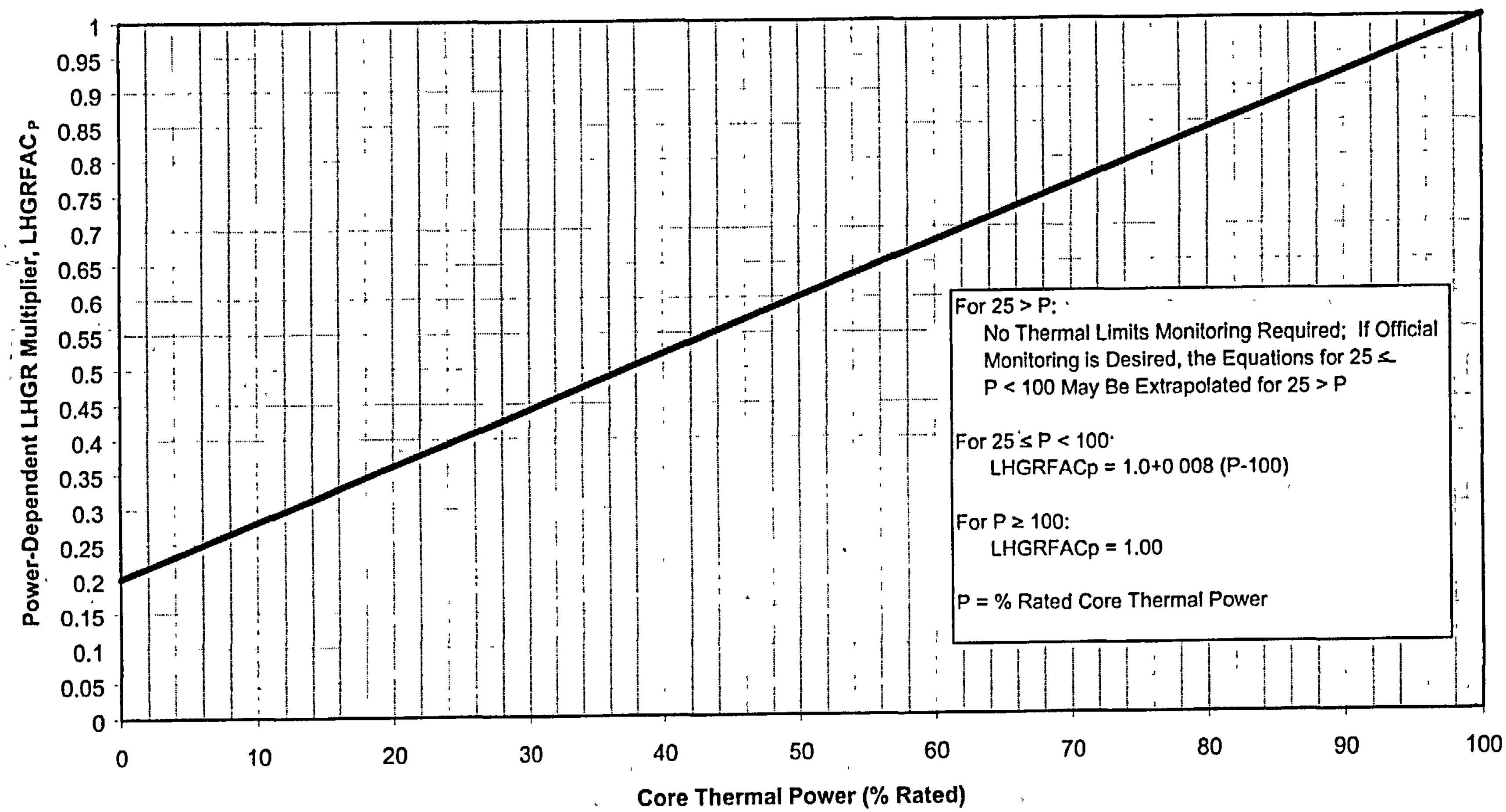


Figure 3.2-3 Flow-Dependent LHGR Multiplier for GE Fuel (formerly MAPFAC $_F$)
(References 8, 13, 18, and 19)

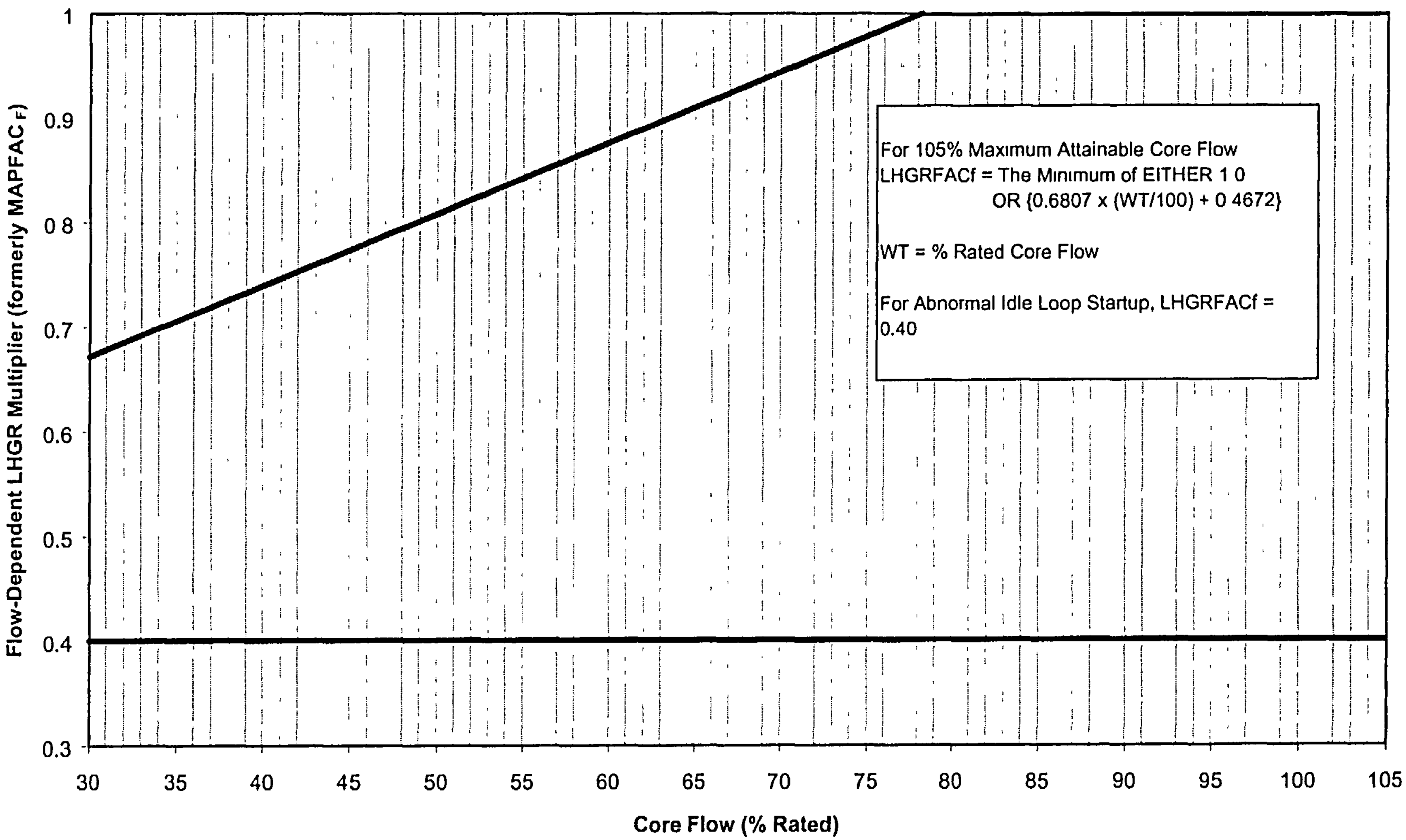


Table 3-1
LHGRFACp for Siemens Fuel

(References 3, 51, 54, and 57)

	Percent Core Thermal Power[1]						
EOOS Combination	0	25	40	60	80	80	100
No EOOS with TSSS (BOC to Last Sequence Exchange[2])	0.77	0.77		1.00			1.00
Single RR Loop only with TSSS (BOC to Last Sequence Exchange[2])	0.77	0.77		1.00			1.00
EOOS[4] with TSSS (BOC to Last Sequence Exchange[2])	0.67	0.67			0.85	0.89	0.89
EOOS[4]/Single RR Loop with TSSS (BOC to Last Seqeunce Exchange[2])	0.67	0.67			0.85	0.89	0.89
No EOOS with TSSS (Last Sequence Exchange[2] to Coastdown[3])	0.77	0.77		1.00			1.00
Single RR Loop only with TSSS (Last Sequence Exchange[2] to Coastdown[3])	0.77	0.77		1.00			1.00
EOOS[4] with TSSS (Last Sequence Exchange[2] to Coastdown[3])	0.67	0.67			0.85	0.89	0.89
EOOS[4]/Single RR Loop with TSSS (Last Sequence Exchange[2] to Coastdown[3])	0.67	0.67			0.85	0.89	0.89
No EOOS with TSSS (Coastdown[3])	0.77	0.77		1.00			1.00
Single RR Loop only with TSSS (Coastdown[3])	0.77	0.77		1.00			1.00
Feedwater Heaters OOS with TSSS (Coastdown[3])	0.68	0.68		0.96			1.00
Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	0.68	0.68		0.96			1.00
Feedwater Heaters OOS/Turbine Bypass Valves OOS with TSSS (Coastdown[3])	0.68	0.68		0.96			0.97
Feedwater Heaters OOS/Turbine Bypass Valves OOS/Single RR Loop with TSSS (Coastdown[3])	0.68	0.68		0.96			0.97
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS with TSSS (Coastdown[3])	0.67	0.67	0.79		0.79	0.79	0.79
TCV Slow Closure/EOC RPT OOS/ Feedwater Heaters OOS/Single RR Loop with TSSS (Coastdown[3])	0.67	0.67	0.79		0.79	0.79	0.79

[1] Values are interpolated between relevant power levels. For operation at exactly 80% CTP, the more limiting value is used. 3489 MWt is rated power.

[2] 'Last Sequence Exchange' is defined as the A1 to A2 sequence exchange that occurs at approximately 15,600 MWd/MTU cycle exposure.

[3] Coastdown is defined as occurring at a core average exposure of 30,266.2 MWd/MTU. The coastdown thermal limits are to be applied for core average exposures between 30,266.2 MWd/MTU and 31,242.7 MWd/MTU. Limits are not provided in the COLR for cycle exposures beyond 31,242.7 MWd/MTU.

[4] Allowable EOOS conditions are listed in Section 5.

Table 3-2
$LHGRFAC_F$ for Siemens Fuel
(Reference 3)

Values Applicable for up to 105% Maximum Attainable Core Flow

Flow (% rated)	$LHGRFAC_F$ ATRIUM-9B
0	0.69
30	0.69
76	1.00
105	1.00

These $LHGRFAC_f$ multipliers apply from BOC through coastdown and in all EOOS scenarios.

4. Control Rod Withdrawal Block Instrumentation (3.3.2.1)

4.1 Tech Spec Reference:

Tech Spec Table 3.3.2.1-1.

4.2 Description:

The Rod Block Monitor Upscale Instrumentation Setpoints are determined from the relationships shown below:

ROD BLOCK MONITOR UPSCALE TRIP FUNCTION	TRIP SETPOINT	ALLOWABLE VALUE
Two Recirculation Loop Operation*	0.66 W + 51%**	0.66 W + 54%**
Single Recirculation Loop Operation*	0.66 W + 45.7%**	0.66 W + 48.7%**

* This setpoint may be lower/higher and will still comply with the RWE Analysis, because RWE is analyzed unblocked.

** Clamped, with an allowable value not to exceed the allowable value for recirculation loop flow (W) of 100%.

5. Allowed Modes of Operation (B 3.2.2, B 3.2.3)

The Allowed Modes of Operation with combinations of Equipment Out-of-Service are as described below:

	---------OPERATING REGION---------			
Equipment Out of Service Options[1]	Standard	MELLLA	ICF[7]	Coastdown[9]
None	Yes	Yes	Yes	Yes
Feedwater Heaters[2] (Reference 8)	Yes	No[3]	Yes	Yes
Single RR Loop[10] (Reference 8)	Yes	No[8]	N/A	Yes
Turbine Bypass Valves (Reference 8)	Yes	Yes	Yes	Yes[11]
EOC Recirculation Pump Trip (Reference 8)	Yes	Yes	Yes	Yes
TCV Slow Closure/EOC Recirculation Pump Trip (Reference11)	Yes	Yes	Yes	Yes
TCV Slow Closure/EOC Recirculation Pump Trip / Feedwater Heaters [2] (References 11, 16, and 17)	Yes	No[3]	Yes	Yes
Turbine Bypass Valves / Feedwater Heaters [2,5] (Reference 8)	No[12]	No[12]	No[12]	Yes
EOC Recirculation Pump Trip / Feedwater Heaters [2] (Reference 8)	Yes[4]	No[3]	Yes[4]	Yes
TCV Stuck Closed[6] (Reference 12)	Yes	Yes	Yes	No

1. Each EOOS condition may be combined with one SRV OOS, up to two TIP Machines OOS or the equivalent number of TIP channels (100% available at startup from a refuel outage), a 20°F reduction in feedwater temperature (without Feedwater Heaters considered OOS), cycle startup with uncalibrated LPRMs (BOC to 500 MWd/MTU), and/or up to 50% of the LPRMs out of service.
2. Up to 100°F Reduction in Feedwater Temperature Allowed with Feedwater Heaters Out-of-Service. Feedwater Heaters OOS may be an actual OOS condition, or an intentionally entered mode of operation to extend the cycle energy.
3. If operating with Feedwater Heaters Out-of-Service, operation in MELLLA is supported by current transient analyses, but administratively prohibited due to core stability concerns.
4. EOC Recirculation Pump Trip OOS/Feedwater Heaters OOS is allowed using the TCV Slow Closure/EOC Recirculation Pump Trip OOS/Feedwater Heaters OOS operating limits.
5. Only when operating in coastdown, otherwise this combination is not allowed.
6. Operation prior to coastdown is only allowed when less than 10.5 million lbm/hr steam flow and when average position of 3 open TCVs is less than 50% open, with FCL <103%, and the MCFL setpoint ≥ 120%. TCV Stuck Closed may be in combination with any EOOS except TBVOOS or TCV Slow Closure. If in combination with other EOOS(s), thermal limits may require adjustment for the other EOOS(s) as designated in Sections 1, 2, and 3.
7. ICF is analyzed for up to 105% core flow.
8. The SLO boundary was not moved up with the incorporation of MELLLA. The flow boundary for SLO at uprated conditions remains the ELLLA boundary for pre-uprate conditions. (Reference 20)
9. Coastdown is defined to begin at a core average exposure of 30,266.2 MWd/MTU (which is the licensing basis exposure used by SPC). ICF is allowed during coastdown. (Reference 3 and 57)
10. Single loop operation is allowed with any of the EOOS options listed in this table.
11. Turbine Bypass Valves OOS is allowed during coastdown operation using the Feedwater Heaters OOS/Turbine Bypass OOS operating limits.
12. Operation in these regions is permitted during coastdown only.

6. Traversing In-Core Probe System (3.2.1, 3.2.2, 3.2.3)

6.1 Tech Spec Reference:

Tech Spec Sections 3.2.1, 3.2.2, 3.2 3 for thermal limits require the TIP system for recalibration of the LPRM detectors and monitoring thermal limits.

6.2 Description:

When the traversing in-core probe (TIP) system (for the required measurement locations) is used for recalibration of the LPRM detectors and monitoring thermal limits, the TIP system shall be operable with the following:

1. movable detectors, drives and readout equipment to map the core in the required measurement locations, and
2. indexing equipment to allow all required detectors to be calibrated in a common location.

For BOC to BOC + 500 MWD/MT, cycle analyses support thermal limit monitoring without the use of the TIPs.

Following the first TIP set (required prior to BOC + 500 MWD/MT), the following applies for use of the SUBTIP methodology:

With one or more TIP measurement locations inoperable, the TIP data for an inoperable measurement location may be replaced by data obtained from a 3-dimensional BWR core monitoring software system adjusted using the previously calculated uncertainties, provided the following conditions are met:

1. All TIP traces have previously been obtained at least once in the current operating cycle when the reactor core was operating above 20% power, (References 14, 15 and 23) and
2. The total number of simulated channels (measurement locations) does not exceed 42% (18 channels).

Otherwise, with the TIP system inoperable, suspend use of the system for the above applicable monitoring or calibration functions.

6.3 Bases:

The operability of the TIP system with the above specified minimum complement of equipment ensures that the measurements obtained from use of this equipment accurately represent the spatial neutron flux distribution of the reactor core. The normalization of the required detectors is performed internal to the core monitoring software system.

Substitute TIP data, if needed, is 3-dimensional BWR core monitoring software calculated data which is adjusted based on axial and radial factors calculated from previous TIP sets. Since uncertainty could be introduced by the simulation and adjustment process, a maximum of 18 channels may be simulated to ensure that the uncertainties assumed in the substitution process methodology remain valid.

Section 2

LaSalle Unit 2 Cycle 9

Reload Transient Analysis Results

August 2002

Technical Requirements Manual - Appendix J
L2C9 Reload Transient Analysis Results

Table of Contents

Attachment 1

LaSalle Unit 2 Cycle 9

Neutronics Licensing Report

NSB

DocID# DG00-001303

NUCLEAR FUEL MANAGEMENT
TRANSMITTAL OF DESIGN INFORMATION

☐ SAFETY RELATED ☐ NON-SAFETY RELATED ☐ REGULATORY RELATED	Originating Organization ☒ Nuclear Fuel Management ☐ Other (specify) ______	NFM ID# NFM0000115 Sequence 0 Page 1 of 21

Station: LaSalle Unit: 2 Cycle: 9 Generic: ______

To: Jeffery K. Nugent (LS)

Subject: LaSalle Unit 2 Cycle 9 Neutronics Licensing Report

Ming-Yuan Hsiao Preparer	Ming-Yuan Hsiao Preparer's Signature	9-15-00 Date
Peter A. Weggeman Reviewer	Peter A. Weggeman Reviewer's Signature	9-15-00 Date
Adelmo S. pallotta NFM Department Head	Approver's Signature	10/5/00 Date

Status of Information:
☐ Verified
☐ Unverified
☐ Engineering Judgement

Action Tracking # for Method and Schedule of Verification for Unverified DESIGN INFORMATION: ______________

Description of Information: Provide the station and BSS group LaSalle Unit 2 Cycle 9 Neutronics Licensing Report (NLR).

Purpose of Information:

Seq. 0: Provide the station and BSS group LaSalle Unit 2 Cycle 9 Neutronics Licensing Report (NLR).

Source of Information: As referenced

Supplemental Distribution:				
	Danny Bost (LS)	John J. Reimer (LS)	Amy Goss (LS)	Edward A. McVey
	Thomas J. Rausch	R. W. Tsai	Adelmo S. Pallotta	Ming Y. Hsiao
	LaSalle Central File	Downers Grove Central File		

COMMONWEALTH EDISON COMPANY
NUCLEAR FUEL SERVICES

NEUTRONICS LICENSING REPORT

for

LaSalle Unit 2 Cycle 9

preparer: MYH, 8-31-00

reviewer PAW 8-31-00

Licensing Basis

This document, in conjunction with the references 1, 2 and 4 in Section VIII provide the licensing basis for LaSalle Unit 2 Reload 8, Cycle 9.

Table of Contents

preparer: MYH, 8-31-00

reviewer PAW 8-31-

I. Nuclear Design Analysis

I.1 Fuel Bundle Nuclear Design Analysis

Assembly Average Enrichment (ATRIUM-9B), w/o U-235

SPCA9-391B-14G8.0-100M	3.91
SPCA9-410B-19G8.0-100M	4.10
SPCA9-383B-16G8.0-100M	3.83
SPCA9-396B-12GZ-100M	3.96

Axial Enrichment and Burnable Poison Distribution

SPCA9-391B-14G8.0-100M	Figure 1
SPCA9-410B-19G8.0-100M	Figure 1
SPCA9-383B-16G8.0-100M	Figure 2
SPCA9-396B-12GZ-100M	Figure 2

Radial Enrichment and Burnable Poison Distribution

SPCA9-4.53L-11G8.0-100M	Figure 3
SPCA9-4.56L-12G8.0-100M	Figure 4
SPCA9-4.21L-13G8.0-100M	Figure 5
SPCA9-4.27L-12G8.0-100M	Figure 6
SPCA9-3.96L-8G5.0-100M	Figure 7
SPCA9-4.58L-8G6.0-100M	Figure 8
SPCA9-4.58L-8G6.0/4G3.0-100M	Figure 9

preparer: myH, 8-31-00 reviewer PAW 8-31-0

I.2 Core Nuclear Design Analysis

I.2.1 Core Configuration and Licensing Exposure Limits

Bundle Type	Cycle Loaded	Number in Core
GE9B-P8CWB322-11GZ-100M-150-CECO	7	84
GE9B-P8CWB320-9GZ-100M-150-CECO	7	76
SPCA9-381B-13GZ7-80M	8	128
SPCA9-384B-11GZ6-80M	8	128
SPCA9-391B-14G8.0-100M	9	40
SPCA9-410B-19G8.0-100M	9	120
SPCA9-383B-16G8.0-100M	9	132
SPCA9-396B-12GZ-100M	9	56

Licensing Exposure Limits

Value of Interest	Core Average Exposure (MWD/MT)	Cycle Incremental Exposure (MWD/MT)
Nominal EOC 8 Exposure	27892	13750
Short EOC 8 Exposure	27392	13250
Minimum EOC 8 Energy for which C9 Neutronic Licensing Analyses are Valid	27392	13250
BOC 9 Exposure *(assuming nominal EOC 8 energy)*	11799	0
BOC 9 Exposure *(assuming short EOC 8 energy)*	11470	0
Nominal EOC 9 Exposure *(assuming nominal EOC 8 energy)*	29598	17800

Core UO_2 Weights

Cycle of Interest	UO_2 Total Weight (MT)
Cycle 8	135.11
Cycle 9	133.50

preparer: MYH, 9-1-00 reviewer PAW 9-1-00

I.2.2 Core Reactivity Characteristics

All values reported below are with zero xenon and are for 68°F moderator temperature. The MICROBURN-B cold BOC best estimate K-effective bias is 1.004 at BOC. The shutdown margin calculations are based on the short EOC8 energy given in Section I.2.1.

BOC Cold K-Effective, All Rods Out	1.11257
BOC Cold K-Effective All Rods In	0.95674
BOC Cold K-Effective, Strongest Rod Out	0.99360
BOC Shutdown Margin, % ΔK	1.040
Minimum Shutdown Margin, % ΔK	1.020
Reactivity Defect (R-value), % ΔK	0.020
Cycle Incremental Exposure Corresponding to Minimum Shutdown Margin R-Value (MWD/MTU)	250
Standby Liquid Control System Shutdown Margin, Cold Condition, (% ΔK)	17.8

LaSalle station has upgraded its Standby Liquid Control System so that the B-10 enrichment has been increased from 18.9% to 45%. The above SBLC analysis assumes 660 ppm with the boron enriched to 45% B-10.

preparer: *MYH, 9-15-00* reviewer *PAW 9.15.00*

II. Control Rod Withdrawal Error

The control rod withdrawal error event is analyzed at 100% of rated power, 100% of rated flow and unblocked conditions only.

Distance Withdrawn (ft)	ΔCPR
12 (Unblocked)	0.30

The design complies with the SPC 1% plastic strain and centerline melt criteria via conformance to the PAPT (Protection Against Power Transient) LHGR limits. The design complies with the GE centerline melt criteria via conformance to the GE thermal overpower protection (TOP) criteria. The design complies with the GE 1% plastic strain criteria via conformance to the GE mechanical overpower protection (MOP) criteria..

III. Fuel Loading Error

The Fuel Loading Error, including fuel mislocation and misorientation, is classified as an accident. By demonstrating that the Fuel Loading Error meets the more stringent Anticipated Operational Occurrence (AOO) requirements, the offsite dose requirement is assured to be met. Because the events listed below result in a ΔCPR value that is less than that of the limiting transient, the AOO requirements and hence off-site dose requirements are met for the Fuel Loading Error.

III.1 Fuel Mislocation Error

The following value bounds both the SPC and the co-resident GE fuel types.

Event	ΔCPR
Mislocated Bundle	0.23

III.2 Fuel Misrotation Error

The following value bounds both the SPC and the co-resident GE fuel types.

Event	ΔCPR
Misoriented Bundle	0.15

preparer: mTH. 9-1-00 reviewer PAW 9-1-00

IV. Control Rod Drop Accident

LaSalle is a banked position withdrawal sequence plant. In order to allow the site the option of inserting control rods using the simplified control rod sequence shown in Table 1, a control rod drop accident analysis was performed for the simplified sequence. The results from this simplified sequence analysis bound those where BPWS guidelines are followed. The results demonstrate that the simplified shutdown sequence meets the Technical Specification limit of 280 cal/g for a control rod drop accident. Therefore, the simplified sequence is valid for for control rod insertion for shutdown.

An adder of 0.32 %ΔK is incorporated in this analysis (for other than 00 to 48 control rod drops) to account for possible rod mispositioning errors as well as clumping effects.

Maximum Dropped Control Rod Worth, %ΔK	1.375
Doppler Coefficient, Δk/k/°F	-9.50E-06
Effective Delayed Neutron Fraction used	0.0053
Four-Bundle Local Peaking Factor	1.281
Maximum Deposited Fuel Rod Enthalpy, (cal/g)	222
Number of Rods Greater than 170 cal/g	266

Note that the limit on maximum deposited fuel rod enthalpy is 280 cal/g and the limit on the number of rods greater than 170 cal/g (failed rods) is 770 for the GE 8x8 fuel and 850 for the SPC ATRIUM-9B fuel (in LaSalle UFSAR).

V. Loss of Feedwater Heating

The loss of feedwater heating event is analyzed at 100% of rated power for 81%, 100% and 105% of rated flow and an assumed inlet temperature decrease of 145°F. The event was analyzed from BOC to EOC. The ΔCPR value reported below is bounding for both the SPC and the co-resident GE fuel types and all the analyzed flows.

Event	ΔCPR
Loss of Feedwater Heating	0.23

The design complies with the SPC 1% plastic strain and centerline melt criteria via conformance to the PAPT (Protection Against Power Transient) LHGR limits. The design complies with the GE

preparer: MYH, 10-4-00

reviewer PAW 10-4-00

1% plastic strain criteria via conformance to the mechanical overpower protection (MOP) limit. The design does not meet the GE thermal overpower protection (TOP) criteria during a loss of feedwater heating event; hence, the LHGR values in the COLR for the affected lattice are adjusted accordingly (References 9, 13 and 14) as follows:

GE9B-P8CWB322-11GZ-100M-150-CECO Bundle (Fuel Type 1)
LHGR Limits for L2C9

Nodal Exposure (GWD/ST)	Nodal Exposure (GWD/MT)	LHGR Limit
0	0	13.75
11.8459	13.06	13.75
25.2182	27.80	11.75
45.6410	50.31	10.31
55.2370	60.89	6.00

GE9B-P8CWB320-9GZ-100M-150-CECO Bundle (Fuel Type 2)
LHGR Limits for L2C9

Nodal Exposure (GWD/ST)	Nodal Exposure (GWD/MT)	LHGR Limit
0	0	14.25
11.0152	12.14	14.25
23.7593	26.19	12.18
43.6866	48.16	10.80
54.3675	59.93	6.00

VI. Maximum Exposure Limit Compliance

Note that the following exposures are based on a nominal Cycle 8 EOC exposure of 13750 MWD/MT and a nominal Cycle 9 exposure of 17800 MWD/MT. If Cycle 9 reaches it's long window (approximately 500 MWD/MTU beyond the nominal Cycle 9 energy), the exposure limits will still be met.

Exposure (MWD/MT)	GE9B Projected (MWD/MT)	GE9B Limit (MWD/MT)	ATRIUM-9B Projected (MWD/MT)	ATRIUM-9B Limit* (MWD/MT)
Peak Batch	39989	42000	36794	NA
Peak Assembly	45399	NA	39460	48000
Peak Rod	NA	NA	43243	55000
Peak Pellet	62595	65000	54918	66000

*The ATRIUM-9B exposure limits identified are not applicable until document EMF-85-74 is added to the Technical Specifications (Tech Specs). Until this document is added to the Tech Specs, the ATRIUM-9B exposure limits are 48.0 GWD/MT for Peak Fuel Assembly (no change), 50.0 GWD/MT for Peak Fuel Rod and 60.0 GWD/MT for Peak Fuel Pellet.

VII. Spent Fuel Pool and Fresh Fuel Vault Criticality Compliance

For the L2C9 reload, there are four new SPC ATRIUM-9B assembly types consisting of seven unique enriched lattices, as identified in **I.1 Fuel Bundle Nuclear Design Analysis.**

VII.1 Fresh Fuel Vault Criticality Compliance

The fuel storage vault criticality analysis that is detailed in Reference 5 remains valid for the above lattices. All the new (ATRIUM-9B) assemblies comply with the fresh fuel vault criticality limits, i.e., all lattices have an enrichment of less than 5.00 wt % U-235 and a gadolinia content that is greater than 6 rods at 3.0 wt% Gd_2O_3.

Note that the new fuel vault is a moderation-controlled area which implies that hydrogenous materials will be limited within the new fuel storage array. Administrative controls as generally defined in GE SIL No. 152 (dated March 31,1976) must be incorporated for the area.

VII.2 L1 Spent Fuel Pool Criticality Compliance

The LaSalle Unit 1 spent fuel pool criticality analysis that is detailed in Reference 6 remains valid for the above lattices. All the new (ATRIUM-9B) assemblies comply with the spent fuel pool criticality limits, i.e., all lattices have an enrichment of less than 4.60 wt % U-235 and a gadolinia content that is greater than 8 rods at 3.0 wt% Gd_2O_3.

VII.3 L2 Spent Fuel Pool Criticality Compliance

The LaSalle Unit 2 spent fuel pool criticality analysis that is detailed in Reference 7 remains valid for the above lattices. As shown below, all the new (ATRIUM-9B) assemblies comply with the LaSalle Unit 2 spent fuel pool criticality limit of
k-eff < 0.95.

Lattice Type	Maximum k-inf*	Maximum in-Rack k-eff**	Spent Fuel Pool k-eff Limit
SPCA9-4.21L-13G8.0-100M	1.169	< 0.85	0.95
SPCA9-4.27L-12G8.0-100M	1.180	< 0.85	0.95
SPCA9-4.53L-11G8.0-100M	1.192	< 0.85	0.95
SPCA9-4.56L-12G8.0-100M	1.187	< 0.85	0.95
SPCA9-3.96L-8G5.0-100M	1.231	< 0.86	0.95
SPCA9-4.58L-8G6.0/4G3.0-100M	1.233	< 0.86	0.95
SPCA9-4.58L-8G6.0-100M	1.236	< 0.86	0.95

* From 68 °F, uncontrolled CASMO-3G results.
** From Figure 6.1 of Reference 7.

preparer: MYH, 9-15-00

reviewer PAW 9.15.00

VIII. References

1. "LaSalle Unit 2 Cycle 9 Reload Analysis", Siemens Power Corporation, EMF-2437, Latest Revision.

2. "LaSalle Unit 2 Cycle 9 Plant Transient Analysis", Siemens Power Corporation, EMF-2440, Latest Revision.

3. "LaSalle 2 cycle 9 Core Design," NDIT NFM0000056 Seq. 1, April 7, 2000 and "L2C9 FLLP," BNDL:00-005, Revision 0, 4/7/2000.

4. Commonwealth Edison, Nuclear Fuel Services, NFSR-0091, "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods", as supplemented and approved.

5. "Criticality Safety Analysis for ATRIUM-9B Fuel, LaSalle Units 1 and 2 New Fuel Storage Vault," Siemens Power Corporation, EMF-95-134(P), December 1995. [NDIT 960089, Rev. 0]

6. "Criticality Safety Analysis for ATRIUM-9B Fuel, LaSalle Unit 1 Spent Fuel Storage Pool (BORAL Rack)," Siemens Power Corporation, EMF-96-117(P), April 1996. [NDIT 960087, Rev. 0]

7. "Criticality Safety Analysis for ATRIUM-9B Fuel, LaSalle Unit 2 Spent Fuel Storage Pool (Boraflex Rack)," Siemens Power Corporation, EMF-95-088(P), February 1996. [NDIT 960088, Rev. 0]

8. "L2C9 Standby Liquid Control System Worth Calculations," BNDL:00-028, Revision 0, July 14, 2000.

9. "L2C9 Loss of Feedwater Heating Licensing Analysis," BNDL:00-024, Revision 0, July 13, 2000.

10. "LaSalle Unit 2 Cycle 9 RWE - delta CPR," BNDL:00-026, Revision 0, August 23, 2000.

11. "L2C9 Rod Withdrawal Error MOP/TOP Analysis," BNDL:00-023, Revision 0, August 17, 2000.

12. "LaSalle Unit 2 Cycle 9 Neutronic Licensing Shutdown Margin Calculation," BNDL:00-032, Revision 0, August 17, 2000.

13. "LaSalle 2 Cycle 9 LFWH TOP Violation and LHGR Limit Calculation," Letter NFM:BND:00-050, July 13, 2000.

14. "LaSalle 2 Cycle 9 GE9 Curve Adjustment for LFWH TOP Violation," GE Letter KF-00-063, August 24, 2000.

15. "LaSalle 2 Cycle 9 LFWH TOP Violation and LHGR Limit Calculation," Letter NFM:BND:00-050, July 13, 2000.

16. "L2C9 Mislocation Licensing Analysis," BNDL:00-025, September 2000.

17. "L2C9 Bundle Misorientation Analysis," BNDL:00-030, September 2000.

preparer: MYH, 8-31-00 reviewer PAW 8.31.00

Table 1

L2C9 Simplified Shutdown Sequence

Shutdown From an A1 Sequence

Rod Group*	Insertion (Bank)	Comments**
7 or 8	48-00	Either Group 7 or 8 may be inserted first.
10	48-00	Groups 7 and 8 must be fully inserted prior to inserting any Group 10 rod.
9	48-00	Group 10 must be fully inserted prior to inserting any Group 9 rod.
5 or 6	48-00	Groups 5 and 6 may be inserted without banking anytime after Groups 7 and 8 have been inserted and before Group 4 is inserted.
4	48-00	Groups 5 through 10 must be fully inserted prior to inserting any Group 4 rod.
3	48-00	Group 4 must be fully inserted prior to inserting any Group 3 rod.
2	48-00	Group 3 must be fully inserted prior to inserting any Group 2 rod.
1	48-00	Group 2 must be fully inserted prior to inserting any Group 1 rod.

Shutdown from an A2 Sequence

Rod Group*	Insertion (Bank)	Comments**
9 or 10	48-00	Either Group 9 or 10 may be inserted first.
8	48-00	Groups 9 and 10 must be fully inserted prior to inserting any Group 8 rod.
7	48-00	Group 8 must be fully inserted prior to inserting any Group 7 rod.
5 or 6	48-00	Groups 5 and 6 may be inserted without banking anytime after Groups 9 and 10 have been inserted and before Group 4 is inserted.
4	48-00	Groups 5 through 10 must be fully inserted prior to inserting any Group 4 rod.
3	48-00	Group 4 must be fully inserted prior to inserting any Group 3 rod.
2	48-00	Group 3 must be fully inserted prior to inserting any Group 2 rod.
1	48-00	Group 2 must be fully inserted prior to inserting any Group 1 rod.

*Group definitions are from LAP-100-13 Revision 21.

** The standard BPWS rules concerning out-of-service rods apply to the shutdown sequences.

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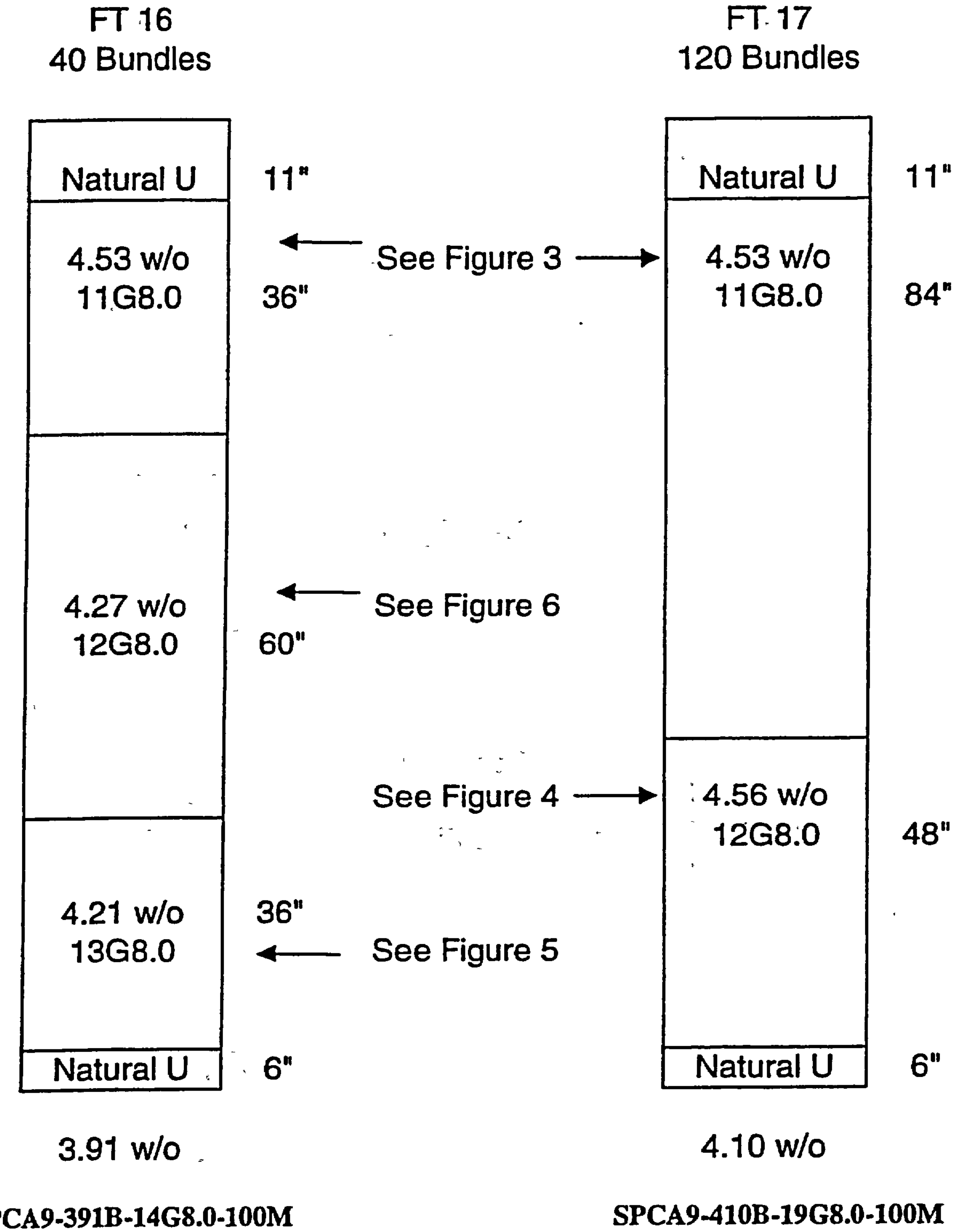

Figure 1. L2C9 Bundle Design (Fuel Types 16 and 17)

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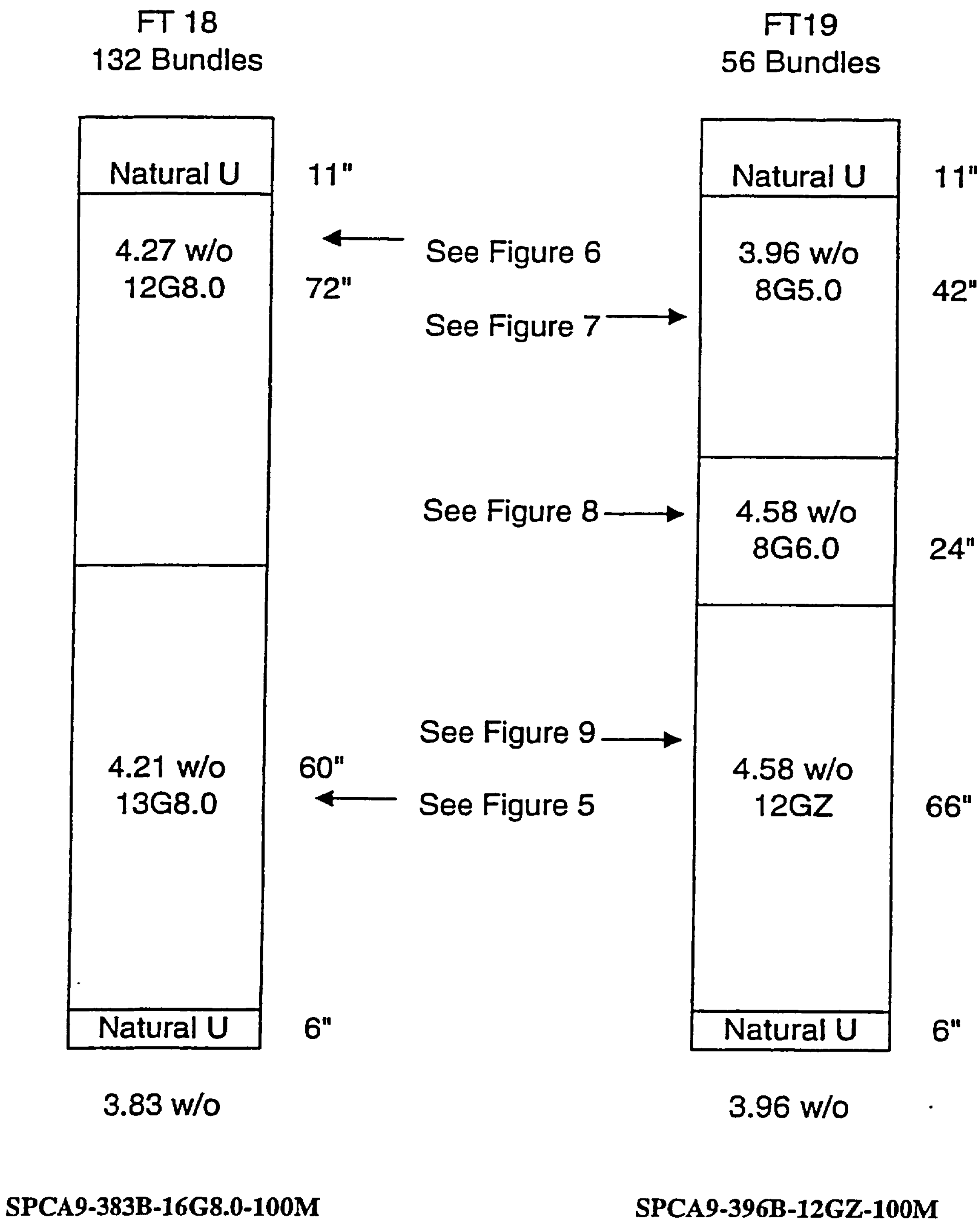


Figure 2. L2C9 Bundle Design (Fuel Types 18 and 19)

preparer: MYH, 8-31-00 reviewer DAW 8-31-0

1 3.00	2 3.60	3 4.40	5 4.70	4 4.95	5 4.70	3 4.40	2 3.60	1 3.00
2 3.60	8 4.40 8.00	4 4.95	4 4.95	8 4.40 8.00	4 4.95	4 4.95	8 4.40 8.00	2 3.60
3 4.40	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.40
5 4.70	4 4.95	4 4.95				8 4.40 8.00	4 4.95	4 4.95
4 4.95	8 4.40 8.00	4 4.95		Internal Water Channel		4 4.95	8 4.40 8.00	4 4.95
5 4.70	4 4.95	4 4.95				4 4.95	4 4.95	4 4.95
3 4.40	4 4.95	4 4.95	8 4.40 8.00	4 4.95	4 4.95	8 4.40 8.00	4 4.95	3 4.40
2 3.60	8 4.40 8.00	4 4.95	4 4.95	8 4.40 8.00	4 4.95	4 4.95	8 4.40 8.00	2 3.60
1 3.00	2 3.60	3 4.40	4 4.95	4 4.95	4 4.95	3 4.40	2 3.60	1 3.00

TYPE	#	ENR	GD
1	4	3.00	0
2	8	3.60	0
3	8	4.40	0
4	37	4.95	0
5	4	4.70	0
6	0		0
7	0		0
8	11	4.40	8.00
9	0	0.00	0

Figure 3. SPCA9-4.53L-11G8.0-100M Lattice Enrichment Distribution

preparer: MYH, 8-31-00 reviewer PAW 8-31-00

1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00
2 4.00	2 4.00	G1 4.20	4 4.95	G2 4.70	4 4.95	G1 4.20	2 4.00	2 4.00
3 4.70	G1 4.20	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	G1 4.20	3 4.70
4 4.95	4 4.95	4 4.95				4 4.95	4 4.95	4 4.95
4 4.95	G2 4.70	4 4.95		Internal Water Channel		4 4.95	G2 4.70	4 4.95
4 4.95	4 4.95	4 4.95				4 4.95	4 4.95	4 4.95
3 4.70	G1 4.20	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	G1 4.20	3 4.70
2 4.00	2 4.00	G1 4.20	4 4.95	G2 4.70	4 4.95	G1 4.20	2 4.00	2 4.00
1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00

1	Rods (4)	3.00 w/o U-235
2	Rods (12)	4.00 w/o U-235
3	Rods (8)	4.70 w/o U-235
4	Rods (36)	4.95 w/o U-235
G1	Rods (8)	4.20 w/o U-235+8.0 w/o Gd2O3
G2	Rods (4)	4.70 w/o U-235+8.0 w/o Gd2O3

Figure 4. SPCA9-4.56L-12G8.0-100M Lattice Enrichment Distribution

preparer: mYH, 8-31-00 reviewer PAW 8.31.00

1 2.60	2 3.20	3 4.00	3 4.00	5 4.40	3 4.00	3 4.00	2 3.20	1 2.60
2 3.20	8 4.40 8.00	4 4.70	4 4.70	8 4.40 8.00	4 4.70	8 4.40 8.00	3 4.00	2 3.20
3 4.00	4 4.70	4 4.70	4 4.70	4 4.70	4 4.70	4 4.70	8 4.40 8.00	3 4.00
3 4.00	4 4.70	4 4.70				8 4.40 8.00	4 4.70	4 4.70
5 4.40	8 4.40 8.00	4 4.70		Internal Water Channel		4 4.70	8 4.40 8.00	4 4.70
3 4.00	4 4.70	4 4.70				4 4.70	4 4.70	4 4.70
3 4.00	8 4.40 8.00	4 4.70	8 4.40 8.00	4 4.70	4 4.70	8 4.40 8.00	4 4.70	3 4.00
2 3.20	3 4.00	8 4.40 8.00	4 4.70	8 4.40 8.00	4 4.70	4 4.70	8 4.40 8.00	2 3.20
1 2.60	2 3.20	3 4.00	4 4.70	4 4.70	4 4.70	3 4.00	2 3.20	1 2.60

TYPE	#	ENR	GD
1	4	2.60	0
2	8	3.20	0
3	14	4.00	0
4	31	4.70	0
5	2	4.40	0
6	0		0
7	0		0
8	13	4.40	8.00
9	0	0.00	0

Figure 5. SPCA9-4.21L-13G8.0-100M Lattice Enrichment Distribution

preparer: MYH, 8-31-00 reviewer DAW 8-31-00

1 2.60	2 3.20	3 4.00	5 4.40	4 4.70	5 4.40	3 4.00	2 3.20	1 2.60
2 3.20	8 4.40 8.00	4 4.70	4 4.70	8 4.40 8.00	4 4.70	4 4.70	8 4.40 8.00	2 3.20
3 4.00	4 4.70	8 4.40 8.00	4 4.70	4 4.70	4 4.70	4 4.70	4 4.70	3 4.00
5 4.40	4 4.70	4 4.70				8 4.40 8.00	4 4.70	4 4.70
4 4.70	8 4.40 8.00	4 4.70		Internal Water Channel		4 4.70	8 4.40 8.00	4 4.70
5 4.40	4 4.70	4 4.70				4 4.70	4 4.70	4 4.70
3 4.00	4 4.70	4 4.70	8 4.40 8.00	4 4.70	4 4.70	8 4.40 8.00	4 4.70	3 4.00
2 3.20	8 4.40 8.00	4 4.70	4 4.70	8 4.40 8.00	4 4.70	4 4.70	8 4.40 8.00	2 3.20
1 2.60	2 3.20	3 4.00	4 4.70	4 4.70	4 4.70	3 4.00	2 3.20	1 2.60

TYPE	#	ENR	GD
1	4	2.60	0
2	8	3.20	0
3	8	4.00	0
4	36	4.70	0
5	4	4.40	0
6	0		0
7	0		0
8	12	4.40	8.00
9	0	0.00	0

Figure 6. SPCA9-4.27L-12G8.0-100M Lattice Enrichment Distribution

preparer: MYH, 8-31-00

reviewer PAW 8-31-00

1 2.60	2 3.40	3 3.80	4 4.40	4 4.40	4 4.40	3 3.80	2 3.40	1 2.60
2 3.40	2 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	4 4.40	2 3.40	2 3.40
3 3.80	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	3 3.80
4 4.40	G1 3.40	4 4.40				4 4.40	G1 3.40	4 4.40
4 4.40	4 4.40	4 4.40		Internal Water Channel		4 4.40	4 4.40	4 4.40
4 4.40	G1 3.40	4 4.40				4 4.40	G1 3.40	4 4.40
3 3.80	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	3 3.80
2 3.40	2 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	4 4.40	2 3.40	2 3.40
1 2.60	2 3.40	3 3.80	4 4.40	4 4.40	4 4.40	3 3.80	2 3.40	1 2.60

1	Rods (4)	2.60 w/o U-235
2	Rods (12)	3.40 w/o U-235
3	Rods (8)	3.80 w/o U-235
4	Rods (40)	4.40 w/o U-235
G1	Rods (8)	3.40 w/o U-235+5.0 w/o Gd2O3

Figure 7. SPCA9-3.96L-8G5.0-100M Lattice Enrichment Distribution

preparer: MYH, 8-31-00 reviewer PAW 8.31-00

1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00
2 4.00	2 4.00	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	2 4.00	2 4.00
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
4 4.95	G1 4.20	4 4.95				4 4.95	G1 4.20	4 4.95
4 4.95	4 4.95	4 4.95		Internal Water Channel		4 4.95	4 4.95	4 4.95
4 4.95	G1 4.20	4 4.95				4 4.95	G1 4.20	4 4.95
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
2 4.00	2 4.00	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	2 4.00	2 4.00
1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00

1	Rods (4)	3.00 w/o U-235
2	Rods (12)	4.00 w/o U-235
3	Rods (8)	4.70 w/o U-235
4	Rods (40)	4.95 w/o U-235
G1	Rods (8)	4.20 w/o U-235+6.0 w/o Gd_2O_3

Figure 8. SPCA9-4.58L-8G6.0-100M Lattice Enrichment Distribution

preparer: mYH, 8-31-00

reviewer PAW 8-31-00

1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00
2 4.00	G2 4.00	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G2 4.00	2 4.00
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
4 4.95	G1 4.20	4 4.95				4 4.95	G1 4.20	4 4.95
4 4.95	4 4.95	4 4.95		Internal Water Channel		4 4.95	4 4.95	4 4.95
4 4.95	G1 4.20	4 4.95				4 4.95	G1 4.20	4 4.95
3 4.70	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	3 4.70
2 4.00	G2 4.00	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G2 4.00	2 4.00
1 3.00	2 4.00	3 4.70	4 4.95	4 4.95	4 4.95	3 4.70	2 4.00	1 3.00

1	Rods (4)	3.00 w/o U-235
2	Rods (8)	4.00 w/o U-235
3	Rods (8)	4.70 w/o U-235
4	Rods (40)	4.95 w/o U-235
G1	Rods (8)	4.20 w/o U-235+6.0 w/o Gd2O3
G2	Rods (4)	4.00 w/o U-235+3.0 w/o Gd2O3

Figure 9. SPCA9-4.58L-8G6.0/4G3.0-100M Lattice Enrichment Distribution

preparer: mYH, 8-31-00

reviewer PAW 8-31-00

Attachment 2

LaSalle Unit 2 Cycle 9

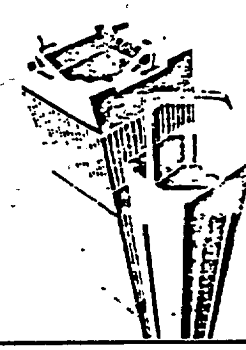
Reload Analysis Report

SIEMENS

EMF-2437
Revision 0

LaSalle Unit 2 Cycle 9 Reload Analysis

October 2000



Siemens Power Corporation
Nuclear Division

Siemens Power Corporation

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EMF-2437
Revision 0

LaSalle Unit 2 Cycle 9
Reload Analysis

Prepared:	J. M. Haun, Engineer BWR Neutronics	10/2/00 Date
Prepared:	D. B. McBurney, Engineer BWR Safety Analysis	10/2/00 Date
Prepared:	J. A. White, Engineer Product Mechanical Engineering	10/2/00 Date
Concurred:	H. D. Curet, Manager Product Licensing	10/3/00 Date
Concurred:	D. J. Denver, Manager Commercial Operations	[illegible] Date
Approved:	DDW D. R. Gordheim, for OCB O. C. Brown, Manager BWR Neutronics	10/04/00 Date
Approved:	DW R. R. Schnig for M. E. Garrett, Manager Safety Analysis	10/03/00 Date
Approved:	T. M. Howe, Manager Product Mechanical Engineering	10-03-00 Date

/sp

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Nature of Changes

Item	Page	Description and Justification
1.	All	This is a new document.

Contents

Tables

Figures

Nomenclature

AOO	abnormal operational occurrence
BOC	beginning of cycle
EFPH	effective full power hours
EOC	end of cycle
EOD	extended operating domain
EOFP	end of full power
EOOS	equipment out of service
FFTR	final feedwater temperature reduction
FHOOS	feedwater heater out of service
FWCF	feedwater controller failure
ICA	interim corrective actions
ICF	increased core flow
LFWH	loss of feedwater heating
LHGR	linear heat generation rate
LHGRFAC	LHGR multiplier
LOCA	loss of coolant accident
LPRM	local power range monitor
LRNB	load rejection no bypass
MAPFAC	MAPLHGR multiplier
MAPLHGR	maximum average planar linear heat generation rate
MCPR	minimum critical power ratio
MELLLA	maximum extended load line limit analysis
MSIV	main steam isolation valve
NSS	nominal scram speed
PAPT	protection against power transient
PCT	peak clad temperature
RPT	recirculation pump trip
SLMCPR	safety limit minimum critical power ratio
SLO	single-loop operation
SPC	Siemens Power Corporation
SRVOOS	safety/relief valve out of service
TBVOOS	turbine bypass valves out of service
TCV	turbine control valve
TIP	traversing in-core probe
TIPOOS	traversing in-core probe out of service

TSSS	technical specification scram speed
UFSAR	updated final safety analysis report
ΔCPR	change in critical power ratio

1.0 Introduction

This report provides the results of the analysis performed by Siemens Power Corporation (SPC) as part of the reload analysis in support of the Cycle 9 reload for LaSalle Unit 2. This report is intended to be used in conjunction with the SPC topical Report XN-NF-80-19(P)(A), Volume 4, Revision 1, *Application of the ENC Methodology to BWR Reloads*, which describes the analyses performed in support of this reload, identifies the methodology used for those analyses, and provides a generic reference list. Section numbers in this report are the same as corresponding section numbers in XN-NF-80-19(P)(A), Volume 4, Revision 1. Methodology used in this report which supersedes XN-NF-80-19(P)(A), Volume 4, Revision 1, is referenced in Section 8.0. The NRC Technical Limitations presented in the methodology documents, including the documents referenced in Section 8.0, have been satisfied by these analyses.

Analyses performed by Commonwealth Edison Company (ComEd) are described elsewhere. This document alone does not necessarily identify the limiting events or the appropriate operating limits for Cycle 9. The limiting events and operating limits must be determined in conjunction with results from ComEd analyses.

The Cycle 9 core consists of a total of 764 fuel assemblies, including 348 unirradiated and 256 irradiated ATRIUM™-9B* assemblies and 160 irradiated GE9 assemblies. The reference core configuration is described in Section 4.2.

The design and safety analyses reported in this document were based on the design and operational assumptions in effect for LaSalle Unit 2 during the previous operating cycle. The effects of channel bow are explicitly accounted for in the safety limit analysis. The extended operating domain (EOD) and equipment out of service (EOOS) conditions presented in Table 1.1 are supported.

* ATRIUM is a trademark of Siemens.

Table 1.1 EOD and EOOS Operating Conditions

Extended Operating Domain (EOD) Conditions

Increased Core Flow

Maximum Extended Load Line Limit Analysis (MELLLA)

Coastdown

Final Feedwater Temperature Reduction (FFTR)

FFTR/Coastdown

Equipment Out of Service (EOOS) Conditions*

Feedwater Heaters Out of Service (FHOOS)

Single-Loop Operation (SLO) - Recirculation Loop Out of Service

Turbine Bypass Valves Out of Service (TBVOOS)

Recirculation Pump Trip Out of Service (No RPT)

Turbine Control Valve (TCV) Slow Closure and/or No RPT

Safety Relief Valve Out of Service (SRVOOS)

Up to 2 TIP Machine(s) Out of Service or the Equivalent Number of TIP Channels (100% available at startup)

Up to 50% of the LPRMs Out of Service

TCV Slow Closure, FHOOS and/or No RPT

---

* EOOS conditions are supported for EOD conditions as well as the standard operating domain. Each EOOS condition combined with 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels) and/or up to 50% of the LPRMs out of service is supported.

2.0 Fuel Mechanical Design Analysis

Applicable SPC Fuel Design Reports — References 9.1 & 9.2

To assure that the power history for the ATRIUM-9B fuel to be irradiated during Cycle 9 of LaSalle Unit 2 is bounded by the assumed power history in the fuel mechanical design analysis, LHGR operating limits have been specified in Section 7.2.3. In addition, LHGR limits for Anticipated Operational Occurrences have been specified in Reference 9.1 and are presented in Section 7.2.3 as Figure 7.1.

3.0 Thermal-Hydraulic Design Analysis

3.2 *Hydraulic Characterization*

3.2.1 Hydraulic Compatibility

Component hydraulic resistances for the fuel types in the LaSalle Unit 2 Cycle 9 core have been determined in single-phase flow tests of full-scale assemblies. The hydraulic demand curves for SPC ATRIUM-9B and GE9 fuel in the LaSalle Unit 2 core are provided in Reference 9.1, Figure 4.2.

3.2.3 Fuel Centerline Temperature

Applicable Report ATRIUM-9B		Reference 9.1, Figure 3.3

3.2.5 Bypass Flow

Calculated Bypass Flow at 100%P/100%F (includes water channel flow)	14.8 Mlb/hr	Reference 9.3

3.3 *MCPR Fuel Cladding Integrity Safety Limit (SLMCPR)*

Two-Loop Operation*	1.11	Reference 9.3
Single-Loop Operation*	1.12	

3.3.1 Coolant Thermodynamic Condition

Thermal Power (at SLMCPR)	5167.29 MWt
Feedwater Flow Rate (at SLMCPR)	22.4 Mlbm/hr
Core Exit Pressure (at Rated Conditions)	1031.35 psia
Feedwater Temperature	426.5°F

* Includes the effects of channel bow, up to 2 TIPOOS (or the equivalent number of TIP channels), a 2500 EFPH LPRM calibration interval, cycle startup with uncalibrated LPRMs (BOC to 500 MWd/MTU), and up to 50% of the LPRMs out of service.

3.3.2 Design Basis Radial Power Distribution

Figure 3.1 shows the radial power distribution used in the MCPR Fuel Cladding Integrity Safety Limit analysis.

3.3.3 Design Basis Local Power Distribution

Figures 3.2, 3.3, 3.4 and 3.5 show the local power peaking factors used in the MCPR Fuel Cladding Integrity Safety Limit analysis.

SPCA9-391B-14G8.0-100M	Figure 3.2
SPCA9-410B-19G8.0-100M	Figure 3.3
SPCA9-383B-16G8.0-100M	Figure 3.4
SPCA9-396B-12GZ-100M	Figure 3.5

3.4 *Licensing Power and Exposure Shape*

The licensing axial power profile used by SPC for the plant transient analyses bounds the projected end of full power (EOFP) axial power profile. The conservative licensing axial power profile as well as the corresponding axial exposure ratio are given in Table 3.1. Future projected Cycle 9 power profiles are considered to be in compliance when the EOFP normalized power generated in the bottom of the core is greater than the licensing axial power profile at the given state conditions when the comparison is made over the bottom third of the core height.

Table 3.1 Licensing Basis Core Average Axial Power Profile and Licensing Axial Exposure Ratio

State Conditions for Power Shape Evaluation

Power, MWt	3489.00
Core Pressure, psia	1020.00
Inlet Subcooling, Btu/lbm	18.20
Flow, Mlb/hr	108.50

Licensing Axial Power Profile

Node	Power
Top 25	0.211
24	0.417
23	0.967
22	1.207
21	1.371
20	1.445
19	1.454
18	1.428
17	1.384
16	1.346
15	1.299
14	1.248
13	1.199
12	1.151
11	1.102
10	1.053
9	1.002
8	0.944
7	0.887
6	0.835
5	0.796
4	0.770
3	0.726
2	0.583
Bottom 1	0.177

Licensing Axial Exposure Ratio (EOFP)
Average Bottom 8ft/12 ft = 1.098

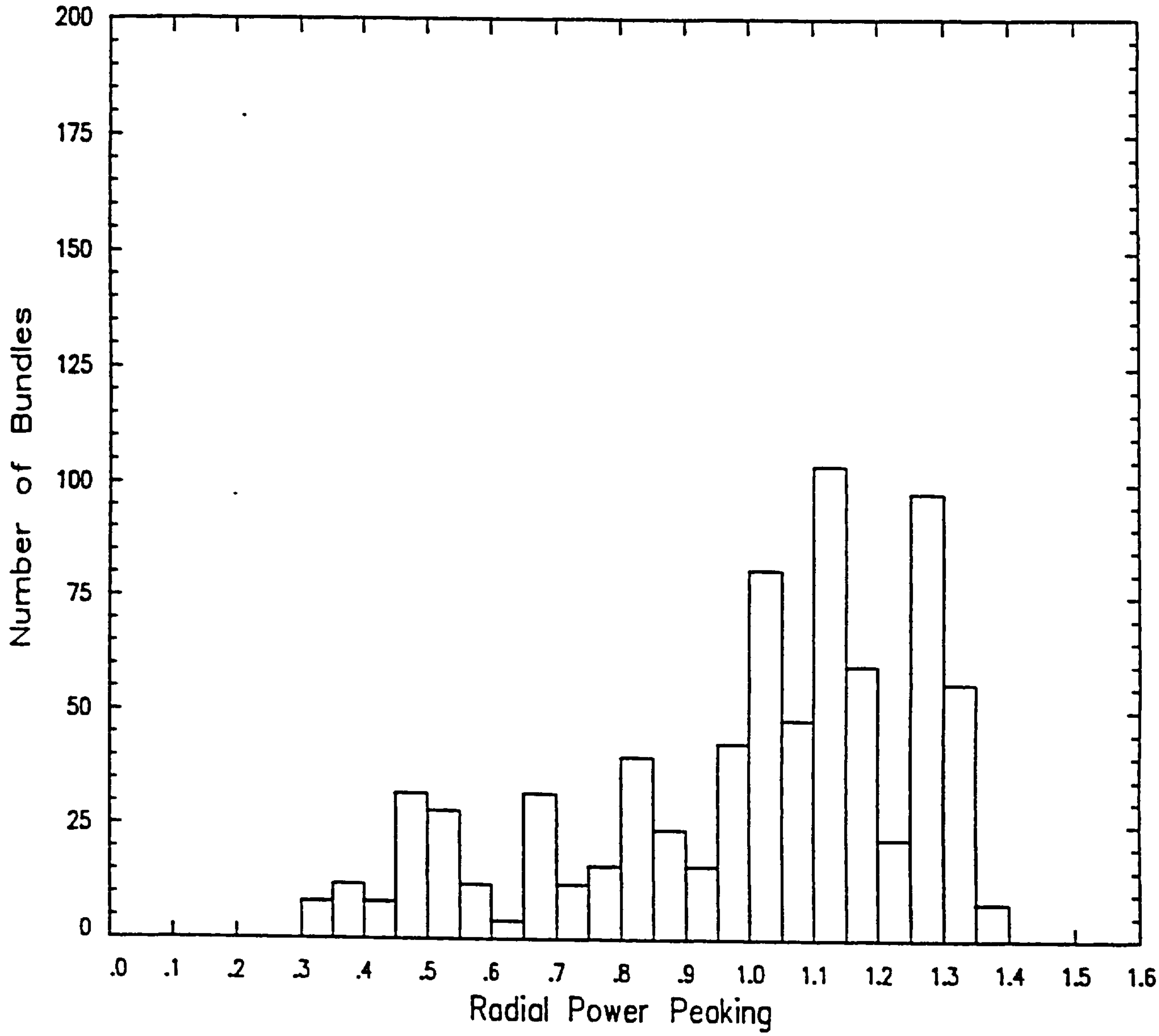

Figure 3.1 Radial Power Distribution for SLMCPR Determination

Control Rod Corner

1.052	1.045	1.088	1.088	1.104	1.079	1.068	1.013	1.005
1.045	0.951	1.019	0.996	0.852	0.986	0.998	0.914	0.991
1.088	1.019	1.001	1.059	1.089	1.051	0.982	0.981	1.027
1.088	0.996	1.059				0.905	0.957	1.050
1.104	0.852	1.089		Internal Water Channel		1.068	0.807	1.035
1.079	0.986	1.051				1.025	0.942	1.039
1.068	0.998	0.982	0.905	1.068	1.025	0.811	0.954	1.005
1.013	0.914	0.981	0.957	0.807	0.942	0.954	0.874	0.957
1.005	0.991	1.027	1.050	1.035	1.039	1.005	0.957	0.956

Figure 3.2 LaSalle Unit 2 Cycle 9 Safety Limit Local Peaking Factors SPCA9-391B-14G8.0-100M With Channel Bow

Control Rod Corner

Control Rod Corner

1.058	1.049	1.092	1.091	1.107	1.082	1.072	1.017	1.010
1.049	0.945	1.020	0.996	0.843	0.987	0.998	0.906	0.995
1.092	1.020	1.002	1.061	1.090	1.052	0.981	0.980	1.030
1.091	0.996	1.061	Internal Water Channel			0.894	0.955	1.053
1.107	0.843	1.090				1.067	0.797	1.036
1.082	0.987	1.052				1.024	0.941	1.041
1.072	0.998	0.981	0.894	1.067	1.024	0.800	0.952	1.007
1.017	0.906	0.980	0.955	0.797	0.941	0.952	0.865	0.960
1.010	0.995	1.030	1.053	1.036	1.041	1.007	0.960	0.960

Figure 3.3 LaSalle Unit 2 Cycle 9 Safety Limit Local Peaking Factors SPCA9-410B-19G8.0-100M With Channel Bow

Control Rod Corner

Control Rod Corner

1.017	1.017	1.068	1.083	1.107	1.074	1.048	0.985	0.970
1.017	0.986	1.024	1.000	0.885	0.992	1.004	0.956	0.965
1.068	1.024	0.890	1.063	1.091	1.055	0.990	0.989	1.009
1.083	1.000	1.063				0.944	0.966	1.055
1.107	0.885	1.091		Internal Water Channel		1.074	0.846	1.040
1.074	0.992	1.055				1.032	0.951	1.043
1.048	1.004	0.990	0.944	1.074	1.032	0.850	0.964	0.988
0.985	0.956	0.989	0.966	0.846	0.951	0.964	0.916	0.932
0.970	0.965	1.009	1.055	1.040	1.043	0.988	0.932	0.924

Figure 3.4 LaSalle Unit 2 Cycle 9 Safety Limit Local Peaking Factors SPCA9-383B-16G8.0-100M With Channel Bow

Control Rod Corner

Control Rod Corner

1.025	1.058	1.062	1.117	1.100	1.108	1.043	1.026	0.979
1.058	0.934	1.018	0.852	1.003	0.845	0.999	0.903	1.005
1.062	1.018	1.003	1.067	1.092	1.058	0.984	0.983	1.006
1.117	0.852	1.067				1.046	0.823	1.056
1.100	1.003	1.092		Internal Water Channel		1.072	0.968	1.039
1.108	0.845	1.058				1.038	0.816	1.046
1.043	0.999	0.984	1.046	1.072	1.038	0.965	0.963	0.986
1.026	0.903	0.983	0.823	0.968	0.816	0.963	0.873	0.973
0.979	1.005	1.006	1.056	1.039	1.046	0.986	0.973	0.933

Figure 3.5 LaSalle Unit 2 Cycle 9 Safety Limit Local Peaking Factors SPCA9-396B-12GZ-100M With Channel Bow

4.0 Nuclear Design Analysis

4.1 *Fuel Bundle Nuclear Design Analysis*

The detailed fuel bundle design information for the fresh ATRIUM™-9B fuel to be loaded in LaSalle Unit 2 Cycle 9 is provided in References 9.1 and 9.12. The following summary provides the appropriate cross-references.

Assembly Average Enrichment (ATRIUM-9B fuel)

SPCA9-391B-14G8.0-100M	(FT16)	3.91 wt%
SPCA9-410B-19G8.0-100M	(FT17)	4.10 wt%
SPCA9-383B-16G8.0-100M	(FT18)	3.83 wt%
SPCA9-396B-12GZ-100M	(FT19)	3.96 wt%

Radial Enrichment Distribution

SPCA9-4.56L-12G8.0-100M	Ref. 9.12	Figure B.19
SPCA9-4.21L-13G8.0-100M	Ref. 9.1	Figure D.1
SPCA9-4.27L-12G8.0-100M	Ref. 9.1	Figure D.2
SPCA9-4.53L-11G8.0-100M	Ref. 9.1	Figure D.3
SPCA9-3.96L-8G5.0-100M	Ref. 9.12	Figure B.122
SPCA9-4.58L-8G6.0/4G3.0-100M	Ref. 9.12	Figure B.140
SPCA9-4.58L-8G6.0-100M	Ref. 9.12	Figure B.157

Axial Enrichment Distribution	Ref. 9.1	Figures 5.1–5.4
Burnable Absorber Distribution	Ref. 9.1	Figures 5.1–5.4
Non-Fueled Rods	Ref. 9.1	Figures 5.1-5.4
Neutronic Design Parameters		Table 4.1

Fuel Storage

LaSalle New Fuel Storage Vault — Reference 9.4

The LSB-2 Reload Batch fuel designs meet the fuel design limitations defined in Table 2.1 of Reference 9.4 and therefore can be safely stored in the vault.

LaSalle Unit 1 Spent Fuel Storage Pool (BORAL Racks) — Reference 9.5

The LSB-2 Reload Batch fuel designs meet the fuel design limitations defined in Table 2.1 of Reference 9.5 and therefore can be safely stored in the pool.

LaSalle Unit 2 Spent Fuel Storage Pool (Boraflex Racks) Reference 9.6

The LSB-2 Reload Batch fuel designs can be safely stored as long as the fuel assembly reactivity limitations defined in Reference 9.6 are met.

< ComEd has responsibility to confirm that fuel meets reactivity limitations. >

4.2 *Core Nuclear Design Analysis*

4.2.1 Core Configuration — Figure 4.1

Core Exposure at EOC8, MWd/MTU (nominal value)	27,893.9
Core Exposure at BOC9, MWd/MTU (from nominal EOC8)	11,808.0
Core Exposure at EOC9, MWd/MTU (licensing basis to EOFP)	30,266.2

NOTE: Analyses in this report are applicable for EOFP up to a core exposure of 30,266.2 MWd/MTU.

< Cycle 9 short window exposure to be determined by ComEd. >

4.2.2 Core Reactivity Characteristics

< This data is to be furnished by ComEd. >

4.2.4 Core Hydrodynamic Stability — Reference 8.7

LaSalle Unit 2 utilizes the BWROG Interim Corrective Actions (ICAs) to address thermal hydraulic instability issues. This is in response to Generic Letter 94-02. When the long term solution OPRM is fully implemented, the ICAs will remain as a backup to the OPRM system.

In order to support the ICAs and remain cognizant of the relative stability of one cycle compared with previous cycles, decay ratios are calculated at various points on the power to flow map and at various points in the cycle. This satisfies the following functions:

- Provides trending information to qualitatively compare the stability from cycle to cycle.
- Provides decay ratio sensitivities to rod line and flow changes near the ICA regions.
- Allows ComEd to review this information to determine if any administrative conservatisms are appropriate beyond the existing requirements.

The NRC approved STAIF computer code was used in the core hydrodynamic stability analysis performed in support of LaSalle Unit 2 Cycle 9. The power/flow state points used for this analysis were chosen to assist ComEd in performing the three functions described above. The Cycle 9 licensing basis control rod step-through projection was used to establish expected core depletion conditions. For each power/flow point, decay ratios were calculated at multiple cycle exposures to determine the highest expected decay ratio throughout the cycle. The results from this analysis are shown below.

Power/Flow (%)*	Maximum Global	Maximum Regional
30.1/26.6	0.59	0.53
31.6/29.2	0.40	0.50
61.9/45.0	0.50	0.88
73.6/50.0	0.52	0.95
78.2/60.0	0.33	0.63
82.4/60.0	0.36	0.72

For reactor operation under conditions of power coastdown, single-loop operation, final feedwater temperature reduction (FFTR) and/or operation with feedwater heaters out of service, it is possible that higher decay ratios could be achieved than are shown for normal operation.

* NOTE: % power is based on 3489 MWt as rated. % flow is based on 108.5 Mlb/hr as rated.

Table 4.1 Neutronic Design Values

Number of Fuel Assemblies	764
Rated Thermal Power, MWt	3489
Rated Core Flow, Mlbm/hr	108.5
Core Inlet Subcooling, Btu/lbm	18.2
Moderator Temperature, °F	548.8
Channel Thickness, inch	0.100
Fuel Assembly Pitch, inch	6.0
Wide Water Gap Thickness, inch	0.261
Narrow Water Gap Thickness, inch	0.261
Control Rod Data*	
Absorber Material	B_4C
Total Blade Support Span, inch	1.580
Blade Thickness, inch	0.260
Blade Face-to-Face Internal Dimension, inch	0.200
Absorber Rod OD, inch	0.188
Absorber Rod ID, inch	0.138
Percentage B_4C, %TD	70

* The control rod data represents original equipment control blades at LaSalle and were used in the neutronic calculations.

I \ J	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59
60									1	2	2	1	1	1	1	1	1	1	1	2	2	1								
58								2	14	19	19	19	15	19	19	19	19	15	19	19	19	14	2							
56						2	2	15	19	17	15	17	16	17	14	14	17	16	17	15	17	19	15	2	2					
54						1	19	17	18	14	1	15	18	15	1	1	15	18	15	1	14	18	17	19	1					
52					1	14	17	17	15	15	15	18	14	17	18	18	17	14	18	15	15	15	17	17	14	1				
50			2	1	14	1	14	17	17	17	2	17	17	15	15	15	15	17	17	2	17	17	17	14	1	14	1	2		
48			2	19	17	14	1	18	17	18	1	15	18	14	2	2	14	18	15	1	18	17	18	1	14	17	19	2		
46		2	15	17	17	17	18	14	14	18	14	18	18	17	14	14	17	18	18	14	18	14	14	18	17	17	17	15	2	
44	1	14	19	18	15	17	17	14	14	18	18	18	18	14	18	18	14	18	18	18	18	14	14	17	17	15	18	19	14	1
42	2	19	17	14	15	17	18	18	18	14	14	17	15	18	14	14	18	15	17	14	14	18	18	18	17	15	14	17	19	2
40	2	19	15	1	15	2	1	14	18	14	2	14	16	15	2	2	15	16	14	2	14	18	14	1	2	15	1	15	19	2
38	1	19	17	15	18	17	15	18	18	17	14	2	15	16	15	15	16	15	2	14	17	18	18	15	17	18	15	17	19	1
36	1	15	16	18	14	17	18	18	18	15	16	15	14	16	16	16	16	14	15	16	15	18	18	18	17	14	18	16	15	1
34	1	19	17	15	17	15	14	17	14	18	15	16	16	18	15	15	18	16	16	15	18	14	17	14	15	17	15	17	19	1
32	1	19	14	1	18	15	2	14	18	14	2	15	16	15	2	2	15	16	15	2	14	18	14	2	15	18	1	14	19	1
30	1	19	14	1	18	15	2	14	18	14	2	15	16	15	2	2	15	16	15	2	14	18	14	2	15	18	1	14	19	1
28	1	19	17	15	17	15	14	17	14	18	15	16	16	18	15	15	18	16	16	15	18	14	17	14	15	17	15	17	19	1
26	1	15	16	18	14	17	18	18	18	15	16	15	14	16	16	16	16	14	15	16	15	18	18	18	17	14	18	16	15	1
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6						2	2	15	19	17	15	17	16	17	14	14	17	16	17	15	17	19	15	2	2					
4								2	14	19	19	19	15	19	19	19	19	15	19	19	19	14	2							
2									1	2	2	1	1	1	1	1	1	1	1	2	2	1								

Fuel Type	Bundle Name	Number of Bundles	Load Cycle
1	GE9B-P8CWB322-11GZ-100M-150	84	7
2	GE9B-P8CWB320-9GZ-100M-150	76	7
14	SPCA9-381B-13GZ7-80M	128	8
15	SPCA9-384B-11GZ6-80M	128	8
16	SPCA9-391B-14G8.0-100M	40	9
17	SPCA9-410B-19G8.0-100M	120	9
18	SPCA9-383B-16G8.0-100M	132	9
19	SPCA9-396B-12GZ-100M	56	9

Figure 4.1 LaSalle Unit 2 Cycle 9 Reference Loading Map

5.0 Anticipated Operational Occurrences

Applicable Disposition of Events — Reference 9.7

5.1 *Analysis of Plant Transients at Rated Conditions* — Reference 9.3

Limiting Transients: Load Rejection No Bypass (LRNB)
Feedwater Controller Failure (FWCF)
Loss of Feedwater Heating (LFWH)

Transient	Scram Speed	Peak Neutron Flux (% Rated)	Peak Heat Flux (% Rated)	Peak Lower Plenum Pressure (psig)	ΔCPR ATRIUM-9B/GE9
LRNB*	TSSS	422	127	1218	0.30/0.40
FWCF*	TSSS	298	123	1176	0.25/0.31
LRNB*	NSS	380	124	1211	0.28/0.37
FWCF*	NSS	263	120	1169	0.23/0.29
LFWH†		†	†	†	†

5.2 *Analysis for Reduced Flow Operation* — Reference 9.3

Limiting Transient: Slow Flow Excursion

$MCPR_f$ Manual Flow Control — ATRIUM-9B and GE9 Fuel	Figure 5.1
$LHGRFAC_f$ — ATRIUM-9B Fuel	Figure 5.2
$MAPFAC_f$ — GE9 Fuel	†

$MCPR_f$ and $LHGRFAC_f$ results are applicable at all Cycle 9 exposures and in all EOD and EOOS scenarios presented in Table 1.1.

* Based on 100%P/105%F conditions.

† This data to be furnished by ComEd.

5.3	***Analysis for Reduced Power Operation***	Reference 9.3
	Limiting Transient: Load Rejection No Bypass (LRNB) Feedwater Controller Failure (FWCF)	
	$MCPR_p$ Base Case Operation	Tables 5.1–5.4 Figures 5.3–5.6
	$LHGRFAC_p$ Base Case Operation*	Tables 5.1–5.4
	$MCPR_p$, EOOS Conditions	Tables 5.1–5.4
	$LHGRFAC_p$, EOOS Conditions*	Tables 5.1–5.4
	$MAPFAC_p$ — All Operating Conditions*	<To be furnished by ComEd.>
5.4	***ASME Overpressurization Analysis***	Reference 9.3
	Limiting Event	MSIV Closure
	Worst Single Failure	Valve Position Scram
	Maximum Vessel Pressure (Lower Plenum)	1346 psig
	Maximum Steam Dome Pressure	1320 psig
5.5	***Control Rod Withdrawal Error***	
	Starting Control Pattern for Analysis	Figure 5.7

< This data is to be furnished by ComEd. >

5.6 *Fuel Loading Error*

< This data is to be furnished by ComEd. >

5.7 *Determination of Thermal Margins*

The results of the analyses presented in Sections 5.1–5.3 are used for the determination of the operating limit. Section 5.1 provides the results of analyses at rated conditions. Section 5.2 provides for the determination of the MCPR and LHGR limits at reduced flow ($MCPR_f$, Figure

* $LHGRFAC_p$ values presented are applicable to SPC fuel. GE $MAPFAC_p$ limits will continue to be applied to GE9 fuel at off-rated power.

5.1; $LHGRFAC_f$, Figure 5.2). Section 5.3 provides for the determination of the MCPR and LHGR limits at conditions of reduced power (Figures 5.3–5.6, Tables 5.1–5.4). Limits are presented for base case operation and the EOD and EOOS scenarios presented in Table 1.1. The results presented are based on the analyses performed by SPC. As indicated above, the final Cycle 9 MCPR operating limits need to be established in conjunction with the results from ComEd analyses.

Table 5.1 EOC Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Base case operation	0	2.70	0.78	2.70
	25	2.20	0.78	2.20
	25	1.91	0.78	1.99
	60	1.46	1.00	1.52
	100	1.41	1.00	1.51
Feedwater heaters out-of-service (FHOOS)	0	2.85	0.69	2.85
	25	2.35	0.69	2.35
	25	2.14	0.69	2.22
	60	1.51	0.97	1.57
	100	1.41	1.00	1.51
Single-loop operation (SLO)	0	2.71	0.78	2.71
	25	2.21	0.78	2.21
	25	1.92	0.78	2.00
	60	1.47	1.00	1.53
	100	1.42	1.00	1.52
Turbine bypass valves out-of-service (TBVOOS)	0	2.70	0.76	2.70
	25	2.20	0.76	2.20
	25	1.98	0.76	2.08
	60	1.52	0.97	1.62
	100	1.43	0.99	1.52

Table 5.1 EOC Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times (Continued)

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Recirculation pump trip out-of-service (no RPT)	0	2.70	0.78	2.70
	25	2.20	0.78	2.20
	25	1.91	0.78	1.99
	60	1.51	0.89	1.61
	100	1.51	0.89	1.61
Turbine control valve (TCV) slow closure AND/OR no RPT	0	2.70	0.70	2.70
	25	2.20	0.70	2.20
	25	2.10	0.70	2.10
	80	1.69	0.86	1.95
	80	1.61	0.89	1.84
	100	1.53	0.89	1.63
TCV slow closure/ FHOOS AND/OR no RPT	0	2.85	0.68	2.85
	25	2.35	0.68	2.35
	25	2.14	0.68	2.22
	80	1.69	0.86	1.95
	80	1.61	0.89	1.84
	100	1.53	0.89	1.63
Idle loop startup	0	2.60	0.40	2.60
	25	2.60	0.40	2.60
	25	2.60	0.40	2.60
	60	2.60	0.40	2.60
	100	2.60	0.40	2.60

Table 5.2 EOC Base Case $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Base case operation	0	2.70	0.79	2.70
	25	2.20	0.79	2.20
	25	1.89	0.79	1.97
	60	1.44	1.00	1.51
	100	1.39	1.00	1.48

Table 5.3 Coastdown Operation Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Coastdown base case operation	0	2.70	0.75	2.70
	25	2.20	0.75	2.20
	25	2.05	0.75	2.05
	60	1.48	0.99	1.54
	100	1.42	1.00	1.52
Coastdown with single-loop operation	0	2.71	0.75	2.71
	25	2.21	0.75	2.21
	25	2.06	0.75	2.06
	60	1.49	0.99	1.55
	100	1.43	1.00	1.53
Coastdown with turbine bypass valves out-of-service (TBVOOS)	0	2.70	0.73	2.70
	25	2.20	0.73	2.20
	25	2.05	0.73	2.15
	60	1.55	0.97	1.64
	100	1.44	0.99	1.53
Coastdown with recirculation pump trip out-of-service (no RPT)	0	2.70	0.75	2.70
	25	2.20	0.75	2.20
	25	2.05	0.75	2.05
	60	1.55	0.88	1.67
	100	1.55	0.88	1.67

Table 5.3 Coastdown Operation Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times (Continued)

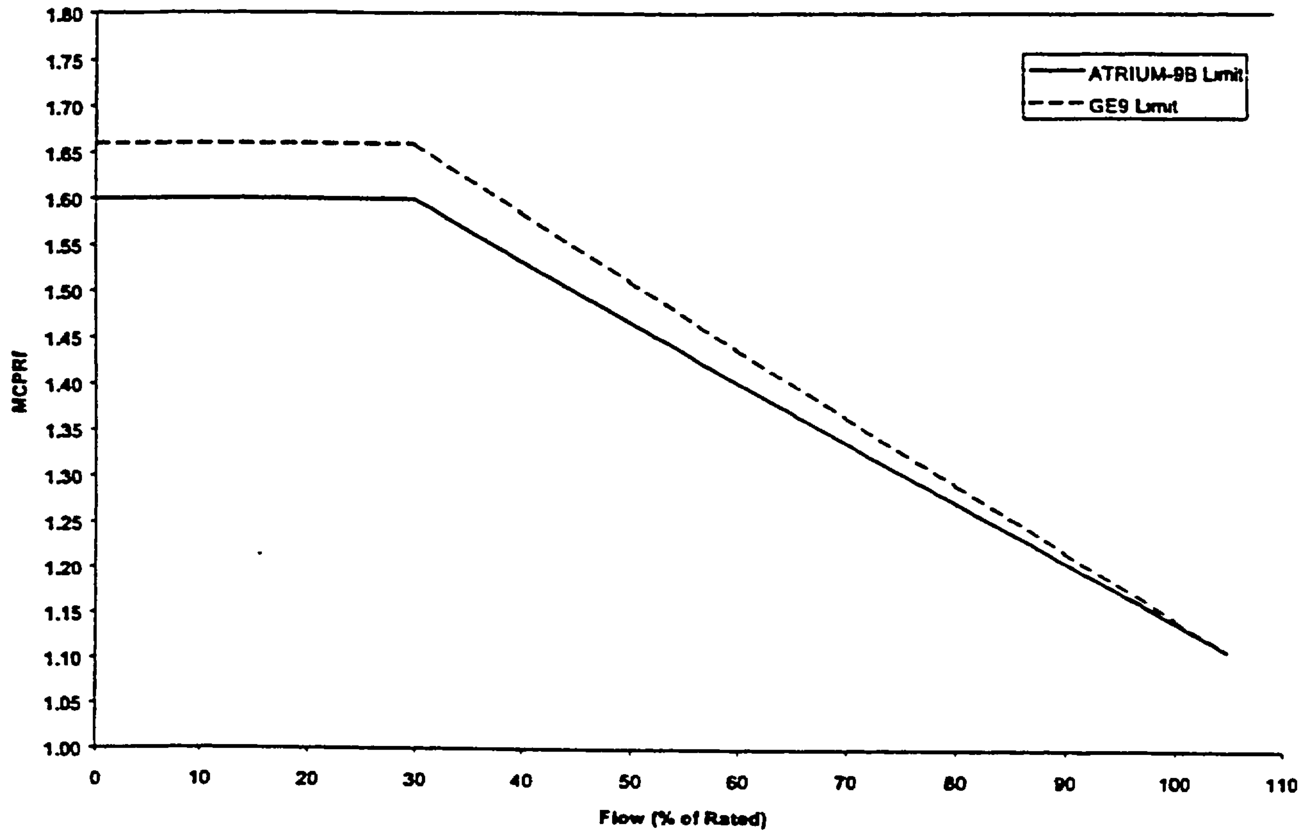
EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Coastdown with turbine control valve (TCV) slow closure AND/OR no RPT	0	2.70	0.68	2.70
	25	2.20	0.68	2.20
	25	2.15	0.68	2.15
	80	1.70	0.85	1.96
	80	1.62	0.88	1.85
	100	1.55	0.88	1.67
Coastdown with idle loop startup	0	2.60	0.40	2.60
	25	2.60	0.40	2.60
	25	2.60	0.40	2.60
	60	2.60	0.40	2.60
	100	2.60	0.40	2.60

Table 5.4 FFTR/Coastdown Operation Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
FFTR/coastdown base case operation	0	2.85	0.65	2.85
	25	2.35	0.65	2.35
	25	2.30	0.65	2.30
	60	1.56	0.97	1.59
	100	1.42	1.00	1.52
FFTR/coastdown with single-loop operation	0	2.86	0.65	2.86
	25	2.36	0.65	2.36
	25	2.31	0.65	2.31
	60	1.57	0.97	1.60
	100	1.43	1.00	1.53
FFTR/coastdown with turbine bypass valves out-of-service (TBVOOS)	0	2.85	0.65	2.85
	25	2.35	0.65	2.35
	25	2.30	0.65	2.30
	60	1.57	0.97	1.64
	100	1.44	0.99	1.53
FFTR/coastdown with recirculation pump trip out-of-service (no RPT)	0	2.85	0.65	2.85
	25	2.35	0.65	2.35
	25	2.30	0.65	2.30
	60	1.56	0.88	1.67
	100	1.55	0.88	1.67

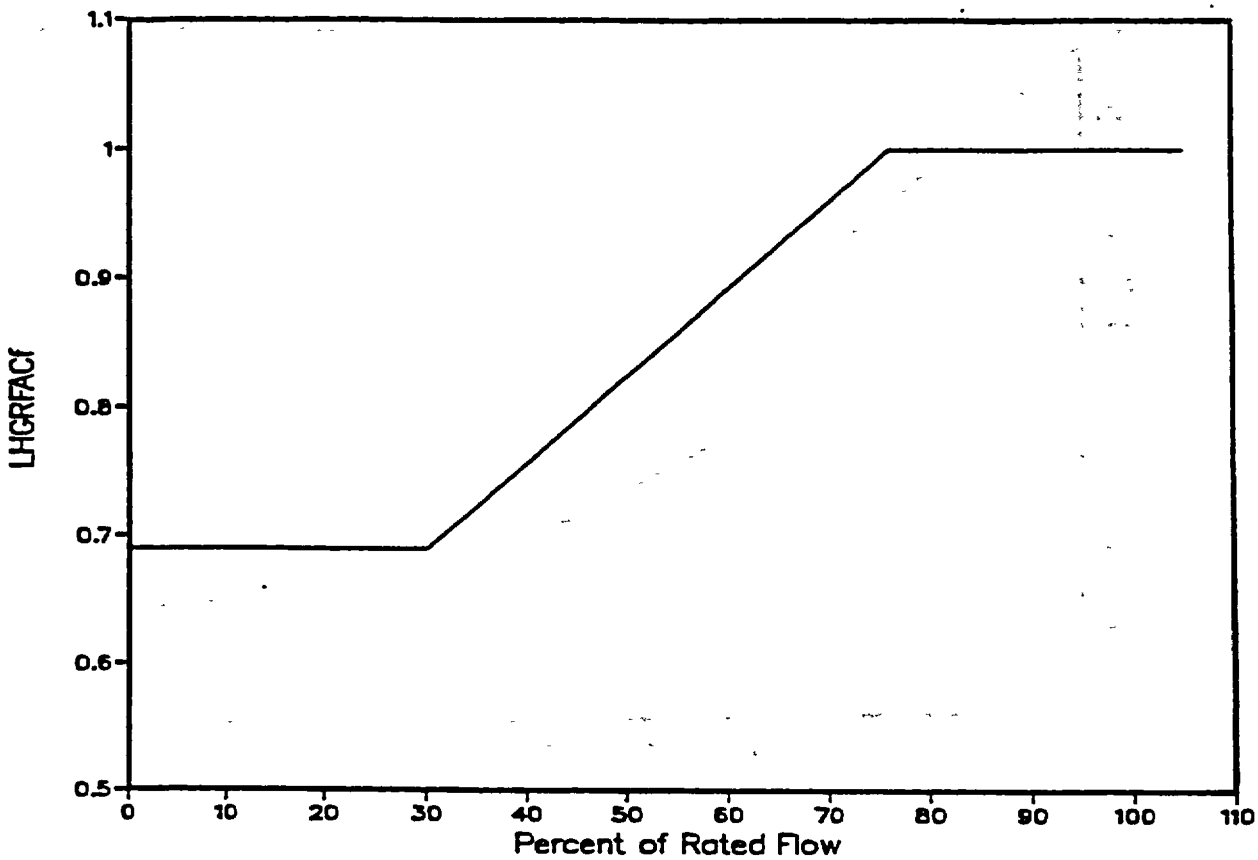
Table 5.4 FFTR/Coastdown Operation Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times (Continued)

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
FFTR/coastdown with turbine control valve (TCV) slow closure AND/OR no RPT	0	2.85	0.65	2.85
	25	2.35	0.65	2.35
	25	2.30	0.65	2.30
	80	1.70	0.85	1.96
	80	1.62	0.88	1.85
	100	1.55	0.88	1.67
FFTR/coastdown with idle loop startup	0	2.60	0.40	2.60
	25	2.60	0.40	2.60
	25	2.60	0.40	2.60
	60	2.60	0.40	2.60
	100	2.60	0.40	2.60



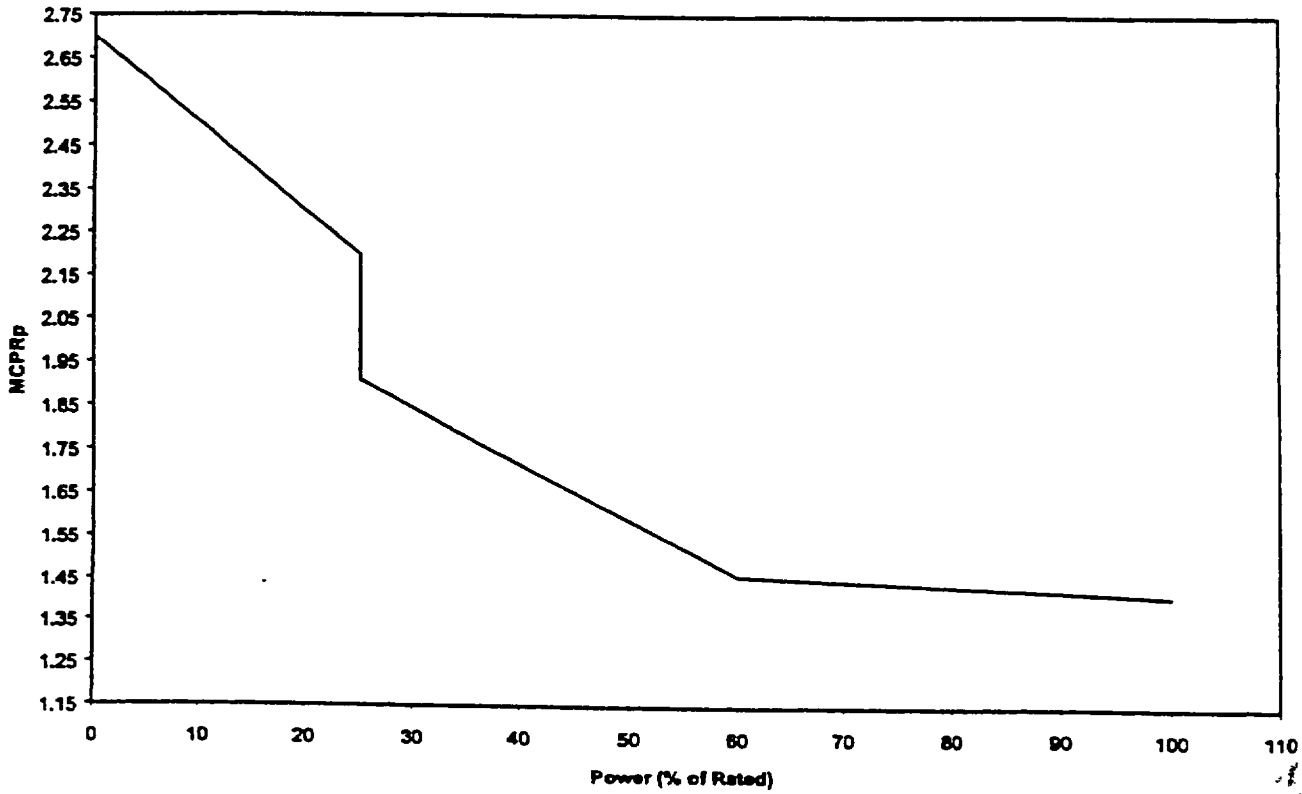
Flow (% of rated)	$MCPR_f$ ATRIUM-9B	$MCPR_f$ GE9 (penalty included)
0	1.60	1.66
30	1.60	1.66
105	1.11	1.11

Figure 5.1 Flow-Dependent MCPR Limits for Manual Flow Control Mode



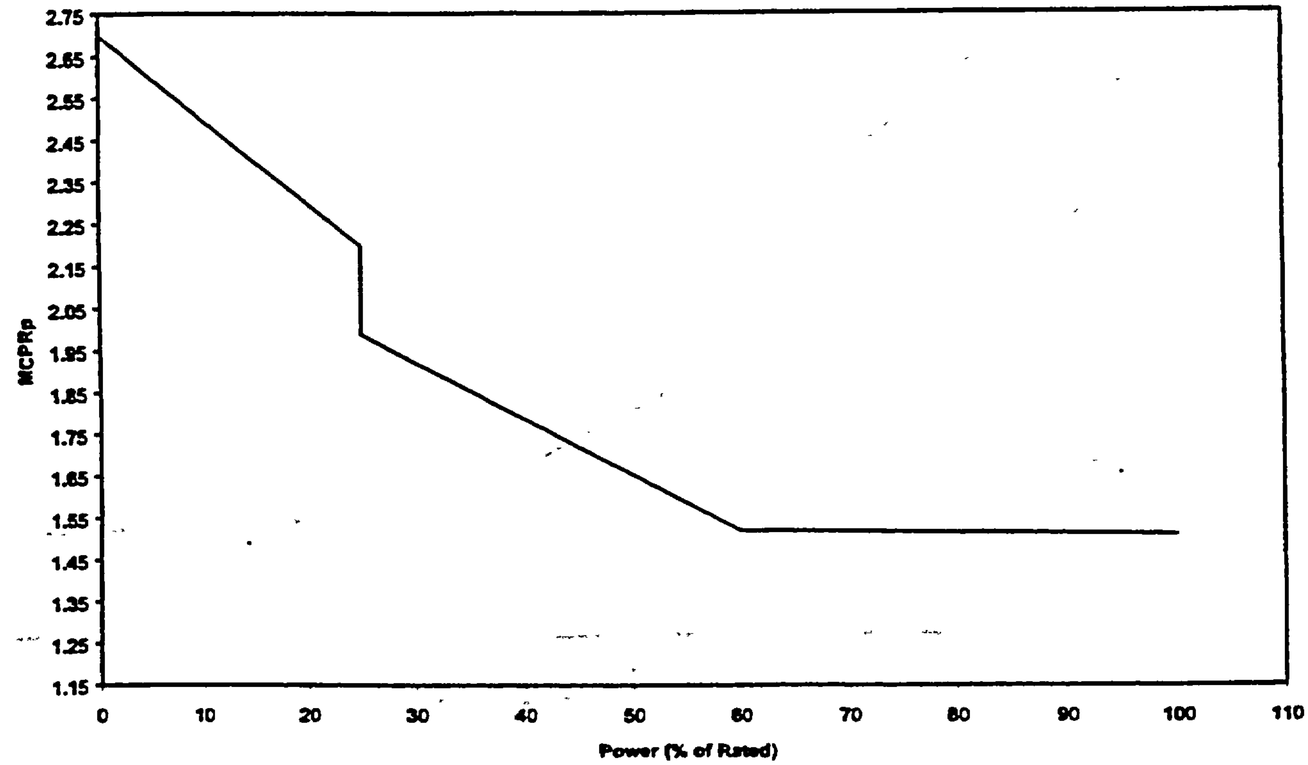
Flow (% rated)	$LHGRFAC_f$
0	0.69
30	0.69
76	1.00
105	1.00

Figure 5.2 Flow Dependent LHGR Multipliers for ATRIUM-9B Fuel



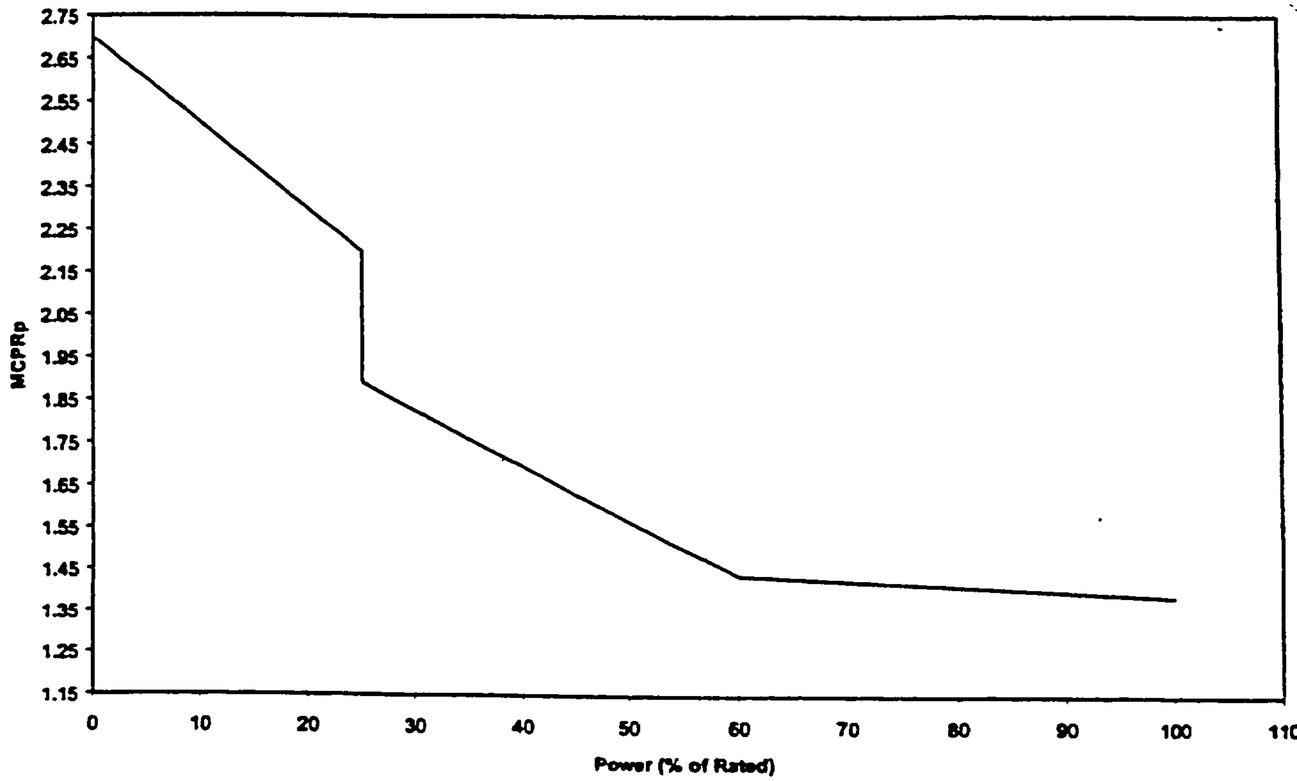
Power (%)	$MCPR_p$ Limit
100	1.41
60	1.46
25	1.91
25	2.20
0	2.70

Figure 5.3 EOC Base Case Power-Dependent MCPR Limits for ATRUM-9B Fuel – TSSS Insertion Times



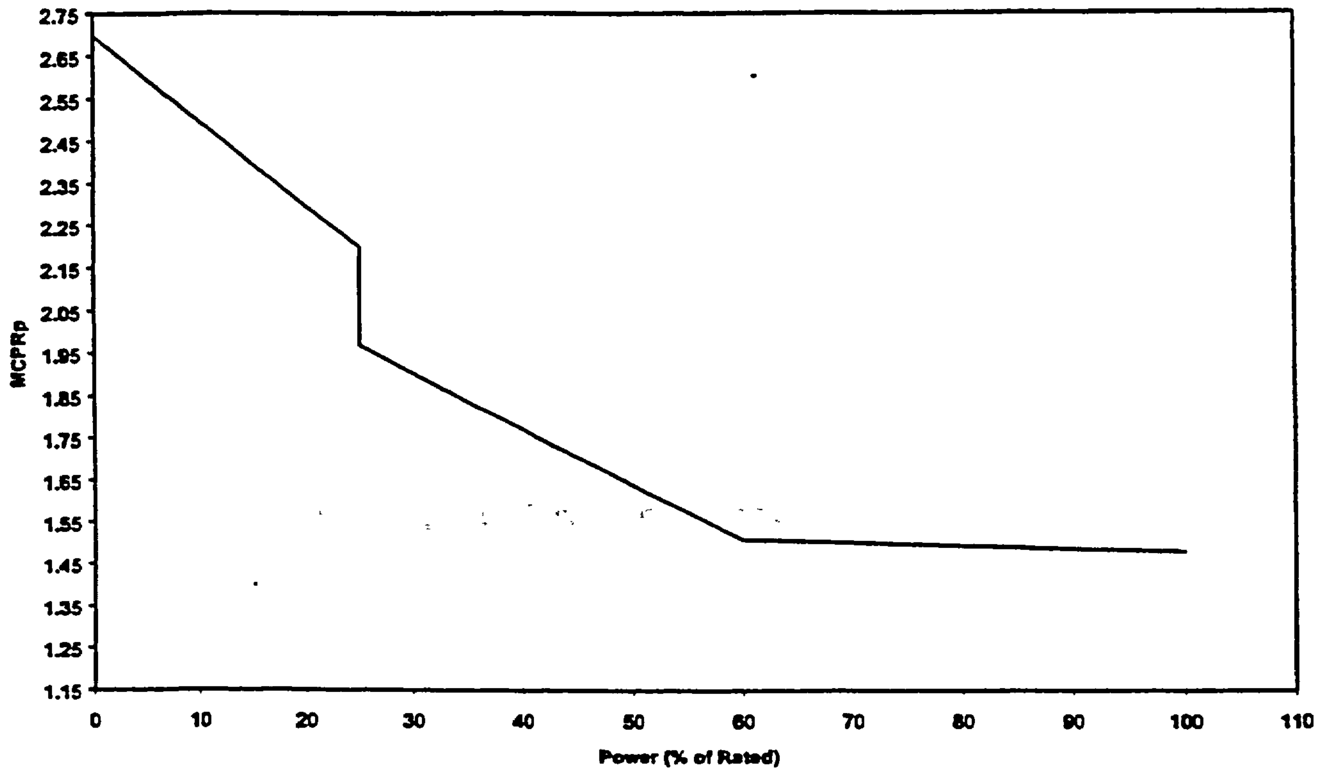
Power (%)	$MCPR_p$ Limit
100	1.51
60	1.52
25	1.99
25	2.20
0	2.70

Figure 5.4 EOC Base Case Power-Dependent MCPR Limits for GE9 Fuel – TSSS Insertion Times



Power (%)	$MCPR_p$ Limit
100	1.39
60	1.44
25	1.89
25	2.20
0	2.70

Figure 5.5 EOC Base Case Power-Dependent MCPR Limits for ATRUM-9B Fuel – NSS Insertion Times



Power (%)	$MCPR_p$ Limit
100	1.48
60	1.51
25	1.97
25	2.20
0	2.70

Figure 5.6 EOC Base Case Power-Dependent MCPR Limits for GE9 Fuel – NSS Insertion Times

< This data is to be furnished by ComEd. >

Figure 5.7 Starting Control Rod Pattern for Control Rod Withdrawal Analysis

6.0 Postulated Accidents

6.1 *Loss-of-Coolant Accident*

6.1.1 Break Location Spectrum

Reference 9.8

6.1.2 Break Size Spectrum

Reference 9.8

6.1.3 MAPLHGR Analyses

The MAPLHGR limits presented in Reference 9.9 are valid for LaSalle Unit 2 ATRIUM-9B (LSB-2) fuel for Cycle 9 operation.

Limiting Break: 1.1 ft^2 Break
Recirculation Pump Discharge Line
High Pressure Core Spray Diesel Generator Single Failure

Peak clad temperature and peak local metal water reaction results for the Cycle 9 ATRIUM-9B reload fuel are 1810°F and 0.70% respectively. These results are bounded by the results presented in Reference 9.11, which support the Reference 9.9 MAPLHGR limits. The maximum core-wide metal-water reaction for Cycle 9 remains less than 0.16%. LOCA/heatup analysis results for LaSalle ATRIUM-9B are presented below (Reference 9.11):

	Maximum PCT (°F)	Peak Local Metal-Water Reaction (%)
ATRIUM-9B Fuel	1825	0.79*

The maximum core wide metal-water reaction is < 0.16%.

6.2 *Control Rod Drop Accident*

< This data is to be furnished by ComEd. >

6.3 *Spent Fuel Cask Drop Accident*

The radiological consequences of a spent fuel cask drop accident have been evaluated for SPC ATRIUM fuel designs in conformance with the analysis described in the LSCS UFSAR Section

* The peak local metal water reaction result is consistent with the limiting PCT analysis results reported in Reference 9.11.

15.7.5. The analysis is assumed to occur 360 days following shutdown of the reactor, and it is assumed that all 32 fuel assemblies in the cask completely fail as a result of the accident.

Because the accident is assumed not to occur sooner than 360 days following shutdown of the reactor, the source term for the accident will be very low due to fission product decay. Hence, the commensurate radiological whole-body and thyroid doses will be very low. The results of this analysis demonstrate that spent fuel cask drop accidents involving SPC ATRIUM fuel will not exceed the established radiological whole-body and thyroid dose limits which are a small fraction of the 10 CFR 100 limits for radiological exposures.

7.0 Technical Specifications

7.1 *Limiting Safety System Settings*

7.1.1 MCPR Fuel Cladding Integrity Safety Limit

MCPR Safety Limit (all fuel) — two-loop operation	1.11*
MCPR Safety Limit (all fuel) — single-loop operation	1.12*

7.1.2 Steam Dome Pressure Safety Limit

Pressure Safety Limit	1325 psig

7.2 *Limiting Conditions for Operation*

7.2.1 Average Planar Linear Heat Generation Rate — Reference 9.9

ATRIUM-9B Fuel MAPLHGR Limits		GE9 Fuel MAPLHGR Limits
Average Planar Exposure (GWd/MTU)	MAPLHGR (kW/ft)	< To be furnished by ComEd. >
0.0	13.5	
20.0	13.5	
61.1	9.39	

Single Loop Operation MAPLHGR Multiplier for SPC Fuel is 0.90 — Reference 9.9

7.2.2 Minimum Critical Power Ratio

Rated Conditions MCPR Limit †

Flow Dependent MCPR Limits:

Manual Flow Control — Figure 5.1

---

* Includes the effects of channel bow, up to 2 TIPOOS (or the equivalent number of TIP channels), a 2500 EFPH LPRM calibration interval, cycle startup with uncalibrated LPRMs (BOC to 500 MWd/MTU) and up to 50% of the LPRMs out of service.

† This data is to be furnished by ComEd.

Power Dependent MCPR Limits:

Base Case Operation - TSSS Insertion Times	Figures 5.3 & 5.4
Base Case Operation - NSS Insertion Times	Figures 5.5 & 5.6
EOD and EOOS Operation	Tables 5.1–5.4

7.2.3 Linear Heat Generation Rate — Reference 9.1

ATRIUM-9B Fuel Steady-State LHGR Limits

Average Planar Exposure (GWd/MTU)	LHGR (kW/ft)
0.0	14.4
15.0	14.4
61.1	8.32

GE9 Fuel Steady-State LHGR Limits

< To be furnished by ComEd. >

The protection against power transient (PAPT) linear heat generation rate curve for ATRIUM-9B fuel is identified in Reference 9.1 and is presented here as Figure 7.1 for convenience. $LHGRFAC_f$ and $LHGRFAC_p$ multipliers are applied directly to the steady-state LHGR limits at reduced power, reduced flow and/or EOD/EOOS conditions to ensure the PAPT LHGR limits are not violated during an AOO. Comparison of the Cycle 9 nodal power histories for the rated power pressurization transients with the approved bounding curves to show compliance with the 1% strain criteria for GE9 fuel is discussed in Reference 9.10.

LHGRFAC Multipliers for Off-Rated Conditions - ATRIUM-9B Fuel:

$LHGRFAC_f$	Figure 5.2
$LHGRFAC_p$	Tables 5.1–5.4

MAPFAC Multipliers for Off-Rated Conditions - GE9 Fuel:

$MAPFAC_f$	< To be furnished by ComEd. >
$MAPFAC_p$	< To be furnished by ComEd. >

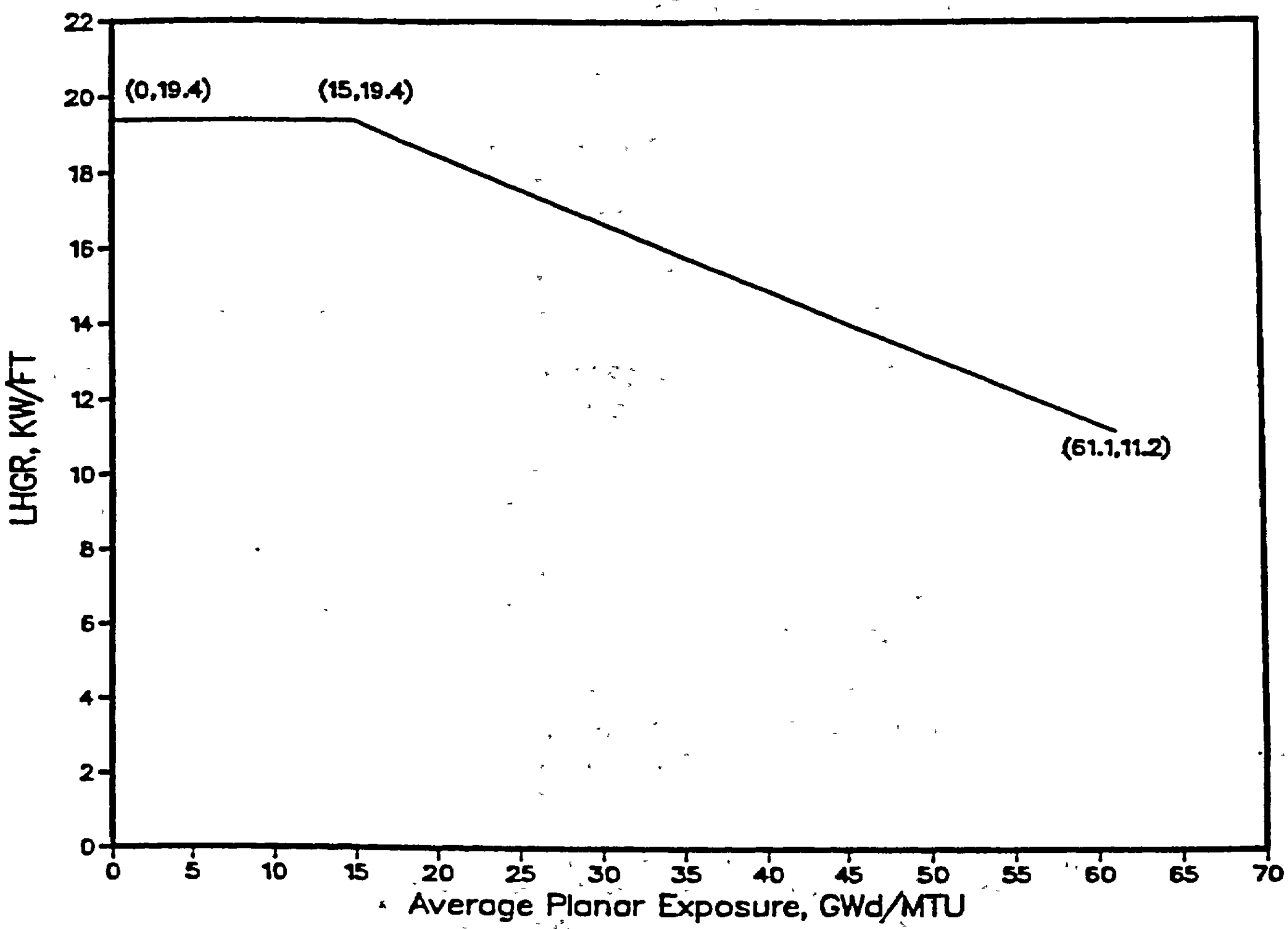


Figure 7.1 Protection Against Power Transient LHGR Limit for ATRIUM-9B Fuel

8.0 Methodology References

See XN-NF-80-19(P)(A) Volume 4 Revision 1 for a complete bibliography.

8.1 ANF-913(P)(A) Volume 1 Revision 1 and Volume 1 Supplements 2, 3 and 4, *COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses*, Advanced Nuclear Fuels Corporation, August 1990.

8.2 ANF-524(P)(A) Revision 2 and Supplements 1 and 2, *ANF Critical Power Methodology for Boiling Water Reactors*, Advanced Nuclear Fuels Corporation, November 1990.

8.3 ANF-1125(P)(A) and ANF-1125(P)(A), Supplements 1 and 2, *ANFB Critical Power Correlation*, Advanced Nuclear Fuels Corporation, April 1990.

8.4 EMF-1125(P)(A), Supplement 1 Appendix C, *ANFB Critical Power Correlation Application for Co-Resident Fuel*, Siemens Power Corporation, August 1997.

8.5 ANF-1125(P)(A), Supplement 1 Appendix E, *ANFB Critical Power Correlation Determination of ATRIUM-9B Additive Constant Uncertainties*, Siemens Power Corporation, September 1998.

8.6 XN-NF-80-19(P)(A) Volume 1 Supplement 3, Supplement 3 Appendix F, and Supplement 4, *Advanced Nuclear Fuels Methodology for Boiling Water Reactors: Benchmark Results for CASMO-3G/MICROBURN-B Calculation Methodology*, Advanced Nuclear Fuels Corporation, November 1990.

8.7 EMF-CC-074(P)(A) Volume 1, *STAIF - A Computer Program for BWR Stability Analysis in the Frequency Domain*, and Volume 2, *STAIF - A Computer Program for BWR Stability Analysis in the Frequency Domain - Code Qualification Report*, Siemens Power Corporation, July 1994.

9.0 Additional References

9.1 EMF-2404(P) Revision 1, *Fuel Design Report for LaSalle Unit 2 Cycle 9 ATRIUM™-9B Fuel Assemblies*, Siemens Power Corporation, September 2000.

9.2 ANF-89-014(P)(A) Revision 1 and Supplements 1 and 2, *Advanced Nuclear Fuels Corporation Generic Mechanical Design for Advanced Nuclear Fuels 9x9-IX and 9x9-9X BWR Reload Fuel*, Advanced Nuclear Fuels Corporation, October 1991.

9.3 EMF-2440 Revision 0, *LaSalle Unit 2 Cycle 9 Plant Transient Analysis*, Siemens Power Corporation, October 2000.

9.4 EMF-95-134(P), *Criticality Safety Analysis for ATRIUM™-9B Fuel, LaSalle Units 1 and 2 New Fuel Storage Vault*, Siemens Power Corporation, December 1995.

9.5 EMF-96-117(P) Revision 0, *Criticality Safety Analysis for ATRIUM™-9B Fuel, LaSalle Unit 1 Spent Fuel Storage Pool (BORAL Rack)*, Siemens Power Corporation, April 1996.

9.6 EMF-95-088(P) Revision 0, *Criticality Safety Analysis for ATRIUM™-9B Fuel, LaSalle Unit 2 Spent Fuel Storage Pool (Boraflex Rack)*, Siemens Power Corporation, February 1996.

9.7 EMF-95-205(P) Revision 2, *LaSalle Extended Operating Domain (EOD) and Equipment Out of Service (EOOS) Safety Analysis for ATRIUM™-9B Fuel*, Siemens Power Corporation, June 1996.

9.8 EMF-2174(P), *LOCA Break Spectrum Analysis for LaSalle Units 1 and 2*, Siemens Power Corporation, March 1999.

9.9 EMF-2175(P), *LaSalle LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM™-9B Fuel*, Siemens Power Corporation, March 1999.

9.10 Letter, D. E. Garber (SPC) to R. J. Chin (ComEd), "LaSalle Unit 2 Cycle 9 Transient Power History for Confirming Mechanical Limits for GE9 Fuel." DEG:00:185, August 3, 2000.

9.11 Letter, D. E. Garber (SPC) to R. J. Chin (ComEd), "10 CFR 50.46 Reporting for the LaSalle Units," DEG:00:203, August 29, 2000.

9.12 EMF-2249(P) Revision 1, *Fuel Design Report for LaSalle Unit 1 Cycle 9 ATRIUM™-9B Fuel Assemblies*, Siemens Power Corporation, September 1999.

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Notification List
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Attachment 3

LaSalle Unit 2 Cycle 9

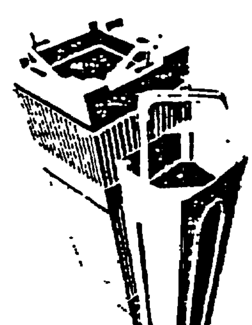
Plant Transient Analysis

SIEMENS

EMF-2440
Revision 0

LaSalle Unit 2 Cycle 9 Plant Transient Analysis

October 2000



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Nuclear Division

Siemens Power Corporation

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EMF-2440
Revision 0

LaSalle Unit 2 Cycle 9
Plant Transient Analysis

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D. B. McBurney, Engineer — Date
BWR Safety Analysis

Reviewed: Darrell G. Carr — 10-3-00
D. G. Carr, Team Leader — Date
BWR Safety Analysis

Concurred: Gerald S Holm for — 10/3/00
H. D. Curet, Manager — Date
Product Licensing

Approved: David P. Jordheim, for OCB — 10/03/00
O. C. Brown, Manager — Date
BWR Neutronics

Approved: for — 10/3/00
M. E. Garrett, Manager — Date
Safety Analysis

Approved: for — 3Oct00
D. J. Denver, Manager — Date
Commercial Operations

paj

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Nature of Changes

Item	Page	Description and Justification
1.	All	This is a new document.

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Nomenclature

AOO	anticipated operational occurrence
ComEd	Commonwealth Edison Company
CPR	critical power ratio
EFPH	effective full power hours
EOC	end of cycle
EOD	extended operating domain
EOFP	end of full power
EOOS	equipment out-of-service
FFTR	final feedwater temperature reduction
FHOOS	feedwater heater out-of-service
FWCF	feedwater controller failure
HFR	heat flux ratio
ICF	increased core flow
L2C9	LaSalle Unit 2 Cycle 9
LFWH	loss-of-feedwater heating
LHGR	linear heat generation rate
$LHGRFAC_f$	flow-dependent linear heat generation rate factors
$LHGRFAC_p$	power-dependent linear heat generation rate factors
LHGROL	linear heat generation rate operating limit
LPRM	local power range monitor
LRNB	generator load rejection with no bypass
MCPR	minimum critical power ratio
$MCPR_f$	flow-dependent minimum critical power ratio
$MCPR_p$	power-dependent minimum critical power ratio
MELLLA	maximum extended load line limit analysis
MFC	manual flow control
MSIV	main steam isolation valve
NSS	nominal scram speed
PAPT	protection against power transient
RPT	recirculation pump trip
SLMCPR	safety limit MCPR
SLO	single-loop operation
SPC	Siemens Power Corporation
SRV	safety/relief valve
SRVOOS	safety/relief valve out-of-service
SSLHGR	steady-state LHGR

Nomenclature *(Continued)*

TBVOOS	turbine bypass valve out-of-service
TCV	turbine control valve
TIP	traversing incore probe
TIPOOS	tip machine(s) out-of-service
TSSS	technical specification scram speed
TSV	turbine stop valve
TTNB	turbine trip with no bypass
ΔCPR	change in critical power ratio

1.0 Introduction

This report presents results of the plant transient analyses performed by Siemens Power Corporation (SPC) as part of the reload safety analyses to support LaSalle Unit 2 Cycle 9 (L2C9) operation. The Cycle 9 core contains 348 fresh ATRIUM™-9B* assemblies, 256 previously loaded ATRIUM-9B assemblies and 160 previously loaded GE9 assemblies. Those portions of the reload safety analysis for which Commonwealth Edison Company (ComEd) has responsibility are presented elsewhere. The appropriate operating limits for Cycle 9 operation must be determined in conjunction with results from ComEd analyses. The scope of the transient analyses performed by SPC is presented in Reference 1.

The analyses reported in this document were performed using the plant transient analysis methodology approved by the Nuclear Regulatory Commission (NRC) for generic application to boiling water reactors (Reference 2). The transient analyses were performed in accordance with the NRC technical limitations as stated in the methodology (References 3–7). Parameters for the transient analyses are documented in Reference 8.

The Cycle 9 transient analysis consists of the calculation of the limiting transients identified in Reference 9 to support base case operation† for the power/flow map presented in Figure 1.1. Results are also presented to support operation in the extended operating domain (EOD) and equipment out-of-service (EOOS) scenarios identified in Table 1.1. The analysis results are used to establish operating limits to protect against fuel failures. Minimum critical power ratio (MCPR) limits are established to protect the fuel from overheating during normal operation and anticipated operational occurrences (AOOs). Power-dependent MCPR ($MCPR_p$) limits are required in order to provide the necessary protection during operation at reduced power. Flow-dependent MCPR ($MCPR_f$) limits provide protection against fuel failures during flow excursions initiated at reduced flow. Cycle 9 power- and flow-dependent MCPR limits are presented to protect both ATRIUM-9B and GE9 fuel.

Protection against violating the linear heat generation rate (LHGR) limits at rated and off-rated conditions is provided through the application of power- and flow-dependent LHGR factors

* ATRIUM is a trademark of Siemens.

† Base case operation is defined as two-loop operation within the standard operating domain, including the ICF and MELLLA regions, with all equipment in-service.

($LHGRFAC_p$ and $LHGRFAC_f$, respectively). These factors or multipliers are applied directly to the steady-state LHGR limit to ensure that the LHGR does not exceed the protection against power transient (PAPT) limit during postulated AOOs. Cycle 9 power- and flow-dependent LHGR multipliers are presented for ATRIUM-9B fuel.

Results of analyses that demonstrate compliance with the ASME Boiler and Pressure Vessel Code overpressurization limit are presented.

The results of the plant transient analyses are used in a subsequent reload analysis report (Reference 15) along with core and accident analysis results to justify plant operating limits and set points.

Table 1.1 EOD and EOOS Operating Conditions

Extended Operating Domain (EOD) Conditions
Increased core flow
Maximum extended load line limit analysis (MELLLA)
Coastdown
Final feedwater temperature reduction (FFTR)
Combined FFTR/coastdown
Equipment Out-of-Service (EOOS) Conditions*
Feedwater heaters out-of-service (FHOOS)
Single-loop operation (SLO) - recirculation loop out-of-service
Turbine bypass valves out-of-service (TBVOOS)
Recirculation pump trip out-of-service (no RPT)
Turbine control valve (TCV) slow closure and/or no RPT
Safety relief valve out-of-service (SRVOOS)
Up to 2 tip machines out-of-service or the equivalent number of TIP channels (100% available at startup)
Up to 50% of the LPRMs out-of-service
TCV slow closure, FHOOS, and/or no RPT

* EOOS conditions are supported for EOD conditions as well as the standard operating domain. Each EOOS condition combined with 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of channels) and/or up to 50% of the LPRMs out-of-service is supported.

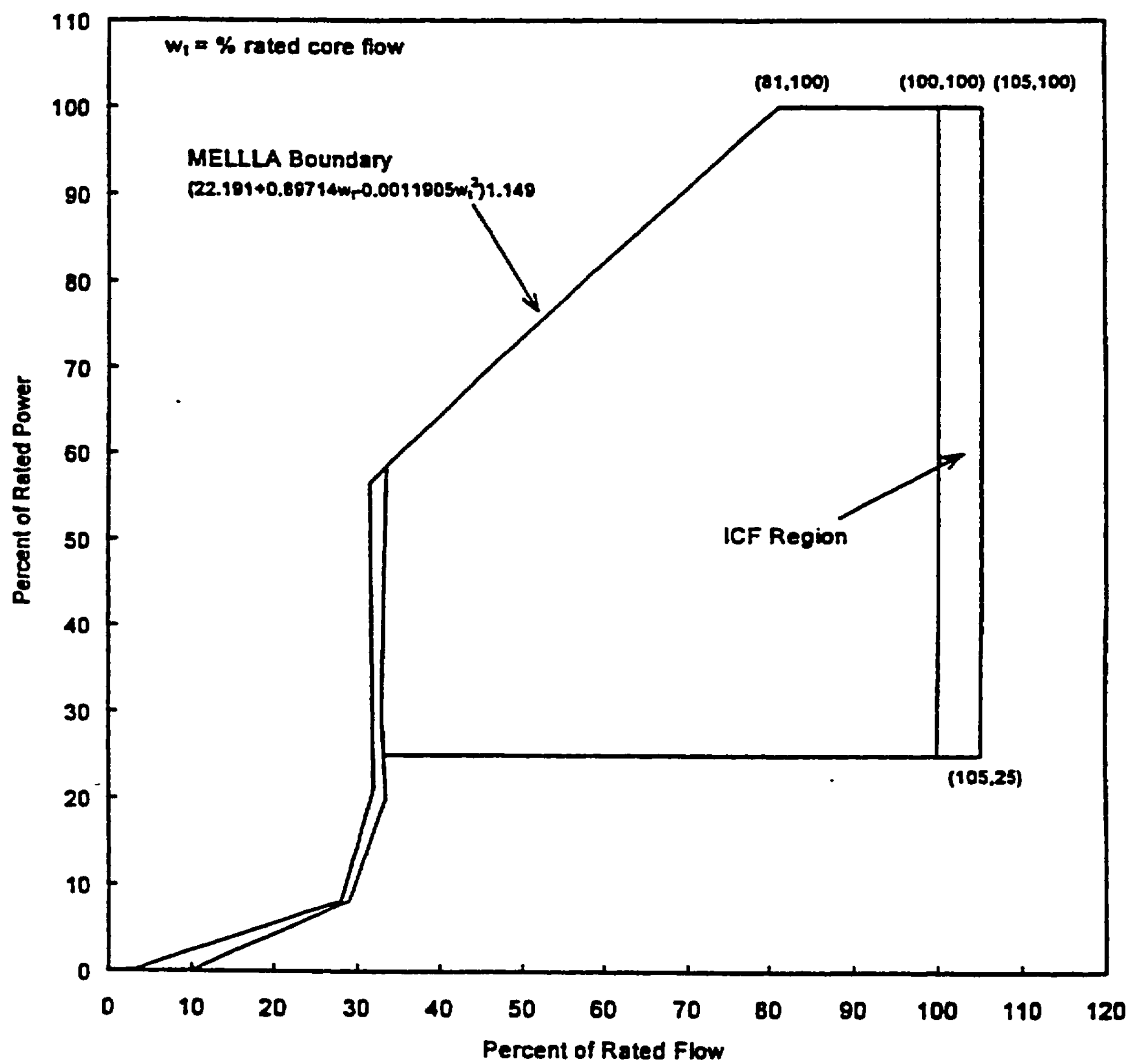


Figure 1.1 LaSalle County Nuclear Station Power / Flow Map

2.0 Summary

The determination of the thermal limits (MCPR limits and LHGRFAC multipliers) for LaSalle Unit 2 Cycle 9 is based on analyses of the limiting operational transients identified in Reference 9. Although the Reference 9 conclusions are based on 18-month cycles, the limiting operational transients identified remain valid for 24-month cycles. The transients evaluated are the generator load rejection with no bypass (LRNB), feedwater controller failure to maximum demand (FWCF) and loss-of-feedwater heating (LFWH). Thermal limits identified for Cycle 9 operation include both MCPR limits and LHGRFAC multipliers. The MCPR operating limits are established so that less than 0.1% of the fuel rods in the core are expected to experience boiling transition during an AOO initiated from rated or off-rated conditions and are based on a two-loop operation MCPR safety limit of 1.11. LHGRFAC multipliers are applied directly to the LHGR limits at reduced power and/or flow conditions to protect against fuel melting and overstraining of the cladding during an AOO. Operating limits are established to support both base case operation and the EOOS scenarios presented in Table 1.1. Operating limits are also established for the EOD and combined EOD/EOOS conditions presented in Table 1.1.

Base case $MCPR_p$ limits and $LHGRFAC_p$ multipliers are based on results presented in Section 3.0. Results presented in Sections 4.0–6.0 are used to establish the operating limits for operation in the EOD, EOOS, and combined EOD/EOOS scenarios.

Cycle 9 $MCPR_p$ limits and $LHGRFAC_p$ multipliers for ATRIUM-9B fuel and $MCPR_p$ limits for GE9 fuel that support base case operation and operation in the EOD, EOOS and combined EOD/EOOS scenarios are presented in Tables 2.1–2.4. Tables 2.1 and 2.2 present base case limits and multipliers for Technical Specifications scram speed (TSSS) insertion times and nominal scram speed (NSS) insertion times, respectively. Table 2.3 presents the limits and multipliers for coastdown operation. The combined FFTR/coastdown limits and multipliers are identified in Table 2.4.

$MCPR_f$ limits for both ATRIUM-9B and GE9 that protect against fuel failures during a slow flow excursion event in manual flow control are presented in Figure 2.1. Automatic flow control is not supported for L2C9. The GE9 $MCPR_f$ limits include the effect of applying the MCPR penalty described in Reference 10. The $MCPR_f$ limits presented are applicable for all EOD and EOOS conditions presented in Table 1.1.

The Cycle 9 $LHGRFAC_f$ multipliers for the ATRIUM-9B fuel are presented in Figure 2.2 and are applicable in all the EOD and EOOS scenarios presented in Table 1.1. Comparison of the Cycle 9 nodal power histories for the rated power pressurization transients with the approved bounding curves to show compliance with the 1% clad strain and centerline melt criteria for GE9 fuel is discussed in Reference 19.

The results of the maximum overpressurization analyses show that the requirements of the ASME code regarding overpressure protection are met for Cycle 9. The analysis shows that the dome pressure limit of 1325 psig is not exceeded and the vessel pressure does not exceed the limit of 1375 psig.

Table 2.1 EOC Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times*

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Base case operation	0	2.70	0.78	2.70
	25	2.20	0.78	2.20
	25	1.91	0.78	1.99
	60	1.46	1.00	1.52
	100	1.41	1.00	1.51
Feedwater heaters out-of-service (FHOOS)	0	2.85	0.69	2.85
	25	2.35	0.69	2.35
	25	2.14	0.69	2.22
	60	1.51	0.97	1.57
	100	1.41	1.00	1.51
Single-loop operation (SLO)	0	2.71	0.78	2.71
	25	2.21	0.78	2.21
	25	1.92	0.78	2.00
	60	1.47	1.00	1.53
	100	1.42	1.00	1.52
Turbine bypass valves out-of-service (TBVOOS)	0	2.70	0.76	2.70
	25	2.20	0.76	2.20
	25	1.98	0.76	2.08
	60	1.52	0.97	1.62
	100	1.43	0.99	1.52

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

Table 2.1 EOC Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times*
(Continued)

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Recirculation pump trip out-of-service (no RPT)	0	2.70	0.78	2.70
	25	2.20	0.78	2.20
	25	1.91	0.78	1.99
	60	1.51	0.89	1.61
	100	1.51	0.89	1.61
Turbine control valve (TCV) slow closure AND/OR no RPT	0	2.70	0.70	2.70
	25	2.20	0.70	2.20
	25	2.10	0.70	2.10
	80	1.69	0.86	1.95
	80	1.61	0.89	1.84
	100	1:53	0.89	1.63
TCV slow closure/ FHOOS AND/OR no RPT	0	2.85	0.68	2.85
	25	2.35	0.68	2.35
	25	2.14	0.68	2.22
	80	1.69	0.86	1.95
	80	1.61	0.89	1.84
	100	1.53	0.89	1.63
Idle loop startup	0	2.60	0.40	2.60
	25	2.60	0.40	2.60
	25	2.60	0.40	2.60
	60	2.60	0.40	2.60
	100	2.60	0.40	2.60

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

Table 2.2 EOC Base Case $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times*

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Base case operation	0	2.70	0.79	2.70
	25	2.20	0.79	2.20
	25	1.89	0.79	1.97
	60	1.44	1.00	1.51
	100	1.39	1.00	1.48

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature (except for conditions with FHOOS), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

Table 2.3 Coastdown Operation Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times*

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Coastdown base case operation	0	2.70	0.75	2.70
	25	2.20	0.75	2.20
	25	2.05	0.75	2.05
	60	1.48	0.99	1.54
	100	1.42	1.00	1.52
Coastdown with single-loop operation	0	2.71	0.75	2.71
	25	2.21	0.75	2.21
	25	2.06	0.75	2.06
	60	1.49	0.99	1.55
	100	1.43	1.00	1.53
Coastdown with turbine bypass valves out-of-service (TBVOOS)	0	2.70	0.73	2.70
	25	2.20	0.73	2.20
	25	2.05	0.73	2.15
	60	1.55	0.97	1.64
	100	1.44	0.99	1.53
Coastdown with recirculation pump trip out-of-service (no RPT)	0	2.70	0.75	2.70
	25	2.20	0.75	2.20
	25	2.05	0.75	2.05
	60	1.55	0.88	1.67
	100	1.55	0.88	1.67

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater, and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

Table 2.3 Coastdown Operation Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times*
(Continued)

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Coastdown with turbine control valve (TCV) slow closure **AND/OR** no RPT	0	2.70	0.68	2.70
	25	2.20	0.68	2.20
	25	2.15	0.68	2.15
	80	1.70	0.85	1.96
	80	1.62	0.88	1.85
	100	1.55	0.88	1.67
Coastdown with idle loop startup	0	2.60	0.40	2.60
	25	2.60	0.40	2.60
	25	2.60	0.40	2.60
	60	2.60	0.40	2.60
	100	2.60	0.40	2.60

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), up to a 20°F reduction in feedwater temperature, and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

Table 2.4 FFTR/Coastdown Operation Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times*

EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
FFTR/coastdown base case operation	0	2.85	0.65	2.85
	25	2.35	0.65	2.35
	25	2.30	0.65	2.30
	60	1.56	0.97	1.59
	100	1.42	1.00	1.52
FFTR/coastdown with single-loop operation	0	2.86	0.65	2.86
	25	2.36	0.65	2.36
	25	2.31	0.65	2.31
	60	1.57	0.97	1.60
	100	1.43	1.00	1.53
FFTR/coastdown with turbine bypass valves out-of-service (TBVOOS)	0	2.85	0.65	2.85
	25	2.35	0.65	2.35
	25	2.30	0.65	2.30
	60	1.57	0.97	1.64
	100	1.44	0.99	1.53
FFTR/coastdown with recirculation pump trip out-of-service (no RPT)	0	2.85	0.65	2.85
	25	2.35	0.65	2.35
	25	2.30	0.65	2.30
	60	1.56	0.88	1.67
	100	1.55	0.88	1.67

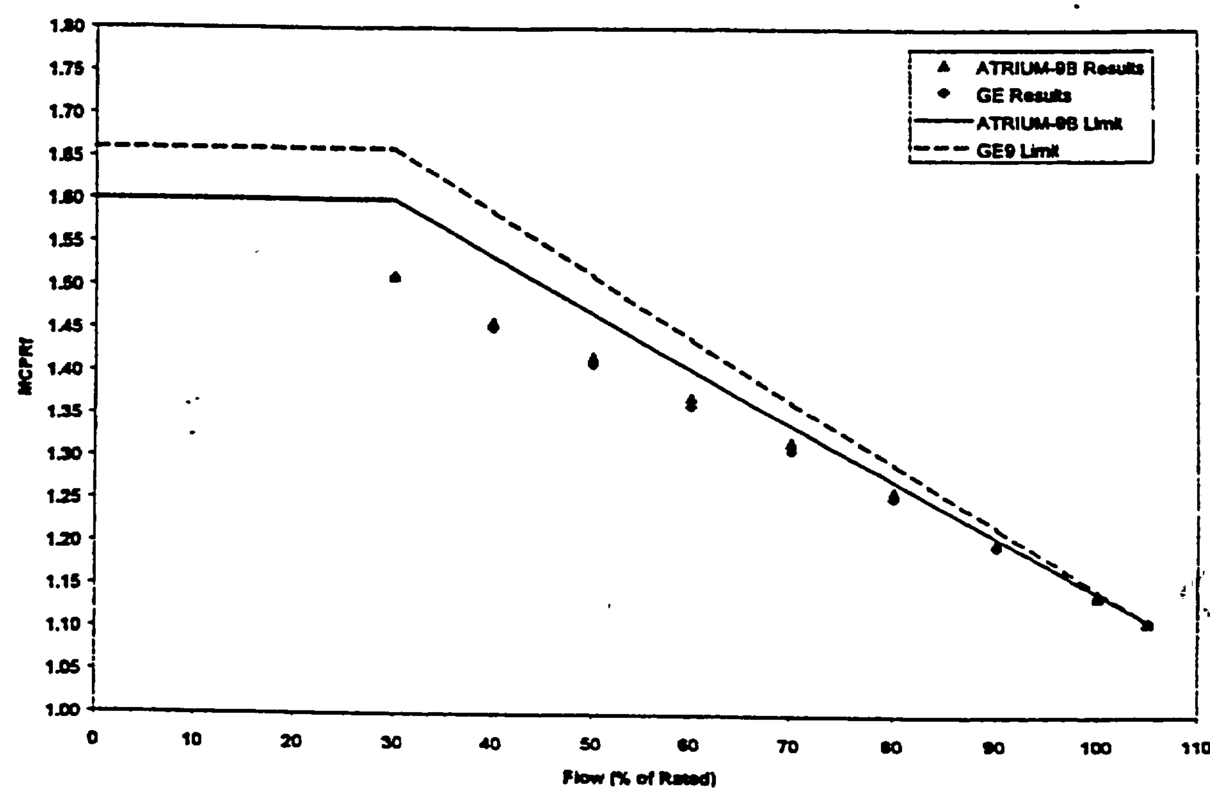
* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.

Table 2.4 FFTR/Coastdown Operation Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times*

(Continued)

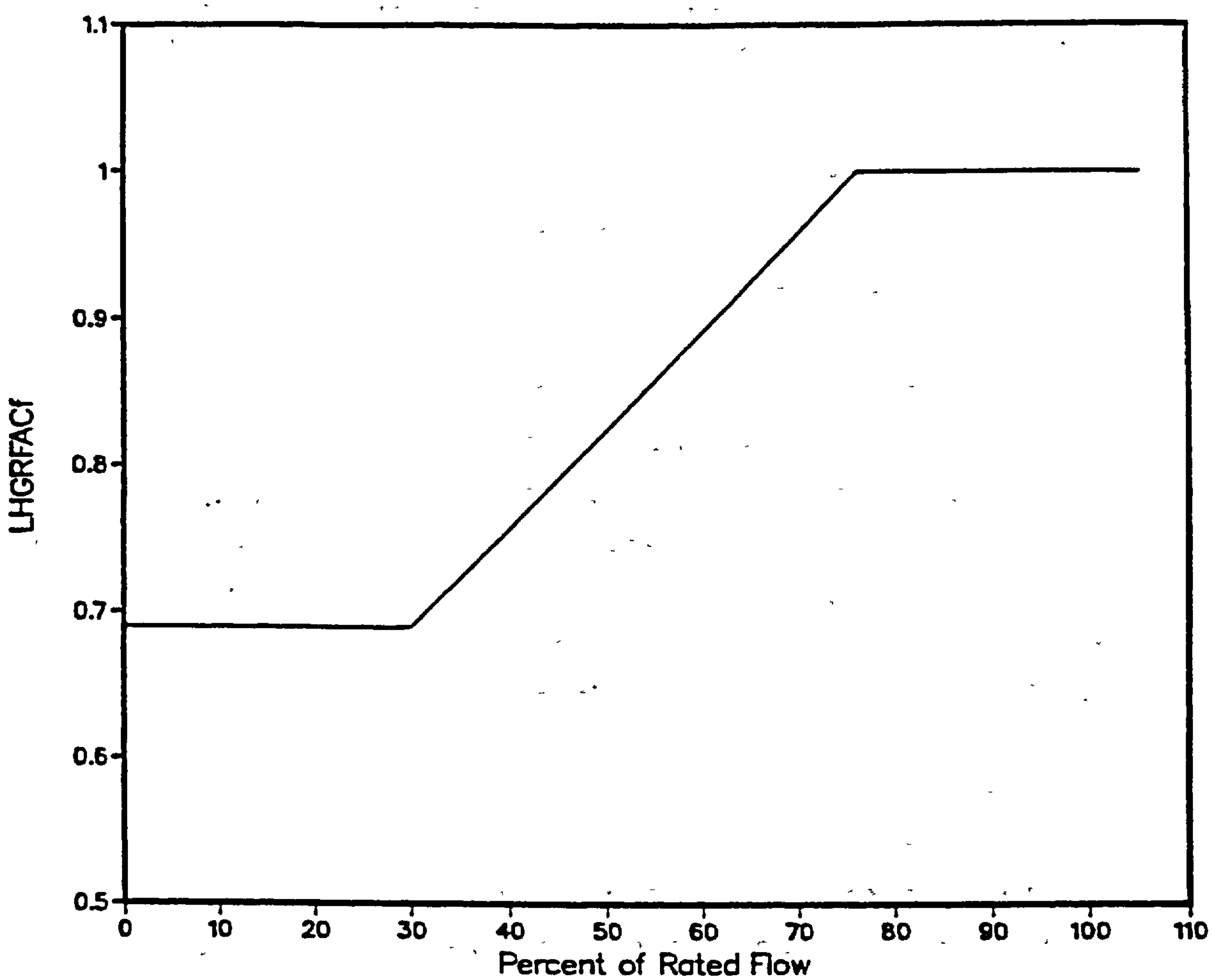
EOOS / EOD Condition	Power (% rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
FFTR/coastdown with turbine control valve (TCV) slow closure AND/OR no RPT	0	2.85	0.65	2.85
	25	2.35	0.65	2.35
	25	2.30	0.65	2.30
	80	1.70	0.85	1.96
	80	1.62	0.88	1.85
	100	1.55	0.88	1.67
FFTR/coastdown with idle loop startup	0	2.60	0.40	2.60
	25	2.60	0.40	2.60
	25	2.60	0.40	2.60
	60	2.60	0.40	2.60
	100	2.60	0.40	2.60

* Limits support operation with any combination of 1 SRVOOS, up to 2 TIPOOS (or the equivalent number of TIP channels), and up to 50% of the LPRMs out of service in the standard, ICF, and MELLLA regions of the power/flow map.



Flow (% of rated)	$MCPR_f$ ATRIUM-9B	$MCPR_f$ GE9 (penalty included)
0	1.60	1.66
30	1.60	1.66
105	1.11	1.11

Figure 2.1 Flow-Dependent MCPR Limits for Manual Flow Control Mode



Flow (% rated)	$LHGRFAC_f$
0	0.69
30	0.69
76	1.00
105	1.00

Figure 2.2 Flow-Dependent LHGRFAC Multipliers for ATRIUM-9B Fuel

3.0 Transient Analysis for Thermal Margin - Base Case Operation

This section describes the analyses performed to determine the power- and flow-dependent MCPR and LHGR operating limits for base case operation at LaSalle Unit 2 Cycle 9.

COTRANSA2 (Reference 4), XCOBRA-T (Reference 11), XCOBRA (Reference 7) and CASMO-3G/MICROBURN-B (Reference 3) are the major codes used in the thermal limits analyses as described in SPC's THERMEX methodology report (Reference 7) and neutronics methodology report (Reference 3). COTRANSA2 is a system transient simulation code, which includes an axial one-dimensional neutronics model that captures the effects of axial power shifts associated with the system transients. XCOBRA-T is a transient thermal-hydraulics code used in the analysis of thermal margins for the limiting fuel assembly. XCOBRA is used in steady-state analyses. The ANFB critical power correlation (Reference 6) is used to evaluate the thermal margin of the fuel assemblies. Calculations have been performed to demonstrate the applicability of the ANFB critical power correlation to GE9 fuel at LaSalle using the Reference 12 methodology. Fuel pellet-to-cladding gap conductance values are based on RODEX2 (Reference 13) calculations for the LaSalle Unit 2 Cycle 9 core configuration.

3.1 *System Transients*

System transient calculations have been performed to establish thermal limits to support L2C9 operation. Reference 9 identifies the potential limiting events that need to be evaluated on a cycle-specific basis. The potentially limiting transients for which SPC has analysis responsibility are the LRNB and FWCF events. Other transient events are either bound by the consequences of one of the limiting transients, or are part of ComEd's analysis responsibility.

Reactor plant parameters for the system transient analyses are shown in Table 3.1 for the 100% power/100% flow conditions. Additional plant parameters used in the analyses are presented in Reference 8. Analyses have been performed to determine power-dependent MCPR and LHGR limits that protect operation throughout the power/flow domain depicted in Figure 1.1. At LaSalle, direct scram and recirculation pump high- to low-speed transfer on turbine stop valve (TSV) and turbine control valve (TCV) position are bypassed at power levels less than 25% of rated. Reference 14 indicates that MCPR and LHGR limits need to be monitored at power levels greater than or equal to 25% of rated. As a result, all analyses used to establish base case $MCPR_p$ limits and $LHGRFAC_p$ multipliers are performed with both direct scram and RPT operable for power levels at or above 25% of rated.

The limiting exposure for rated power pressurization transients is at end of full power (EOFP) when the control rods are fully withdrawn. Off-rated power analyses were performed at earlier cycle exposures to ensure that the operating limits provide the necessary protection.

All pressurization transients assumed only the 11 highest set point safety relief valves (SRVs) were operable, consistent with the discussion in Section 7. In order to support operation with 1 SRV out-of-service, the pressurization transient analyses were performed with the lowest set point SRV out-of-service, which makes a total of 10 SRVs available.

The term, recirculation pump trip (RPT), is used synonymously with recirculation pump high- to low-speed transfer as it applies to pressurization transients. During the high- to low-speed transfer, the recirculation pumps trip off line and coast. When they reach the low-speed setting, the pumps reengage at the low speed. The time it takes for the pumps to coast to the low-speed condition is much longer than the duration of the pressurization transients. Therefore, a recirculation pump trip has the same effect on pressurization transients as a recirculation pump high- to low-speed transfer.

Reductions in feedwater temperature of less than 20°F from the nominal feedwater temperature are considered base case operation, not an EOOS condition. As discussed in Reference 9, the reduced feedwater temperature is limiting for FWCF transients. As a result, the base case FWCF results are based on a 20°F reduction in feedwater temperature.

The results of the system pressurization transients are sensitive to the scram speed used in the calculations. To take advantage of scram speeds faster than the TSSS insertion times presented in Reference 14 scram speed-specific $MCPR_p$ limits and $LHGRFAC_p$ multipliers are provided. The NSS insertion times used in the analyses reported are presented in Reference 8 and reproduced in Table 3.2. The NSS $MCPR_p$ limits and $LHGRFAC_p$ multipliers can only be applied if the scram speed surveillance tests meet the NSS insertion times. System transient analyses were performed to establish $MCPR_p$ limits and $LHGRFAC_p$ multipliers for base case operation for both NSS and TSSS insertion times.

3.1.1 Load Rejection No Bypass

The load rejection causes a fast closure of the turbine control valve. The resulting compression wave travels through the steam lines into the vessel and creates a rapid pressurization. The increase in pressure causes a decrease in core void, which in turn causes a rapid increase in power. The fast closure of the turbine control valve also causes a reactor scram and a recirculation pump high- to low-speed transfer which helps mitigate the pressurization effects. Turbine bypass system operation, which also mitigates the consequences of the event, is not credited. The excursion of the core power due to the void collapse is terminated primarily by the reactor scram and revoiding of the core. The analysis assumes 3-element feedwater level control; however, manual- or single-element feedwater level control will not significantly affect thermal limit or pressure results.

The generator load rejection without turbine bypass system (LRNB) is a more limiting transient than the turbine trip no bypass (TTNB) transient. The initial position of the TCV is such that it closes faster than the turbine stop valve. This more than makes up for any differences in the scram signal delays between the two events. This has been demonstrated in calculations that support the Reference 9 conclusion that the TTNB event is bound by the LRNB event.

LRNB analyses were performed for several power/flow conditions to support generation of thermal limits. Table 3.3 presents the LRNB transient results for both TSSS and NSS insertion times for Cycle 9. For illustration, Figures 3.1–3.3 are presented to show the responses of various reactor and plant parameters during the LRNB event initiated at 100% of rated power and 105% of rated core flow with TSSS insertion times.

3.1.2 Feedwater Controller Failure

The increase in feedwater flow due to a failure of the feedwater control system to maximum demand results in an increase in the water level and a decrease in the coolant temperature at the core inlet. The increase in core inlet subcooling causes an increase in core power. As the feedwater flow continues at maximum demand, the water level will continue to rise and eventually reaches the high water level trip set point. The initial water level is conservatively assumed to be at the lower level operating range at 30 inches above instrument zero to delay the high level trip and maximize the core inlet subcooling that results from the FWCF. The high water level trip causes the turbine stop valves to close in order to prevent damage to the turbine from excessive liquid inventory in the steam line. The valve closures create a compression wave that travels to the core causing a void collapse and subsequent rapid power excursion. The closure of the turbine valves initiates a reactor scram and a recirculation pump high- to low-speed transfer. In addition, the turbine bypass valves are assumed operable and provide some pressure relief. The core power excursion is mitigated in part by the pressure relief, but the primary mechanisms for termination of the event are reactor scram and revoiding of the core.

FWCF analyses were performed for several power/flow conditions to support generation of the thermal limits. Table 3.4 presents the base case FWCF transient results for both TSSS and NSS insertion times for Cycle 9. For illustration, Figures 3.4–3.6 are presented to show the responses of various reactor and plant parameters during the FWCF event initiated at 100% of rated power and 105% of rated core flow with TSSS insertion times.

3.1.3 Loss-of-Feedwater Heating

ComEd has the analysis responsibility for the loss-of-feedwater heating (LFWH) event at rated conditions. At reactor power levels less than rated, the LFWH event is less limiting than the LFWH event at rated conditions for the following reasons:

- At lower power/flow conditions with other core conditions such as control rod patterns and exposure unchanged, the initial MCPR is higher than the MCPR at rated power and flow. This results in additional MCPR margin to the MCPR safety limit.
- The possible change in feedwater temperature during an LFWH event decreases as the reactor power decreases.

3.2 *MCPR Safety Limit*

The MCPR safety limit is defined as the minimum value of the critical power ratio at which the fuel can be operated, with the expected number of rods in boiling transition not exceeding 0.1% of the fuel rods in the core. The MCPR safety limit for all fuel in the LaSalle Unit 2 Cycle 9 core was determined using the methodology described in Reference 5. The effects of channel bow on core limits are determined using a statistical procedure. The mean channel bow is determined from the exposure of the fuel channels and measured channel bow data. CASMO-3G is used to determine the effect on the local peaking factor distribution. Once the channel bow effects on the local peaking factors are determined, the impact on the core limits is determined in the MCPR safety limit analysis. Further discussion of how the effects of channel bow are accounted for is presented in Reference 5. The main input parameters and uncertainties used in the safety limit analysis are listed in Table 3.5. The radial power uncertainty includes the effects of up to 2 TIPOOS or the equivalent number of TIP channels (100% available at startup), up to 50% of the LPRMs out-of-service, and an LPRM calibration interval of 2500 EFPH as discussed in References 16 and 24. The channel bow local peaking uncertainty is a function of the nominal and bowed local peaking factors and the standard deviation of the measured bow data.

The determination of the safety limit explicitly includes the effects of channel bow and relies on the following assumptions:

- Cycle 9 will not contain channels used for more than one fuel bundle lifetime.
- The channel exposure at discharge will not exceed 48,000 MWd/MTU based on the fuel bundle average exposure.
- The Cycle 9 core contains all CarTech-supplied channels.

Analyses were performed with input parameters (including the radial power and local peaking factor distributions) consistent with each exposure step in the design basis step-through. The analysis that produced the highest number of rods in boiling transition corresponds to a Cycle 9 exposure of 15,000 MWd/MTU. The radial power distribution corresponding to a Cycle 9 exposure of 15,000 MWd/MTU is shown in Figure 3.7. Eight fuel types were represented in the LaSalle Unit 2 Cycle 9 safety limit analysis: four SPC ATRIUM-9B fuel types loaded in Cycle 9 (SPCA9-391B-14G8.0-100M, SPCA9-410B-19G8.0-100M, SPCA9-383B-16G8.0-100M, and SPCA9-396B-12GZ-100M); two ATRIUM-9B fuel types loaded in Cycle 8 (SPCA9-381B-13GZ7-80M and SPCA9-384B-11GZ6-80M); and two GE9 fuel types loaded in Cycle 7 (GE9B-P8CWB322-11GZ-100M-150 and GE9B-P8CWB320-9GZ-100M-150).

The local power peaking factors, including the effects of channel bow, at 70% void and assembly exposures consistent with a Cycle 9 exposure of 15,000 MWd/MTU are presented in Figures 3.8 through 3.11 for the Cycle 9 SPC ATRIUM-9B fuel. The bowed local peaking factor data used in the MCPR safety limit analysis for fuel type SPCA9-391B-14G8.0-100M is at an assembly average exposure of 18,000 MWd/MTU. The data for fuel types SPCA9-410B-19G8.0-100M and SPCA9-383B-16G8.0-100M is at an assembly average exposure of 17,500 MWd/MTU. The data is at an assembly average exposure of 15,000 MWd/MTU for fuel type SPCA9-396B-12GZ-100M.

The results of the analysis support a two-loop operation MCPR safety limit of 1.11 and a single-loop operation MCPR safety limit of 1.12 for all fuel types in the Cycle 9 core. These results are applicable for all EOD and EOOS conditions presented in Table 1.1 and support startup with uncalibrated LPRMs for an exposure range of BOC to 500 MWd/MTU .

3.3 *Power-Dependent MCPR and LHGR Limits*

Figures 3.12 and 3.13 present the base case operation TSSS ATRIUM-9B and GE9 $MCPR_p$ limits for Cycle 9. Figures 3.14 and 3.15 present the ATRIUM-9B and GE9 $MCPR_p$ limits for base case operation with NSS insertion times. The limits are based on the ΔCPR results from the limiting system transient analyses discussed above and a MCPR safety limit of 1.11.

Relative to the TSSS $MCPR_p$ limits, using the faster NSS insertion times provide lower $MCPR_p$ limits.

The pressurization transient analyses provide the necessary information to determine appropriate multipliers on the fuel design LHGR limit for ATRIUM-9B fuel to support off-rated power operation. Application of the $LHGRFAC_p$ multipliers to the steady-state LHGR limit ensures that the LHGR during AOOs initiated at reduced power does not exceed the PAPT limits. The method used to calculate the $LHGRFAC_p$ multipliers is presented in Appendix A. The results of the LRNB and FWCF analyses discussed above were used to determine the base case $LHGRFAC_p$ multipliers. The base case ATRIUM-9B $LHGRFAC_p$ multipliers for Cycle 9 TSSS and NSS insertion times are presented in Figures 3.16 and 3.17, respectively.

3.4 *Flow-Dependent MCPR and LHGR Limits*

Flow-dependent MCPR and LHGR limits are established to support operation at off-rated core flow conditions. The limits are based on the CPR and heat flux changes experienced by the fuel during slow flow excursions. The slow flow excursion event assumes a failure of the recirculation flow control system such that the core flow increases slowly to the maximum flow physically attainable by the equipment. An uncontrolled increase in flow creates the potential for a significant increase in core power and heat flux. A conservatively steep flow run-up path was determined starting at a low-power/low-flow state point of 58.1%P/30%F increasing to the high-power/high-flow state point of 124.2%P/105%F.

$MCPR_f$ limits are determined for the manual flow control (MFC) mode of operation for both ATRIUM-9B and GE9 fuel. XCOBRA is used to calculate the change in critical power ratio during a two-loop flow run-up to the maximum flow rate. The $MCPR_f$ limit is set so that the increase in core power resulting from the maximum increase in core flow is such that the MCPR safety limit of 1.11 is not violated. Calculations were performed for several initial flow rates to determine the corresponding MCPR values that put the limiting assembly on the MCPR safety limit at the high-flow condition at the end of the flow excursion.

Results of the MFC flow run-up analysis are presented in Table 3.6 for both the ATRIUM-9B and GE9 fuel. $MCPR_f$ limits that provide the required protection during MFC operation are presented in Figure 2.1. The Cycle 9 $MCPR_f$ limits were established such that they support base case operation and operation in the EOD, EOOS, and combined EOD/EOOS scenarios. The $MCPR_f$ limits are valid for all exposure conditions during Cycle 9. Since a low- to high-speed pump upshift is required to attain high-flow rates, for initial core flows less than 30% of rated, the limit is conservatively set equal to the 30% flow value. The $MCPR_f$ penalty described in Reference 10 has been applied to the GE9 $MCPR_f$ limits shown in Figure 2.1. The penalty is a function of core flow with a value of 0.0 at 100% of rated and increases linearly to 0.05 at 40% of rated. The penalty continues to increase to 30% of rated core flow where a penalty of 0.06 is applied.

SPC has performed $LHGRFAC_f$ analyses with the CASMO-3G/MICROBURN-B core simulator codes. The analysis assumes that the recirculation flow increases slowly along the limiting rod line to the maximum flow physically attainable by the equipment. A series of flow excursion analyses were performed at several exposures throughout the cycle starting from different initial power/flow conditions. Xenon is assumed to remain constant during the event. The $LHGRFAC_f$ multipliers were established to ensure that the LHGR during the flow run-up does not violate the PAPT LHGR limit. Since a low- to high-speed pump upshift is required to attain high-flow rates, for initial core flows less than 30% of rated, the $LHGRFAC_f$ multiplier is conservatively set equal to the 30% flow value. The $LHGRFAC_f$ values as a function of core flow for the ATRIUM-9B fuel are presented in Figure 2.2. The Cycle 9 $LHGRFAC_f$ multipliers were established to support base case operation and operation in the EOD, EOOS, and combined EOD/EOOS scenarios for all Cycle 9 exposure conditions.

3.5 *Nuclear Instrument Response*

The impact of loading ATRIUM-9B fuel into the LaSalle core will not affect the nuclear instrument response. The neutron lifetime is an important parameter affecting the time response of the incore detectors. The neutron lifetime is a function of the nuclear and mechanical design of the fuel assembly, the in-channel void fraction, and the fuel exposure. The neutron lifetimes are similar for the SPC and GE LaSalle fuel with typical values of $39(10^{-6})$ to $40(10^{-6})$ seconds for the ATRIUM-9B lattices and $41(10^{-6})$ to $43(10^{-6})$ seconds for the GE9 lattices as calculated with the CASMO-3G code at core average void and exposure conditions. Therefore, the neutron lifetimes for a full core of ATRIUM-9B fuel, a mixed core of ATRIUM-9B and GE9 fuel, and a full core of GE9 fuel are essentially equivalent.

Table 3.1 LaSalle Unit 2 Plant Conditions at Rated Power and Flow

Reactor thermal power	3489 MWt
Total core flow Core active flow Core bypass flow*	108.5 Mlbm/hr 93.7 Mlbm/hr 14.8 Mlbm/hr
Core inlet enthalpy	523.9 Btu/lbm
Vessel pressures Steam dome Core exit (upper-plenum) Lower-plenum	 1001 psia 1013 psia 1038 psia
Turbine pressure	948 psia
Feedwater / steam flow	15.145 Mlbm/hr
Feedwater enthalpy	406.6 Btu/lbm
Recirculating pump flow (per pump)	15.83 Mlbm/hr
Core average gap coefficient (EOC)	1162 Btu/hr-ft^2-°F

* Includes water channel flow.

Table 3.2 Scram Speed Insertion Times

Control Rod Position (notch)	TSSS Time (sec)	NSS Time (sec)
48 (*full-out*)	0.000	0.000
48*	0.200*	0.200*
45	0.430	0.380
39	0.860	0.680
25	1.930	1.680
5	3.490	2.680
0 (*full-in*)	3.880	2.804

* As indicated in Reference 8, the delay between scram signal and control rod motion is conservatively modeled. Sensitivity analyses indicate that using no delay provides slightly conservative results (Reference 22).

Table 3.3 EOC Base Case LRNB Transient Results

Power/ Flow	ATRIUM-9B ΔCPR	ATRIUM-9B $LHGRFAC_p$	GE9 ΔCPR	Peak Neutron Flux (% rated)	Peak Heat Flux (% rated)
TSSS Insertion Times					
100 / 105	0.30	1.01	0.40	422	127
100 / 100	0.29	1.01	0.39	431	128
100 / 81	0.28	1.01	0.38	437	126
80 / 105	0.29	1.04	0.39	324	100
80 / 57.2	0.29	1.05	0.39	265	96
60 / 105	0.27	1.06	0.36	245	73
60 / 35.1	0.17	1.13	0.21	96	63
40 / 105	0.23*	1.13	0.27	100*	46*
25 / 105	0.17*	1.22*	0.19*	44*	27*
NSS Insertion Times					
100 / 105	0.28	1.02	0.37	380	124
100 / 81	0.22	1.03	0.30	358	120
80 / 105	0.27	1.04	0.36	302	98
80 / 57.2	0.20	1.09	0.26	218	90
60 / 105	0.26	1.07	0.35	236	73
60 / 35.1	0.13	1.18	0.14	76	60
40 / 105	0.20	1.14	0.27	115	47
25 / 105	0.15*	1.22	0.17	42*	27*

* The analysis results are from an earlier cycle exposure. The ΔCPR and $LHGRFAC_p$ results are conservatively used to establish the thermal limits.

Table 3.4 EOC Base Case FWCF Transient Results

Power/ Flow	ATRIUM-9B ΔCPR	ATRIUM-9B $LHGRFAC_p$	GE9 ΔCPR	Peak Neutron Flux (% rated)	Peak Heat Flux (% rated)
TSSS Insertion Times					
100 / 105	0.25	1.09	0.31	298	123
100 / 100	0.24	1.11	0.31	288	122
100 / 81	0.23	1.09	0.28	285	121
80 / 105	0.28	1.07	0.35	253	101
80 / 57.2	0.19	1.16	0.23	154	91
60 / 105	0.35*	1.02*	0.41	154*	77*
60 / 35.1	0.11	1.25	0.14	74	63
40 / 105	0.51*	0.94*	0.57*	104*	58*
25 / 105	0.80*	0.79*	0.88*	69*	44*
NSS Insertion Times					
100 / 105	0.23	1.10	0.29	263	120
100 / 81	0.18	1.11	0.22	237	116
80 / 105	0.27	1.10	0.33	235	99
80 / 57.2	0.15	1.20	0.17	131	88
60 / 105	0.33	1.05*	0.40	188	79
60 / 35.1	0.11	1.28	0.13	65	63
40 / 105	0.48*	0.95*	0.55*	96*	57*
25 / 105	0.78*	0.79*	0.86*	66*	44*

* The analysis results are from an earlier cycle exposure. The ΔCPR and $LHGRFAC_p$ results are conservatively used to establish the thermal limits.

Table 3.5 Input for MCPR Safety Limit Analysis

Fuel-Related Uncertainties

Parameter	Source Document	Statistical Treatment
ANFB correlation*		
ATRIUM-9B	Reference 17	Convoluted
GE9	Reference 12	Convoluted
Radial power	References 16 and 21	Convoluted
Local peaking factor	Reference 5	Convoluted
Assembly flow rate (mixed core)	Reference 5	Convoluted
Channel bow local peaking	Function of nominal and bowed local peaking and standard deviation of bow data (see Reference 18)	Convoluted

Nominal Values and Plant Measurement Uncertainties

Parameter	Value	Uncertainty (%) (Reference 8)	Statistical Treatment
Feedwater flow rate† (Mlbm/hr)	22.4	1.76	Convoluted
Feedwater temperature (°F)	426.5	0.76	Convoluted
Core pressure (psia)	1031.35	0.50	Convoluted
Total core flow (Mlbm/hr)	113.9	2.50	Convoluted
Core power† (MWth)	5167.29	—	—

* Additive constant uncertainties values are used.

† Feedwater flow rate and core power were increased above design values to attain desired core MCPR for safety limit evaluation consistent with Reference 5 methodology

Table 3.6 Flow-Dependent MCPR Results

Core Flow (% rated)	105% Maximum Core Flow	
	GE9	ATRIUM-9B
30	1.52	1.52
40	1.46	1.46
50	1.41	1.42
60	1.37	1.38
70	1.31	1.32
80	1.26	1.27
90	1.20	1.21
100	1.14	1.14
105	1.11	1.11

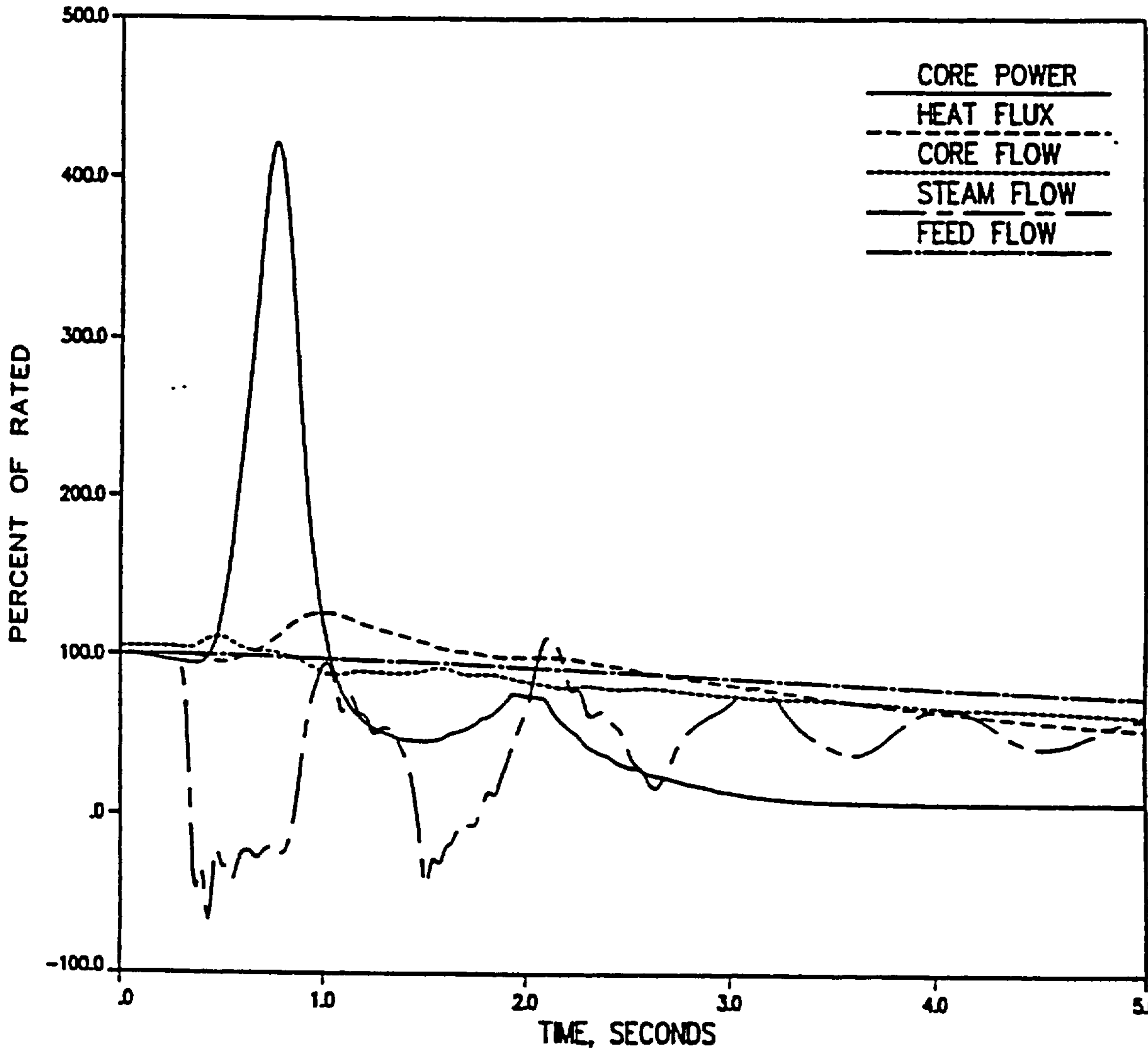


Figure 3.1 EOC Load Rejection No Bypass at 100/105 – TSSS Key Parameters

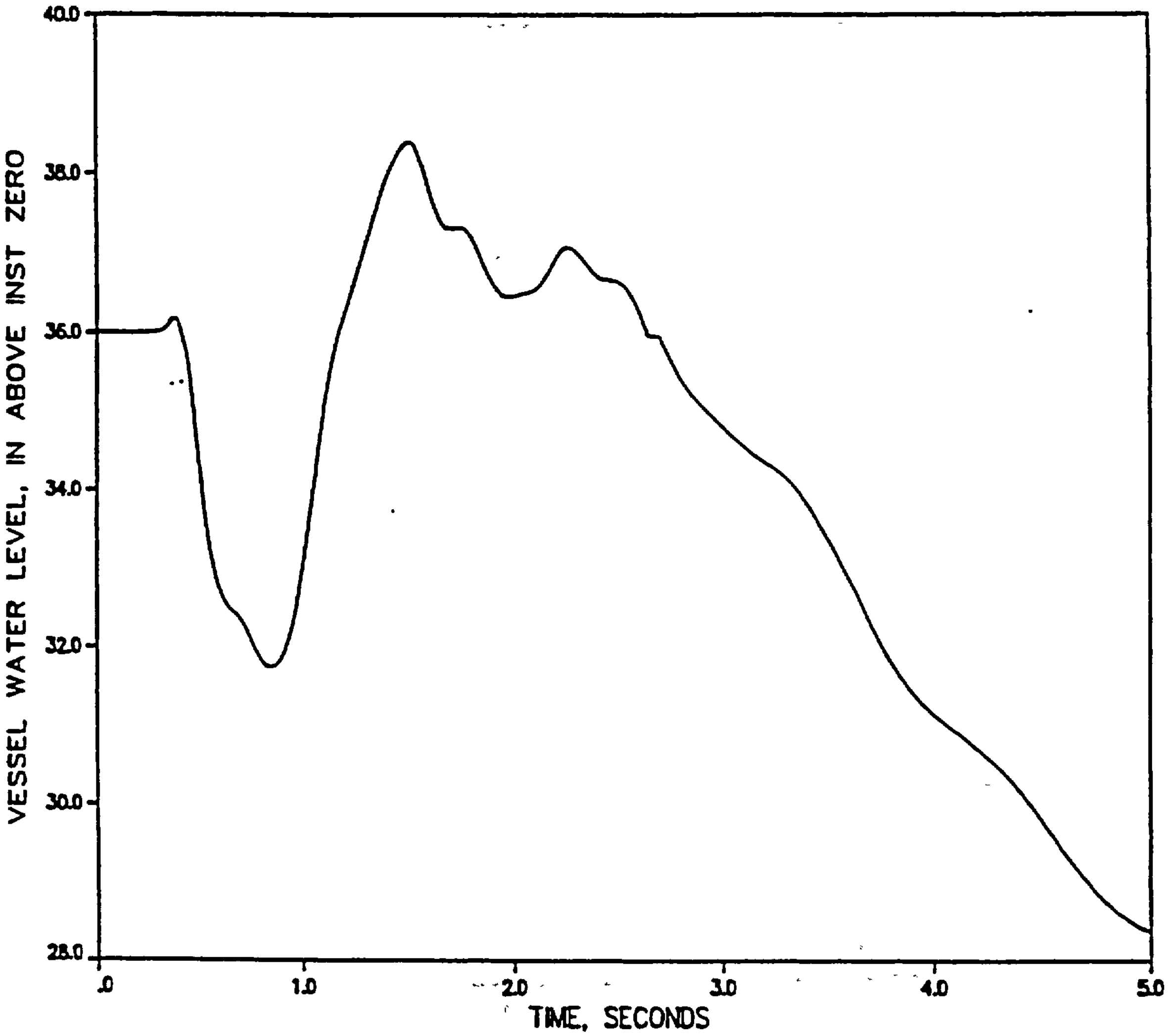


Figure 3.2 EOC Load Rejection No Bypass at 100/105 – TSSS Vessel Water Level

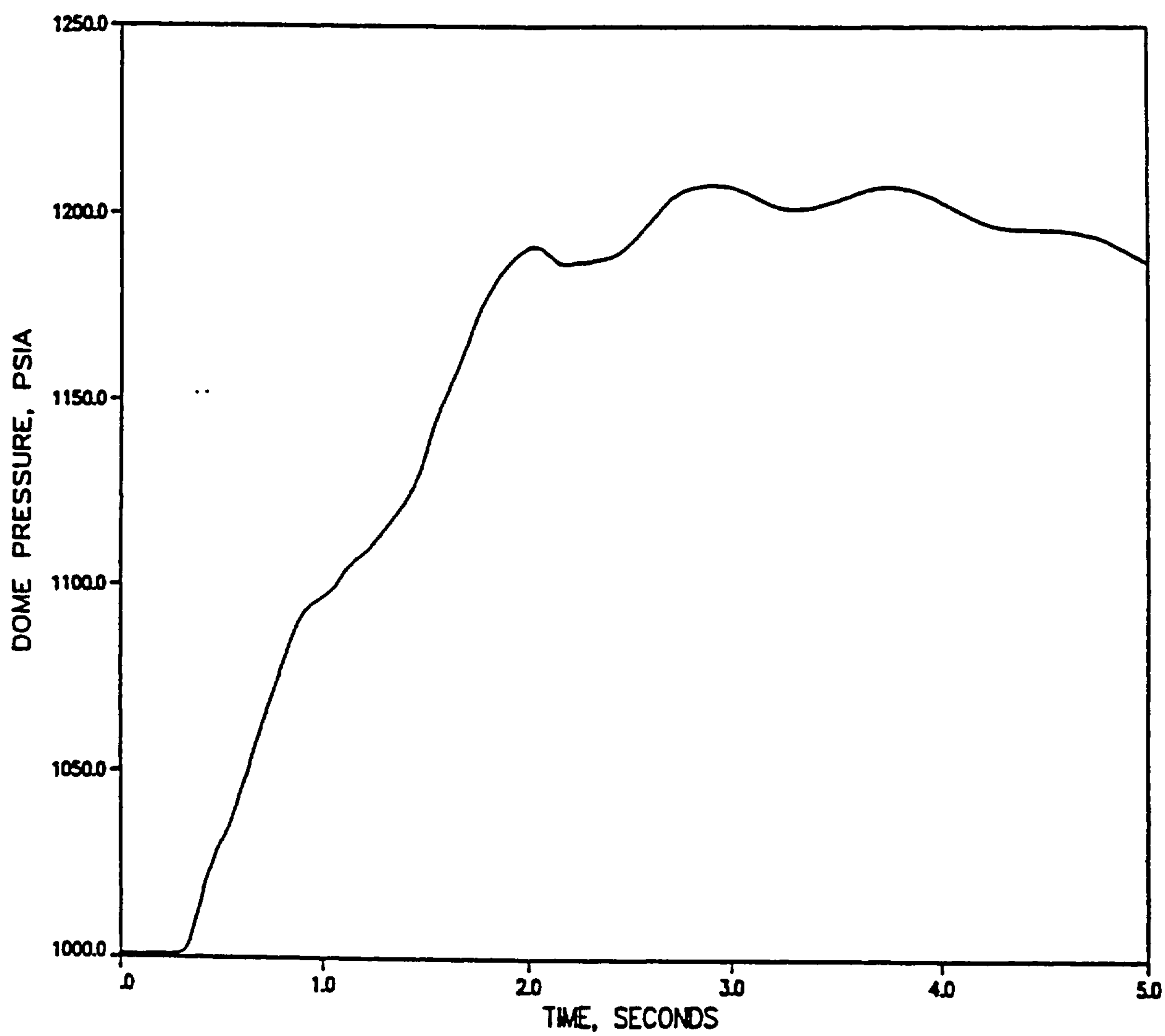


Figure 3.3 EOC Load Rejection No Bypass at 100/105 – TSSS Dome Pressure

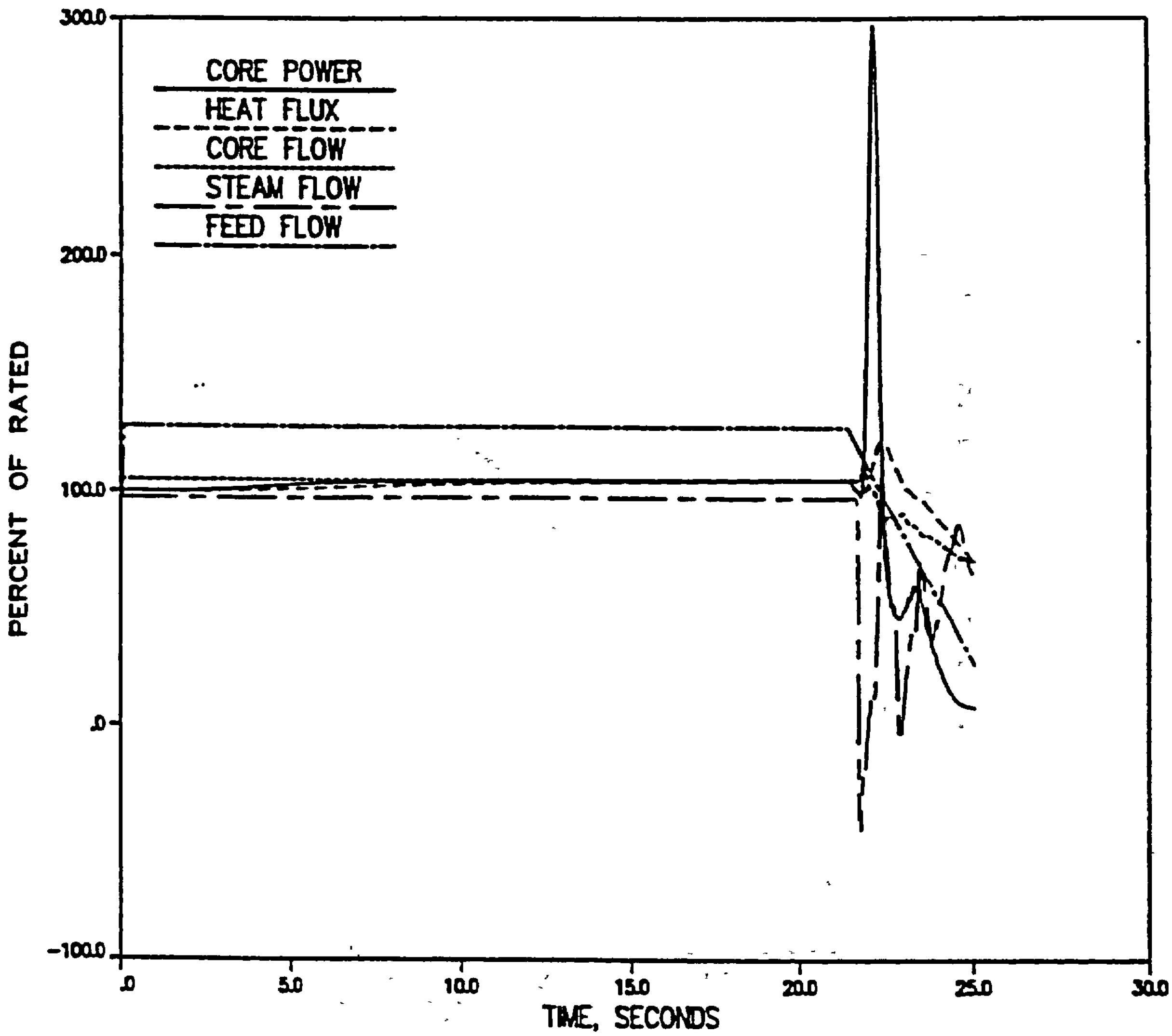


Figure 3.4 EOC Feedwater Controller Failure at 100/105 – TSSS Key Parameters

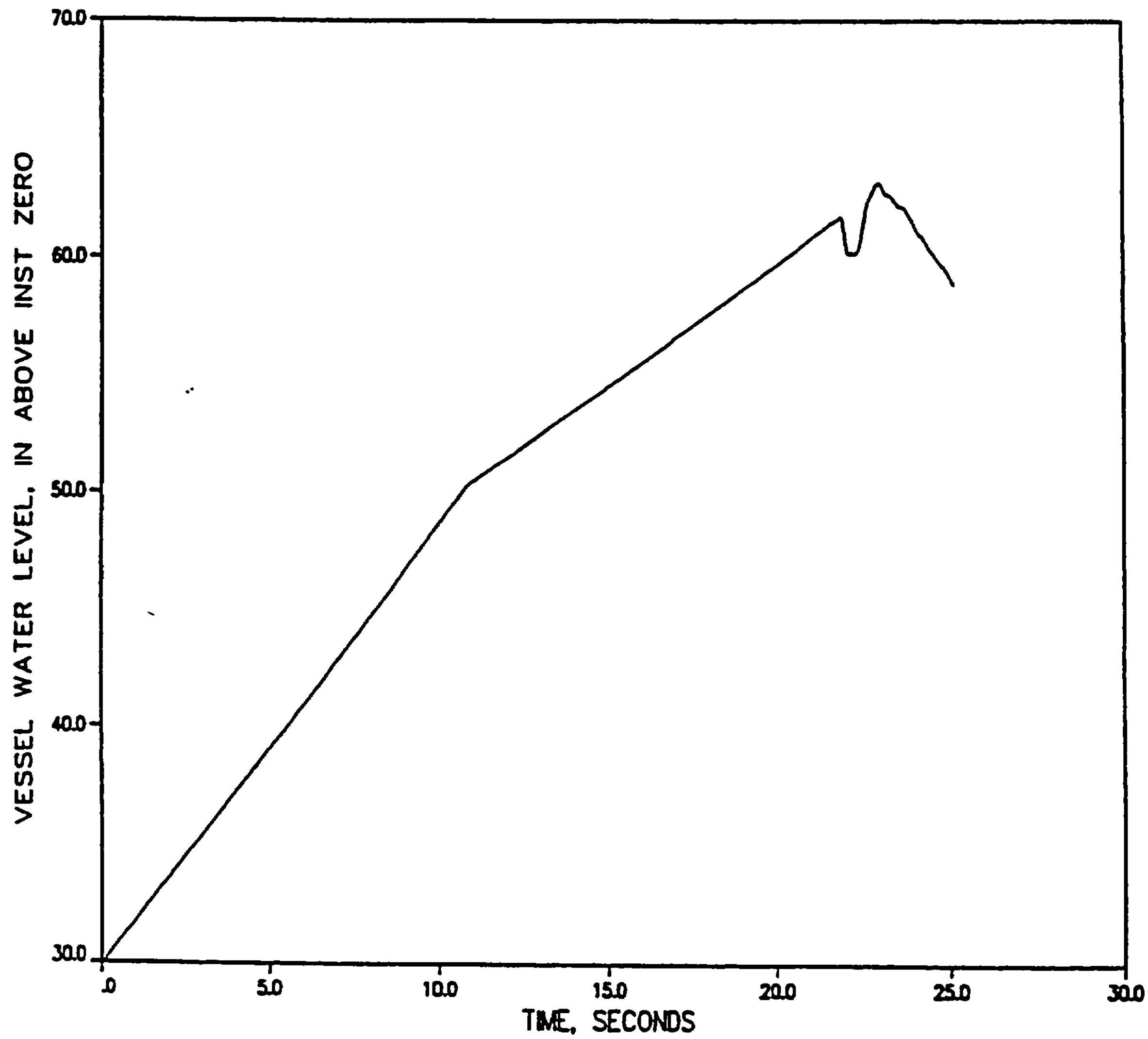


Figure 3.5 EOC Feedwater Controller Failure at 100/105 – TSSS Vessel Water Level

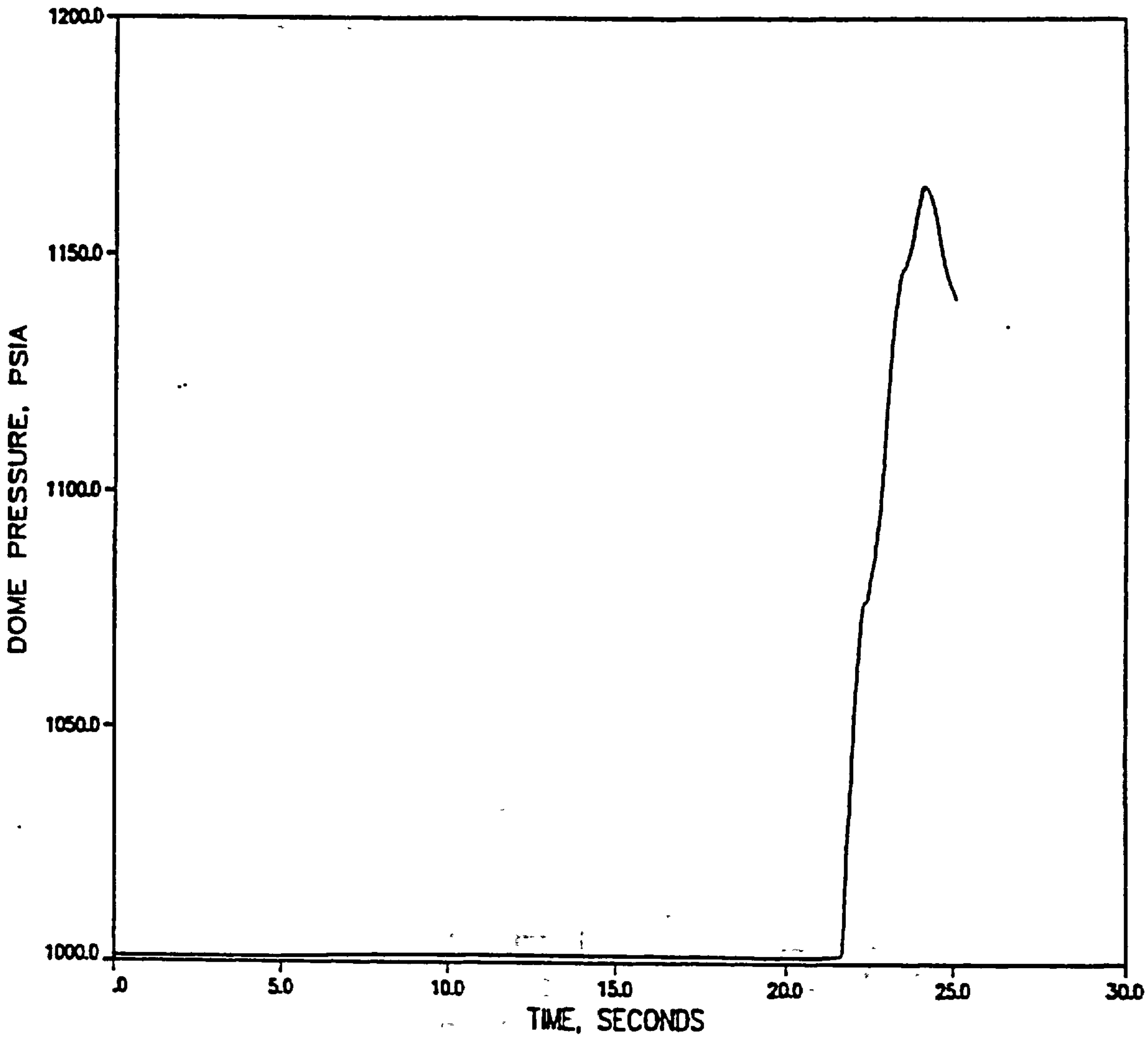


Figure 3.6 EOC Feedwater Controller Failure at 100/105 – TSSS Dome Pressure

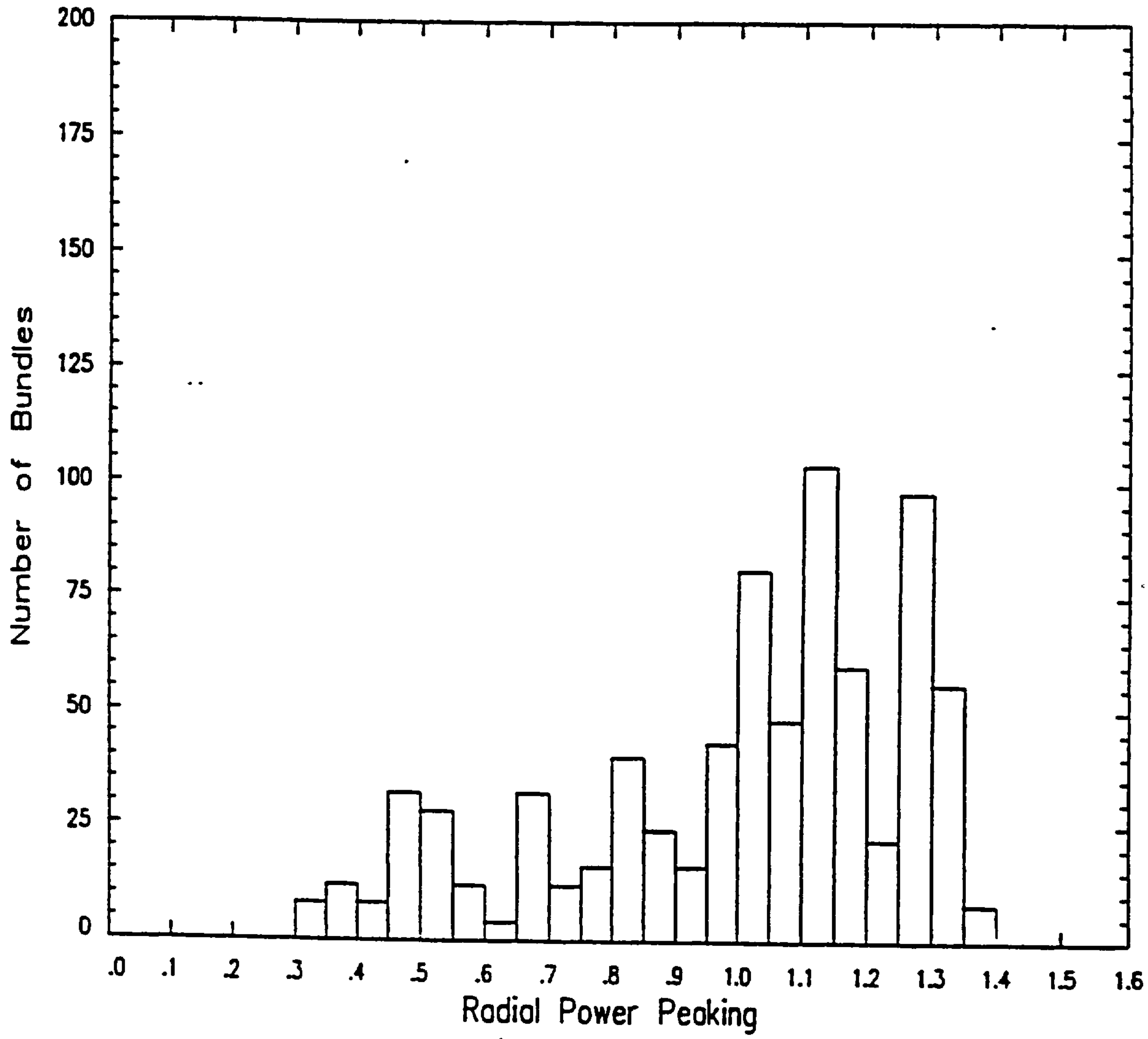


Figure 3.7 Radial Power Distribution for SLMCPR Determination

Control Rod Corner

Control Rod Corner

1.052	1.045	1.088	1.088	1.104	1.079	1.068	1.013	1.005
1.045	0.951	1.019	0.996	0.852	0.986	0.998	0.914	0.991
1.088	1.019	1.001	1.059	1.089	1.051	0.982	0.981	1.027
1.088	0.996	1.059				0.905	0.957	1.050
1.104	0.852	1.089		Internal Water Channel		1.068	0.807	1.035
1.079	0.986	1.051				1.025	0.942	1.039
1.068	0.998	0.982	0.905	1.068	1.025	0.811	0.954	1.005
1.013	0.914	0.981	0.957	0.807	0.942	0.954	0.874	0.957
1.005	0.991	1.027	1.050	1.035	1.039	1.005	0.957	0.956

**Figure 3.8 LaSalle Unit 2 Cycle 9
Safety Limit Local Peaking Factors
SPCA9-391B-14G8.0-100M With Channel Bow
(Assembly Exposure of 18,000 MWd/MTU)**

Control Rod Corner (top edge and left edge)

1.058	1.049	1.092	1.091	1.107	1.082	1.072	1.017	1.010
1.049	0.945	1.020	0.996	0.843	0.987	0.998	0.906	0.995
1.092	1.020	1.002	1.061	1.090	1.052	0.981	0.980	1.030
1.091	0.996	1.061		Internal		0.894	0.955	1.053
1.107	0.843	1.090		Water		1.067	0.797	1.036
1.082	0.987	1.052		Channel		1.024	0.941	1.041
1.072	0.998	0.981	0.894	1.067	1.024	0.800	0.952	1.007
1.017	0.906	0.980	0.955	0.797	0.941	0.952	0.865	0.960
1.010	0.995	1.030	1.053	1.036	1.041	1.007	0.960	0.960

Figure 3.9. LaSalle Unit 2 Cycle 9
Safety Limit Local Peaking Factors
SPCA9-410B-19G8.0-100M With Channel Bow
(Assembly Exposure of 17,500 MWd/MTU)

Control Rod Corner

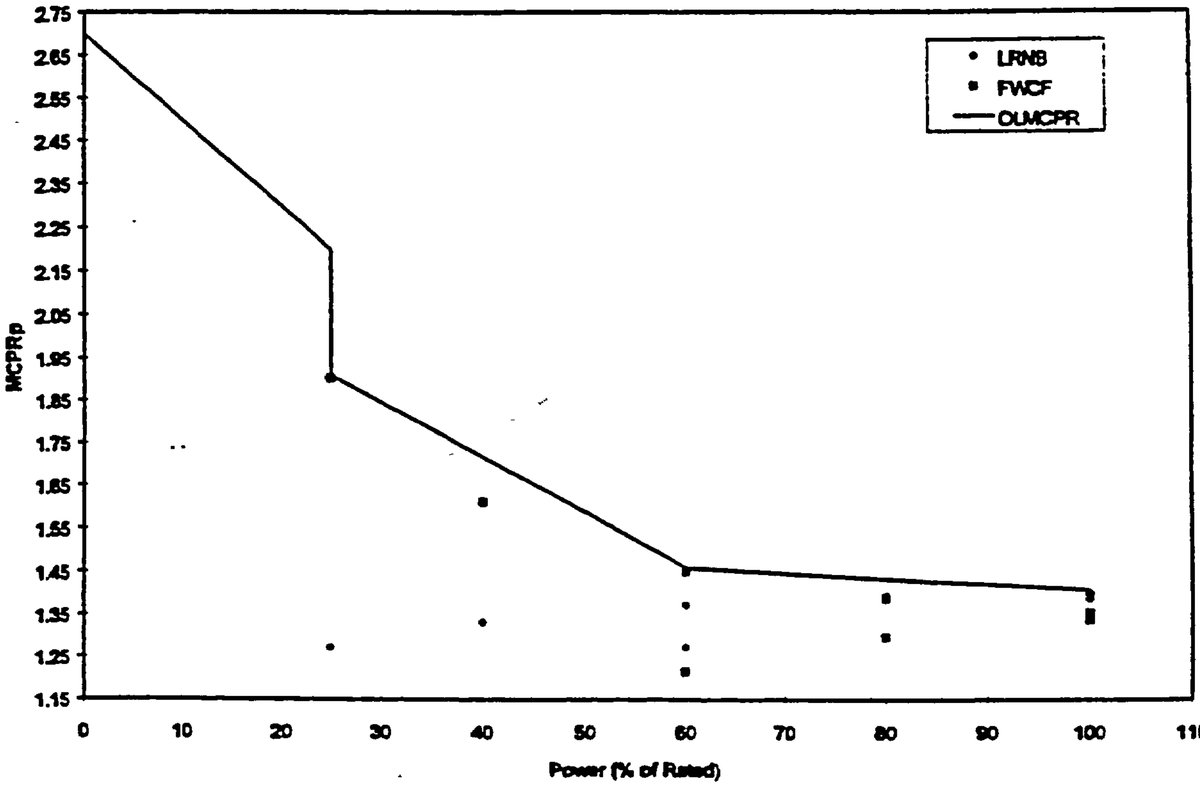
1.017	1.017	1.068	1.083	1.107	1.074	1.048	0.985	0.970
1.017	0.986	1.024	1.000	0.885	0.992	1.004	0.956	0.965
1.068	1.024	0.890	1.063	1.091	1.055	0.990	0.989	1.009
1.083	1.000	1.063	Internal Water Channel			0.944	0.966	1.055
1.107	0.885	1.091				1.074	0.846	1.040
1.074	0.992	1.055				1.032	0.951	1.043
1.048	1.004	0.990	0.944	1.074	1.032	0.850	0.964	0.988
0.985	0.956	0.989	0.966	0.846	0.951	0.964	0.916	0.932
0.970	0.965	1.009	1.055	1.040	1.043	0.988	0.932	0.924

Figure 3.10 LaSalle Unit 2 Cycle 9
Safety Limit Local Peaking Factors
SPCA9-383B-16G8.0-100M With Channel Bow
(Assembly Exposure of 17,500 MWd/MTU)

Control Rod Corner

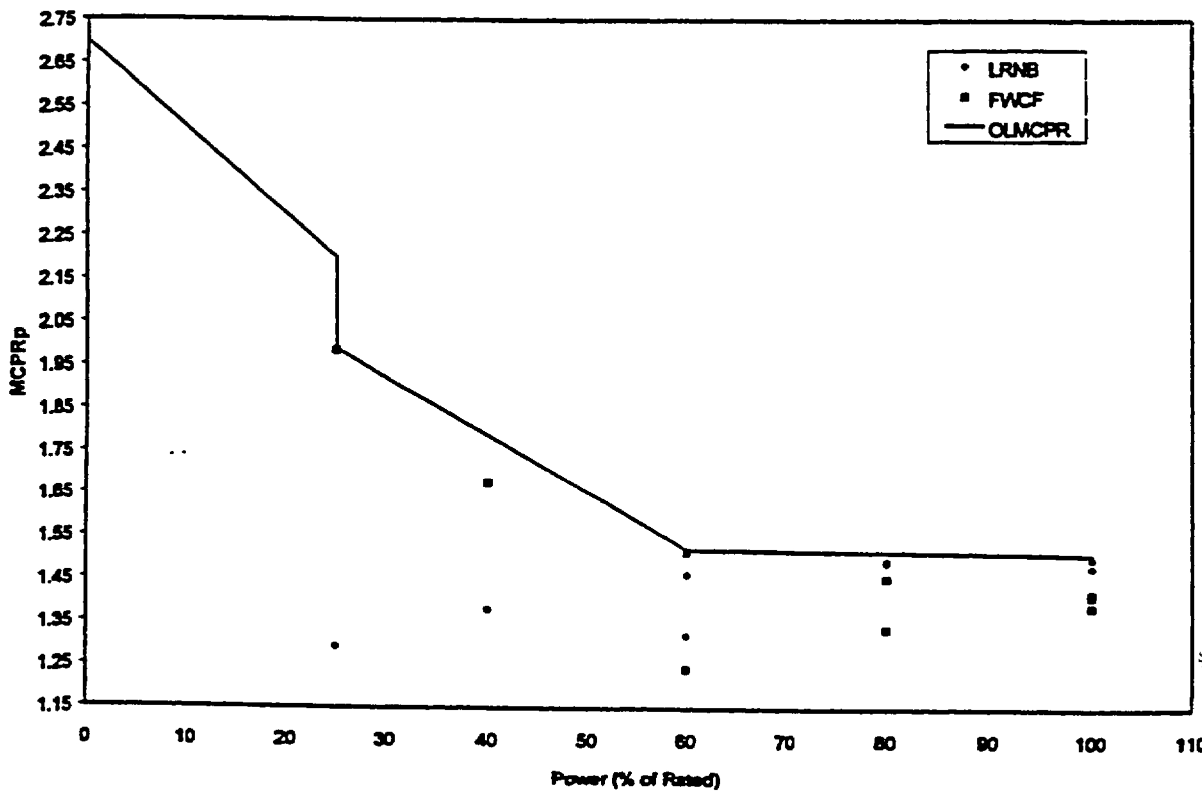
1.025	1.058	1.062	1.117	1.100	1.108	1.043	1.026	0.979
1.058	0.934	1.018	0.852	1.003	0.845	0.999	0.903	1.005
1.062	1.018	1.003	1.067	1.092	1.058	0.984	0.983	1.006
1.117	0.852	1.067				1.046	0.823	1.056
1.100	1.003	1.092		Internal Water Channel		1.072	0.968	1.039
1.108	0.845	1.058				1.038	0.816	1.046
1.043	0.999	0.984	1.046	1.072	1.038	0.965	0.963	0.986
1.026	0.903	0.983	0.823	0.968	0.816	0.963	0.873	0.973
0.979	1.005	1.006	1.056	1.039	1.046	0.986	0.973	0.933

**Figure 3.11 LaSalle Unit 2 Cycle 9
Safety Limit Local Peaking Factors
SPCA9-396B-12GZ-100M With Channel Bow
(Assembly Exposure of 15,000 MWdMTU)**



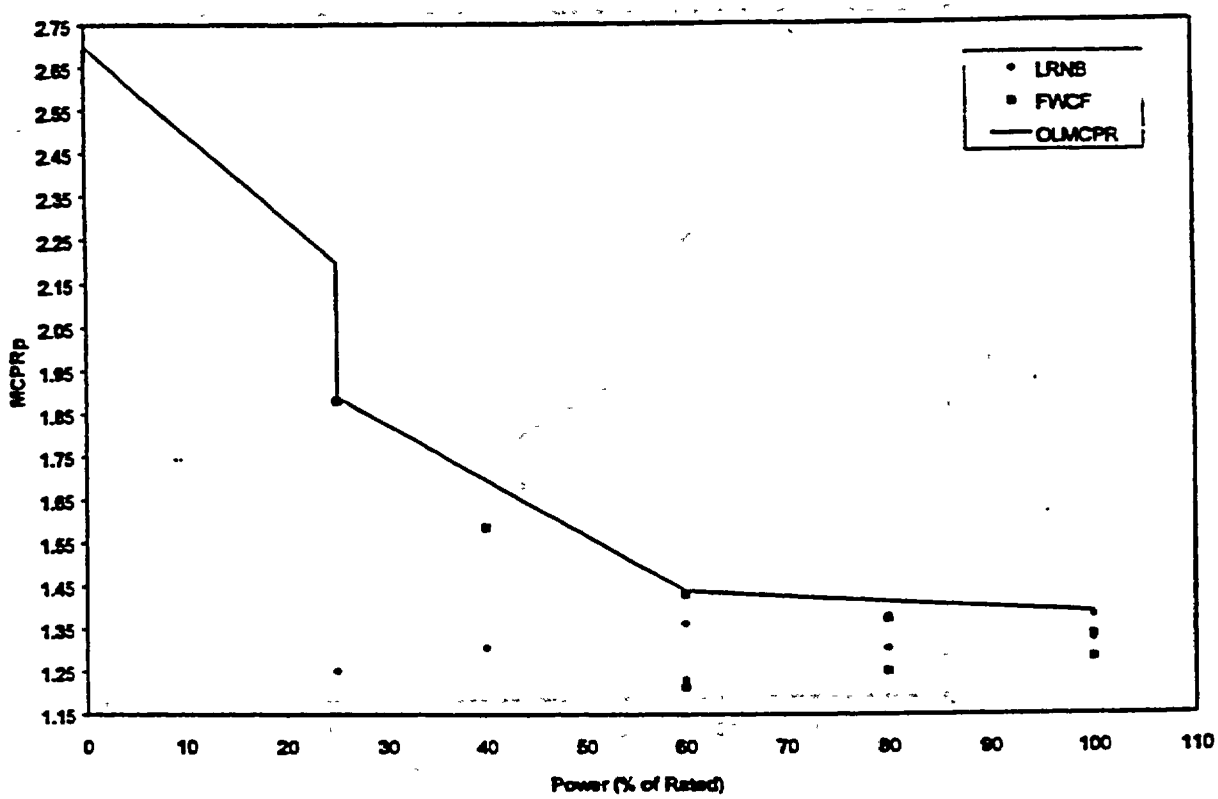
Power (%)	$MCPR_p$ Limit
100	1.41
60	1.46
25	1.91
25	2.20
0	2.70

Figure 3.12 EOC Base Case Power-Dependent MCPR Limits for ATRUM-9B Fuel – TSSS Insertion Times



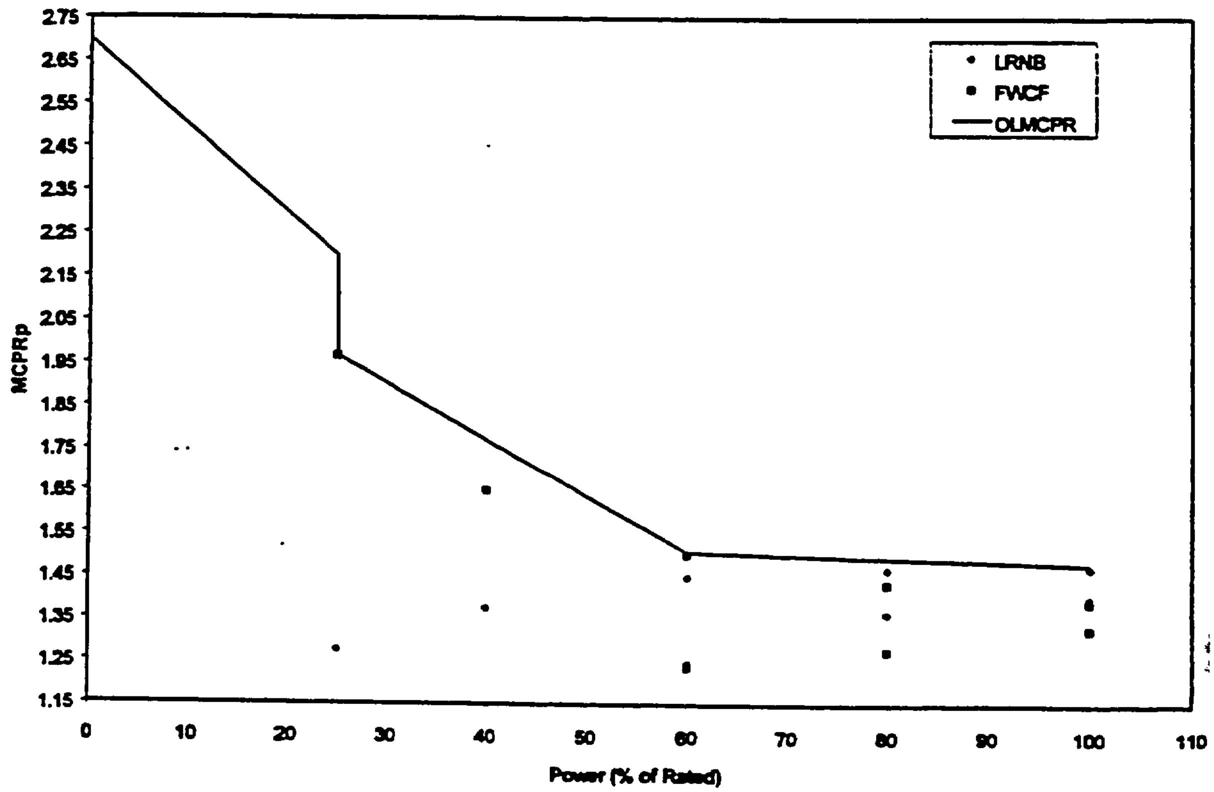
Power (%)	$MCPR_p$ Limit
100	1.51
60	1.52
25	1.99
25	2.20
0	2.70

Figure 3.13 EOC Base Case Power-Dependent MCPR Limits for GE9 Fuel – TSSS Insertion Times



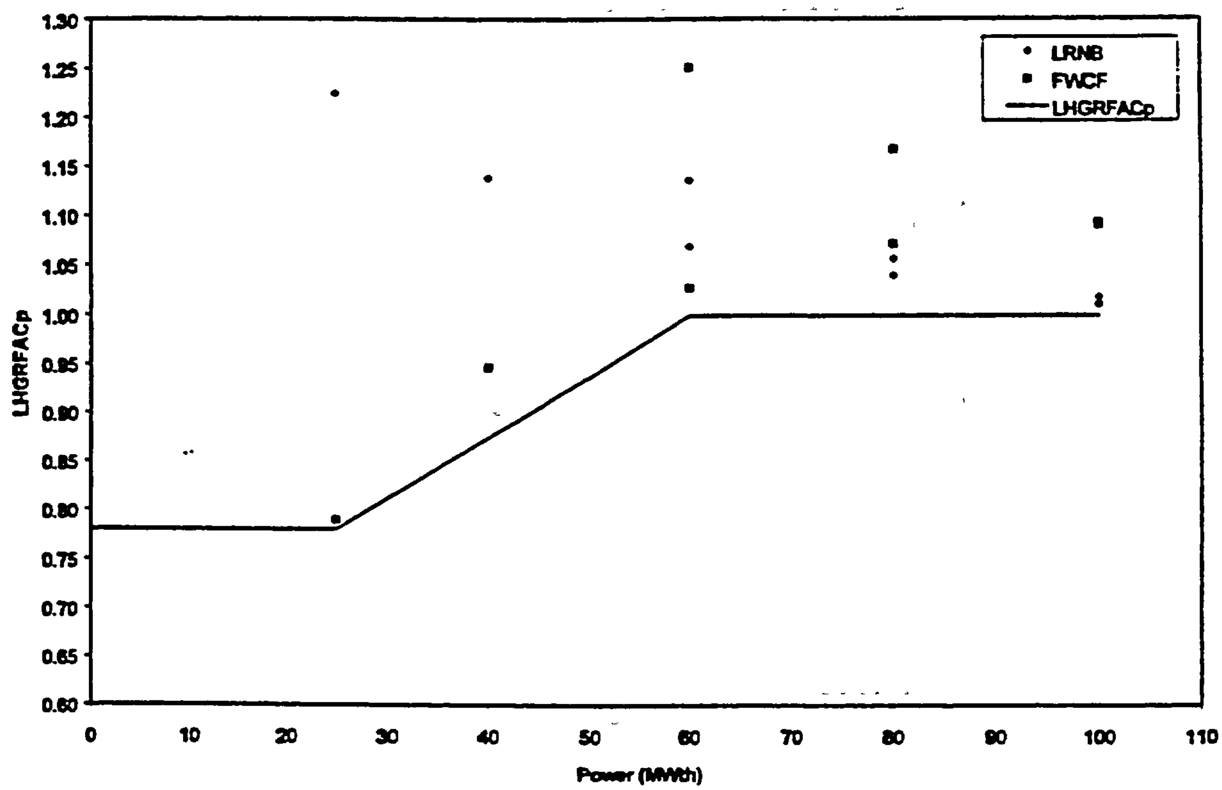
Power (%)	$MCPR_p$ Limit
100	1.39
60	1.44
25	1.89
25	2.20
0	2.70

Figure 3.14 EOC Base Case Power-Dependent MCPR Limits for ATRUM-9B Fuel – NSS Insertion Times



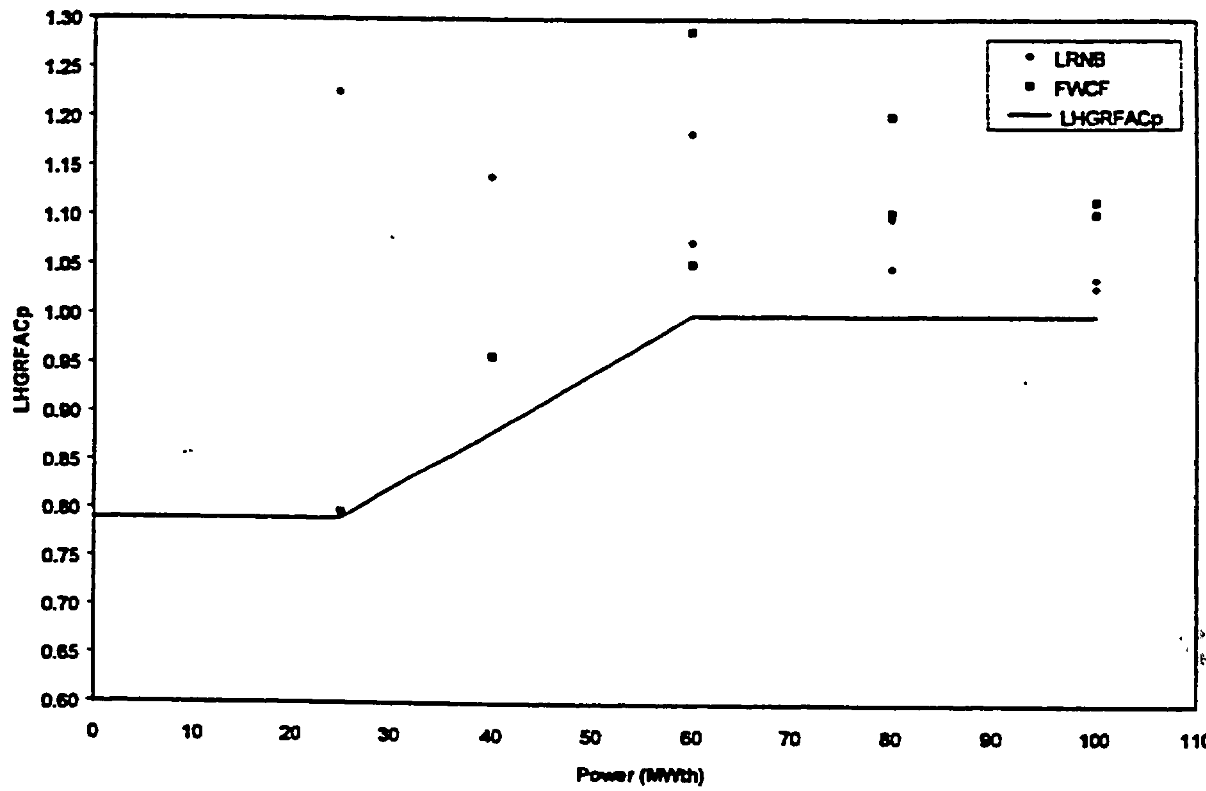
Power (%)	$MCPR_p$ Limit
100	1.48
60	1.51
25	1.97
25	2.20
0	2.70

Figure 3.15 EOC Base Case Power-Dependent MCPR Limits for GE9 Fuel – NSS Insertion Times



Power (%)	$LHGRFAC_p$ Multiplier
100	1.00
60	1.00
25	0.78
25	0.78
0	0.78

Figure 3.16 EOC Base Case Power-Dependent LHGR Multipliers for ATRUM-9B Fuel – TSSS Insertion Times



Power (%)	$LHGRFAC_p$ Multiplier
100	1.00
60	1.00
25	0.79
25	0.79
0	0.79

Figure 3.17 EOC Base Case Power-Dependent LHGR Multipliers for ATRUM-9B Fuel – NSS Insertion Times