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ComEd

May 12, 2000

United States Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, D.C. 20555

LaSalle County Station Unit 1
Facility Operating License No. NPF-11
NRC Docket No. 50-373

Subject: Unit 1 Cycle 9 Core Operating Limits Report for Operation at Uprated Power Conditions Using the Maximum Extended Load Line Limit

Reference: Letter from D. M. Skay, U.S. NRC, to O.D. Kingsley, Commonwealth Edison (ComEd) Company, "LaSalle – Issuance of Amendments Regarding Power Uprate (TAC Nos. MA6070 and MA6071)", dated May 9, 2000.

LaSalle County Unit 1 is currently preparing for power ascension to the uprated power level as was approved on May 9, 2000, by the NRC in amendment 140 for Facility Operating License NPF-11. To support operation at this uprated power condition, a revision to the LaSalle Unit 1 Core Operating Limits Report (COLR) is necessary to incorporate the results of the cycle specific analyses for L1C9, including operation with the Maximum Extended Load Line Limit (MELLL).

In accordance with Technical Specification Section 6.6A.6.d, "Core Operating Limits Report," and 10 CFR 50.4, "Written Communications," ComEd is submitting the COLR to the NRC. ComEd has reviewed the mid-cycle changes to the LaSalle Unit 1 Cycle 9 COLR under the provisions of 10CFR50.59 and has determined the changes do not impact the operating license and do not constitute an unreviewed safety question.

A001

Also included with this transmittal letter are proposed changes to the Technical Specification Bases pages for LaSalle Unit 1. These changes are required to the LaSalle Technical Specification Bases due to changes by General Electric in the calculation of the LHGR limit. These changes result in LOCA impacts being accounted for only in the average planar linear heat generation rate (APLHGR) limits and fuel mechanical limits only considered in the linear heat generation rate (LHGR) limits.

Should you have any questions concerning this letter, please contact Mr. Frank A. Spangenberg, III, Regulatory Assurance Manager, at (815) 357-6761, extension 2383.

Respectfully,

Charles G. Pardee
Site Vice President
LaSalle County Station

Attachment

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – LaSalle County Station

STATE OF ILLINOIS	)	
IN THE MATTER OF	)	
COMMONWEALTH EDISON COMPANY	)	
LASALLE COUNTY STATION - UNIT 1	)	Docket No. 50-373

Subject: Unit 1 Cycle 9 Core Operating Limits Report for Operation at Uprated Power Conditions Using the Maximum Extended Load Line Limit

AFFIDAVIT

I affirm that the content of this transmittal is true and correct to the best of my knowledge, information and belief.

Charles G. Pardee
Site Vice President
LaSalle County Station

Subscribed and sworn to before me, a Notary Public in and for the State above named, this 12th day of May, 2000.
My Commission expires on 10-1, 2000.

OFFICIAL SEAL
DEBRA J. FEENEY
NOTARY PUBLIC, STATE OF ILLINOIS
MY COMMISSION EXPIRES10-1-2000

Notary Public

3/4.2 POWER DISTRIBUTION LIMITS

BASES

The specifications of this section assure that the peak cladding temperature following the postulated design basis loss-of-coolant accident will not exceed the 2200°F limit specified in 10 CFR 50.46.

3/4.2.1 AVERAGE PLANAR LINEAR HEAT GENERATION RATE

DELETE

GE Fuel

This specification assures that the peak cladding temperature following the postulated design basis loss-of-coolant accident will not exceed the limit specified in 10 CFR 50.46. The specification also assures that fuel rod mechanical integrity is maintained during normal and transient operations.

The peak cladding temperature (PCT) following a postulated loss-of-coolant accident is primarily a function of the average heat generation rate of all the rods of a fuel assembly at any axial location and is dependent only secondarily on the rod-to-rod power distribution within an assembly. The peak clad temperature is calculated assuming a LHGR for the highest powered rod which is equal to or less than the design LHGR corrected for densification. This LHGR times 1.02 is used in the heatup code along with the exposure dependent steady state gap conductance and rod-to-rod local peaking factor. The Technical Specification AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) is this LHGR of the highest powered rod divided by its local peaking factor.

However, the current General Electric (GE) calculational models (SAFER/GESTR described in Reference 8), which are consistent with the requirements of Appendix K to 10 CFR 50, have established that APLHGR values are not expected to be limited by LOCA/ECCS considerations. APLHGR limits are still required, for GE fuel, to assure that fuel rod mechanical integrity is maintained. They are specified for all GE fuel types in the CORE OPERATING LIMITS REPORT based on the fuel thermal-mechanical design analysis.

The purpose of the power- and flow-dependent MAPLHGR factors specified in the CORE OPERATING LIMITS REPORT is to define operating limits at other than rated core flow and core power conditions. At less than 100% of rated flow or rated power, the required MAPLHGR is the minimum of either (a) the product of the rated MAPLHGR limit and the power-dependent MAPLHGR factor or (b) the product of the rated MAPLHGR limit and the flow-dependent MAPLHGR factor. The power- and flow-dependent MAPLHGR factors assure that the fuel remains within the fuel design basis during transients at off-rated conditions. Methodology for establishing these factors is described in Reference 9.

3/4.2.1 AVERAGE PLANAR LINEAR HEAT GENERATION RATE (Con't)

SPC Fuel

This specification assures that the peak cladding temperature of ~~SPC~~ the fuel following a postulated design basis loss-of-coolant accident will not exceed the peak cladding temperature (PCT) and maximum oxidation limits specified in 10 CFR 50.46. The calculational procedure used to establish the AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) limits is based on a loss-of-coolant accident analysis. The analysis is performed using calculational models which are consistent with the requirements of APPENDIX K to 10 CFR Part 50. The models are described in Reference 1. for SPC and Reference 8 for GE.

The PCT following a postulated loss-of-coolant accident is primarily a function of the average heat generation rate of all the rods of a fuel assembly at any axial location and is not strongly influenced by the rod-to-rod power distribution within the assembly.

The AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) limits for two-loop operation are specified in the CORE OPERATING LIMITS REPORT (COLR).

For single-loop operation, an APLHGR limit corresponding to the product of the two-loop limit and a reduction factor specified in the COLR can be conservatively used to ensure that the PCT for single-loop operation is bound by the PCT for two-loop operation.

3/4.2.4 LINEAR HEAT GENERATION RATE

DELETE

GE Fuel

The specification assures that the LINEAR HEAT GENERATION RATE (LHGR) in any rod is less than the design linear heat generation even if fuel pellet densification is postulated. The effects of fuel densification are discussed in the General Electric Standard Application for Reactor Fuel (GESTAR), NEDE-24011-P-A. The GESTAR discusses the methods used to ensure LHGR remains below the design limit.

SPC Fuel

The Linear Heat Generation Rate (LHGR) is a measure of the heat generation rate per unit length of a fuel rod in a fuel assembly at any axial location. LHGR limits are specified to ensure that fuel integrity limits are not exceeded during normal operation or anticipated operational occurrences (AOOs). Operation above the LHGR limit followed by the occurrence of an AOO could potentially result in fuel damage and subsequent release of radioactive material. Sustained operation in excess of the LHGR limit could also result in exceeding the fuel design limits. The failure mechanism prevented by the LHGR limit that could cause fuel damage during AOOs is rupture of the fuel rod cladding caused by strain from the expansion of the fuel pellet. One percent plastic strain of the fuel cladding has been defined as the limit below which fuel damage caused by overstraining of the fuel cladding is not expected to occur. Fuel design evaluations are performed to demonstrate that the mechanical design limits are not exceeded during continuous operation with LHGRs up to the limit defined in the CORE OPERATING LIMITS REPORT. The analysis also includes allowances for short term transient operation above the LHGR limit.

flow dependent multiplier

At reduced power and flow conditions, the LHGR limit may need to be reduced to ensure adherence to the fuel mechanical design bases during limiting transients. At reduced power and flow conditions, the LHGR limit is reduced (multiplied) using the smaller of either the flow-dependent LHGR ~~factor~~ multiplier ($LHGRFAC_f$) or the power-dependent LHGR factor ($LHGRFAC_p$) corresponding to the existing core flow and power. The $LHGRFAC_f$ multipliers are used to protect the core during slow flow runout transients. The $LHGRFAC_p$ multipliers are used to protect the core during plant transients other than core flow transients. The applicable $LHGRFAC_f$ and $LHGRFAC_p$ multipliers are specified in the CORE OPERATING LIMITS REPORT.

power dependent

flow dependent multipliers power dependent

References:

1. Advanced Nuclear Fuels Corporation Methodology for Boiling Water Reactors EXEM BWR ECCS Evaluation Model, ANF-91-048(P)(A), Advanced Nuclear Fuels Corporation, January 1993 and ANF-91-048(P)(A), Supplement 1 and Supplement 2, "BWR Jet Pump Model Revision for RELAX," October 1997.

Administrative Technical Requirements

Appendix A (Amendment 38)

LaSalle Unit 1 Cycle 9

Core Operating Limits Report

and

Reload Transient Analysis Results

May 2000

Section 1

LaSalle Unit 1 Cycle 9

Core Operating Limits Report

May 2000

Issuance of Changes Summary

Affected Section	Affected Pages	Summary of Changes	Date
All	All	Original Issue (Cycle 9)	10/99
All	All	Incorporated administrative changes (including updating the date to be November 1999)	11/99
All	All	Incorporated changes to thermal limits due to uprate and MELLLA operation, revised LHGR and MAPLHGR limits, CBH penalties, and necessary administrative changes.	5/00

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4. Control Rod Withdrawal Block Instrumentation (3/4.3.6) **4-1**

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4.2 Description 4-1

5. Allowed Modes of Operation (B 3/4.2.3, B3/4.2.4) **5-1**

6. Traversing In-Core Probe System (3/4.2.1, 3/4.2.3, 3/4.2.4) **6-1**

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References

1. Commonwealth Edison Company Docket No. 50-373, LaSalle County Station, Unit 1 Facility Operating License, License No. NPF-11.

2. Letter from D. M. Crutchfield to All Power Reactor Licensees and Applicants, Generic Letter 88-16; Concerning the Removal of Cycle-Specific Parameter Limits from Tech Specs, dated October 4, 1988.

3. LaSalle Unit 1 Cycle 9 Neutronics Licensing Report (NLR), NDIT NFM9900149, Sequence No. 00, October 1999.

4. LaSalle Unit 1 Cycle 9 Reload Analysis, EMF-2276, Revision 1, October, 1999.

5. LaSalle Unit 1 Cycle 9 Plant Transient Analysis, EMF-2277, Revision 1, October, 1999.

6. LOCA Break Spectrum Analysis for LaSalle Units 1 and 2, EMF-2174(P), March 1999.

7. LaSalle LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM-9B fuel, EMF-2175(P), March 1999.

8. LaSalle Extended Operating Domain (EOD) and Equipment Out of Service (EOOS) Safety Analysis for ATRIUM-9B Fuel, EMF-95-205(P), Rev. 2, June 1996.

9. ARTS Improvement Program analysis for LaSalle County Station Units 1 and 2, NEDC-31531P, December 1993 and Supplement 1, June 1998 (Removal of Direct Scram Bypassed Limit).

10. Lattice-Dependent MAPLHGR Report for LaSalle County Station Unit 1 Reload 7 Cycle 8, 24A5180AA Revision 0, December 1995.

11. Lattice-Dependent MAPLHGR Report for LaSalle County Station Unit 1 Reload 6 Cycle 7, 23A7231AA, Rev.0, December 1993.

12. LaSalle Unit 1 Cycle 9 Principal Transient Analysis Parameters, EMF-96-189, May 1999.

13. General Electric Standard Application for Reactor Fuel (GESTAR), NEDE-24011-P-A-13, August 1996.

14. "Project Task Report, LaSalle County Station, Power uprate Evaluation, Task 407: ECCS Performance," GE report number GE-NE-A1300384-39-01, Revision 0, Class 3, dated September 1999.

15. Evaluation of a Postulated Slow Turbine Control Valve Closure Event for LaSalle County Station, Units 1 and 2, GE-NE-187-13-0792, Revision 2, July 1998.

16. Transient Analysis Evaluation for LaSalle 3 TCV Operation at Power Uprate and MELLLA Conditions, NFM:BSA:00-025, R.W. Tsai to D. Bost, April 13, 2000.

17. Updated Transient Analysis: Abnormal Start-up of an Idle Recirculation Loop for LaSalle County Nuclear Station, Units 1 and 2, B33-00296-03P, March 1998.

18. "TIP Symmetry Testing", JHR:97:021, J.H. Riddle to R. Chin, January 20, 1997 and "TIP Symmetry Testing", DEG:99:085, D.Garber to R. Chin, March 23, 1999

19. "Use of SUBTIP Methodology with TIP Symmetry Testing Above 50 Percent Power", DEG:99:087, D. Garber to R.Chin, March 24, 1999

20. "On-Site and Off-Site Reviews of the GE Turbine Control Valve Slow Closure Analysis", T.Rieck to G.Spedl, NFS:BSS:93-117, May 19, 1993.

21 "LaSalle Units 1 and 2 Operating Limits with Multiple Equipment Out of Service (EOOS)", NFS:BSA:95-024, April 6, 1995.

22. NFM Calculation No. BSA-L-99-07, MAPFACf Thermal Limit Multiplier for 105% Maximum Core Flow

23. "Evaluation of CBH Effects on Fresh Fuel for LaSalle Unit 1 Cycle 9", DEG:00:025, D. Garber to R. Chin, February 25, 2000.

24. "ComEd GE9/GE10 LHGR Improvement Program" J11-03692-LHGR, Revision 1, February 2000.

25. "LaSalle County Station Power Uprate Project", Task 201: Reactor Power/Flow Map, GE-NE-A1300384-07-01, Revision 1, September 1999

Administrative Technical Requirements - Appendix A
L1C9 Core Operating Limits Report

1. Average Planar Linear Heat Generation Rate (APLHGR) (3/4.2.1)

1.1 Tech Spec Reference:
Tech Spec 3.2.1

1.2 Description:
1.2.1 GE Fuel

The MAPLHGR Limit is determined using the Lattice-Type MAPLHGR limits from Table 1.2 multiplied by the MAPFAC multipliers as indicated in Table 1.1.

TABLE 1.1

Inoperable Equipment	**GE Fuel MAPFAC** For All Power and Flow Levels
None	1.0
Feedwater Heater(s) Out of Service [1]	1.0
Single RR Loop	Figure 1.2-1 and 1.2-2
Abnormal Idle Loop Startup (UFSAR 15.4.4)	Figure 1.2-1 and 1.2-2
Turbine Bypass Valves Out of Service	1.0
EOC Recirculation Pump Trip OOS	1.0
TCV Slow Closure/EOC Recirculation Pump Trip OOS	1.0
TCV(s) Slow Closure / EOC-Recirculation Pump Trip OOS / Feedwater Heater(s) OOS[1]	1.0
Turbine Bypass Valves OOS / Feedwater Heater(s) OOS[1]	1.0
EOC-Recirculation Pump Trip OOS / Feedwater Heater(s) OOS[1]	1.0

1. Up to 100°F reduction (to 326.5°F) in feedwater temperature allowed at full power with Feedwater Heaters Out-of-Service (reduction varies at off-rated power levels). Up to 13°F reduction in feedwater temperature from nominal allowed at all power levels without feedwater heaters considered Out-of-Service.

TABLE 1.2
(Reference 3)

Table for Fuel-Type MAPLHGR Limits	Fuel Type	Cycle First Inserted
1.2-1	GE9B-P8CWB322-11GZ-100M-150-T	7
1.2-2	GE9B-P8CWB320-9GZ-100M-150-T	7
1.2-3	GE9B-P8CWB343-12GZ-80M-150-T	8
1.2-4	GE9B-P8CWB342-10GZ-80M-150-T	8

1.2.2 SPC Fuel

The MAPLHGR Limit is the Lattice-Type MAPLHGR Limit. The Lattice-Type Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) limits are determined from the table given below:

Fuel Type	Cycle First Inserted
SPCA9-393B-16GZ-100M	9
SPCA9-396B-12GZB-100M	9
SPCA9-384B-11GZ6-80M	9
SPCA9-396B-12GZC-100M	9

(References 3 and 4)

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 4 and 7)

For single loop operation (or Abnormal Idle Loop Startup, UFSAR 15.4.4), the MAPLHGR multiplier for SPC fuel is 0.90.
(References 4, 6 and 7)

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

(References 11 and 24)

Table 1.2-1

Exposure (MWD/ST)	Lattice Specific MAPLHGR limit (KW/ft)					
0	12.74	12.09	11.65	11.25	12.11	12.74
200	12.67	12.13	11.70	11.32	12.15	12.67
1000	12.48	12.22	11.83	11.46	12.25	12.48
2000	12.42	12.35	12.00	11.61	12.39	12.42
3000	12.41	12.48	12.14	11.77	12.54	12.41
4000	12.44	12.62	12.28	11.94	12.70	12.44
5000	12.46	12.77	12.43	12.11	12.86	12.46
6000	12.49	12.90	12.58	12.29	13.02	12.49
7000	12.51	13.03	12.73	12.46	13.19	12.51
8000	12.54	13.16	12.88	12.64	13.33	12.54
9000	12.55	13.30	13.01	12.82	13.43	12.55
10000	12.57	13.42	13.12	12.98	13.44	12.57
12500	12.41	13.41	13.08	13.04	13.40	12.41
15000	12.04	13.05	12.78	12.77	13.06	12.04
20000	11.27	12.38	12.16	12.16	12.40	11.27
25000	10.49	11.74	11.51	11.51	11.76	10.49
27215.6	12.314	12.314	12.314	12.314	12.314	12.314
48080.8	10.800	10.800	10.800	10.800	10.800	10.800
58967.1	6.000	6.000	6.000	6.000	6.000	6.000
Lattice No.	733	1817	1818	1819	1820	1821

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) vs. Average Planar Exposure for Fuel Type GE9B-P8CWB320-9GZ-100M-150-T

(References 11 and 24)

Table 1.2-2

Exposure (MWD/ST)	Lattice Specific MAPLHGR limit (kw/ft)					
0	12.74	12.05	11.62	11.10	12.09	12.74
200	12.67	12.09	11.64	11.15	12.14	12.67
1000	12.48	12.19	11.73	11.27	12.25	12.48
2000	12.42	12.32	11.86	11.44	12.39	12.42
3000	12.41	12.44	11.99	11.62	12.53	12.41
4000	12.44	12.57	12.13	11.80	12.67	12.44
5000	12.46	12.70	12.27	11.96	12.81	12.46
6000	12.49	12.83	12.42	12.09	12.89	12.49
7000	12.51	12.97	12.54	12.23	12.98	12.51
8000	12.54	13.07	12.62	12.37	13.07	12.54
9000	12.55	13.15	12.70	12.51	13.15	12.55
10000	12.57	13.20	12.77	12.66	13.22	12.57
12500	12.41	13.19	12.70	12.67	13.20	12.41
15000	12.04	12.89	12.40	12.40	12.90	12.04
20000	11.27	12.29	11.82	11.82	12.30	11.27
25000	10.49	11.69	11.25	11.25	11.70	10.49
27215.6	12.314	12.314	12.314	12.314	12.314	12.314
48080.8	10.800	10.800	10.800	10.800	10.800	10.800
58967.1	6.000	6.000	6.000	6.000	6.000	6.000
Lattice No.	733	1812	1813	1814	1815	1816

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) vs. Average Planar Exposure for Fuel Type GE9B-P8CWB343-12GZ-80M-150-T

(References 10 and 24)

Table 1.2-3

Exposure (MWD/ST)	Lattice Specific MAPLHGR limit (kw/ft)				
0	12.66	11.69	11.37	10.92	12.66
200	12.59	11.71	11.43	10.99	12.59
1000	12.40	11.78	11.55	11.13	12.40
2000	12.34	11.95	11.72	11.33	12.34
3000	12.34	12.16	11.91	11.54	12.34
4000	12.37	12.40	12.11	11.76	12.37
5000	12.40	12.67	12.32	12.00	12.40
6000	12.43	12.90	12.53	12.24	12.43
7000	12.46	13.05	12.76	12.49	12.46
8000	12.48	13.21	12.98	12.75	12.48
9000	12.50	13.37	13.13	13.01	12.50
10000	12.51	13.54	13.30	13.22	12.51
12500	12.35	13.75	13.60	13.57	12.35
15000	11.98	13.48	13.23	13.21	11.98
20000	11.20	12.71	12.40	12.37	11.20
25000	10.42	11.92	11.60	11.57	10.42
27215.6	12.314	12.314	12.314	12.314	12.314
48080.8	10.800	10.800	10.800	10.800	10.800
58967.1	6.000	6.000	6.000	6.000	6.000
Lattice No.	732	2083	2084	2085	2086

Maximum Average Planar Linear Heat Generation Rate (MAPLHGR) vs. Average Planar Exposure for Fuel Type GE9B-P8CWB342-10GZ-80M-150-T

(References 10 and 24)

Table 1.2-4

Exposure (MWD/ST)	Lattice Specific MAPLHGR limit (kw/ft)					
0	12.66	12.04	12.25	11.72	12.09	12.66
200	12.59	12.08	12.28	11.77	12.12	12.59
1000	12.40	12.16	12.35	11.87	12.22	12.40
2000	12.34	12.28	12.45	12.00	12.37	12.34
3000	12.34	12.42	12.55	12.13	12.53	12.34
4000	12.37	12.57	12.65	12.27	12.70	12.37
5000	12.40	12.73	12.76	12.41	12.88	12.40
6000	12.43	12.89	12.87	12.56	13.07	12.43
7000	12.46	13.06	12.98	12.72	13.27	12.46
8000	12.48	13.24	13.10	12.88	13.47	12.48
9000	12.50	13.42	13.21	13.05	13.65	12.50
10000	12.51	13.61	13.31	13.21	13.76	12.51
12500	12.35	13.79	13.35	13.31	13.82	12.35
15000	11.98	13.50	13.06	13.05	13.51	11.98
20000	11.20	12.79	12.47	12.45	12.79	11.20
25000	10.42	11.95	11.67	11.63	11.95	10.42
27215.6	12.314	12.314	12.314	12.314	12.314	12.314
48080.8	10.800	10.800	10.800	10.800	10.800	10.800
58967.1	6.000	6.000	6.000	6.000	6.000	6.000
Lattice No.	732	2087	2088	2089	2090	2091

Figure 1.2-1 Power-Dependent SLO and Abnormal Idle Loop Startup MAPLHGR Multipliers for GE Fuel, $MAPFAC_P$

(Reference 9 and 24)

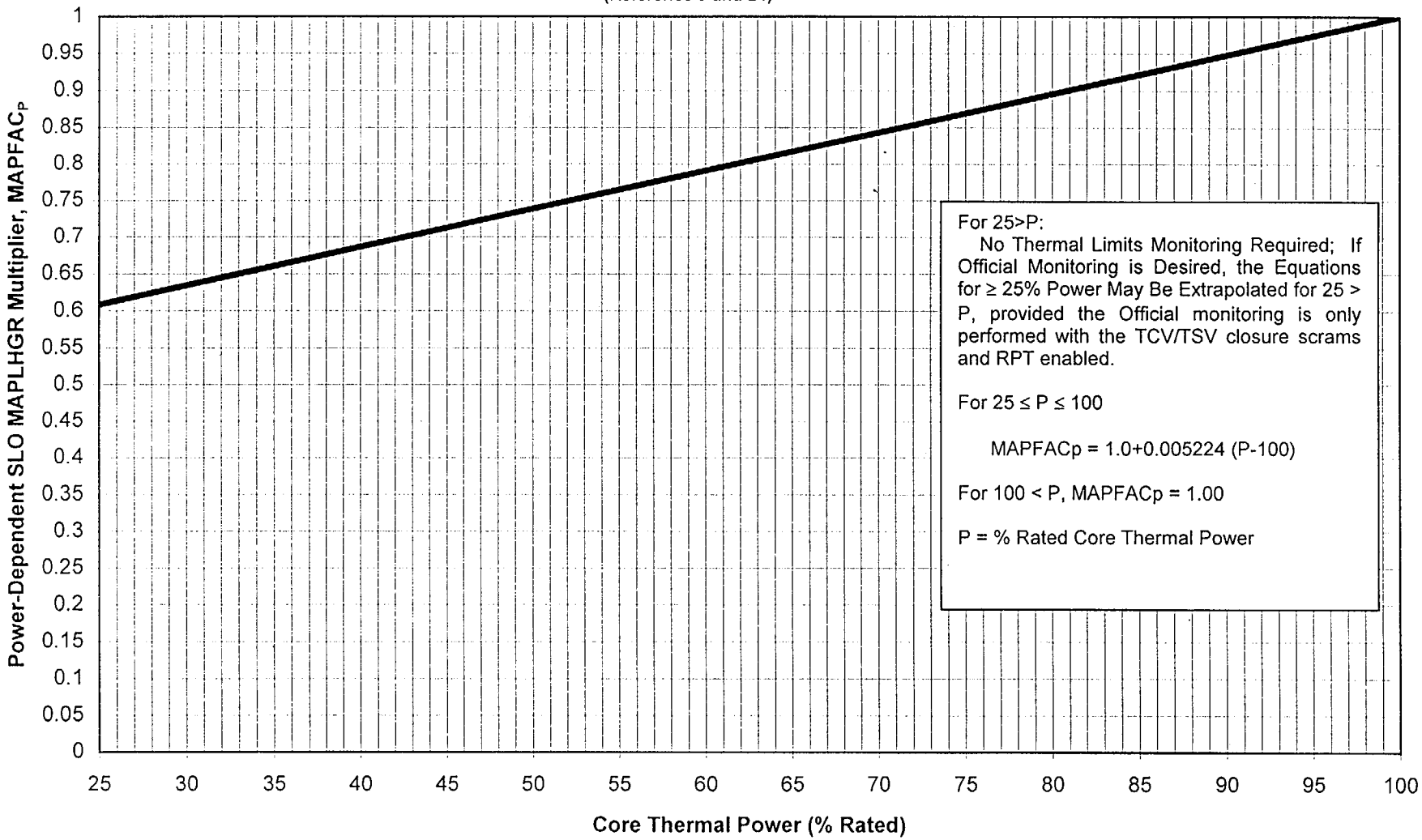
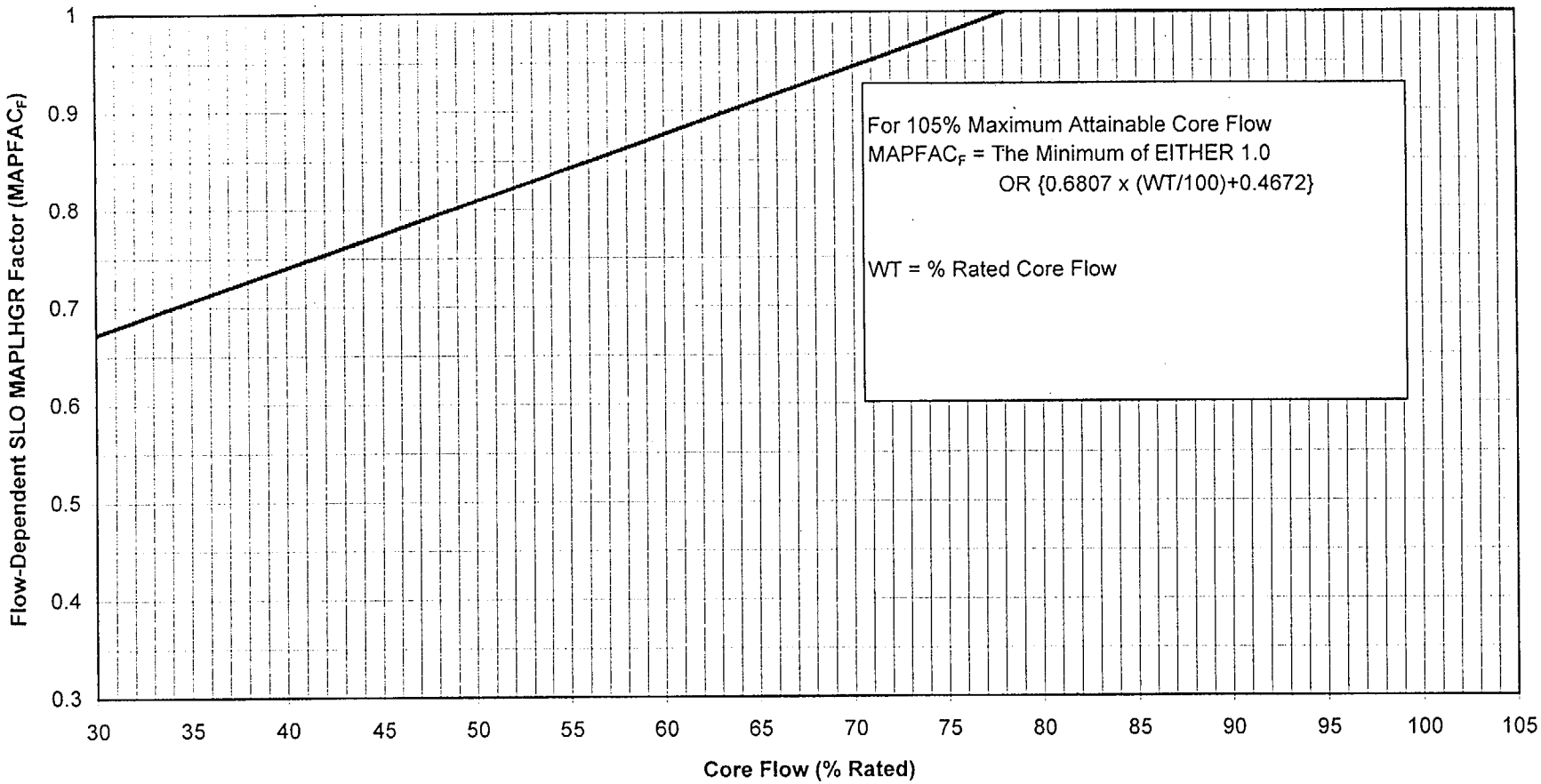


Figure 1.2-2 Flow-Dependent SLO and Abnormal Idle Loop Startup MAPLHGR Multiplier for GE Fuel, $MAPFAC_F$

(References 9, 17, 22, and 24)



2. Minimum Critical Power Ratio (3/4.2.3)

2.1 Tech Spec Reference:

Tech Spec 3.2.3.

2.2 Description:

MCPR limits in this COLR are applicable up to a core average exposure of 29,439 MWd/MTU (which is the licensing basis exposure used by SPC). (Reference 4)

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 ($MCPR_P$)** (Reference 3, 4, and 23)

2.2.1.1.1 GE Fuel
Table 2-1 gives the $MCPR_P$ limit as a function of core thermal power for Tech Spec Scram Speeds. Table 2-2 gives the $MCPR_P$ limit as a function of core thermal power for Nominal Scram Speeds*.

2.2.1.1.2 Siemens Fuel
Table 2-3 gives the $MCPR_P$ limit as a function of core thermal power for Tech Spec Scram Speeds. Table 2-4 gives the $MCPR_P$ limit as a function of core thermal power for Nominal Scram Speeds*.

Note that the 10B rods are defined by the control cell locations 14-39, 22-15, 46-23, 38-47, 14-23, 38-15, 46-39, and 22-47.

2.2.1.2 Flow-Dependent MCPR ($MCPR_F$) (Reference 4)

Table 2-5 gives the $MCPR_F$ limit as a function of flow.

2.2.2 Automatic Flow Control MCPR Limits

Automatic Flow Control MCPR Limits are not provided for L1C9.

* To utilize the MCPR limits for Nominal Scram Speeds, the core average scram speed insertion times must be equal to or less than the following values at the given notch positions:

	Notch Position 45	39	25	05
Time (sec)	0.380	0.680	1.680	2.680

(Reference 5 and 12)

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

$MCPR_P$ for Tech Spec Scram Speeds and GE Fuel

(References 3, 4, and 5)

Table 2-1

Operation from BOC to LFPC

	Percent Core Thermal Power*						
EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.70	2.20	2.10	1.57	1.53		1.49
Feedwater Heater(s)	2.85	2.35	2.35	1.62			1.49
Single RR Loop	2.71	2.21	2.11	1.58	1.54		1.50
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.71	2.54	2.54	2.54			2.54
Turbine Bypass Valves	2.70	2.20	2.15	1.65			1.51
EOC Recirc Pump Trip	2.70	2.20	2.10	1.63			1.55
EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.69	1.67	1.58
TCV Slow Closure/EOC Recirc Pump Trip	2.70	2.20	2.15		1.69	1.67	1.58
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.69	1.67	1.58

Coastdown Operation**

* 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.

** Coastdown limits are not provided in this COLR.

$MCPR_P$ for Nominal Scram Speeds and GE Fuel

(References 3, 4, and 5)

Table 2-2

Operation from BOC to LFPC

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.70	2.20	2.05	1.56	1.51		1.45
Feedwater Heater(s)	2.85	2.35	2.35	1.62			1.49
Single RR Loop	2.71	2.21	2.06	1.57	1.52		1.46
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.71	2.54	2.54	2.54			2.54
Turbine Bypass Valves	2.70	2.20	2.15	1.65			1.51
EOC Recirc Pump Trip	2.70	2.20	2.10	1.63			1.55
EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.69	1.67	1.58
TCV Slow Closure/EOC Recirc Pump Trip	2.70	2.20	2.15		1.69	1.67	1.58
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.69	1.67	1.58

Coastdown Operation**

* 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.

** Coastdown limits are not provided in this COLR.

$MCPR_P$ for Tech Spec Scram Speeds and Siemens Fuel

(References 3, 4, 5 & 23)

Table 2-3

OPERATION FROM BOC TO ROD PATTERN TARGETED FOR APPROXIMATELY 9000 MWD/MTU

All SPC fuel except fuel type 36 in 10B cell locations and fuel type 46 and 47 in A1 cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.70	2.20	2.05	1.56	1.51		1.45
Feedwater Heater(s)	2.85	2.35	2.35	1.62			1.45
Single RR Loop	2.71	2.21	2.06	1.57	1.52		1.46
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.71	2.54	2.54	2.54			2.54
Turbine Bypass Valves	2.70	2.20	2.15	1.63			1.47
EOC Recirc Pump Trip	2.70	2.20	2.05	1.60			1.50
EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip	2.70	2.20	2.15		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54

SPC fuel that is fuel type 36 in 10B cell locations and fuel type 46 and 47 in A1 cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.74	2.24	2.09	1.60	1.55		1.47
Feedwater Heater(s)	2.89	2.39	2.39	1.66			1.47
Single RR Loop	2.75	2.25	2.10	1.61	1.56		1.48
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.75	2.58	2.58	2.58			2.56
Turbine Bypass Valves	2.74	2.24	2.19	1.67			1.49
EOC Recirc Pump Trip	2.74	2.24	2.09	1.64			1.52
EOC Recirc Pump Trip/Feedwater Heater(s)	2.89	2.39	2.39		1.69	1.65	1.56
TCV Slow Closure/EOC Recirc Pump Trip	2.74	2.24	2.19		1.69	1.65	1.56
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.89	2.39	2.39		1.69	1.65	1.56

Coastdown Operation**

* 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.

** Coastdown limits are not provided in this COLR.

$MCPR_P$ for Tech Spec Scram Speeds and Siemens Fuel

(References 3, 4, 5 & 23)

Table 2-3 (cont.)

OPERATION FROM ROD PATTERN TARGETED FOR APPROXIMATELY 9000 MWD/MTU TO ROD PATTERN TARGETED FOR APPROXIMATELY 12,000 MWD/MTU

All SPC fuel except fuel type 36 in 10B cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.70	2.20	2.05	1.56	1.51		1.45
Feedwater Heater(s)	2.85	2.35	2.35	1.62			1.45
Single RR Loop	2.71	2.21	2.06	1.57	1.52		1.46
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.71	2.54	2.54	2.54			2.54
Turbine Bypass Valves	2.70	2.20	2.15	1.63			1.47
EOC Recirc Pump Trip	2.70	2.20	2.05	1.60			1.50
EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip	2.70	2.20	2.15		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54

Only SPC fuel type 36 in 10B cells

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.72	2.22	2.07	1.58	1.53		1.45
Feedwater Heater(s)	2.87	2.37	2.37	1.64			1.45
Single RR Loop	2.73	2.23	2.08	1.59	1.54		1.46
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.73	2.56	2.56	2.56			2.54
Turbine Bypass Valves	2.72	2.22	2.17	1.65			1.47
EOC Recirc Pump Trip	2.72	2.22	2.07	1.62			1.50
EOC Recirc Pump Trip/Feedwater Heater(s)	2.87	2.37	2.37		1.67	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip	2.72	2.22	2.17		1.67	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.87	2.37	2.37		1.67	1.63	1.54

Coastdown Operation**

* 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.

** Coastdown limits are not provided in this COLR.

$MCPR_P$ for Tech Spec Scram Speeds and Siemens Fuel

(References 3, 4, 5 & 23)

Table 2-3 (cont.)

OPERATION FROM ROD PATTERN TARGETED FOR APPROXIMATELY 12000 MWD/MTU TO LFPC

All SPC fuel except fuel type 36 in 10B cell locations and fuel type 46 and 47 in A1 cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.70	2.20	2.05	1.56	1.51		1.45
Feedwater Heater(s)	2.85	2.35	2.35	1.62			1.45
Single RR Loop	2.71	2.21	2.06	1.57	1.52		1.46
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.71	2.54	2.54	2.54			2.54
Turbine Bypass Valves	2.70	2.20	2.15	1.63			1.47
EOC Recirc Pump Trip	2.70	2.20	2.05	1.60			1.50
EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip	2.70	2.20	2.15		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54

SPC fuel that is fuel type 36 in 10B cell locations and fuel type 46 and 47 in A1 cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.74	2.24	2.09	1.60	1.55		1.47
Feedwater Heater(s)	2.89	2.39	2.39	1.66			1.47
Single RR Loop	2.75	2.25	2.10	1.61	1.56		1.48
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.75	2.58	2.58	2.58			2.56
Turbine Bypass Valves	2.74	2.24	2.19	1.67			1.49
EOC Recirc Pump Trip	2.74	2.24	2.09	1.64			1.52
EOC Recirc Pump Trip/Feedwater Heater(s)	2.89	2.39	2.39		1.69	1.65	1.56
TCV Slow Closure/EOC Recirc Pump Trip	2.74	2.24	2.19		1.69	1.65	1.56
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.89	2.39	2.39		1.69	1.65	1.56

Coastdown Operation**

* 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.

** Coastdown limits are not provided in this COLR.

$MCPR_P$ for Nominal Scram Speeds and Siemens Fuel

(References 3, 4, 5 & 23)

Table 2-4

OPERATION FROM BOC TO ROD PATTERN TARGETED FOR APPROXIMATELY 9000 MWD/MTU

All SPC fuel except fuel type 36 in 10B cell locations and fuel type 46 and 47 in A1 cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.70	2.20	2.05	1.54	1.48		1.42
Feedwater Heater(s)	2.85	2.35	2.35	1.62			1.45
Single RR Loop	2.71	2.21	2.06	1.55	1.49		1.43
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.71	2.54	2.54	2.54			2.54
Turbine Bypass Valves	2.70	2.20	2.15	1.63			1.47
EOC Recirc Pump Trip	2.70	2.20	2.05	1.60			1.50
EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip	2.70	2.20	2.15		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54

SPC fuel that is fuel type 36 in 10B cell locations and fuel type 46 and 47 in A1 cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.74	2.24	2.09	1.58	1.52		1.44
Feedwater Heater(s)	2.89	2.39	2.39	1.66			1.47
Single RR Loop	2.75	2.25	2.10	1.59	1.53		1.45
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.75	2.58	2.58	2.58			2.56
Turbine Bypass Valves	2.74	2.24	2.19	1.67			1.49
EOC Recirc Pump Trip	2.74	2.24	2.09	1.64			1.52
EOC Recirc Pump Trip/Feedwater Heater(s)	2.89	2.39	2.39		1.69	1.65	1.56
TCV Slow Closure/EOC Recirc Pump Trip	2.74	2.24	2.19		1.69	1.65	1.56
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.89	2.39	2.39		1.69	1.65	1.56

Coastdown Operation**

* 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.

** Coastdown limits are not provided in this COLR.

$MCPR_P$ for Nominal Scram Speeds and Siemens Fuel

(References 3, 4, 5 & 23)

Table 2-4 (cont.)

OPERATION FROM ROD PATTERN TARGETED FOR APPROXIMATELY 9000 MWD/MTU TO ROD PATTERN TARGETED FOR APPROXIMATELY 12,000 MWD/MTU

All SPC fuel <u>except</u> fuel type 36 in 10B cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.70	2.20	2.05	1.54	1.48		1.42
Feedwater Heater(s)	2.85	2.35	2.35	1.62			1.45
Single RR Loop	2.71	2.21	2.06	1.55	1.49		1.43
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.71	2.54	2.54	2.54			2.54
Turbine Bypass Valves	2.70	2.20	2.15	1.63			1.47
EOC Recirc Pump Trip	2.70	2.20	2.05	1.60			1.50
EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip	2.70	2.20	2.15		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54

Only SPC fuel type 36 in 10B cells

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.72	2.22	2.07	1.56	1.50		1.42
Feedwater Heater(s)	2.87	2.37	2.37	1.64			1.45
Single RR Loop	2.73	2.23	2.08	1.57	1.51		1.43
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.73	2.56	2.56	2.56			2.54
Turbine Bypass Valves	2.72	2.22	2.17	1.65			1.47
EOC Recirc Pump Trip	2.72	2.22	2.07	1.62			1.50
EOC Recirc Pump Trip/Feedwater Heater(s)	2.87	2.37	2.37		1.67	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip	2.72	2.22	2.17		1.67	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.87	2.37	2.37		1.67	1.63	1.54

Coastdown Operation**

* 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.

** Coastdown limits are not provided in this COLR.

$MCPR_P$ for Nominal Scram Speeds and Siemens Fuel

(References 3, 4, 5 & 23)

Table 2-4 (cont.)

OPERATION FROM ROD PATTERN TARGETED FOR APPROXIMATELY 12000 MWD/MTU TO LFPC

All SPC fuel <u>except</u> fuel type 36 in 10B cell locations and fuel type 46 and 47 in A1 cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.70	2.20	2.05	1.54	1.48		1.42
Feedwater Heater(s)	2.85	2.35	2.35	1.62			1.45
Single RR Loop	2.71	2.21	2.06	1.55	1.49		1.43
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.71	2.54	2.54	2.54			2.54
Turbine Bypass Valves	2.70	2.20	2.15	1.63			1.47
EOC Recirc Pump Trip	2.70	2.20	2.05	1.60			1.50
EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip	2.70	2.20	2.15		1.65	1.63	1.54
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.85	2.35	2.35		1.65	1.63	1.54

SPC fuel that is fuel type 36 in 10B cell locations and fuel type 46 and 47 in A1 cell locations

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	2.74	2.24	2.09	1.58	1.52		1.44
Feedwater Heater(s)	2.89	2.39	2.39	1.66			1.47
Single RR Loop	2.75	2.25	2.10	1.59	1.53		1.45
Abnormal Idle Loop Startup (UFSAR 15.4.4)	2.75	2.58	2.58	2.58			2.56
Turbine Bypass Valves	2.74	2.24	2.19	1.67			1.49
EOC Recirc Pump Trip	2.74	2.24	2.09	1.64			1.52
EOC Recirc Pump Trip/Feedwater Heater(s)	2.89	2.39	2.39		1.69	1.65	1.56
TCV Slow Closure/EOC Recirc Pump Trip	2.74	2.24	2.19		1.69	1.65	1.56
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	2.89	2.39	2.39		1.69	1.65	1.56

Coastdown Operation**

* 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.

** Coastdown limits are not provided in this COLR.

$MCPR_F$ for GE and Siemens Fuel

(References 4 & 5)

Table 2-5

MCPRf limits for 105% Maximum Attainable Core Flow

Flow (% rated)	MCPRf ATRIUM-9B	MCPRf GE9
0	1.93	1.93
30	1.93	1.93
102.5	1.14	1.14
105	1.11	1.11

The MCPRf limits are applicable from BOC to LFPC.

3. Linear Heat Generation Rate (3/4.2.4)

3.1 Tech Spec Reference:

Tech Spec 3.2.4.

3.2 Description:

3.2.1 GE Fuel

a. 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 is determined from Figures 3.2-1 through 3.2-3. The following LHGR limits apply for the entire cycle exposure range: (References 9, 14 and 24)

1. GE9B-P8CWB322-11GZ-100M-150-T (bundle 3861 in Reference 24)

Nodal Exposure (GWd/MT)	LHGR Limit (KW/ft)
0.00	14.40
12.34	14.40
26.80	12.31
33.07	11.82
38.58	11.35
44.09	10.94
49.11	10.80
60.89	6.00

2. GE9B-P8CWB320-9GZ-100M-150-T (bundle 3860 in Reference 24)

Nodal Exposure (GWd/MT)	LHGR Limit (KW/ft)
0.00	14.40
12.14	14.40
26.19	12.31
48.16	10.80
59.93	6.00

3. GE9B-P8CWB343-12GZ-80M-150-T (bundle 3866 in Reference 24)

Nodal Exposure (GWd/MT)	LHGR Limit (KW/ft)
0.00	14.40
12.33	14.40
27.86	12.31
49.76	10.80
61.18	6.00

4. GE9B-P8CWB342-10GZ-80M-150-T (bundle 3867 in Reference 24)

Nodal Exposure (GWd/MT)	LHGR Limit (KW/ft)
0.00	14.40
12.71	14.40
27.52	12.31
49.54	10.80
60.95	6.00

3.2.2 Siemens Fuel

The LHGR Limit is the product of the Steady-State LHGR Limit and the minimum of either the power dependent LHGR Factor*, $LHGRFAC_P$ or the flow dependent LHGR Factor, $LHGRFAC_F$. The Steady-State LHGR limits are given below (Reference 4). $LHGRFAC_P$ is determined from Table 3-1 for Technical Specification Scram Speeds and Table 3-2 for Nominal Scram Speeds as defined in Section 2.2. $LHGRFAC_F$ is determined from Table 3-3. SPC LHGRFAC multipliers in this COLR are applicable up to a core average exposure of 29,439 MWd/MTU (which is the licensing basis exposure used by SPC). (Reference 4)

Siemens Fuel Steady-State LHGR Limits for the following fuel types:

1. SPCA9-393B-16GZ-100M
2. SPCA9-396B-12GZB-100M
3. SPCA9-384B-11GZ6-80M
4. SPCA9-396B-12GZC-100M

LHGR limits for all SPC fuel from BOC to LFPC, excluding fuel type 36 in 10B locations from rod pattern targeted for approximately 9000 MWD/MTU to rod pattern targeted for approximately 12,000MWD/MTU.
(Reference 4)

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

LHGR limits for SPC fuel type 36 in 10B locations from rod pattern targeted at approximately 9000 MWD/MTU to rod pattern targeted at approximately 12,000 MWD/MT
(References 4 and 23)

Planar Average Exposure (GWd/MTU)	LHGR limit (kW/ft)
0.0	14.05
15.0	14.05
61.1	7.97

Note that the 10B rods are defined by the control cell locations 14-39, 22-15, 46-23, 38-47, 14-23, 38-15, 46-39, and 22-47.

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

Figure 3.2-1 Power-Dependent LHGR Multipliers for GE fuel (formerly $MAPFAC_P$)

(Reference 9 and 24)

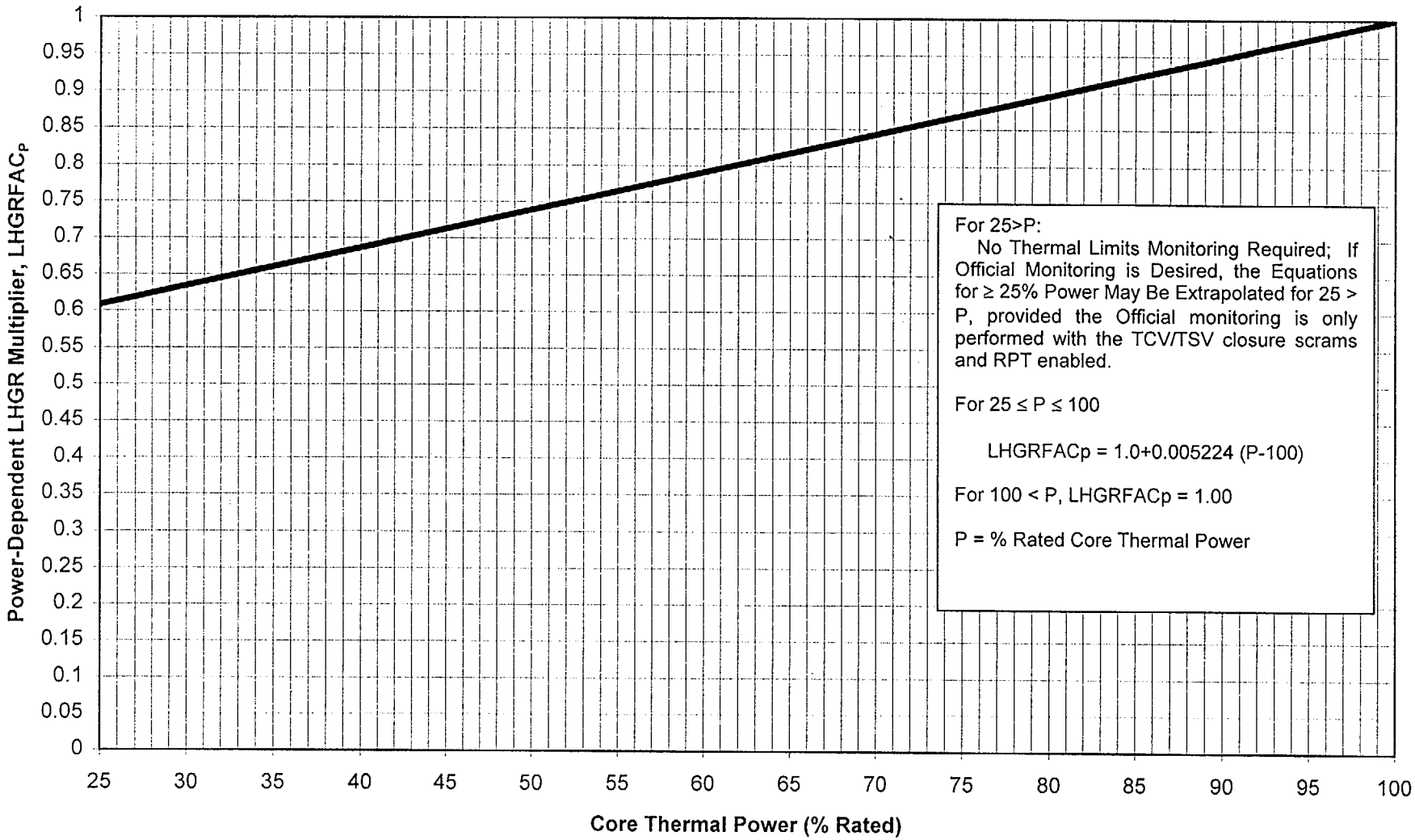


Figure 3.2-2 Power-Dependent LHGR Multiplier for GE Fuel (TCV(s) Slow Closure) (formerly $MAPFAC_P$)

(Reference 15 and 24)

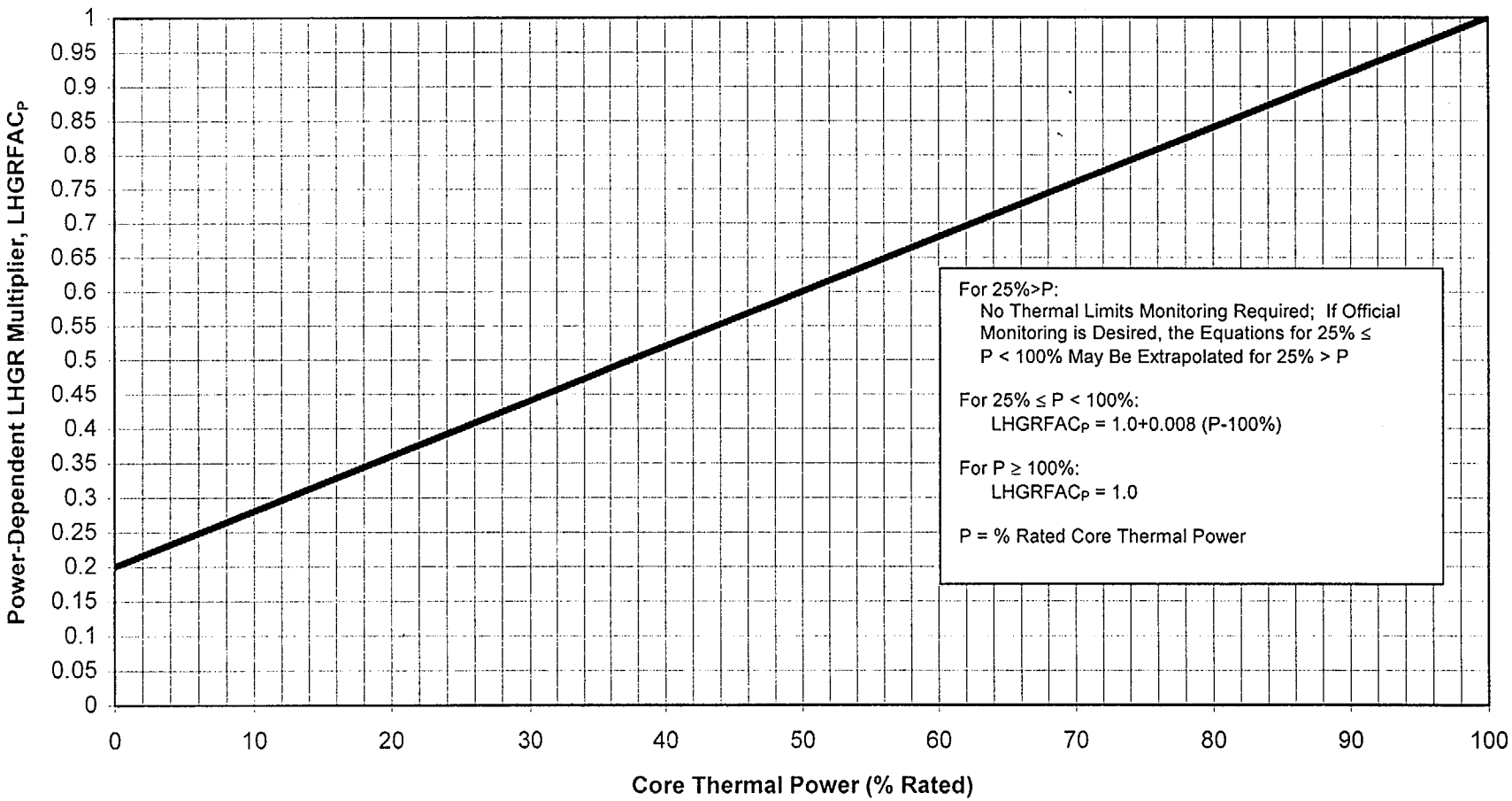
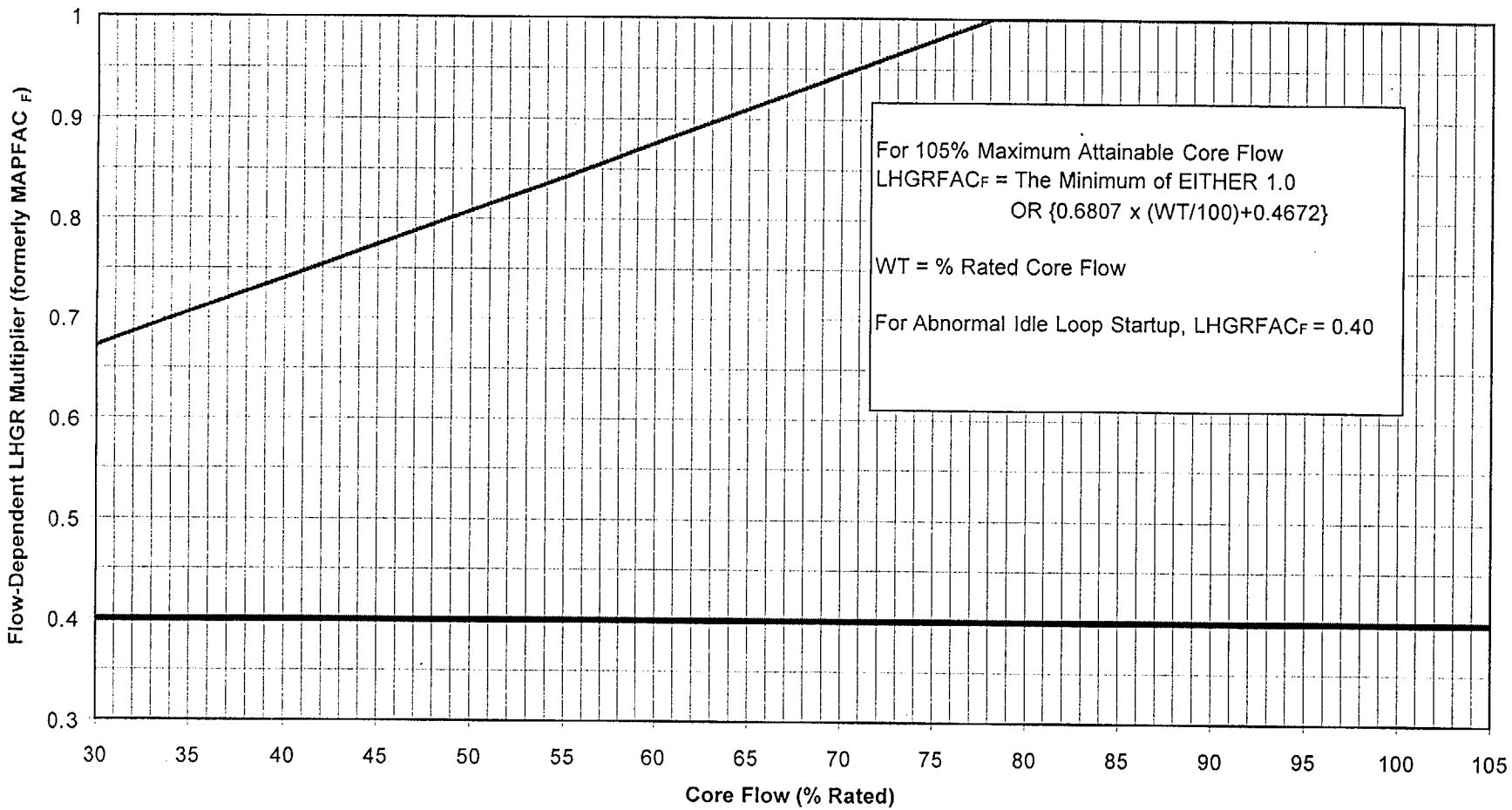


Figure 3.2-3 Flow-Dependent LHGR Multiplier for GE Fuel (formerly $MAPFAC_F$)

(Reference 9 and 17, 22, and 24)



LHGRFAC$_P$ for Siemens Fuel (TSSS Limits)
Table 3-1
(References 4 & 5)

Operation from BOC to LFPC

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	0.67	0.67	0.67	0.94	0.98		1.00
Feedwater Heater(s)	0.65	0.65	0.65	0.90			1.00
Single RR Loop	0.67	0.67	0.67	0.94	0.98		1.00
Abnormal Idle Loop Startup (UFSAR 15.4.4)	0.40	0.40	0.40	0.40			0.40
Turbine Bypass Valves	0.67	0.67	0.67	0.90			0.94
EOC Recirc Pump Trip	0.67	0.67	0.67	0.86			0.86
EOC Recirc Pump Trip/Feedwater Heater(s)	0.64	0.64	0.64		0.86	0.86	0.86
TCV Slow Closure/EOC Recirc Pump Trip	0.67	0.67	0.67		0.86	0.86	0.86
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	0.64	0.64	0.64		0.86	0.86	0.86

Coastdown Operation **

* Values are interpolated between relevant power levels. For operation at exactly 25% or 80% CTP, the more limiting value is used.

** Coastdown Limits are not provided in this COLR

LHGRFAC$_P$ for Siemens Fuel (NSS Times)
Table 3-2
(References 4 & 5)

Operation from BOC to LFPC

Percent Core Thermal Power*

EOOS Combination	0	25	25	60	80	80	100
No EOOS	0.75	0.75	0.75	0.95	1.00		1.00
Feedwater Heater(s)	0.65	0.65	0.65	0.90			1.00
Single RR Loop	0.75	0.75	0.75	0.95	1.00		1.00
Abnormal Idle Loop Startup (UFSAR 15.4.4)	0.40	0.40	0.40	0.40			0.40
Turbine Bypass Valves	0.67	0.67	0.67	0.90			0.94
EOC Recirc Pump Trip	0.67	0.67	0.67	0.86			0.86
EOC Recirc Pump Trip/Feedwater Heater(s)	0.64	0.64	0.64		0.86	0.86	0.86
TCV Slow Closure/EOC Recirc Pump Trip	0.67	0.67	0.67		0.86	0.86	0.86
TCV Slow Closure/EOC Recirc Pump Trip/Feedwater Heater(s)	0.64	0.64	0.64		0.86	0.86	0.86

Coastdown Operation**

* Values are interpolated between relevant power levels. For operation at exactly 25% or 80% CTP, the more limiting value is used.

** Coastdown Limits are not provided in this COLR

$LHGRFAC_F$ for Siemens Fuel

(References 4 & 5)

Table 3-3

Values Applicable for up to 105% Maximum Attainable Core Flow

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

These $LHGRFAC_f$ multipliers apply from BOC to LFPC.

4. Control Rod Withdrawal Block Instrumentation (3/4.3.6)

4.1 Tech Spec Reference:

Tech Spec Table 3.3.6-2.

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 + 45%**	0.66 W + 48%**
Single Recirculation Loop Operation*	0.66 W + 39.7%**	0.66 W + 42.7%**

* 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 3/4.2.3, B 3/4.2.4)

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

Equipment Out of Service Options[1]	----------OPERATING REGION--------- Standard	MELLLA	ICF[7]	Coastdown
None	Yes	Yes	Yes	No
Feedwater Heaters[2] (Reference 9)	Yes	No[3]	Yes	No
Single RR Loop (Reference 9)	Yes	No[8]	N/A	No
Turbine Bypass Valves (Reference 9)	Yes	Yes	Yes	No
EOC Recirculation Pump Trip (Reference 9)	Yes	Yes	Yes	No
TCV Slow Closure/EOC Recirculation Pump Trip (Reference 15)	Yes	Yes	Yes	No
TCV Slow Closure/EOC Recirculation Pump Trip / Feedwater Heaters [2] (Reference 15, 20 and 21)	Yes	No[3]	Yes	No
Turbine Bypass Valves / Feedwater Heaters [2] (Reference 9)	No	No	No[5]	No
EOC Recirculation Pump Trip / Feedwater Heaters [2] (Reference 9)	Yes[4]	No[3]	Yes[4]	No
TCV Stuck Closed[6] (Reference 16)	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 13°F reduction in feedwater temperature (without Feedwater Heaters considered OOS) 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.

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 during non-coastdown operation 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 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 25)

6. Traversing In-Core Probe System (3/4.2.1, 3/4.2.3, 3/4.2.4)

6.1 Tech Spec Reference:

Tech Spec Sections 3/4.2.1, 3/4.2.3, 3/4.2.4 for APLHGR, MCPR, and LHGR 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.

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 during a calibration in the current operating cycle which was performed when the reactor core was operating in an octant symmetric control rod pattern above 50% power, (Reference 19) and

2. The total core TIP uncertainty for the present cycle has been demonstrated to be consistent with the assumptions used in the determination of the MCPR Safety Limit (demonstrated by showing chi squared to be less than 36.19, Reference 18), and

3. 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.

Startup test criteria for symmetric measured TIP differences is that the calculated Chi-squared value shall be less than the critical value at the 1% level of significance; that critical value being 36.19. Compliance is determined based on the values and methodology provided in Reference 18.

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 1 Cycle 9

Reload Transient Analysis Results

May 2000

Administrative Technical Requirements - Appendix A
L1C9 Reload Transient Analysis Results

Table of Contents

Attachment	Preparer	Document
1	ComEd	Neutronics Licensing Report
2	Siemens Power Corporation	Reload Analysis
3	Siemens Power Corporation	Plant Transient Analysis (Excerpts)
4	General Electric	ARTS Improvement Program Supplement 1 (Excerpts)
5	General Electric	TCV Slow Closure (Excerpts)

Attachment 1

LaSalle Unit 1 Cycle 9

Neutronics Licensing Report

NUCLEAR FUEL MANAGEMENT DEPARTMENT
NUCLEAR DESIGN INFORMATION TRANSMITTAL

☒ SAFETY RELATED ☐ NON-SAFETY RELATED ☐ REGULATORY RELATED	Originating Organization ☒ Nuclear Fuel Management ☐ Other (specify) _____	NDIT No. NFM9900149 Seq. No. 00 Page 1 of 27

Station LaSalle Unit 1 Cycle 9 Generic _____

To: Deborah A. Laughton

Subject LaSalle 1 Cycle 9 Neutronics Licensing Report (NLR)

Theodore P. Shannon Preparer	Preparer's Signature	10/7/99 Date
John K. Wheeler Reviewer	Reviewer's Signature	10/7/99 Date
Adelmo S. Pallotta NFM Supervisor	NFM Supervisor's Signature	10/8/99 Date

Status of Information:
☒ Verified
☐ Unverified
☐ Engineering Judgement

Method and Schedule of Verification for Unverified NDITs: _____

Description of Information: Results and bases of neutronics licensings calculations for LaSalle 1 Cycle 9. These calculations cover operation with a rated core power up to 3489 MWt.

Purpose of Information: Provide LaSalle County Station and NFM BSS group with neutronics licensing results.

Source of Information: NFM Calculation Note BNDL:99-050, Revision 0.

Supplemental Distribution: E.A. McVey (LaSalle), Jeff Nugent (LaSalle), Norha Plumey (LaSalle), Adelmo S. Pallotta, Robert W. Tsai, Randall H. Jacobs, LaSalle Central File, DG Central File

Licensing Basis

This document, in conjunction with References 1, 3 and 4 in Section VIII, provides the licensing basis for LaSalle County Station Unit 1 Reload 8, Cycle 9.

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I. Nuclear Design

I.1 New Reload Fuel Assembly Nuclear Design

I.1.1 Assembly Average Enrichment

Assembly Name	Batch Identifier	Enrichment (w/o U-235)
SPCA9-393B-16GZ-100M	19A	3.93
SPCA9-396B-12GZB-100M	19B	3.96
SPCA9-396B-12GZC-100M	19C	3.96
SPCA9-384B-11GZ6-80M	28B	3.84

I.1.2 Axial Enrichment and Burnable Poison Distribution

Assembly Name	Batch Identifier	Figure
SPCA9-393B-16GZ-100M	19A	1
SPCA9-396B-12GZB-100M	19B	1
SPCA9-396B-12GZC-100M	19C	1
SPCA9-384B-11GZ6-80M	28B	2

I.1.3 Radial Enrichment and Burnable Poison Distribution

Lattice Name	Batch Found In	Figure
SPCA9-4.56L-12G8.0/4G3.0-100M	19A	3
SPCA9-4.56L-12G8.0-100M	19A	4
SPCA9-3.91L-12G8.0-100M	19A	5
SPCA9-3.90L-8G5.0-100M	19A	6
SPCA9-4.59L-12G8.0-100M	19B	7
SPCA9-4.59L-12G7.0-100M	19B	8
SPCA9-3.96L-8G7.0/4G8.0-100M	19B	9
SPCA9-3.96L-8G5.0-100M	19B and 19C	10
SPCA9-4.58L-8G6.0/4G3.0-100M	19C	11
SPCA9-4.58L-8G6.0-100M	19C	12
SPCA9-4.06L-11G6.0-80M	28B	13
SPCA9-4.34L-10G6.0-80M	28B	14

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I.2 Core Nuclear Design

I.2.1 Core Configuration and Licensing Exposure Limits

Assembly Name	Cycle Loaded	Number in Core
GE9B-P8CWB322-11GZ-100M-150-CECO	7	56
GE9B-P8CWB320-9GZ-100M-150-CECO	7	89
GE9B-P8CWB343-12GZ-80M-150-CECO	8	104
GE9B-P8CWB342-10GZ-80M-150-CECO	8	143
SPCA9-384B-11GZ6-80M	9	36
SPCA9-393B-16GZ-100M	9	208
SPCA9-396B-12GZB-100M	9	88
SPCA9-396B-12GZC-100M	9	40

	Core Average Exposure	Core Incremental Exposure
Exposure at EOC 8 (Cycle N-1)		
Nominal EOC 8 (MWD/MT)	27966.9	12511.0
Short EOC 8 (MWD/MT) [for shutdown consideration]	27455.9	12000.0

Cycle 9 (Cycle N) neutronics analyses are valid for EOC 8 (Cycle N-1) exposures greater than 12000 MWD/MT. The exposure window that validates the pressurization transients can be found in the L1C9 reload analysis document (Reference 3).

	Core Average Exposure
Exposure at BOC 9 (Cycle N)	
With Nominal EOC 8 (MWD/MT)	10961.0
With Short EOC 8 (MWD/MT)	10634.9

The Cycle 9 incremental exposure to LFPC is 18000.0 MWD/MT (incremental energy to LFPC of 2418.0 GWD) based on a nominal EOC 8.

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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 K-effective bias is 1.0050 (Reference 11). The shutdown margin calculations are based on the short cycle 8 exposure given in Section I.2.1.

BOC Cold K-Effective, All Rods Out	1.11710
BOC Cold K-Effective, All Rods In	0.96354
BOC Cold K-Effective, Strongest Rod Out	0.99407
BOC Shutdown Margin, % ΔK	1.09
Minimum Shutdown Margin, % ΔK	1.01
Cycle Exposure(s) of Minimum Shutdown Margin, MWD/MT	250.0 & 15000.0
Reactivity Defect (R-value) Total, % ΔK	0.08
Standby Liquid Control System (SLCS) Shutdown Margin, Cold Condition, 660 ppm enriched Boron, % ΔK	17.81

Note that the SLCS analysis results credit a B-10 enrichment of 45% at LaSalle.

II. Control Rod Withdrawal Error

Analysis was performed at a core power of 3489 MWt, 100% core flow (108.5 Mlbm/hr), unblocked (RBM not credited) conditions only. Figure 15 is the initial rod pattern for the case that set the limit for the ATRIUM-9B fuel in the core. Figure 16 is initial rod pattern for the case that set the limit for the GE9B fuel in the core. These results bound operation with 3323 MWt as the rated power for the core.

Distance Withdrawn (ft)	ATRIUM-9B ΔCPR	GE9B ΔCPR
12	0.29	0.31

The design complies with the SPC 1% plastic strain 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 updated GE mechanical overpower protection (MOP) criteria during a control rod withdrawal error event.

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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 the off-site dose requirements are met for the fuel loading error.

The values reported below bound all fuel types found in the core.

Event	ΔCPR
Mislocated Bundle	0.31
Misoriented Bundle	0.17

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

IV. Control Rod Drop Accident

LaSalle is a Banked Position Withdrawal Sequence (BPWS) plant. In order to allow the site the option of shutting down the reactor by inserting control rods using the simplified control rod sequences shown in Table 1, the 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 280 cal/g Technical Specification limit for a control rod drop accident is not exceeded. Note that the 0.32%Δk adder mentioned below is included in this analysis to account for possible rod mispositioning errors as well as clumping effects.

Dropped Control Rod Worth without 0.32 %Δk adder, %Δk	0.722
Dropped Control Rod Worth with 0.32 %Δk adder, %Δk	1.042
Doppler Coefficient used, (Δk/k)/°F	-9.50E-06
Effective Delayed Neutron Fraction used	0.0052
Four-Bundle Local Peaking Factor	1.358
Maximum Deposited Fuel Rod Enthalpy with 0.32 %Δk adder, (cal/gm)	184.1
Number of Rods Greater than 170 cal/gm with 0.32%Δk adder	134

Note that the limit on maximum deposited fuel rod enthalpy is 280 cal/gm and the (conservative) limit on the number of rods greater that 170 cal/gm (failed rods) is 770 .

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V. Loss of Feedwater Heating

The loss of feedwater heating event is analyzed at a core power of 3489 MWt for 81%, 100% and 105% rated flow with an assumed inlet temperature decrease of 145°F. These results bound operation with 3323 MWt as the rated power for the core.

Event	ATRIUM-9B ΔCPR	GE9B ΔCPR
Loss of Feedwater Heating	0.19	0.18

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 1% plastic strain criteria via conformance to the mechanical overpower protection (MOP) limit. The design complies with the GE centerline melt criteria via conformance to the thermal overpower protection (TOP) limits. The analyses did not take credit for the thermal power scram function at the site.

VI. Maximum Exposure Limit Compliance

Note that the exposures listed below are based on the nominal Cycle 8 (Cycle N-1) exposure, 12511 MWD/MT, and the licensing basis (Reference 3) Cycle 9 (Cycle N) core average exposure of 29439 MWD/MT.

Exposure Criteria	GE9B Projected Exposure (GWD/MT)	GE9B Exposure Limit (GWD/MT)	ATRIUM-9B Projected Exposure (GWD/MT)	ATRIUM-9B Exposure Limit* (GWD/MT)
Peak Fuel Assembly	44.9	48.0**	23.8	48.0
Peak Fuel Batch	40.4	42.0	N/A	N/A
Peak Fuel Rod	N/A	N/A	26.4	55.0
Peak Fuel Pellet	58.4	60.0	35.6	66.0

* 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.

** There is no peak fuel assembly exposure limit for GE9B fuel. The limit reported above is based on the maximum channel exposure assumption used in developing the safety limit MCPR for LaSalle 1 Cycle 9.

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VII. Spent Fuel Pool and Fresh Fuel Vault Criticality Compliance

For the L1C9 reload, there are three new SPC ATRIUM-9B assembly types consisting of 10 unique enriched lattices as well as one SPC ATRIUM-9B assembly type with 2 unique enriched lattices which was initially manufactured for use in L2C8. These four (total) assembly and twelve (total) enriched lattice types are identified in I.1 New Reload Fuel Assembly Nuclear Design. For the purpose of the following sections all four assembly types will be referred to as "new (ATRIUM-9B) assemblies".

VII.1 Fresh Fuel Vault Criticality Compliance

The fuel storage vault criticality analysis that is detailed in Reference 6 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.

VII.2 L1 Spent Fuel Pool Criticality Compliance

The LaSalle Unit 1 spent fuel pool criticality analysis that is detailed in Reference 7 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 8 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
SPCA9-4.56L-12G8.0/4G3.0-100M	1.182	< 0.85	0.95
SPCA9-4.56L-12G8.0-100M	1.187	< 0.85	0.95
SPCA9-3.91L-12G8.0-100M	1.168	< 0.85	0.95
SPCA9-3.90L-8G5.0-100M	1.233	< 0.86	0.95
SPCA9-4.59L-12G8.0-100M	1.191	< 0.85	0.95
SPCA9-4.59L-12G7.0-100M	1.210	< 0.85	0.95
SPCA9-3.96L-8G7.0/4G8.0-100M	1.186	< 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
SPCA9-4.06L-11G6.0-80M	1.213	< 0.85	0.95
SPCA9-4.34L-10G6.0-80M	1.227	< 0.86	0.95

* From 68 °F, uncontrolled CASMO-3G results.
** From Figure 6.1 of Reference 8.

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VIII. References

1. Commonwealth Edison Topical Report NFSR-0091, "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods", Revision 0, Supplements 1 and 2, December 1991, March 1992, and May 1992, respectively; SER letter dated March 22, 1993.

2. "LaSalle 1 Cycle 9 Core Design", NDIT NFM9900038, Sequence 02, September 23, 1999.

3. "LaSalle Unit 1 Cycle 9 Reload Analysis", Siemens Power Corporation, EMF-2276.

4. "LaSalle Unit 1 Cycle 9 Plant Transient Analysis", Siemens Power Corporation, EMF-2277.

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

6. "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, Revision 0 (sic).]

7. "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, Revision 0 (sic).]

8. "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, Revision 0 (sic).]

9. "LS1 C9 Preliminary Bundle Design", NFM Calculation Note, BNDL:99-009, Revision 0, March 3, 1999.

10. "LS1 Projection to EOC N-1 for Cycle 9 FLLP", NFM Calculation Note, BNDL:99-027, Revision 0, April 22, 1999.

11. "LaSalle 1 Cycle 9 Design Basis for FLLP", NFM Calculation Note, BNDL:99-028, Revision 0, June 2, 1999.

12. "LaSalle 1 Cycle 9 Final Licensing Loading Pattern (FLLP)", NFM Calculation Note, BNDL:99-029, Revision 0, April 29, 1999.

13. "LaSalle 1 Cycle 9 LFWH", NFM Calculation Note, BNDL:99-035, Revision 0, June 25, 1999.

14. "LaSalle 1 Cycle 9 Standard RWE", NFM Calculation Note, BNDL:99-036, Revision 0, July 2, 1999.

15. "LaSalle 1 Cycle 9 MOPs/TOPs RWE", NFM Calculation Note, BNDL:BNDL:99-037, Revision 0, July 7, 1999.

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VIII. References

16. "LaSalle 1 Cycle 9 SLCS, CARO and CARI", NFM Calculation Note, BNDL:99-039, Revision 0, June 23, 1999.

17. "LaSalle 1 Cycle 9 Control Rod Drop Accident Analysis", NFM Calculation Note, BNDL:99-040, Revision 0, July 27, 1999.

18. "LaSalle Unit 1 Cycle 9 Bundle Misorientation Analysis", NFM Calculation Note, BNDL:99-054, Revision 0, August 20, 1999.

19. "LaSalle 1 Cycle 9 Fuel Assembly Mislocation Calculations", NFM Calculation Note, BNDL:99-055, Revision 0, July 29, 1999.

20. "LaSalle 1 Cycle 9 – L1C8 Data for GE Plastic Strain Analysis", NFM Calculation Note, BNDL:99-057, Revision 0, August 20, 1999.

21. "LaSalle 1 Cycle 9 – L1C9 Data for GE Plastic Strain Analysis", NFM Calculation Note, BNDL:99-058, Revision 0, August 18, 1999.

22. "LaSalle Unit 1 Cycle 9 New Fuel Storage", NDIT NFM9900119, Sequence 00, May 26,1999.

23. "LaSalle Unit 2 Cycle 8 Neutronics Licensing Report, Revision 2", NDIT NFM960103, Revision (sic) 2, March 22, 1999.

24. "LaSalle 1 Cycle 9 RWE Clad Strain Compliance", GE Proprietary Letter WHC:99-031 from William H. Hetzel to Dr. R.J. Chin, dated September 27, 1999.

25. "LaSalle 1 Cycle 9 NLR", NFM Calculation Note, BNDL:99-050, Revision 0, October 1999.

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Table 1

LaSalle 1 Cycle 9 Simplified Shutdown Sequences

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	48-10	Groups 7 and 8 must be fully inserted prior to inserting any Group 10 rod.
10	10-00	Group 10 must be at 10 prior to inserting any Group 10 rod to 00.
9	48-10	Group 10 must be fully inserted prior to inserting any Group 9 rod.
9	10-00	Group 9 must be at 10 prior to inserting any Group 9 rod to 00.
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	48-10	Group 4 must be fully inserted prior to inserting any Group 3 rod.
3	10-00	Group 3 must be at 10 prior to inserting any Group 3 rod to 00.
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	48-10	Group 8 must be fully inserted prior to inserting any Group 7 rod.
7	10-00	Group 7 must be at 10 prior to inserting any Group 7 rod to 00.
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	48-10	Group 4 must be fully inserted prior to inserting any Group 3 rod.
3	10-00	Group 3 must be at 10 prior to inserting any Group 3 rod to 00.
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.

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

8/22/99
JKW 10/6/99

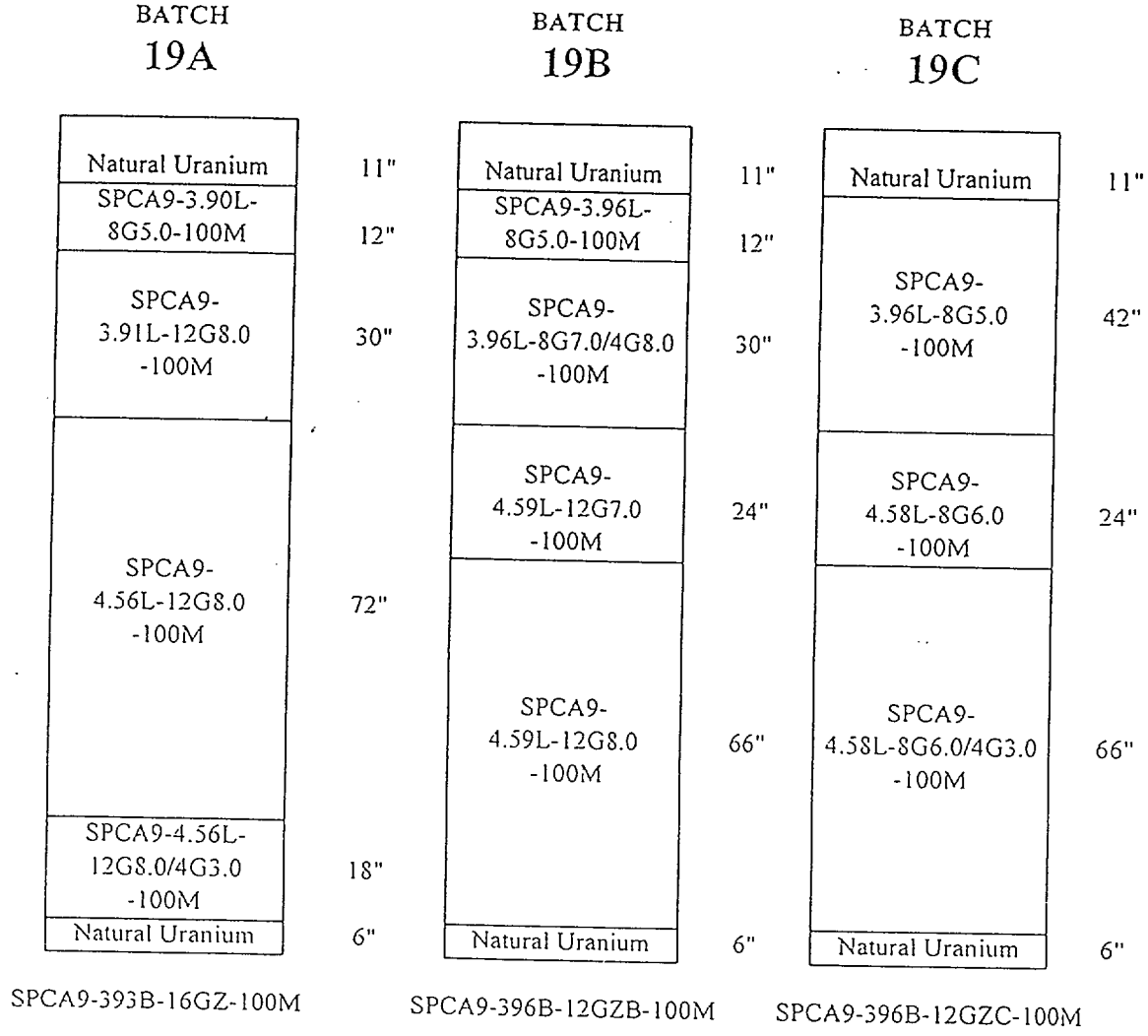


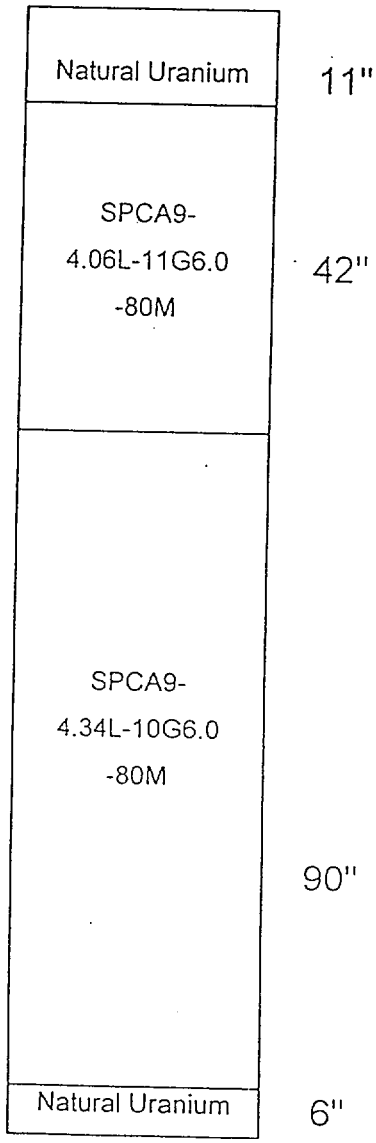
Figure 1

L1C9 ATRIUM-9B Assembly Axial Designs (100M Channels)

8/22/99
JKW 10/6/99

BATCH

28B



SPCA9-384B-11GZ6-80M

Figure 2

L1C9 ATRIUM-9B Assembly Axial Designs (80M Channels)

8/22/99
JKW 10/6/99

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	G3 4.00	G2 4.20	4 4.95	G1 4.70	4 4.95	G2 4.20	G3 4.00	2 4.00
3 4.70	G2 4.20	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	G2 4.20	3 4.70
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 4.70	4 4.95				4 4.95	G1 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	G2 4.20	4 4.95	4 4.95	4 4.95	4 4.95	4 4.95	G2 4.20	3 4.70
2 4.00	G3 4.00	G2 4.20	4 4.95	G1 4.70	4 4.95	G2 4.20	G3 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 (36)	4.95 w/o U-235
G1	Rods (4)	4.70 w/o U-235+8.0 w/o Gd2O3
G2	Rods (8)	4.20 w/o U-235+8.0 w/o Gd2O3
G3	Rods (4)	4.00 w/o U-235+3.0 w/o Gd2O3

Figure 3
SPCA9-4.56L-12G8.0/4G3.0-100M (19A)
Enrichment Distribution

8/20/99
JKW 10/6/99

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

Figure 4
SPCA9-4.56L-12G8.0-100M (19A)
Enrichment Distribution

8/20/99
JKW 10/6/99

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	G1 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	2 3.40	2 3.40
3 3.80	G1 3.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	G1 3.40	3 3.80
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
4 4.40	4 4.40	4 4.40				4 4.40	4 4.40	4 4.40
3 3.80	G1 3.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	G1 3.40	3 3.80
2 3.40	2 3.40	G1 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	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 (36)	4.40 w/o U-235
G1	Rods (12)	3.40 w/o U-235+8.0 w/o Gd2O3

Figure 5
SPCA9-3.91L-12G8.0-100M (19A)
Enrichment Distribution

8/20/99
JKW 10/6/99

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	G1 3.40	4 4.40	2 3.40	4 4.40	G1 3.40	2 3.40	2 3.40
3 3.80	G1 3.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	G1 3.40	3 3.80
4 4.40	4 4.40	4 4.40	Internal Water Channel			4 4.40	4 4.40	4 4.40
4 4.40	2 3.40	4 4.40				4 4.40	2 3.40	4 4.40
4 4.40	4 4.40	4 4.40				4 4.40	4 4.40	4 4.40
3 3.80	G1 3.40	4 4.40	4 4.40	4 4.40	4 4.40	4 4.40	G1 3.40	3 3.80
2 3.40	2 3.40	G1 3.40	4 4.40	2 3.40	4 4.40	G1 3.40	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 (16)	3.40 w/o U-235
3	Rods (8)	3.80 w/o U-235
4	Rods (36)	4.40 w/o U-235
G1	Rods (8)	3.40 w/o U-235+5.0 w/o Gd_2O_3

Figure 6
SPCA9-3.90L-8G5.0-100M (19A)
Enrichment Distribution

8/20/99
JKW 10/6/99

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	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	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	Internal Water Channel			4 4.95	G1 4.20	4 4.95
4 4.95	4 4.95	4 4.95				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	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	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 (12)	4.20 w/o U-235+8.0 w/o Gd_2O_3

Figure 7
SPCA9-4.59L-12G8.0-100M (19B)
Enrichment Distribution

8/20/99
JKW 10/6/99

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	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	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	Internal Water Channel			4 4.95	G1 4.20	4 4.95
4 4.95	4 4.95	4 4.95				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	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	4 4.95	G1 4.20	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 (12)	4.20 w/o U-235+7.0 w/o Gd2O3

Figure 8
SPCA9-4.59L-12G7.0-100M (19B)
Enrichment Distribution

8/20/99
JKW 10/6/99

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	G2 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	4 4.40	G2 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	Internal Water Channel			4 4.40	G1 3.40	4 4.40
4 4.40	4 4.40	4 4.40				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	G2 3.40	4 4.40	G1 3.40	4 4.40	G1 3.40	4 4.40	G2 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 (8)	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+7.0 w/o Gd2O3
G2	Rods (4)	3.40 w/o U-235+8.0 w/o Gd2O3

Figure 9
SPCA9-3.96L-8G7.0/4G8.0-100M (19B)
Enrichment Distribution

TPS 8/20/99
JKW 10/6/99

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	Internal Water Channel			4 4.40	G1 3.40	4 4.40
4 4.40	4 4.40	4 4.40				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 10
SPCA9-3.96L-8G5.0-100M (19B and 19C)
Enrichment Distribution

8/20/99
JKW 10/6/99

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	Internal Water Channel			4 4.95	G1 4.20	4 4.95
4 4.95	4 4.95	4 4.95				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 Gd_2O_3
G2	Rods (4)	4.00 w/o U-235+3.0 w/o Gd_2O_3

Figure 11
SPCA9-4.58L-8G6.0/4G3.0-100M (19C)
Enrichment Distribution

8/20/99
JKW 10/6/99

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	Internal Water Channel			4 4.95	G1 4.20	4 4.95
4 4.95	4 4.95	4 4.95				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 12
SPCA9-4.58L-8G6.0-100M(19C)
Enrichment Distribution

8/20/99
JKW 10/6/99

1 2.72	2 3.53	3 3.94	3 3.94	4 4.53	3 3.94	3 3.94	2 3.53	1 2.72
2 3.53	G 3.69	4 4.53	4 4.53	G 3.69	4 4.53	4 4.53	G 3.69	2 3.53
3 3.94	4 4.53	4 4.53	4 4.53	4 4.53	4 4.53	4 4.53	4 4.53	3 3.94
3 3.94	4 4.53	4 4.53	Internal Water Channel			G 3.69	4 4.53	3 3.94
4 4.53	G 3.69	4 4.53				4 4.53	G 3.69	4 4.53
3 3.94	4 4.53	4 4.53				4 4.53	4 4.53	3 3.94
3 3.94	4 4.53	4 4.53	G 3.69	4 4.53	4 4.53	G 3.69	4 4.53	3 3.94
2 3.53	G 3.69	4 4.53	4 4.53	G 3.69	4 4.53	4 4.53	G 3.69	2 3.53
1 2.72	2 3.53	3 3.94	3 3.94	4 4.53	3 3.94	3 3.94	2 3.53	1 2.72

1	Rods (4)	2.72 w/o U-235
2	Rods (8)	3.53 w/o U-235
3	Rods (16)	3.94 w/o U-235
4	Rods (33)	4.53 w/o U-235
G	Rods (11)	3.69 w/o U-235+6.0 w/o Gd2O3

Figure 13
SPCA9-4.06L-11G6.0-80M (28B)
Enrichment Distribution

8/22/99
JKW 10/6/99

1 2.72	2 3.78	3 4.19	3 4.19	4 4.78	3 4.19	3 4.19	2 3.78	1 2.72
2 3.78	G 4.19	4 4.78	4 4.78	G 4.19	4 4.78	4 4.78	G 4.19	2 3.78
3 4.19	4 4.78	4 4.78	4 4.78	4 4.78	4 4.78	4 4.78	4 4.78	3 4.19
3 4.19	4 4.78	4 4.78	Internal Water Channel			G 4.19	4 4.78	3 4.19
4 4.78	G 4.19	4 4.78				4 4.78	G 4.19	4 4.78
3 4.19	4 4.78	4 4.78				4 4.78	4 4.78	3 4.19
3 4.19	4 4.78	4 4.78	G 4.19	4 4.78	4 4.78	4 4.78	4 4.78	3 4.19
2 3.78	G 4.19	4 4.78	4 4.78	G 4.19	4 4.78	4 4.78	G 4.19	2 3.78
1 2.72	2 3.78	3 4.19	3 4.19	4 4.78	3 4.19	3 4.19	2 3.78	1 2.72

1	Rods (4)	2.72 w/o U-235
2	Rods (8)	3.78 w/o U-235
3	Rods (16)	4.19 w/o U-235
4	Rods (34)	4.78 w/o U-235
G	Rods (10)	4.19 w/o U-235+6.0 w/o Gd_2O_3

Figure 14
SPCA9-4.34L-10G6.0-80M (28B)
Enrichment Distribution

8/22/99
JKW 10/6/99

Cycle 9 Exposure 13000.0 MWd/MTU
1746.3 GWd
Core Average Exposure 23961.4 MWd/MTU

Delta E: MWd/MTU, (GWd)	.0 (.00)	
Power: MWt	3489.0	(100.00 %)
Core Pressure: psia	1020.1	
Inlet Subcooling: Btu/lbm	-18.28	
Flow: Mlb/hr	108.50	(100.00 %)

```
    2  6 10 14 18 22 26 30 34 38 42 46 50 54 58
59              -- -- -- -- -- -- --              59
55           -- -- 16 -- -- -- 16 -- --           55
51        -- --  0 --  0 --  0 --  0 -- --        51
47     -- -- 16 -- -- -- -- -- -- -- 16 -- --     47
43 -- --  0 --  8 --  0 --  0 --  8 --  0 -- -- 43
39 -- 16 -- -- -- -- -- -- -- -- -- -- -- 16 -- 39
35 -- --  0 --  0 -- 16 -- 16 --  0 --  0 -- -- 35
31 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 31
27 -- --  0 --  0 -- 16 -- 16 --  0 --  0 -- -- 27
23 -- 16 -- -- -- -- -- -- -- -- -- -- -- 16 -- 23
19 -- --  0 --  8 --  0 --  0 --  8 --  0 -- -- 19
15     -- -- 16 -- -- -- -- -- -- -- 16 -- --     15
11        -- --  0 --  0 --  0 --  0 -- --        11
 7           -- -- 16 -- -- -- 16 -- --           7
 3              -- -- -- -- -- -- --              3
    2  6 10 14 18 22 26 30 34 38 42 46 50 54 58
```

Control Rod Density: %	20.54
k-effective:	1.00388
Void Fraction:	.448
Core Delta-P: psia	21.675
Core Plate Delta-P: psia	17.213
Coolant Temp: Deg-F	545.8
In Channel Flow: Mlb/hr	93.26
Source Convergence	.00008

Axial Profile

	N	Power	Exposure
Top	25	.153	3.961
	24	.284	6.830
	23	.663	16.284
	22	.806	19.848
	21	.874	21.821
	20	.935	23.364
	19	.978	24.366
	18	1.006	25.256
	17	1.010	26.344
	16	1.011	27.653
	15	1.013	28.409
	14	1.030	28.934
	13	1.056	29.323
	12	1.087	29.530
	11	1.128	29.908
	10	1.177	30.365
	9	1.231	30.778*
	8	1.279	30.556
	7	1.347	30.740
	6	1.421	30.648
	5	1.485*	29.817
	4	1.477	27.607
	3	1.308	23.608
	2	.962	17.267
Bottom	1	.279	4.864

% AXIAL TILT	-18.447	-10.750
AVG BOT 8ft/12ft	1.1042	1.0860

Active Channel Flow: Mlb/hr 93.26

Figure 15
Initial RWE Rod Pattern for Limiting ATRIUM-9B Case
Error Rod is 34-43

8/22/99
JLW 10/6/99

Cycle 9 Exposure .0 MWd/MTU
.0 GWd
Core Average Exposure 10961.0 MWd/MTU

Delta E: MWd/MTU, (GWd)	.0 (.00)	
Power: MWt	3489.0	(100.00 %)
Core Pressure: psia	1020.1	
Inlet Subcooling: Btu/lbm	-18.28	
Flow: Mlb/hr	108.50	(100.00 %)

```
    2  6 10 14 18 22 26 30 34 38 42 46 50 54 58
59              -- -- -- -- -- -- --              59
55           -- -- 20 --  0 -- 20 -- --           55
51        -- -- -- -- -- -- -- -- -- -- --        51
47     -- -- 12 --  0 -- 24 --  0 -- 12 -- --     47
43 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 43
39 -- 20 --  0 -- 24 --  0 -- 24 --  0 -- 20 -- 39
35 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 35
31 --  0 -- 24 --  0 -- 24 --  0 -- 24 --  0 -- 31
27 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 27
23 -- 20 --  0 -- 24 --  0 -- 24 --  0 -- 20 -- 23
19 -- -- -- -- -- -- -- -- -- -- -- -- -- -- -- 19
15     -- -- 12 --  0 -- 24 --  0 -- 12 -- --     15
11        -- -- -- -- -- -- -- -- -- -- --        11
 7           -- -- 20 --  0 -- 20 -- --           7
 3              -- -- -- -- -- -- --              3
    2  6 10 14 18 22 26 30 34 38 42 46 50 54 58
```

Control Rod Density: %	15.23
k-effective:	1.00250
Void Fraction:	.430
Core Delta-P: psia	21.559
Core Plate Delta-P: psia	17.096
Coolant Temp: Deg-F	545.5
In Channel Flow: Mlb/hr	93.36
Source Convergence	.00007

Axial Profile

	N	Power	Exposure
Top	25	.134	1.558
	24	.242	2.748
	23	.614	6.567
	22	.753	8.305
	21	.813	9.766
	20	.885	10.769
	19	.947	11.473
	18	1.008	12.074
	17	1.084	12.760
	16	1.209	13.155
	15	1.271	13.418
	14	1.290	13.606
	13	1.288	13.747
	12	1.256	13.859
	11	1.254	13.965
	10	1.273	14.034*
	9	1.304	14.008
	8	1.326	13.527
	7	1.357	13.424
	6	1.365*	13.358
	5	1.316	13.185
	4	1.164	12.622
	3	.968	11.120
	2	.693	8.223
Bottom	1	.187	2.308

% AXIAL TILT	-13.547	-10.296
AVG BOT 8ft/12ft	1.1172	1.0898

Active Channel Flow: Mlb/hr 93.36

Figure 16
Initial RWE Rod Pattern for Limiting GE9B Case
Error Rod is 30-39

8/22/99
JKW 10/6/99

Attachment 2

LaSalle Unit 1 Cycle 9

Reload Analysis

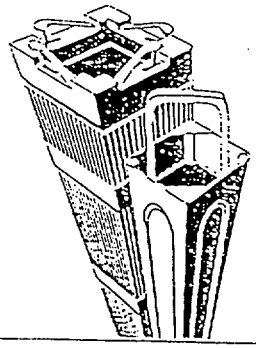
NDIT # NFM9900205

SIEMENS

EMF-2276
Revision 1

LaSalle Unit 1 Cycle 9 Reload Analysis

October 1999



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Nuclear Division

Siemens Power Corporation

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EMF-2276
Revision 1

LaSalle Unit 1 Cycle 9
Reload Analysis

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Nature of Changes

Item	Page	Description and Justification
1.	5-1	Discussion added to indicate $MCPR_f$ limits and $LHGRFAC_f$ multipliers are provided for maximum core flows of 102.5% and 105% of rated.
2.	5-10	Revised Figure 5.1 to include $MCPR_f$ limits for both 102.5% and 105% maximum core flows.
3.	9-1	Updated references to revised plant transient analysis and fuel design reports.

The changed items are further identified by a vertical line (|) in the right-hand margin.

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Nomenclature

AOO	abnormal operational occurrence
BOC	beginning of cycle
CPR	critical power ratio
EFPH	effective full power hour
EOC	end of cycle
EOD	extended operating domain
EOOS	equipment out of service
FHOOS	feedwater heater out of service
FWCF	feedwater controller failure
ICF	increased core flow
LFWH	loss of feedwater heater
LHGR	linear heat generation rate
LHGRFAC	LHGR multiplier
LPRM	local power range monitor
LRNB	load rejection no bypass
MAPLHGR	maximum average planar linear heat generation rate
MCPR	minimum critical power ratio
MELLLA	maximum extended load line limit area
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 1. 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 372 unirradiated ATRIUM™-9B* assemblies and 392 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 1 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.

Analyses were performed to support end-of-cycle (EOC) operating limits. This report provides limits for both pre-power uprate (3323 MWt) and power uprate (3489 MWt) conditions. The analyses upon which the operating limits are based were performed such that both the pre-power uprate and power uprate limits are applicable for all of Cycle 9.

---

* 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)

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)
- 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 1 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 1 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 1 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)	14.7 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)	5232.35 MWt
Feedwater Flow Rate (at SLMCPR)	22.7 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 2000 EFPH LPRM calibration interval, 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 and 3.4 show the local power peaking factors used in the MCPR Fuel Cladding Integrity Safety Limit analysis.

SPCA9-393B-16GZ-100M	Figure 3.2
SPCA9-396B-12GZB-100M and SPCA9-396B-12GZC-100M	Figure 3.3
SPCA9-384B-11GZ-80M	Figure 3.4

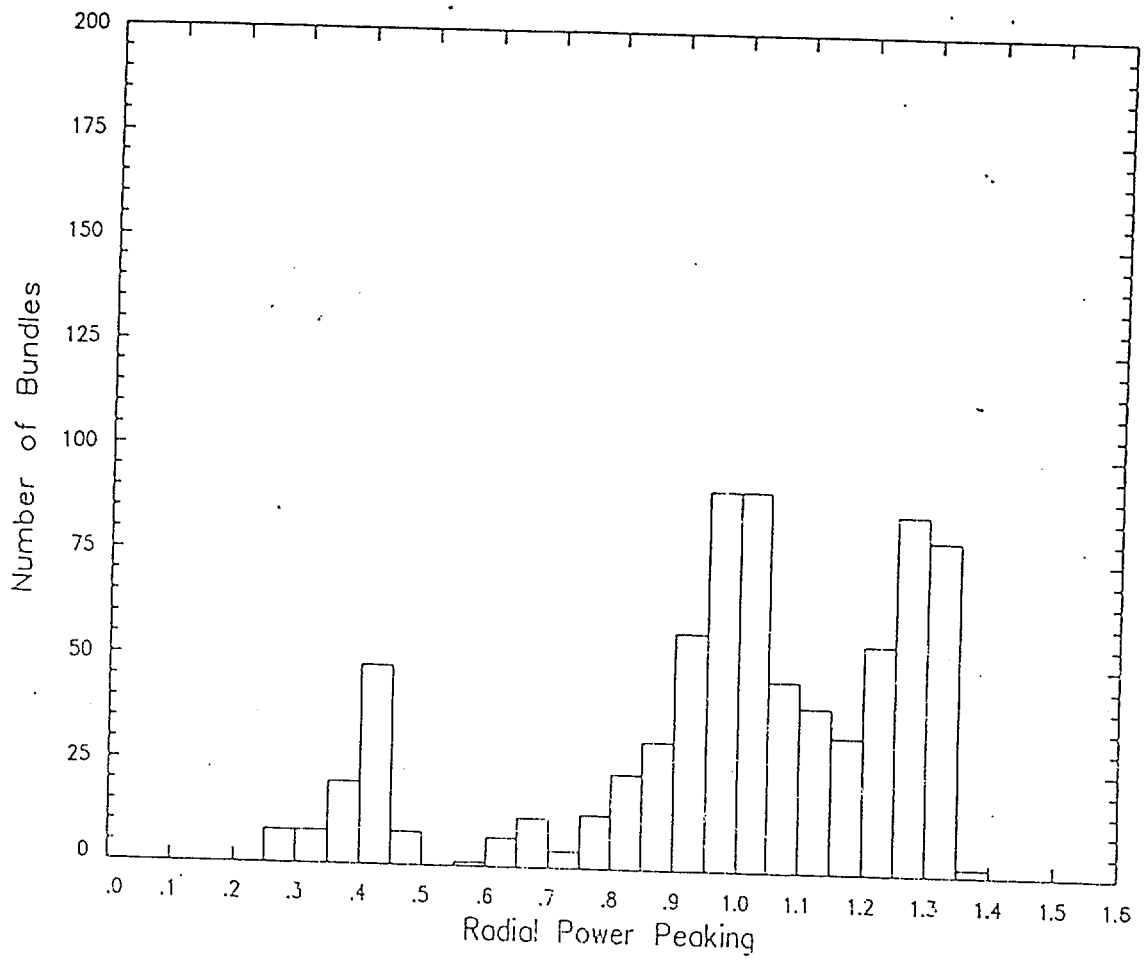


Figure 3.1 Radial Power Distribution
for SLMCPR Determination

Control Rod Corner

Control Rod Corner

1.023	1.055	1.068	1.112	1.099	1.102	1.049	1.023	.977
1.055	.958	.894	1.016	.894	1.007	.877	.927	1.002
1.068	.894	1.031	1.065	1.084	1.056	1.010	.863	1.011
1.112	1.016	1.065	Internal			1.044	.980	1.051
1.099	.894	1.084	Water			1.063	.863	1.038
1.102	1.007	1.056	Channel			1.035	.971	1.041
1.049	.877	1.010	1.044	1.063	1.035	.990	.846	.992
1.023	.927	.863	.980	.863	.971	.846	.895	.970
.977	1.002	1.011	1.051	1.038	1.041	.992	.970	.931

Figure 3.2 LaSalle Unit 1 Cycle 9 Safety Limit Local Peaking Factors
SPCA9-393B-16GZ-100M With Channel Bow

Control Rod Corner

Control Rod Corner

1.013	1.042	1.056	1.110	1.098	1.100	1.037	1.010	.967
1.042	.944	1.025	.879	1.014	.871	1.005	.912	.989
1.056	1.025	1.018	1.064	1.081	1.055	.997	.989	.999
1.110	.879	1.064	Internal			1.043	.848	1.047
1.098	1.014	1.081	Water			1.059	.978	1.035
1.100	.871	1.055	Channel			1.034	.840	1.037
1.037	1.005	.997	1.043	1.059	1.034	.977	.968	.979
1.010	.912	.989	.848	.978	.840	.968	.881	.956
.967	.989	.999	1.047	1.035	1.037	.979	.956	.921

Figure 3.3 LaSalle Unit 1 Cycle 9 Safety Limit Local Peaking Factors SPCA9-396B-12GZB-100M and SPCA9-396B-12GZC-100M With Channel Bow

Control Rod Corner

Control Rod Corner

1.022	1.056	1.061	1.035	1.102	1.028	1.045	1.029	.982
1.056	.947	1.018	1.003	.879	.997	1.004	.919	1.011
1.061	1.018	1.001	1.050	1.081	1.048	.996	.992	1.012
1.035	1.003	1.050	Internal			.926	.983	.987
1.102	.879	1.081	Water			1.077	.853	1.049
1.028	.997	1.048	Channel			1.040	.970	.979
1.045	1.004	.996	.926	1.077	1.040	.859	.980	.996
1.029	.919	.992	.983	.853	.970	.980	.891	.983
.982	1.011	1.012	.987	1.049	.979	.996	.983	.941

Figure 3.4 LaSalle Unit 1 Cycle 9 Safety Limit Local Peaking Factors
SPCA9-384B-11GZ-80M With Channel Bow

4.0 Nuclear Design Analysis

4.1 *Fuel Bundle Nuclear Design Analysis*

Assembly Average Enrichment (ATRIUM-9B fuel)

SPCA9-393B-16GZ-100M	3.93 wt%
SPCA9-396B-12GZB-100M	3.96 wt%
SPCA9-384B-11GZ-80M	3.84 wt%
SPCA9-396B-12GZC-100M	3.96 wt%

Radial Enrichment Distribution

SPCA9-4.56L-12G8.0/4G3.0-100M	Figure 4.1
SPCA9-4.56L-12G8.0-100M	Figure 4.2
SPCA9-3.91L-12G8.0-100M	Figure 4.3
SPCA9-3.90L-8G5.0-100M	Figure 4.4
SPCA9-4.59L-12G8.0-100M	Figure 4.5
SPCA9-4.59L-12G7.0-100M	Figure 4.6
SPCA9-3.96L-8G7.0/4G8.0-100M	Figure 4.7
SPCA9-3.96L-8G5.0-100M	Figure 4.8
SPCA9-4.58L-8G6.0/4G3.0-100M	Figure 4.9
SPCA9-4.58L-8G6.0-100M	Figure 4.10
SPCA9-4.06L-11G6.0-80M	Figures 4.11
SPCA9-4.34L-10G6.0-80M	Figures 4.12

Axial Enrichment Distribution	Figures 4.13–4.16
Burnable Absorber Distribution	Figures 4.13–4.16
Non-Fueled Rods	Figures 4.1–4.12
Neutronic Design Parameters	Table 4.1

Fuel Storage

LaSalle New Fuel Storage Vault — Reference 9.4

The LSA-1 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 LSA-1 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 — Reference 9.6

The LSA-1 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 4.17

Core Exposure at EOC8, MWd/MTU (nominal value)	27,957
Core Exposure at BOC9, MWd/MTU (from nominal EOC8)	10,962
Core Exposure at EOC9, MWd/MTU (licensing basis)	29,439

NOTE: Analyses in this report are applicable to a core exposure of 29,439 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 1 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.

1. Provides trending information to qualitatively compare the stability from cycle to cycle.
2. Provides decay ratio sensitivities to rod line and flow changes near the ICA regions.

3. 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 1 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†
29.6/26.6	0.73	0.61
30.3/29.2	0.48	0.53
51.9/26.6	>1.1	>1.1
54.4/29.2	>1.1	>1.1
61.9/50.0	0.46	0.69
73.6/50.0	0.67	1.04
78.1/55.0	0.57	0.90
82.4/60.0	0.49	0.79
70.0/55.0	0.44	0.69

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.

† NOTE: Decay ratios greater than 1.1 are outside the range of the STAIF methodology applicability. These points should be considered unstable without quantitative comparison.

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	18.1
Moderator Temperature, °F	548.8
Channel Thickness, inch	0.080 & 0.100
Fuel Assembly Pitch, inch	6.0
Wide Water Gap Thickness, inch*	0.281/0.261
Narrow Water Gap Thickness, inch*	0.281/02.61
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 water gap thicknesses presented are based on 80/100-mil channels for ATRIUM-9B fuel.

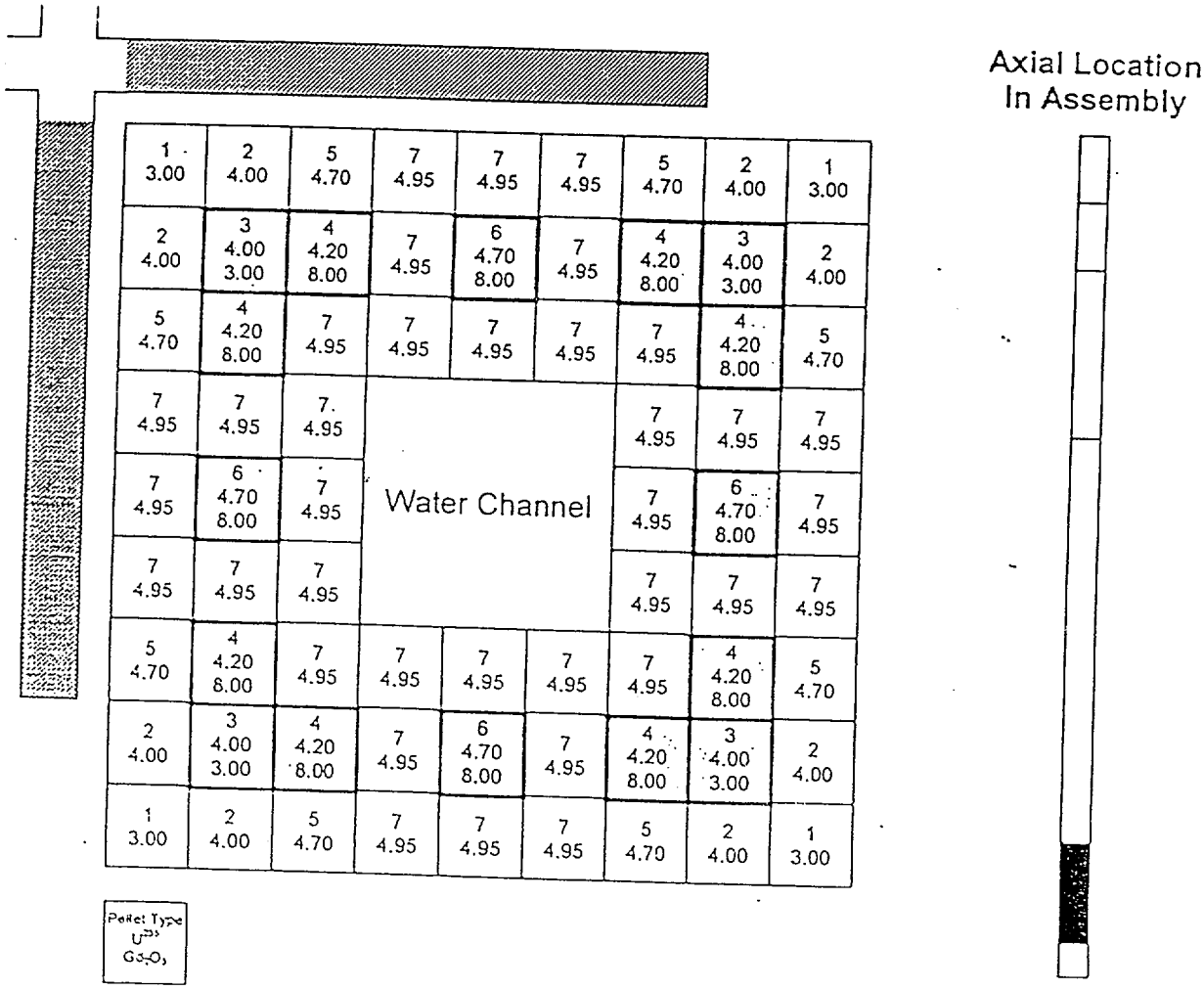
† The control rod data represents original equipment control blades at LaSalle and were used in the neutronic calculations.

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	18.1
Moderator Temperature, °F	548.8
Channel Thickness, inch	0.080 & 0.100
Fuel Assembly Pitch, inch	6.0
Wide Water Gap Thickness, inch*	0.281/0.261
Narrow Water Gap Thickness, inch*	0.281/02.61
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

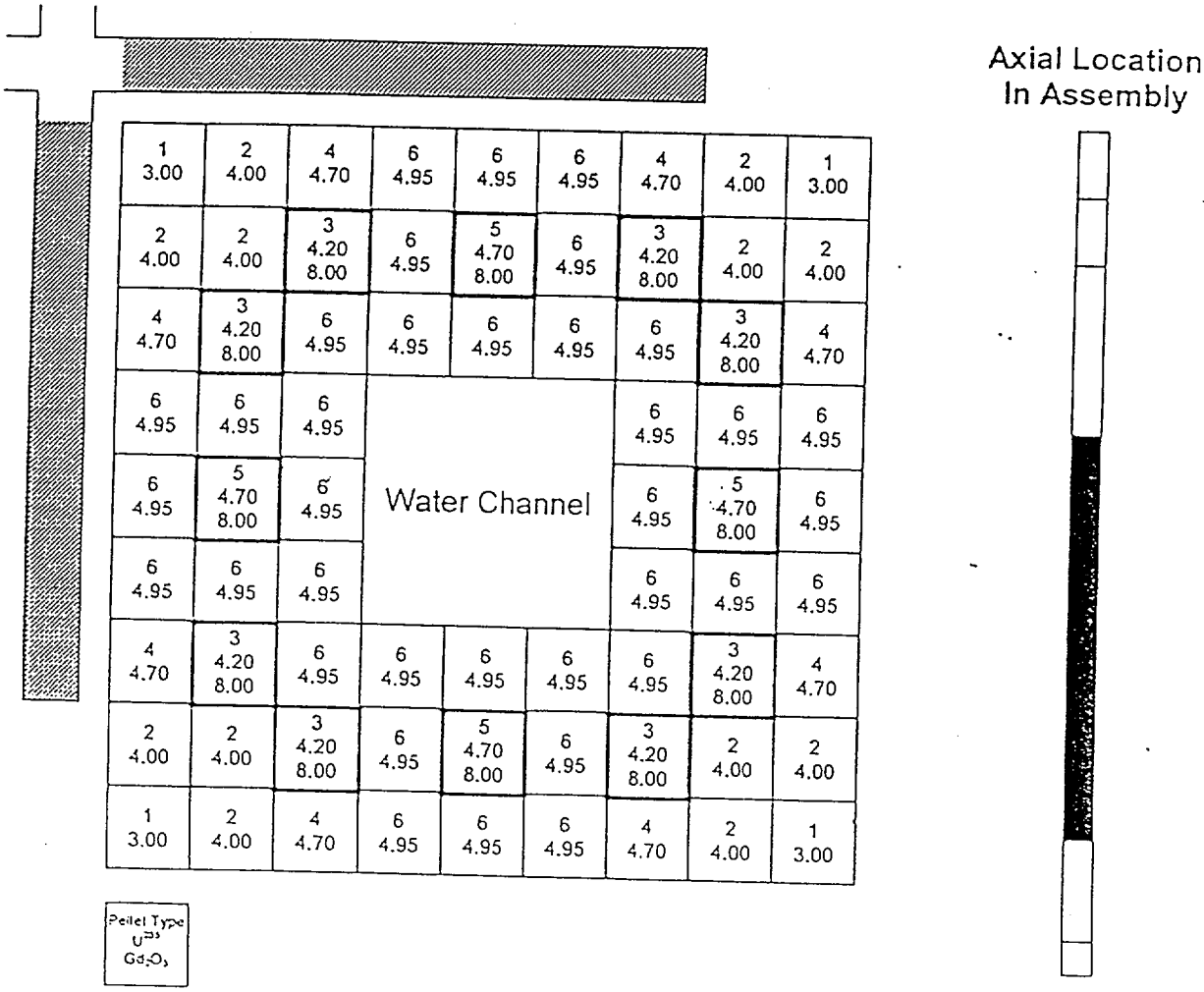
* The water gap thicknesses presented are based on 80/100-mil channels for ATRIUM-9B fuel.

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



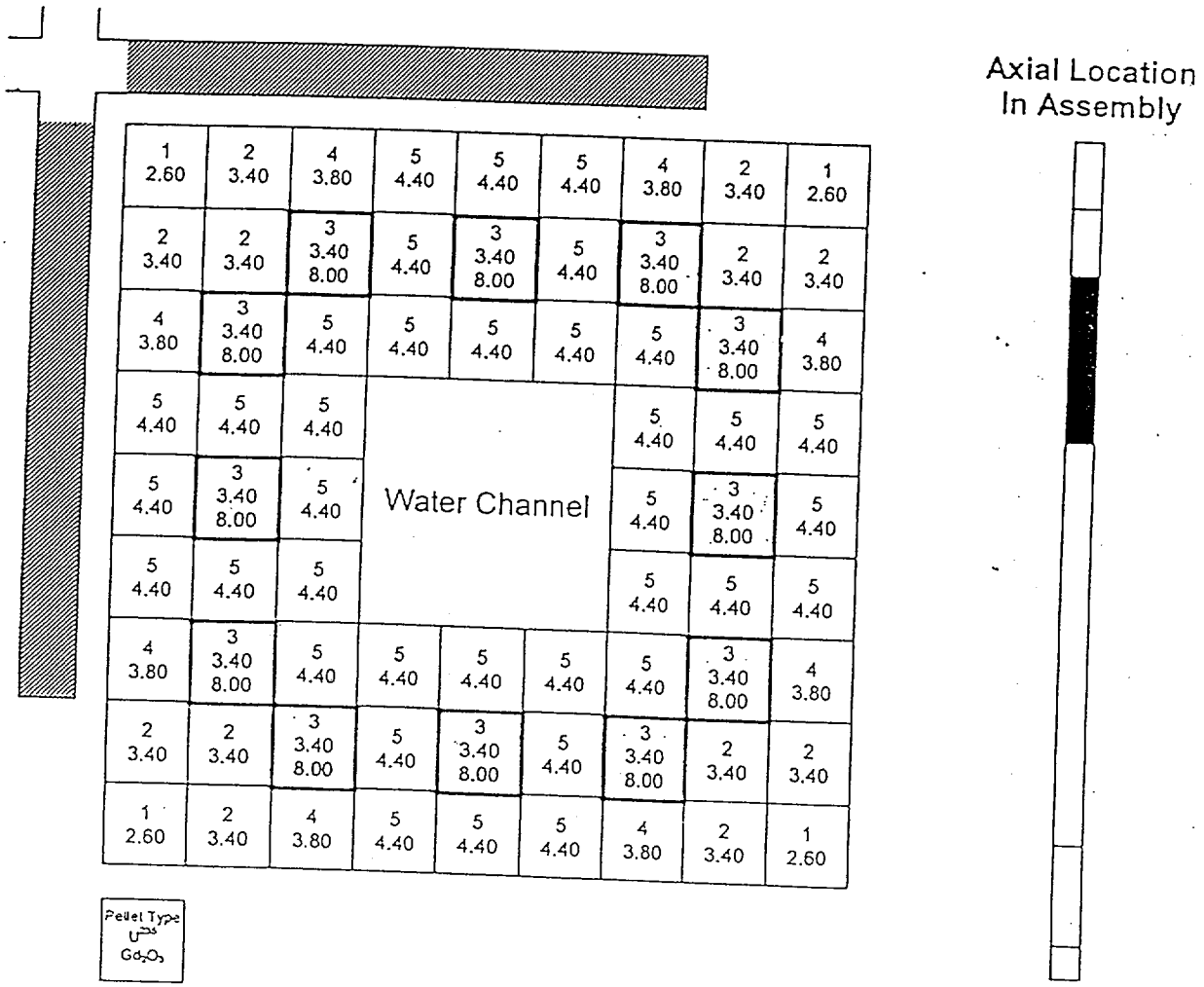
Pellet Type	Quantity	U^{235} + Gd_2O_3 Concentration (wt%)
1	4	3.00
2	8	4.00
3	4	4.00 + 3.00
4	8	4.20 + 8.00
5	8	4.70
6	4	4.70 + 8.00
7	36	4.95

Figure 4.1 SPCA9-4.56L-12G8.0/4G3.0-100M
Enrichment Distribution



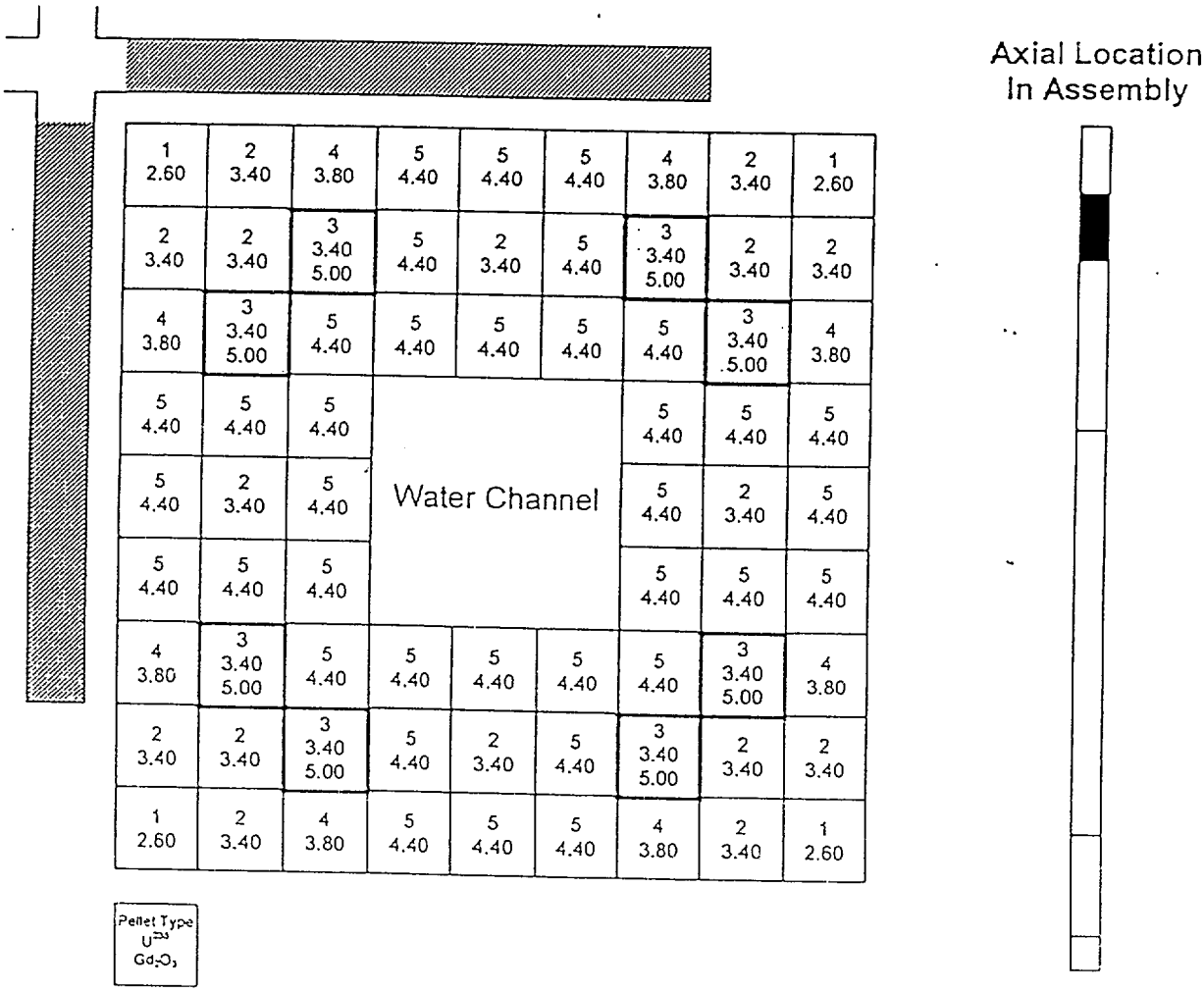
Pellet Type	Quantity	U^{235} + Gd_2O_3 Concentration (wt%)
1	4	3.00
2	12	4.00
3	8	4.20 + 8.00
4	8	4.70
5	4	4.70 + 8.00
6	36	4.95

Figure 4.2 SPCA9-4.56L-12G8.0-100M
Enrichment Distribution



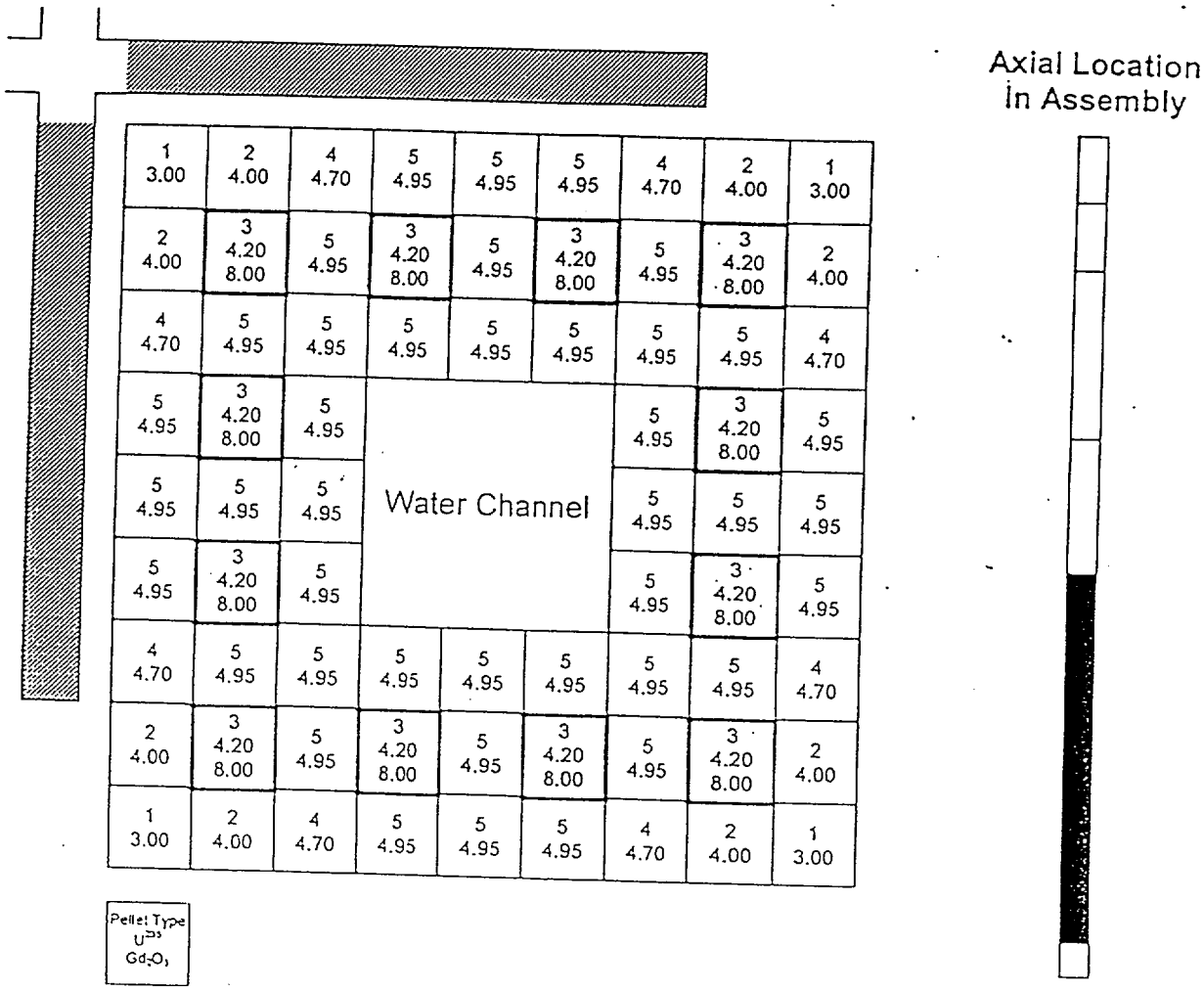
Pellet Type	Quantity	U^{235} + Gd_2O_3 Concentration (wt%)
1	4	2.60
2	12	3.40
3	12	3.40 + 8.00
4	8	3.80
5	36	4.40

Figure 4.3 SPCA9-3.91L-12G8.0-100M
Enrichment Distribution



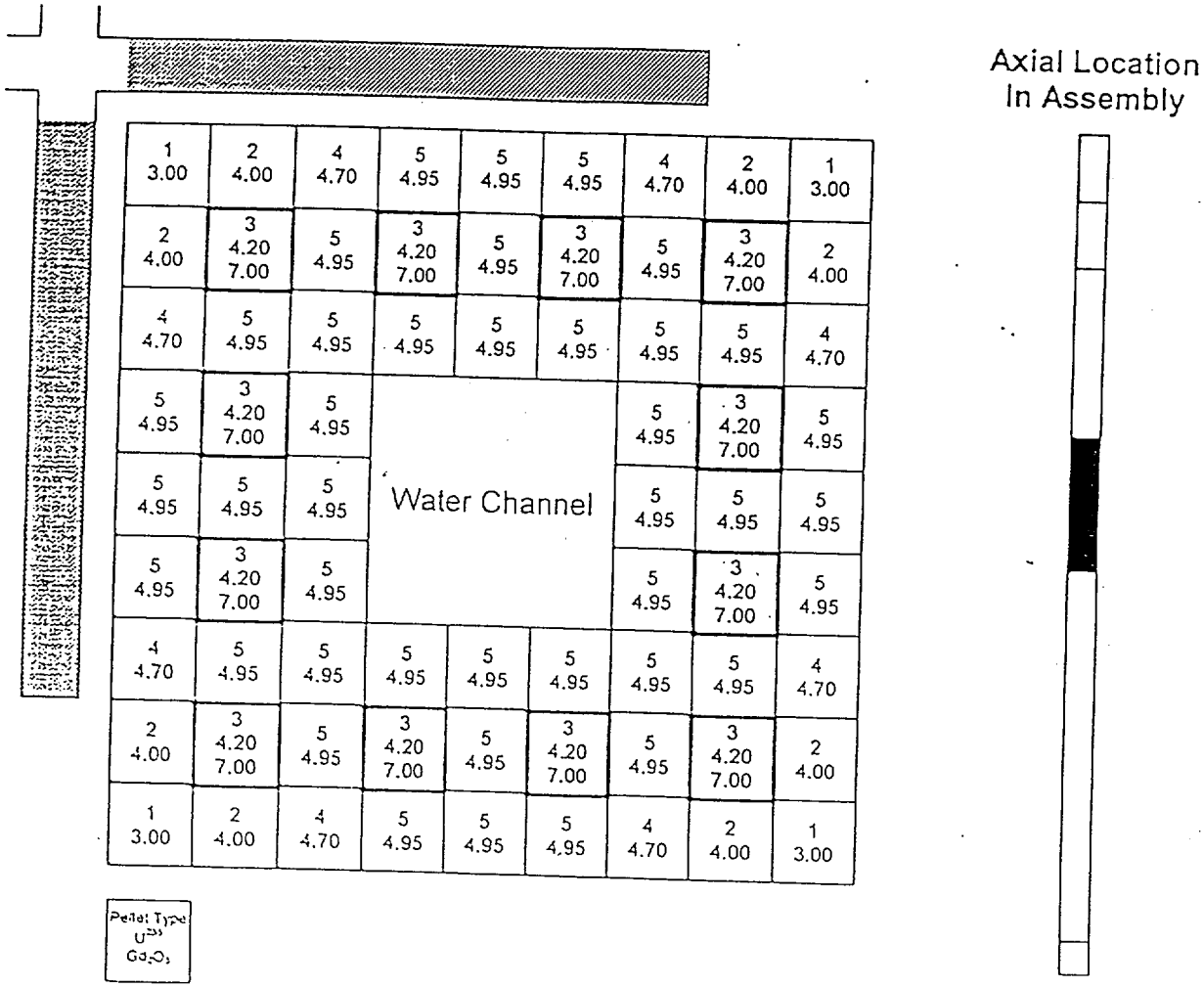
Pellet Type	Quantity	$U^{235} + Gd_2O_3$ Concentration (wt%)
1	4	2.60
2	16	3.40
3	8	3.40 + 5.00
4	8	3.80
5	36	4.40

Figure 4.4 SPCA9-3.90L-8G5.0-100M
Enrichment Distribution



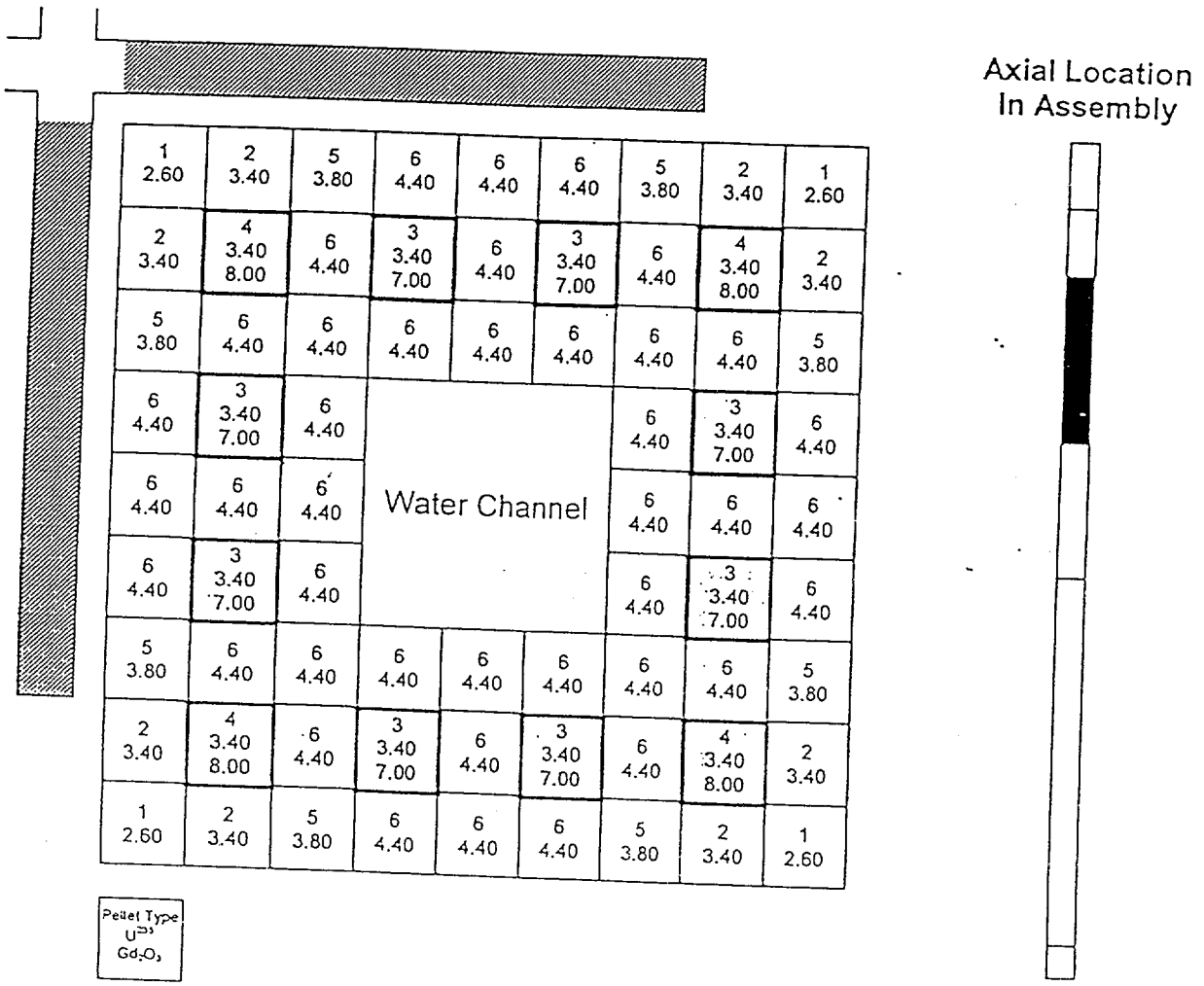
Pellet Type	Quantity	U^{235} + Gd_2O_3 Concentration (wt%)
1	4	3.00
2	8	4.00
3	12	4.20 + 8.00
4	8	4.70
5	40	4.95

Figure 4.5 SPCA9-4.59L-12G8.0-100M
Enrichment Distribution



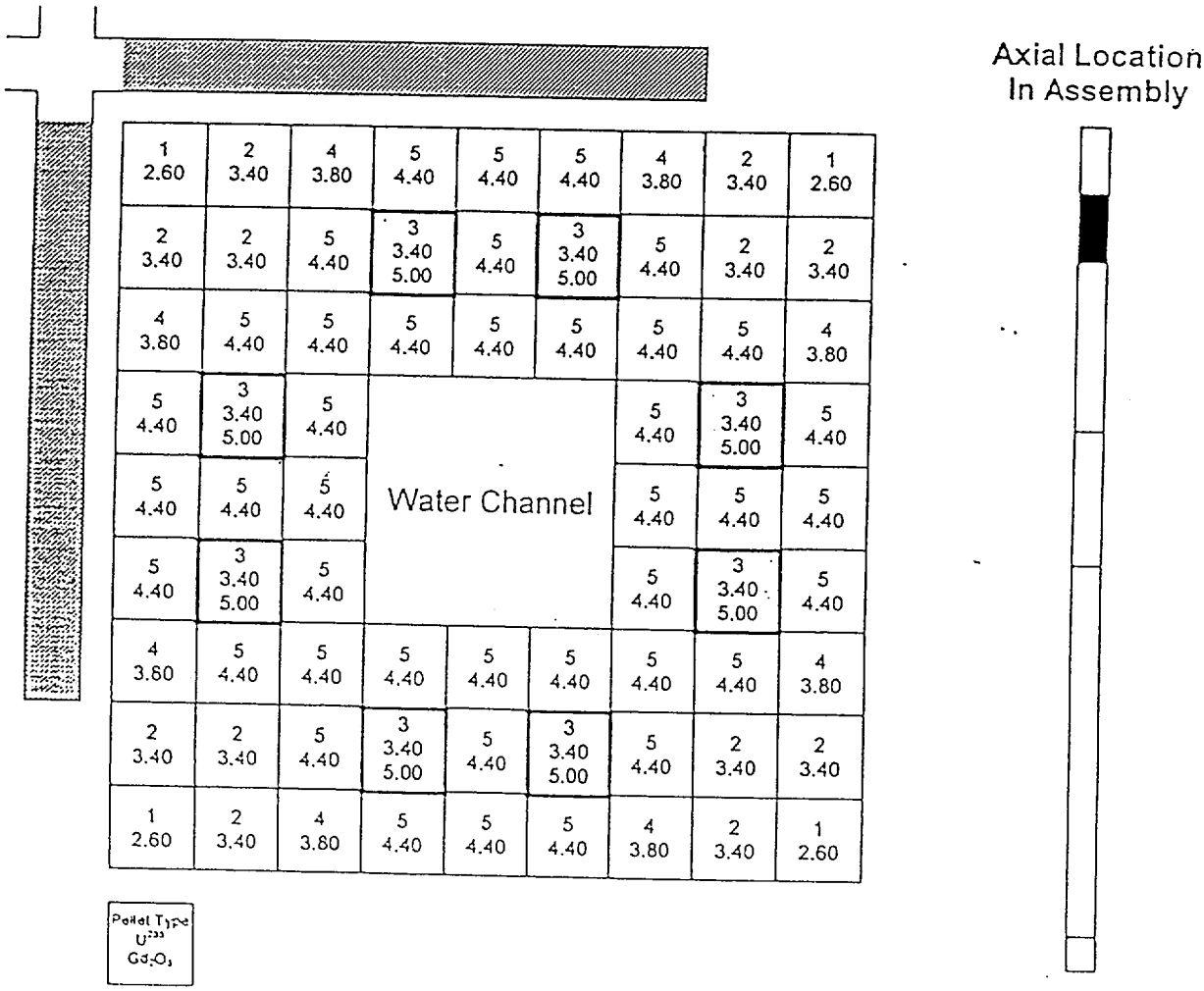
Pellet Type	Quantity	U^{235} + Gd_2O_3 Concentration (wt%)
1	4	3.00
2	8	4.00
3	12	4.20 + 7.00
4	8	4.70
5	40	4.95

Figure 4.6 SPCA9-4.59L-12G7.0-100M
Enrichment Distribution



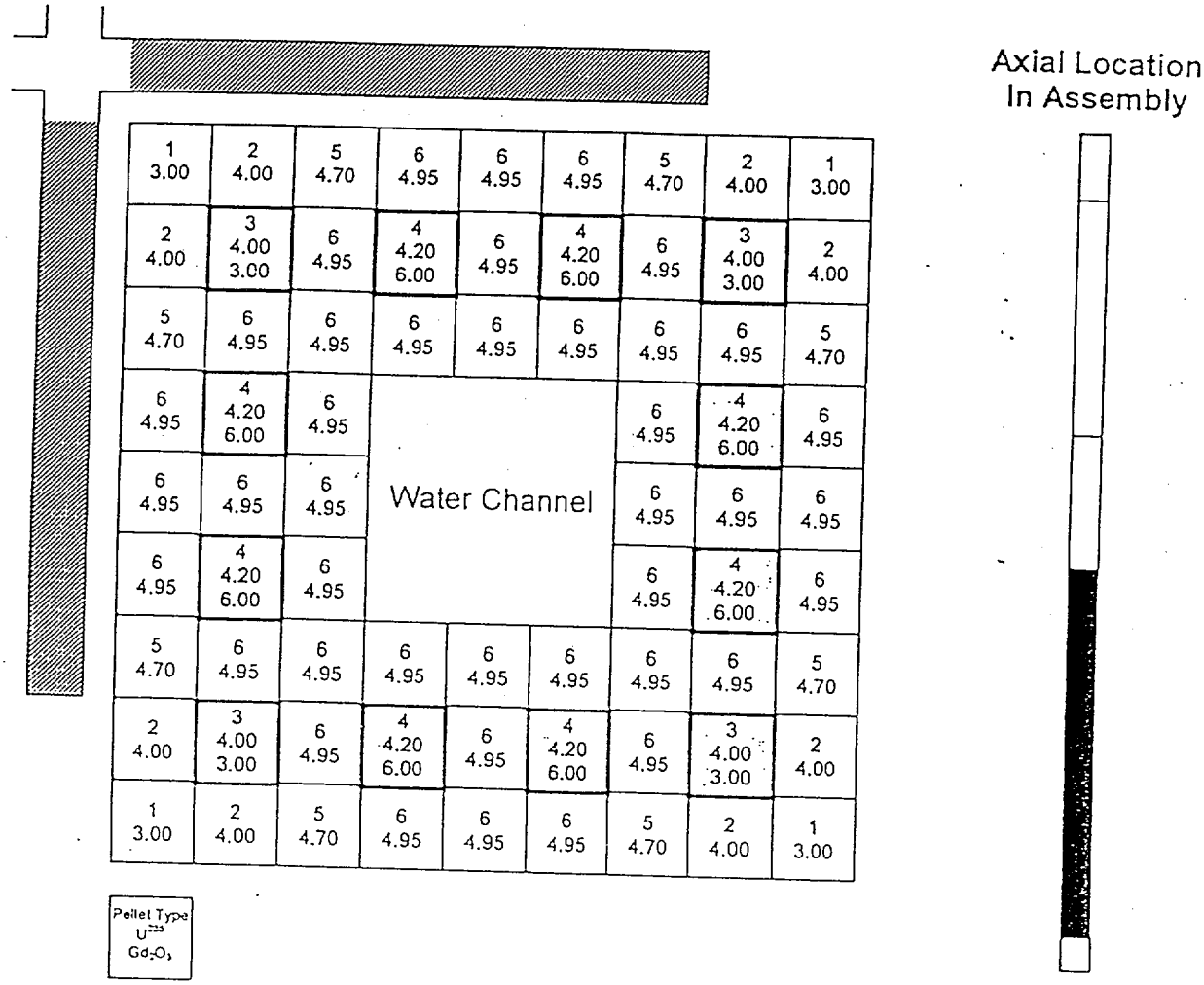
Pellet Type	Quantity	$U^{235} + Gd_2O_3$ Concentration (wt%)
1	4	2.60
2	8	3.40
3	8	3.40 + 7.00
4	4	3.40 + 8.00
5	8	3.80
6	40	4.40

Figure 4.7 SPCA9-3.96L-8G7.0/4G8.0-100M
Enrichment Distribution



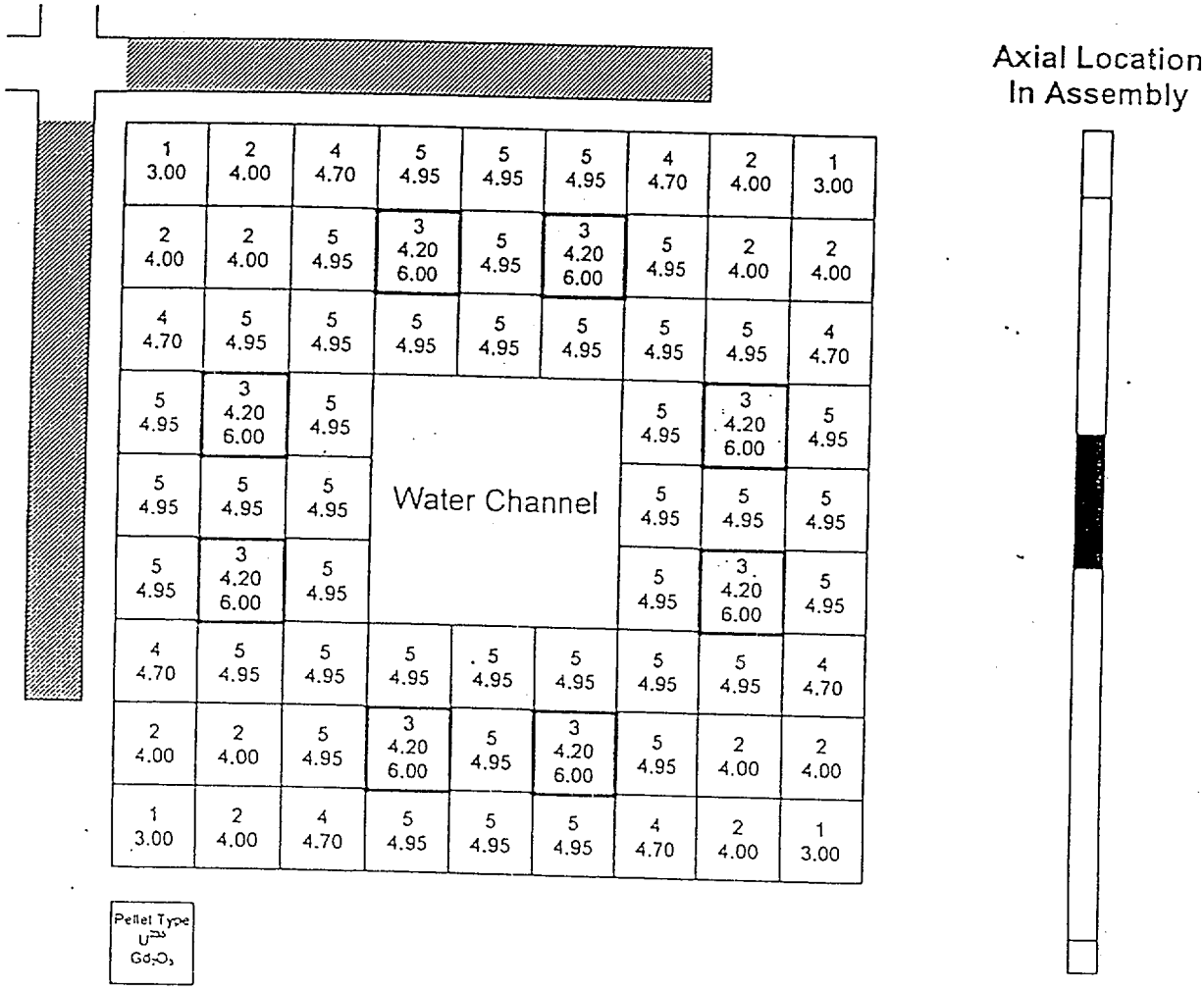
Pellet Type	Quantity	U^{235} + Gd_2O_3 Concentration (wt%)
1	4	2.60
2	12	3.40
3	8	3.40 + 5.00
4	8	3.80
5	40	4.40

Figure 4.8 SPCA9-3.96L-8G5.0-100M
Enrichment Distribution



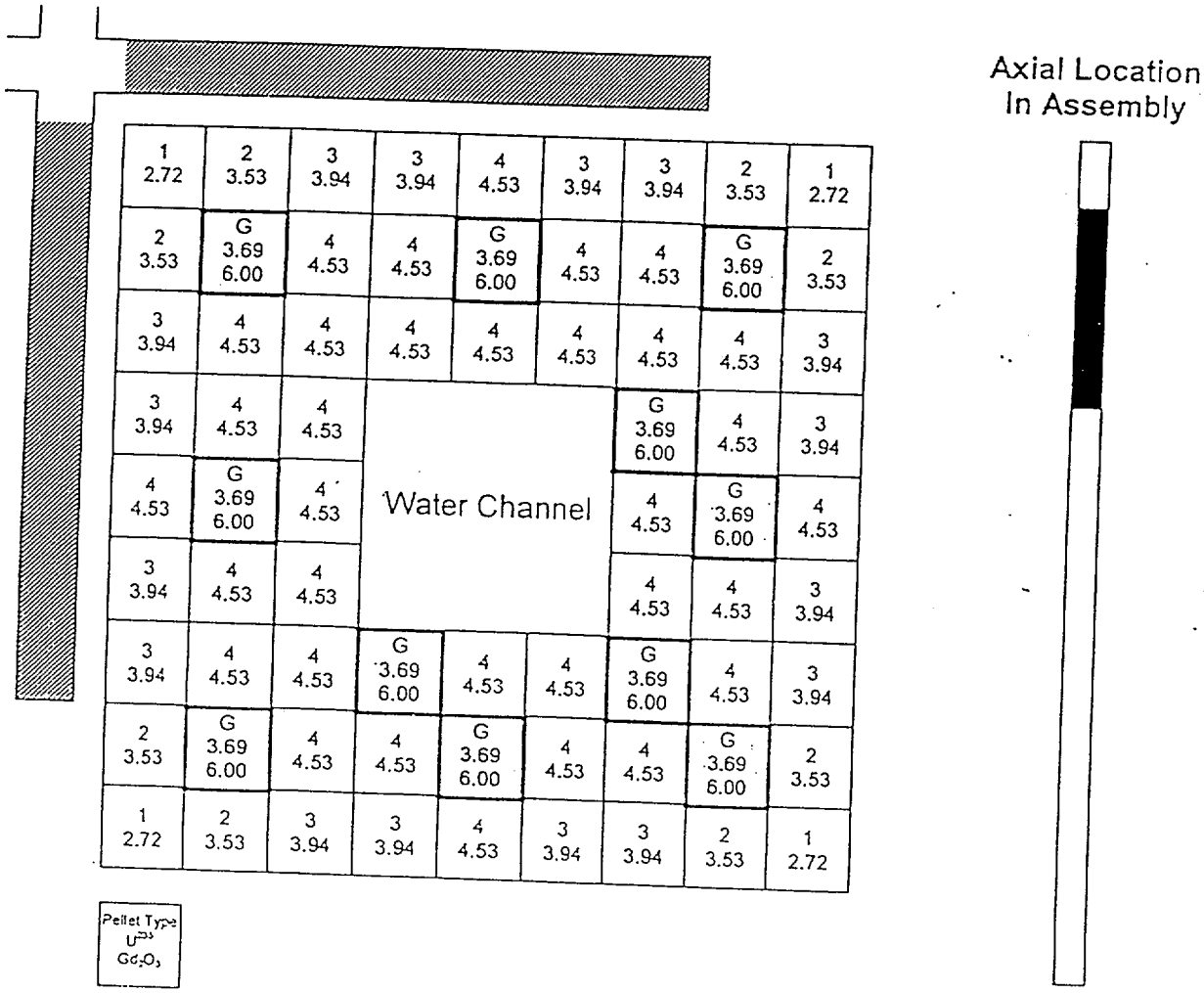
Pellet Type	Quantity	U^{235} + Gd_2O_3 Concentration (wt%)
1	4	3.00
2	8	4.00
3	4	4.00 + 3.00
4	8	4.20 + 6.00
5	8	4.70
6	40	4.95

Figure 4.9 SPCA9-4.58L-8G6.0/4G3.0-100M
Enrichment Distribution



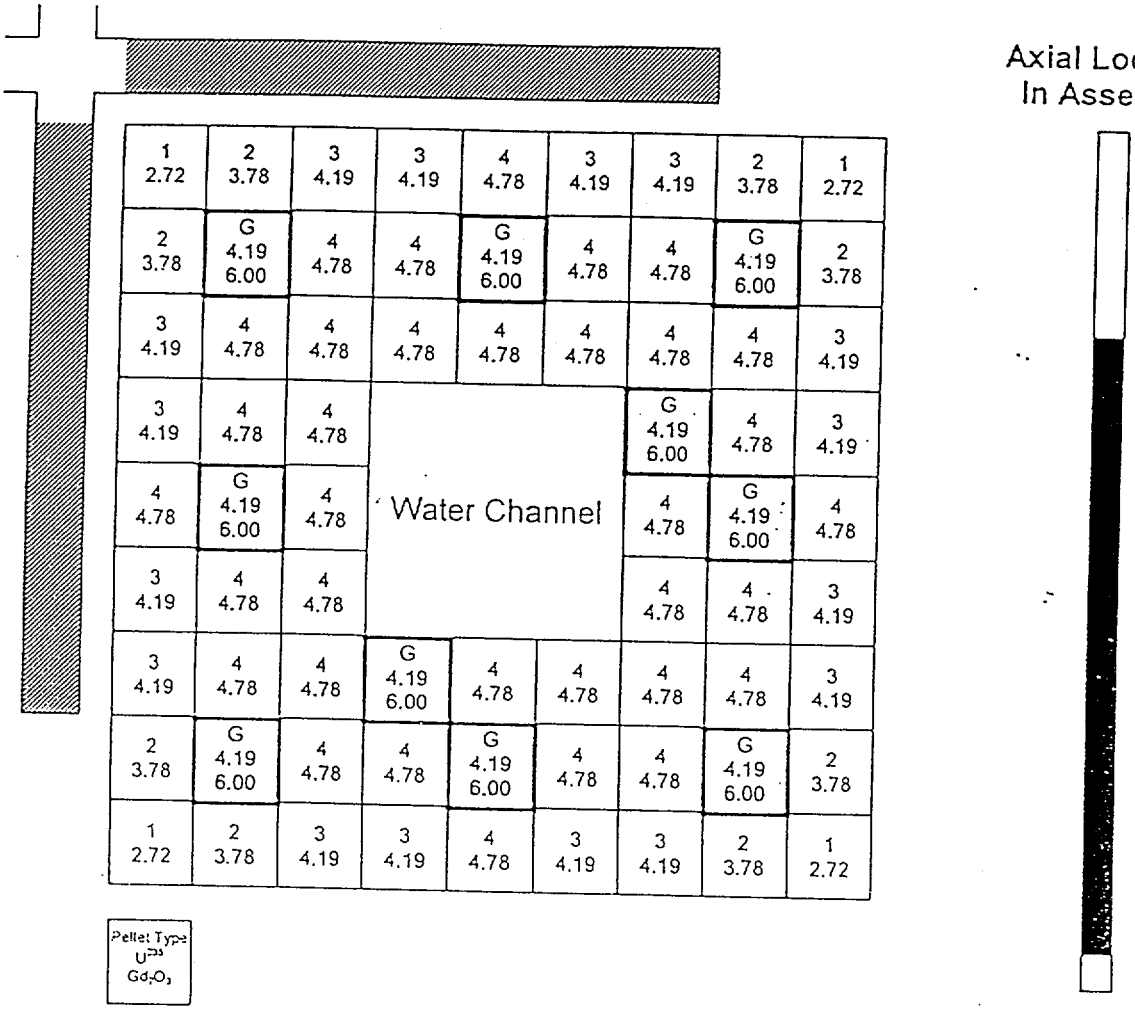
Pellet Type	Quantity	$U^{235} + Gd_2O_3$ Concentration (wt%)
1	4	3.00
2	12	4.00
3	8	4.20 + 6.00
4	8	4.70
5	40	4.95

Figure 4.10 SPCA9-4.58L-8G6.0-100M
Enrichment Distribution



Pellet Type	Quantity	U^{235} + Gd_2O_3 Concentration (wt%)
1	4	2.72
2	8	3.53
3	16	3.94
4	33	4.53
G	11	3.69 + 6.00

Figure 4.11 SPCA9-4.06L-11G6.0-80M
Enrichment Distribution



Pellet Type	Quantity	U^{235} + Gd_2O_3 Concentration (wt%)
1	4	2.72
2	8	3.78
3	16	4.19
4	34	4.78
G	10	4.19 + 6.00

Figure 4.12 SPCA9-4.34L-10G6.0-80M
Enrichment Distribution

SPCA9-393B-16GZ-100M

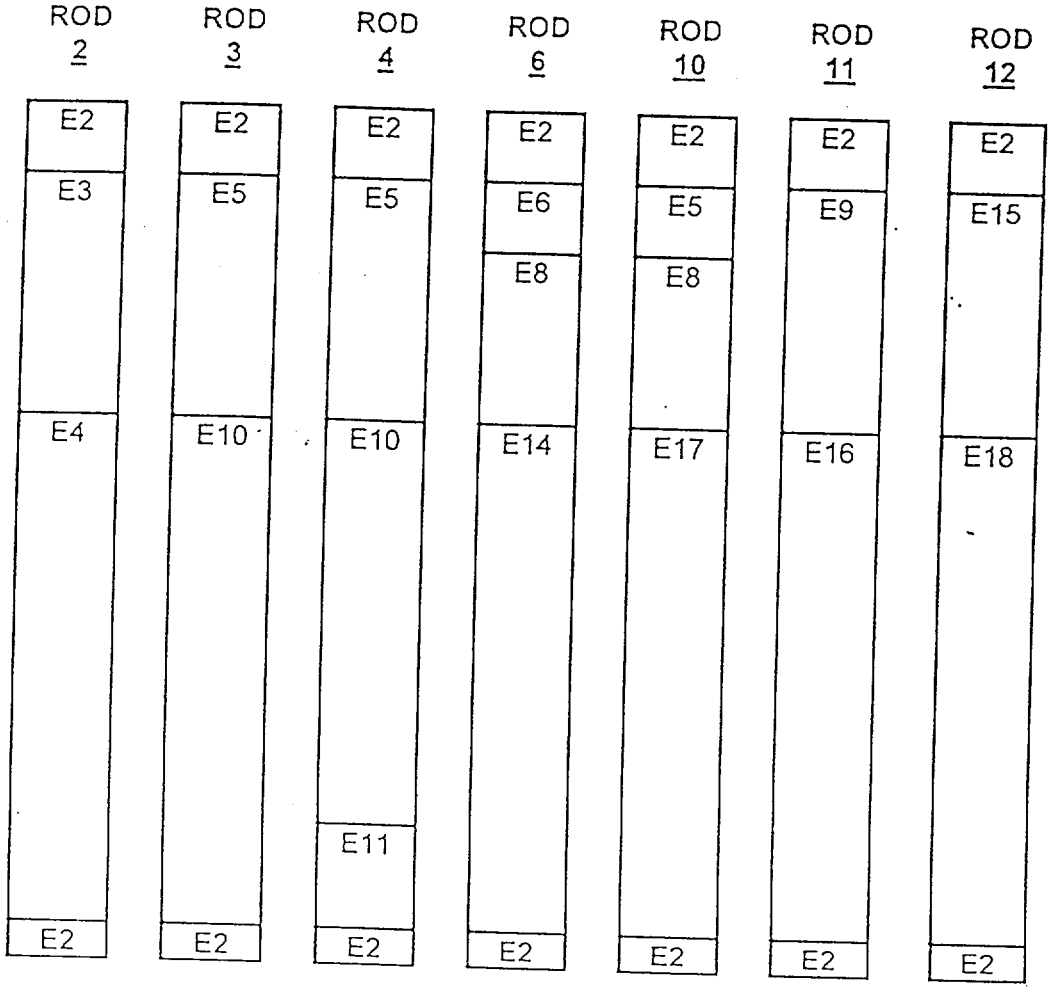
	Lattice
Natural Uranium	SPCA9-0.72L-0.G0.0-100M
3.90-8G5.0	SPCA9-3.90L-8G5.0-100M
3.91-12G8.0	SPCA9-3.91L-12G8.0-100M
4.56-12G8.0	SPCA9-4.56L-12G8.0-100M
4.56-12G8.0/4G3.0	SPCA9-4.56L-12G8.0/4G3.0-100M
Natural Uranium	SPCA9-0.72L-0.G0.0-100M

2	3	11	12	12	12	11	3	2
3	4	6	12	10	12	6	4	3
11	6	12	12	12	12	12	6	11
12	12	12	W	W	W	12	12	12
12	10	12	W	W	W	12	10	12
12	12	12	W	W	W	12	12	12
11	6	12	12	12	12	12	6	11
3	4	6	12	10	12	6	4	3
2	3	11	12	12	12	11	3	2

Fuel Rod Type	No. Rods
2	4
3	8
4	4
6	8
10	4
11	8
12	36

Figure 4.13 ATRIUM-9B LSA-1 19A Assembly Design

SPCA9-393B-16GZ-100M



Lattice Index	Enrichment + Gd
E2	0.72 wt% U-235
E3	2.60 wt% U-235
E4	3.00 wt% U-235
E5	3.40 wt% U-235
E6	3.40 wt% U-235 + 5.0 wt% Gd_2O_3
E7	3.40 wt% U-235 + 7.0 wt% Gd_2O_3
E8	3.40 wt% U-235 + 8.0 wt% Gd_2O_3
E9	3.80 wt% U-235
E10	4.00 wt% U-235

Lattice Index	Enrichment + Gd
E11	4.00 wt% U-235 + 3.0 wt% Gd_2O_3
E12	4.20 wt% U-235 + 6.0 wt% Gd_2O_3
E13	4.20 wt% U-235 + 7.0 wt% Gd_2O_3
E14	4.20 wt% U-235 + 8.0 wt% Gd_2O_3
E15	4.40 wt% U-235
E16	4.70 wt% U-235
E17	4.70 wt% U-235 + 8.0 wt% Gd_2O_3
E18	4.95 wt% U-235

Figure 4.13 ATRIUM-9B LSA-1 19A Assembly Design (continued)

SPCA9-396B-12GZB-100M

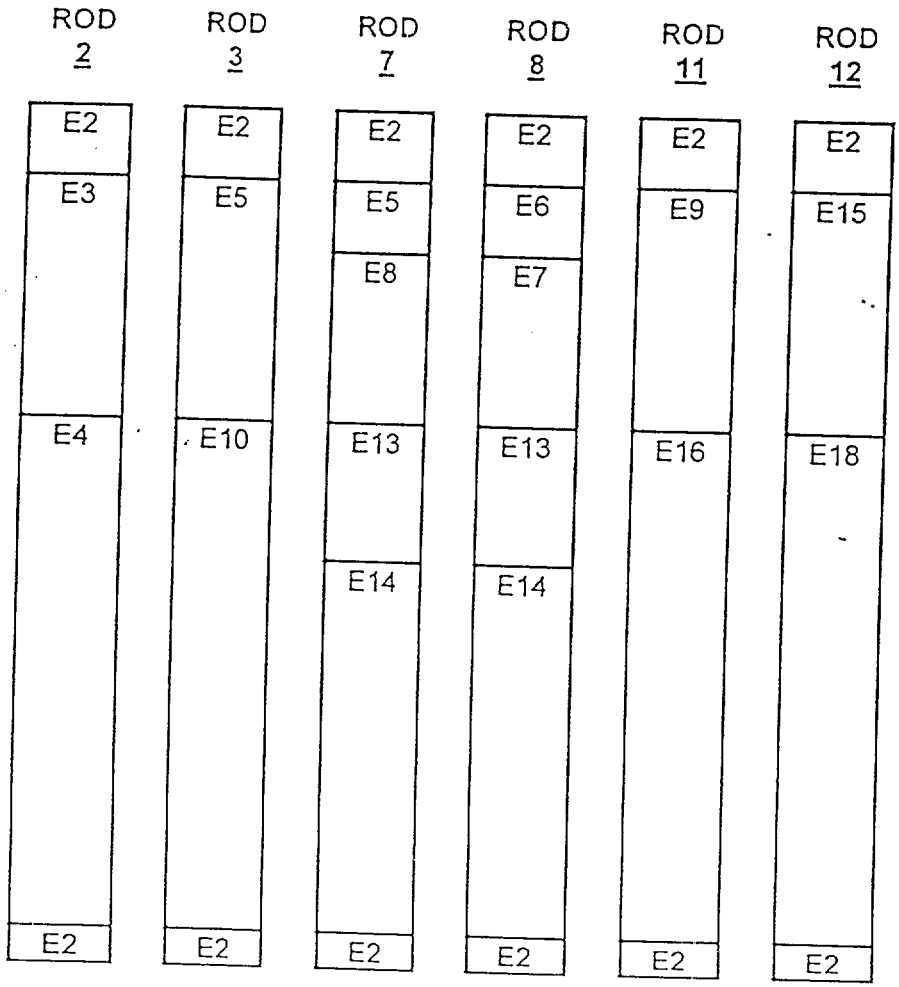
	Lattice
Natural Uranium	SPCA9-0.72L-0.G0.0-100M
3.96-8G5.0	SPCA9-3.96L-8G5.0-100M
3.96-8G7.0/4G8.0	SPCA9-3.96L-8G7.0/4G8.0-100M
4.59-12G7.0	SPCA9-4.59L-12G7.0-100M
4.59-12G8.0	SPCA9-4.59L-12G8.0-100M
Natural Uranium	SPCA9-0.72L-0.G0.0-100M

2	3	11	12	12	12	11	3	2
3	7	12	8	12	8	12	7	3
11	12	12	12	12	12	12	12	11
12	8	12	W	W	W	12	8	12
12	12	12	W	W	W	12	12	12
12	8	12	W	W	W	12	8	12
11	12	12	12	12	12	12	12	11
3	7	12	8	12	8	12	7	3
2	3	11	12	12	12	11	3	2

Fuel Rod Type	No. Rods
2	4
3	8
7	4
8	8
11	8
12	40

Figure 4.14 ATRIUM-9B LSA-1 19B Assembly Design

SPCA9-396B-12GZB-100M



Lattice Index	Enrichment + Gd
E2	0.72 wt% U-235
E3	2.60 wt% U-235
E4	3.00 wt% U-235
E5	3.40 wt% U-235
E6	3.40 wt% U-235 + 5.0 wt% Gd_2O_3
E7	3.40 wt% U-235 + 7.0 wt% Gd_2O_3
E8	3.40 wt% U-235 + 8.0 wt% Gd_2O_3
E9	3.80 wt% U-235
E10	4.00 wt% U-235

Lattice Index	Enrichment + Gd
E11	4.00 wt% U-235 + 3.0 wt% Gd_2O_3
E12	4.20 wt% U-235 + 6.0 wt% Gd_2O_3
E13	4.20 wt% U-235 + 7.0 wt% Gd_2O_3
E14	4.20 wt% U-235 + 8.0 wt% Gd_2O_3
E15	4.40 wt% U-235
E16	4.70 wt% U-235
E17	4.70 wt% U-235 + 8.0 wt% Gd_2O_3
E18	4.95 wt% U-235

Figure 4.14 ATRIUM-9B LSA-1 19B Assembly Design (continued)

SPCA9-396B-12GZC-100M

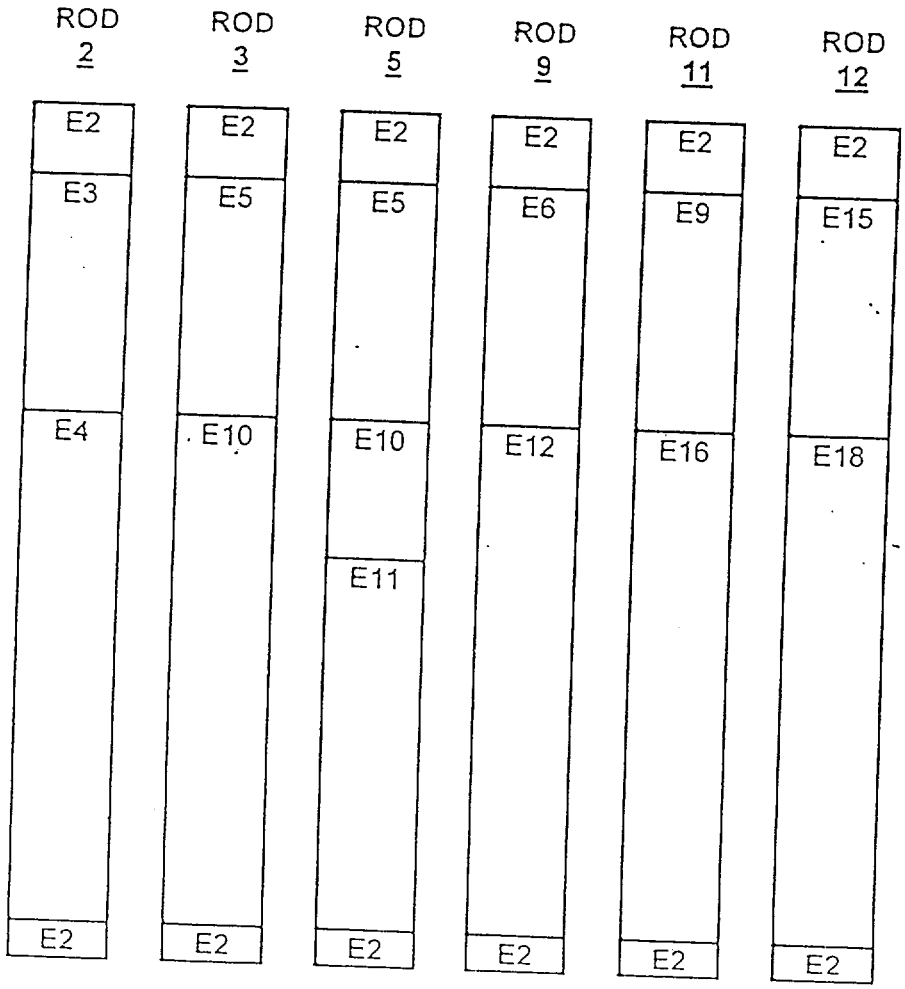
	Lattice
Natural Uranium	SPCA9-0.72L-0.G0.0-100M
3.96-8G5.0	SPCA9-3.96L-8G5.0-100M
4.58-8G6.0	SPCA9-4.58L-8G6.0-100M
4.58-8G6.0/4G3.0	SPCA9-4.58L-8G6.0/4G3.0-100M
Natural Uranium	SPCA9-0.72L-0.G0.0-100M

2	3	11	12	12	12	11	3	2
3	5	12	9	12	9	12	5	3
11	12	12	12	12	12	12	12	11
12	9	12	W	W	W	12	9	12
12	12	12	W	W	W	12	12	12
12	9	12	W	W	W	12	9	12
11	12	12	12	12	12	12	12	11
3	5	12	9	12	9	12	5	3
2	3	11	12	12	12	11	3	2

Fuel Rod Type	No. Rods
2	4
3	8
5	4
9	8
11	8
12	40

Figure 4.15 ATRIUM-9B LSA-1 19C Assembly Design

SPCA9-396B-12GZC-100M

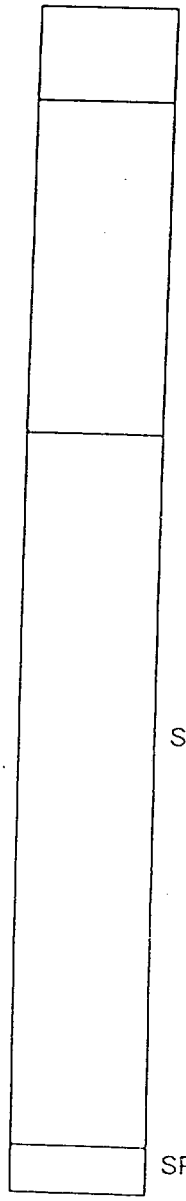


Lattice Index	Enrichment + Gd
E2	0.72 wt% U-235
E3	2.60 wt% U-235
E4	3.00 wt% U-235
E5	3.40 wt% U-235
E6	3.40 wt% U-235 + 5.0 wt% Gd_2O_3
E7	3.40 wt% U-235 + 7.0 wt% Gd_2O_3
E8	3.40 wt% U-235 + 8.0 wt% Gd_2O_3
E9	3.80 wt% U-235
E10	4.00 wt% U-235

Lattice Index	Enrichment + Gd
E11	4.00 wt% U-235 + 3.0 wt% Gd_2O_3
E12	4.20 wt% U-235 + 6.0 wt% Gd_2O_3
E13	4.20 wt% U-235 + 7.0 wt% Gd_2O_3
E14	4.20 wt% U-235 + 8.0 wt% Gd_2O_3
E15	4.40 wt% U-235
E16	4.70 wt% U-235
E17	4.70 wt% U-235 + 8.0 wt% Gd_2O_3
E18	4.95 wt% U-235

Figure 4.15 ATRIUM-9B LSA-1 19C Assembly Design (continued)

SPCA9-384B-11GZ-80M

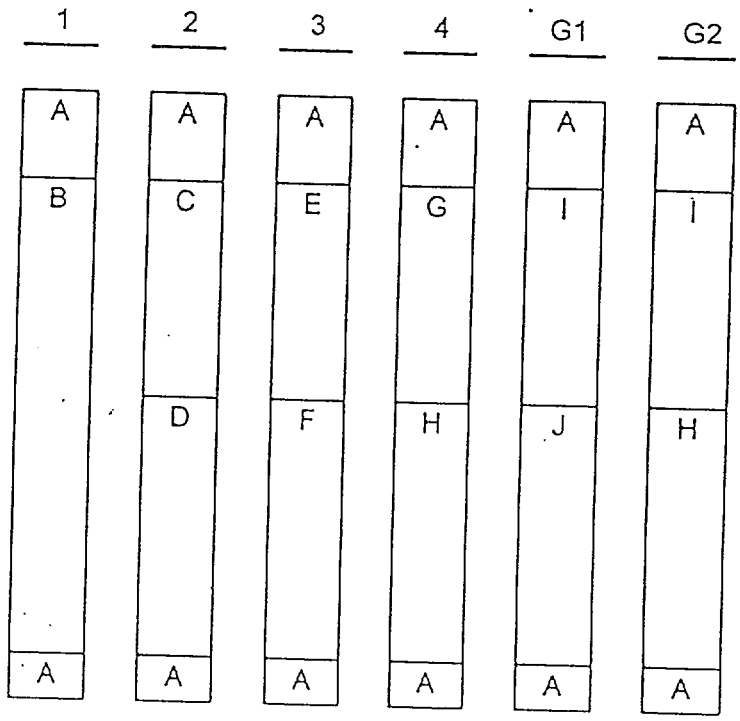


1	2	3	3	4	3	3	2	1
2	G1	4	4	G1	4	4	G1	2
3	4	4	4	4	4	4	4	3
3	4	4	W	W	W	G1	4	3
4	G1	4	W	W	W	4	G1	4
3	4	4	W	W	W	4	4	3
3	4	4	G1	4	4	G2	4	3
2	G1	4	4	G1	4	4	G1	2
1	2	3	3	4	3	3	2	1

Fuel Rod Type	No. Rods
1	4
2	8
3	16
4	33
G1	10
G2	1

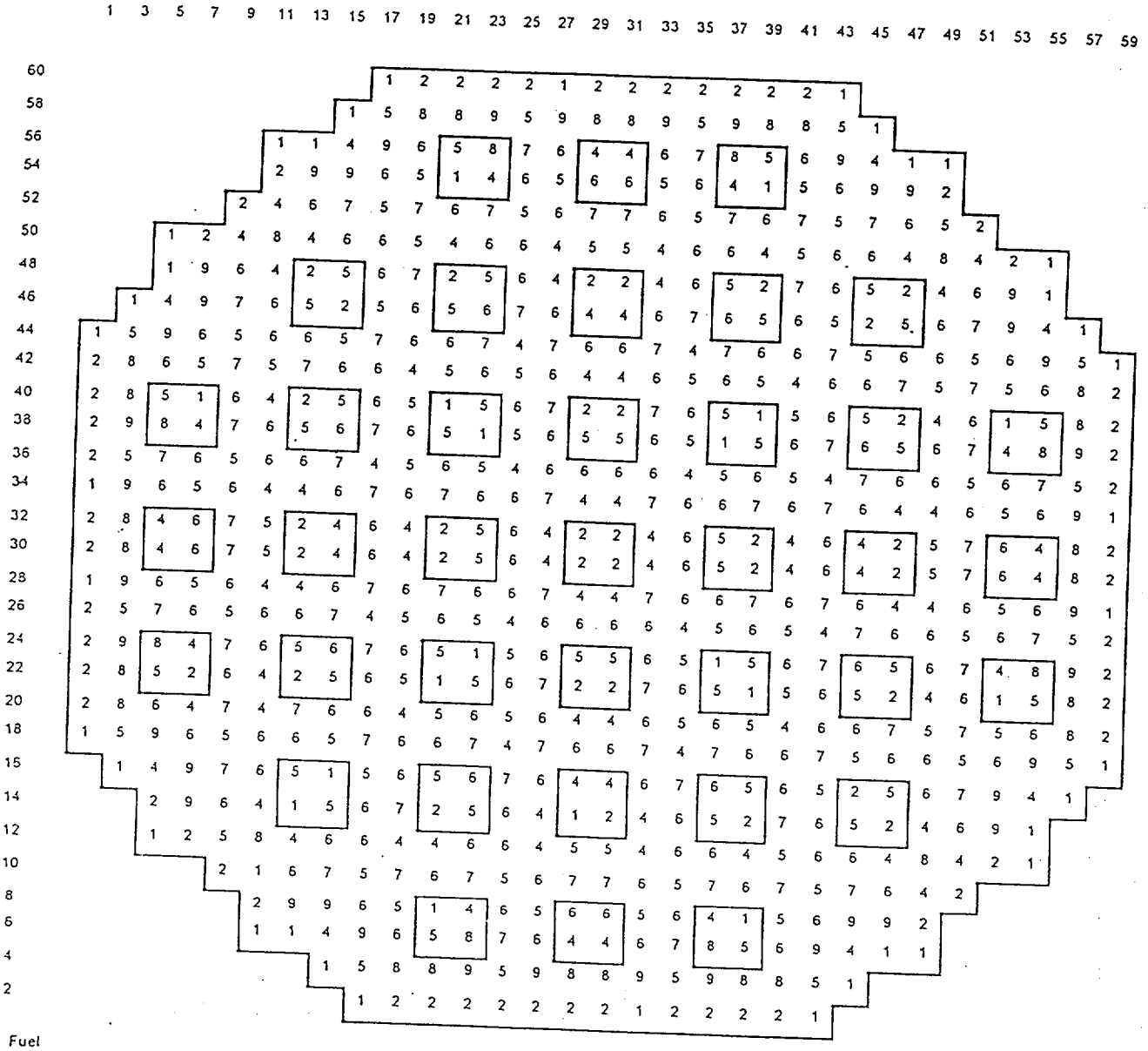
Figure 4.16 ATRIUM-9B SPCA9-384B-11GZ-80M Assembly Design

SPCA9-384B-11GZ-80M



A	0.72 wt% U-235
B	2.72 wt% U-235
C	3.53 wt% U-235
D	3.78 wt% U-235
E	3.94 wt% U-235
F	4.19 wt% U-235
G	4.53 wt% U-235
H	4.78 wt% U-235
I	3.69 wt% U-235 + 6.00 wt% Gd_2O_3
J	4.19 wt% U-235 + 6.00 wt% Gd_2O_3

Figure 4.16 ATRIUM-9B SPCA9-384B-11GZ-80M Assembly Design (continued)



Fuel Type	Bundle Name	Number of Bundles	Load Cycle
1	GE9B-P8CWB322-11GZ-100M-150	56	7
2	GE9B-P8CWB320-9GZ-100M-150	89	7
4	GE9B-P8CWB343-12GZ-80M-150	104	8
5	GE9B-P8CWB342-10GZ-80M-150	143	8
6	SPCA9-393B-16GZ-100M	208	9
7	SPCA9-396B-12GZB-100M	88	9
8	SPCA9-364B-11GZ-80M	36	9
9	SPCA9-396B-12GZC-100M	40	9

Figure 4.17 LaSalle Unit 1 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	460.2	126.5	1206	0.34 / 0.38
FWCF†	TSSS	371.3	122.6	1167	0.30 / 0.33
LRNB†	NSS	401.1	121.3	1203	0.31 / 0.34
FWCF†	NSS	342.9	120.5	1164	0.28 / 0.31
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. $MCPR_f$ limits are provided for maximum core flows of 102.5% and 105% of rated. The $LHGRFAC_f$ multipliers provided in Figure 5.2 are applicable for maximum core flows of 102.5% and 105% of rated.

* Based on 100%P/81%F conditions.
† 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)	1320 psig
Maximum Steam Dome Pressure	1291 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

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* $LHGRFAC_p$ 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 for Prepower Uprate Conditions (3323 MWt Rated Power)*

EOOS Condition	Power (% Rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Base Case Operation	0	2.70	0.66	2.70
	25	2.22	0.66	2.22
	25	2.07	0.66	2.12
	63	1.56	0.94	1.57
	84	1.51	0.98	1.53
	100	1.46	0.99	1.50
Feedwater Heaters Out of Service (FHOOS)	0	2.85	0.64	2.85
	25	2.38	0.64	2.38
	25	2.38	0.64	2.38
	63	1.62	0.90	1.62
	100	1.47	0.99	1.51
Single-Loop Operation	0	2.71	0.66	2.71
	25	2.23	0.66	2.23
	25	2.08	0.66	2.13
	63	1.57	0.94	1.58
	84	1.52	0.98	1.54
	100	1.47	0.99	1.51
Turbine Bypass Valves Out of Service (TBVOOS)	0	2.70	0.66	2.70
	25	2.22	0.66	2.22
	25	2.17	0.66	2.17
	63	1.63	0.90	1.65
	100	1.49	0.94	1.53

* Limits support operation with any combination of one 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 5.1 EOC Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times for Prepower Uprate Conditions (3323 MWt Rated Power)*
(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	0.66	2.70
	25	2.22	0.66	2.22
	25	2.07	0.66	2.12
	63	1.60	0.86	1.63
	100	1.51	0.86	1.56
Turbine Control Valve (TCV) Slow Closure and/or No RPT	0	2.70	0.66	2.70
	25	2.22	0.66	2.22
	25	2.16	0.66	2.16
	84	1.65	0.86	1.69
	84	1.63	0.86	1.67
	100	1.56	0.86	1.60
TCV Slow Closure/ FHOOS and/or No RPT	0	2.85	0.63	2.85
	25	2.38	0.63	2.38
	25	2.38	0.63	2.38
	84	1.65	0.86	1.69
	84	1.63	0.86	1.67
	100	1.56	0.86	1.60
Idle Loop Startup	0	2.54	0.40	2.54
	25	2.54	0.40	2.54
	25	2.54	0.40	2.54
	63	2.54	0.40	2.54
	100	2.54	0.40	2.54

* Limits support operation with any combination of one 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 5.2 Base Case $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times for Prepower Uprate (3323 MWt Rated Power)*

EOOS Condition	Power (% Rated)	ATRIUM-9B Fuel		GE9
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Base Case Operation	0	2.70	0.74	2.70
	25	2.22	0.74	2.22
	25	2.07	0.74	2.07
	63	1.54	0.95	1.56
	84	1.48	1.00	1.51
	100	1.43	1.00	1.46

* Limits support operation with any combination of one 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 for the power/flow map.

Table 5.3 EOC Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ for Multipliers for TSSS Insertion Times for Power Uprate Conditions (3489 MWt Rated Power)*

EOOS/EOD Condition	Power (% Rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Base Case Operation	0	2.70	0.67	2.70
	25	2.20	0.67	2.20
	25	2.05	0.67	2.10
	60	1.56	0.94	1.57
	80	1.51	0.98	1.53
	100	1.45	1.00	1.49
Feedwater Heaters Out of Service (FHOOS)	0	2.85	0.65	2.85
	25	2.35	0.65	2.35
	25	2.35	0.65	2.35
	60	1.62	0.90	1.62
	100	1.45	1.00	1.49
Single-Loop Operation	0	2.71	0.67	2.71
	25	2.21	0.67	2.21
	25	2.06	0.67	2.11
	60	1.57	0.94	1.58
	80	1.52	0.98	1.54
	100	1.46	1.00	1.50
Turbine Bypass Valves Out of Service (TBVOOS)	0	2.70	0.67	2.70
	25	2.20	0.67	2.20
	25	2.15	0.67	2.15
	60	1.63	0.90	1.65
	100	1.47	0.94	1.51

* Limits support operation with any combination of one 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 5.3 EOC Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times for Power Uprate Conditions (3489 MWt Rated Power)*
(continued)

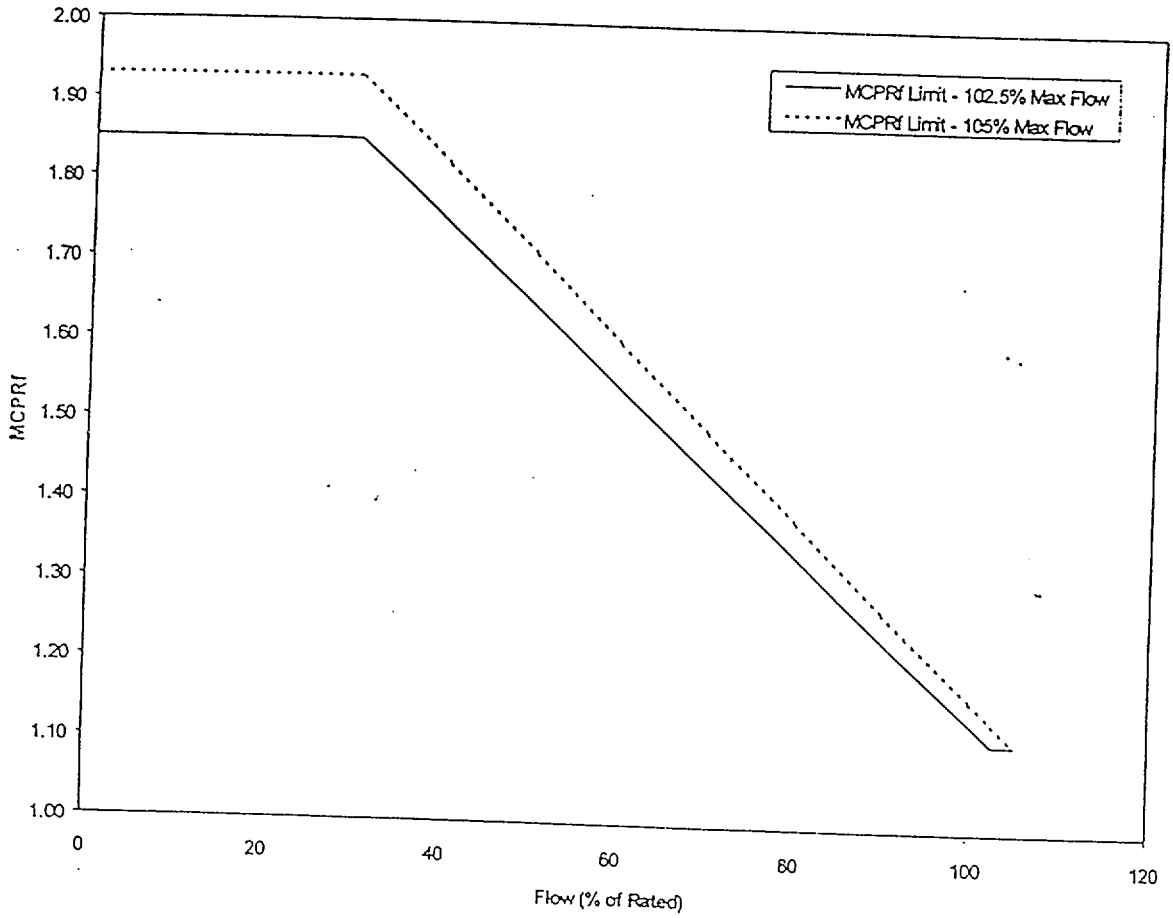
EOOS/EOD Condition	Power (% Rated)	ATRIUM-9B Fuel		GE9 Fuel
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Recirculation Pump Trip Out of Service (No RPT)	0	2.70	0.67	2.70
	25	2.20	0.67	2.20
	25	2.05	0.67	2.10
	60	1.60	0.86	1.63
	100	1.50	0.86	1.55
Turbine Control Valve (TCV) Slow Closure and/or No RPT	0	2.70	0.67	2.70
	25	2.20	0.67	2.20
	25	2.15	0.67	2.15
	80	1.65	0.86	1.69
	80	1.63	0.86	1.67
	100	1.54	0.86	1.58
TCV Slow Closure/ FHOOS and/or No RPT	0	2.85	0.64	2.85
	25	2.35	0.64	2.35
	25	2.35	0.64	2.35
	80	1.65	0.86	1.69
	80	1.63	0.86	1.67
	100	1.54	0.86	1.58
Idle Loop Restart	0	2.54	0.40	2.54
	25	2.54	0.40	2.54
	25	2.54	0.40	2.54
	60	2.54	0.40	2.54
	100	2.54	0.40	2.54

* Limits support operation with any combination of one 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 5.4 EOC $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times for Power Uprate Conditions (3489 MWt Rated Power)*

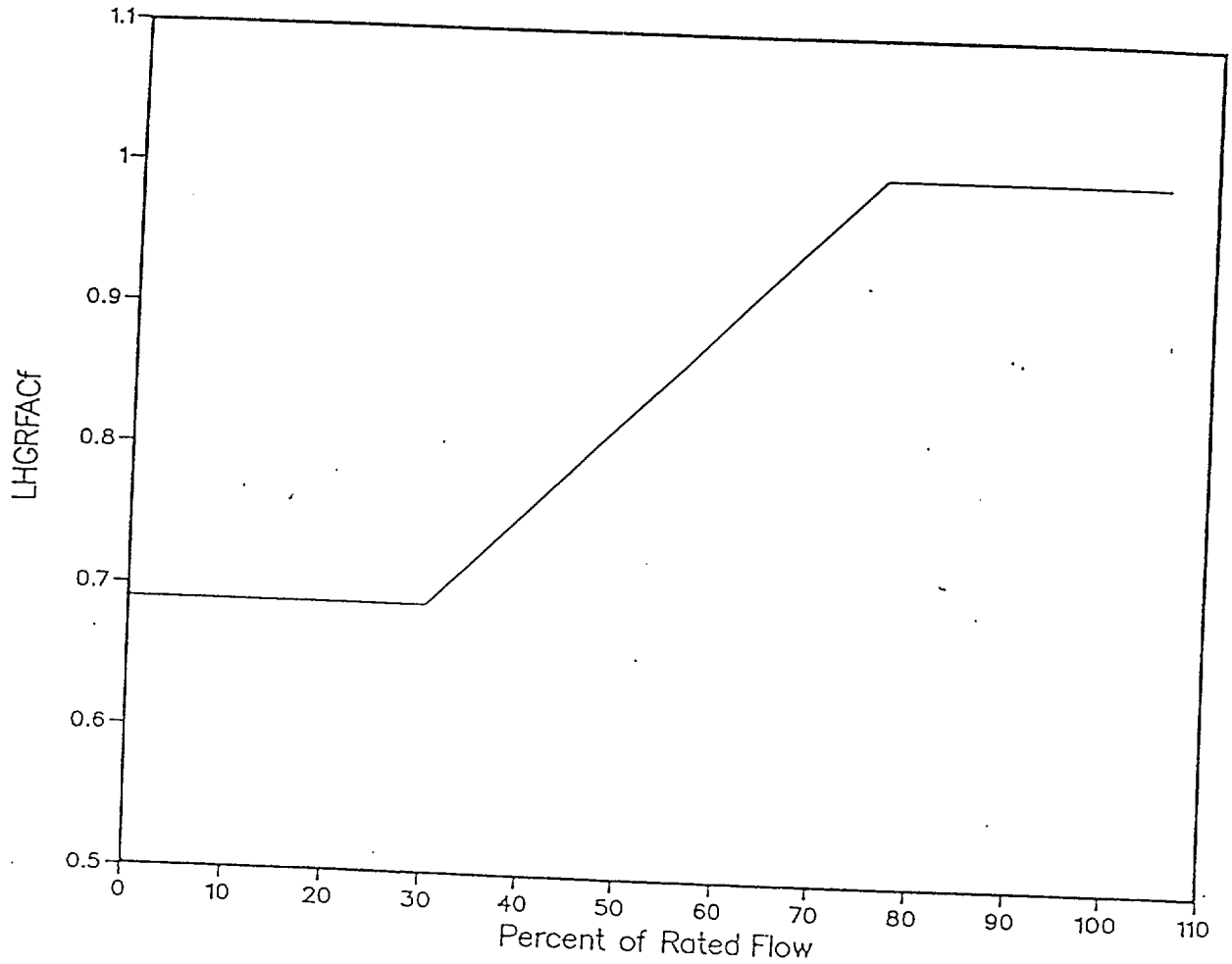
EOOS Condition	Power (% Rated)	ATRIUM-9B Fuel		GE9
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$
Base Case Operation	0	2.70	0.75	2.70
	25	2.20	0.75	2.20
	25	2.05	0.75	2.05
	60	1.54	0.95	1.56
	80	1.48	1.00	1.51
	100	1.42	1.00	1.45

* Limits support operation with any combination of one 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.



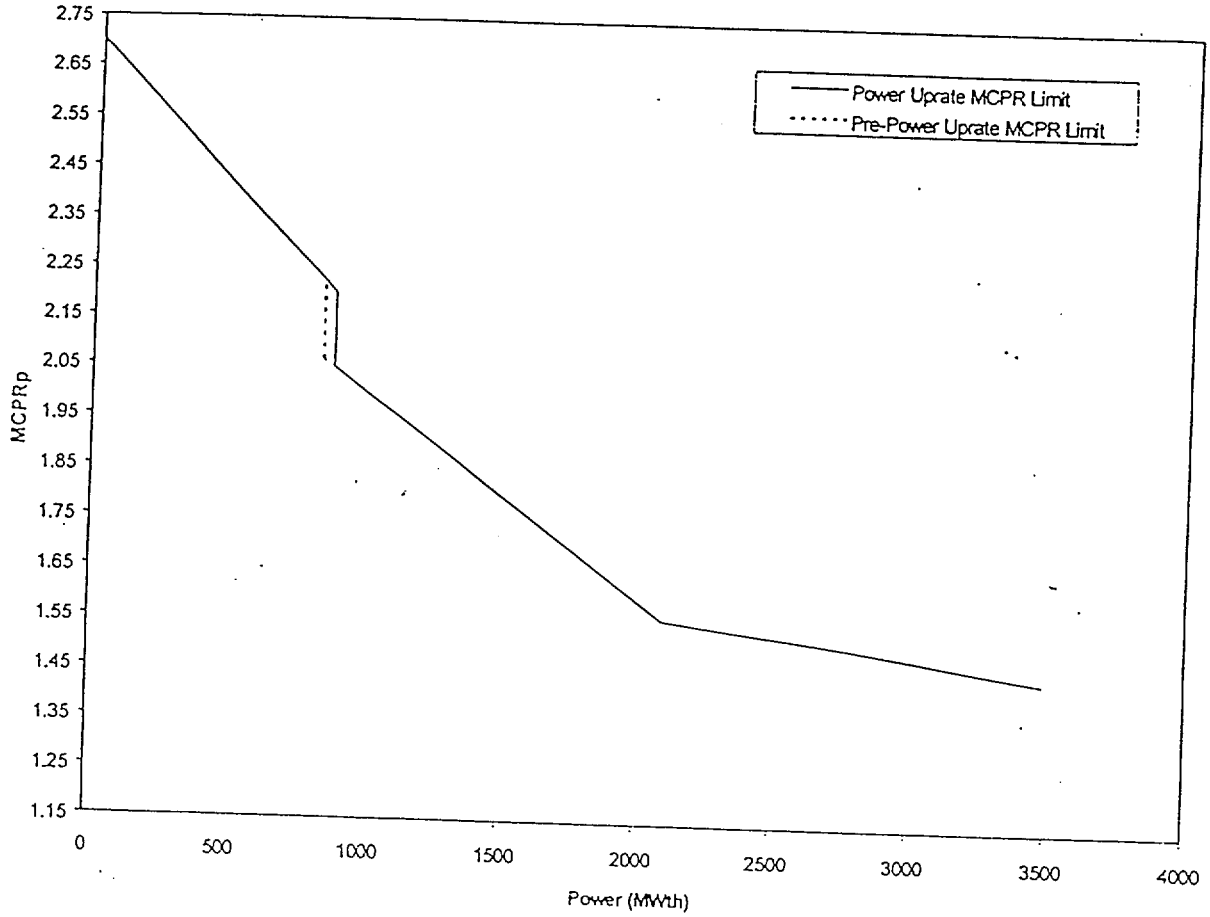
Flow (% rated)	102.5% Maximum Core Flow		105% Maximum Core Flow	
	$MCPR_f$ ATRIUM-9B	$MCPR_f$ GE9	$MCPR_f$ ATRIUM-9B	$MCPR_f$ GE9
0	1.85	1.85	1.93	1.93
30	1.85	1.85	1.93	1.93
102.5	1.11	1.11	1.14	1.14
105	1.11	1.11	1.11	1.11

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



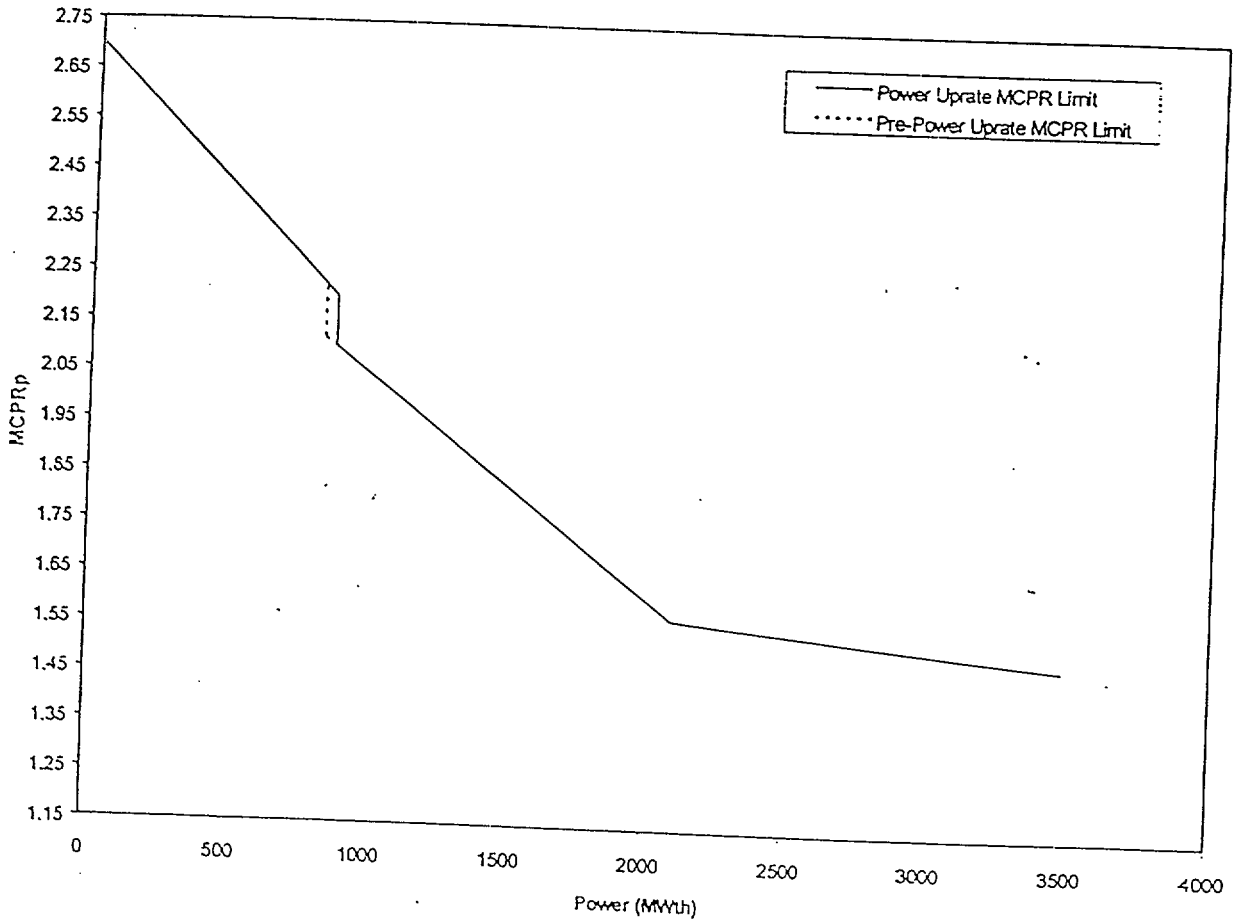
3323 MWt Rated Power

Power (%)	$MCPR_p$ Limits
100	1.46
84	1.51
63	1.56
25	2.07
25	2.22
0	2.70

3489 MWt Rated Power

Power (%)	$MCPR_p$ Limits
100	1.45
80	1.51
60	1.56
25	2.05
25	2.20
0	2.70

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



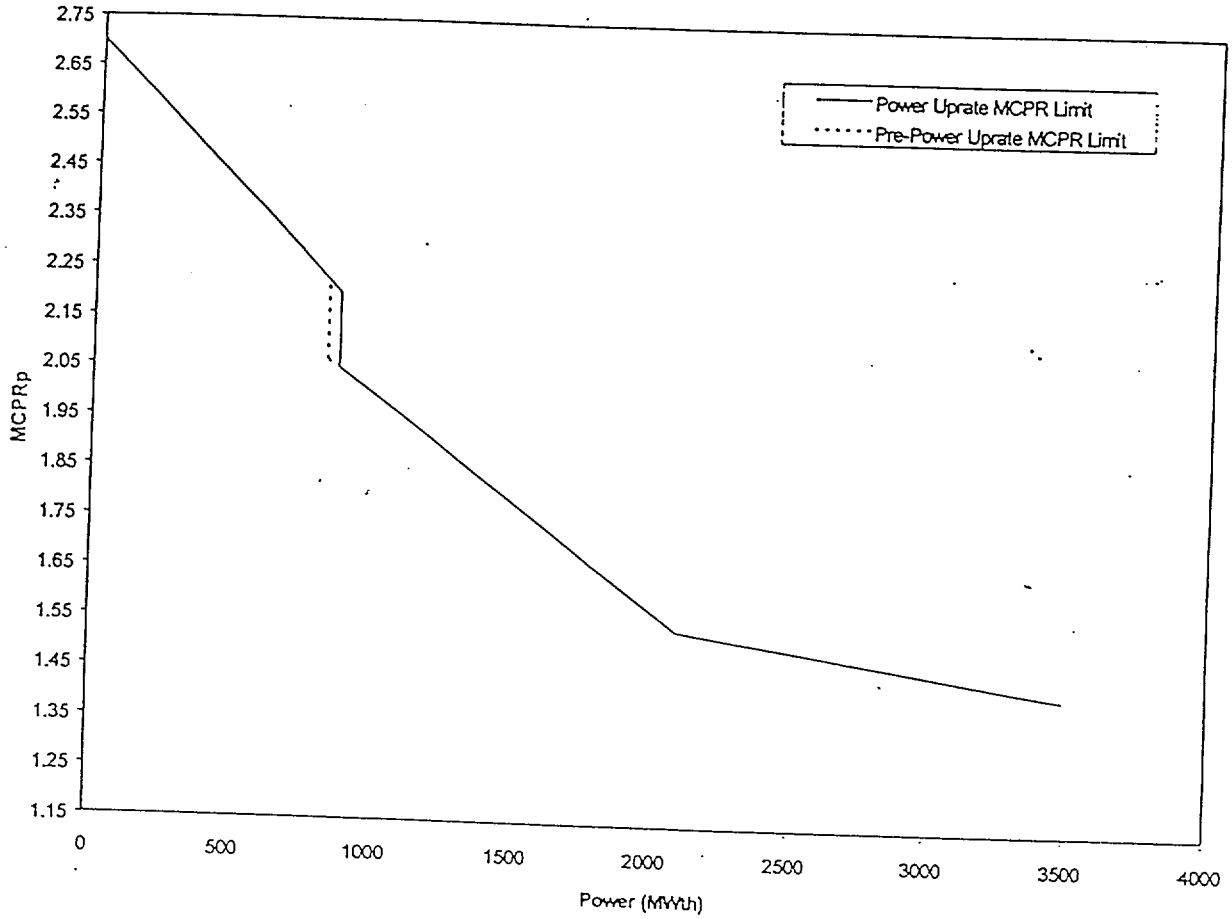
3323 MWt Rated Power

Power (%)	$MCPR_p$ Limits
100	1.50
84	1.53
63	1.57
25	2.12
25	2.22
0	2.70

3489 MWt Rated Power

Power (%)	$MCPR_p$ Limits
100	1.49
80	1.53
60	1.57
25	2.10
25	2.20
0	2.70

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



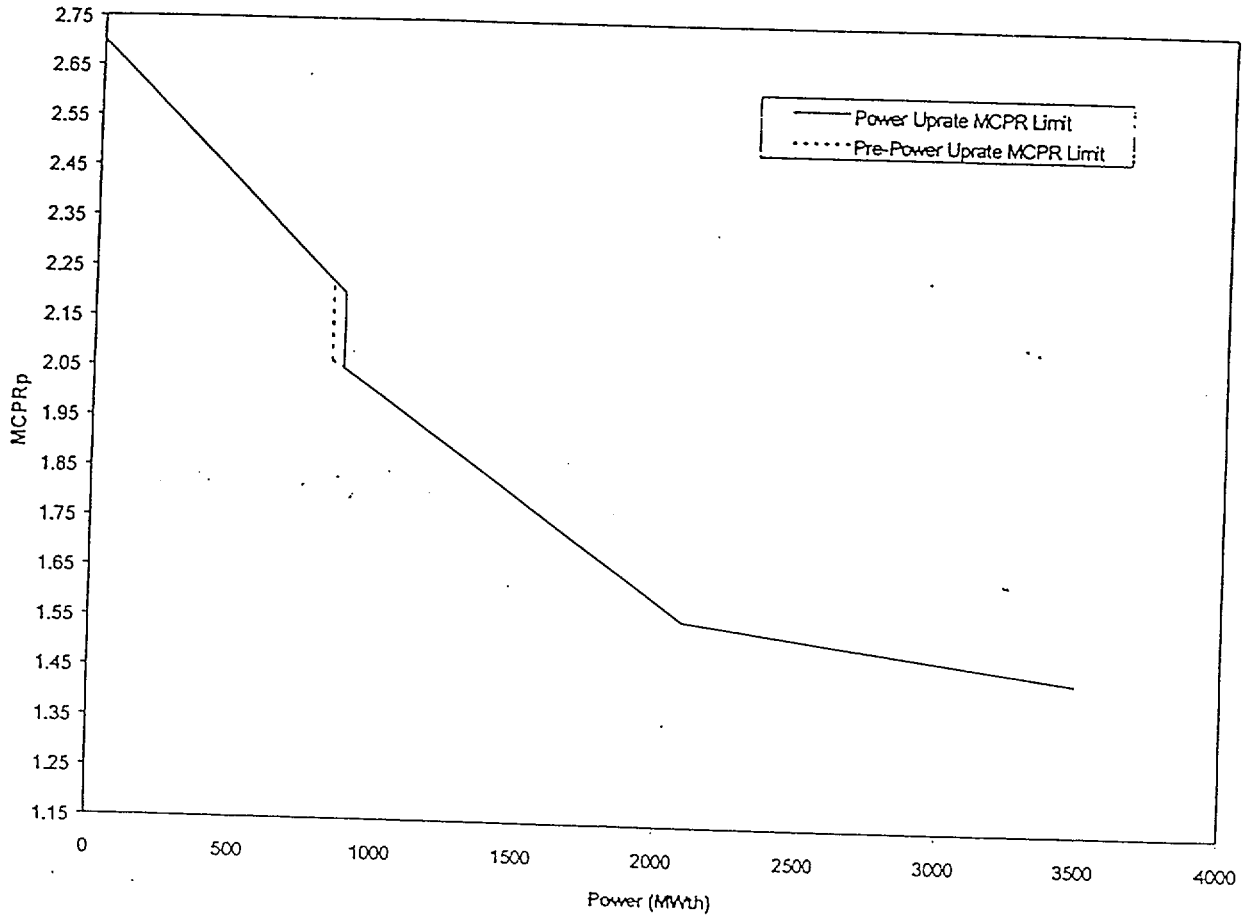
3323 MWt Rated Power

Power (%)	$MCPR_p$ Limits
100	1.43
84	1.48
63	1.54
25	2.07
25	2.22
0	2.70

3489 MWt Rated Power

Power (%)	$MCPR_p$ Limits
100	1.42
80	1.48
60	1.54
25	2.05
25	2.20
0	2.70

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



3323 MWt Rated Power

Power (%)	$MCPR_p$ Limits
100	1.46
84	1.51
63	1.56
25	2.07
25	2.22
0	2.70

3489 MWt Rated Power

Power (%)	$MCPR_p$ Limits
100	1.45
80	1.51
60	1.56
25	2.05
25	2.20
0	2.70

Figure 5.6 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 1 ATRIUM-9B (LSA-1) 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 1795°F and 0.72% 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 (from 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

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* 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

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

GE9-Fuel MAPLHGR Limits

< To be furnished by ComEd. >

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

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* Includes the effects of channel bow, up to 2 TIPOOS (or the equivalent number of TIP channels), a 2000 EFPH LPRM calibration interval 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		GE9 Fuel Steady-State LHGR Limits
Average Planar Exposure (GWd/MTU)	LHGR (kW/ft)	< To be furnished by ComEd. >
0.0	14.4	
15.0	14.4	
61.1	8.32	

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. >

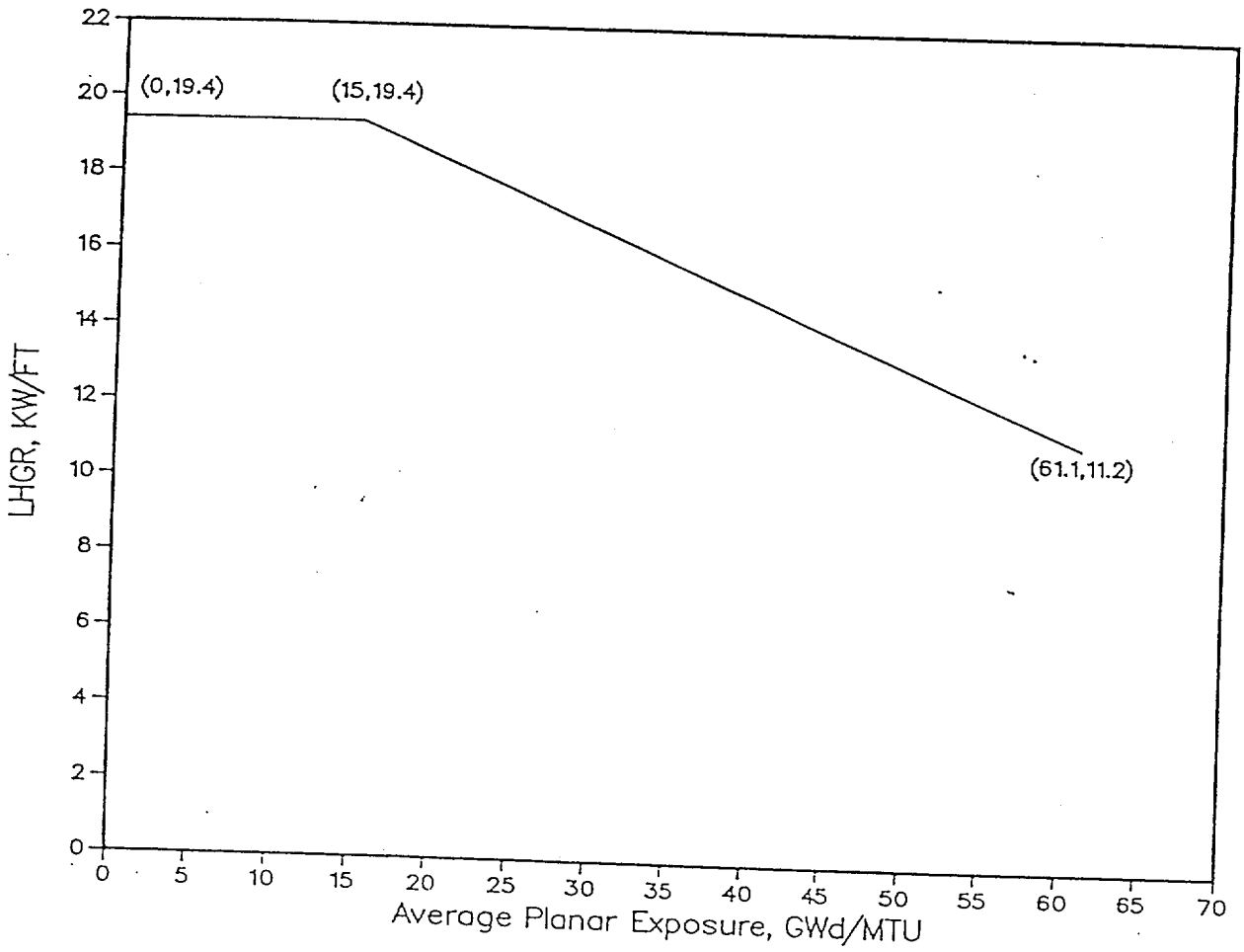


Figure 7.1 Protection Against Power Transient LHGR Limit for ATRIUM-9B Fuel

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 Supplement 1 Revision 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), Supplement 1, *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 Revision 0, *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-2249(P) Revision 1, *Fuel Design Report for LaSalle Unit 1 Cycle 9 ATRIUM™-9B Fuel Assemblies*, Siemens Power Corporation, September 1999.

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-2277 Revision 1, *LaSalle Unit 1 Cycle 9 Plant Transient Analysis*, Siemens Power Corporation, October 1999.

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), *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), *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 1 Cycle 9 Mechanical Limits for GE9 Fuel." DEG:99:213, August 4, 1999.

9.11 Letter, D. E. Garber (SPC) to R. J. Chin (ComEd), "10 CFR 50.46 Reporting for the LaSalle Units," DEG:99:129, May 6, 1999.

Attachment 3

LaSalle Unit 1 Cycle 9

Plant Transient Analysis (Excerpts)

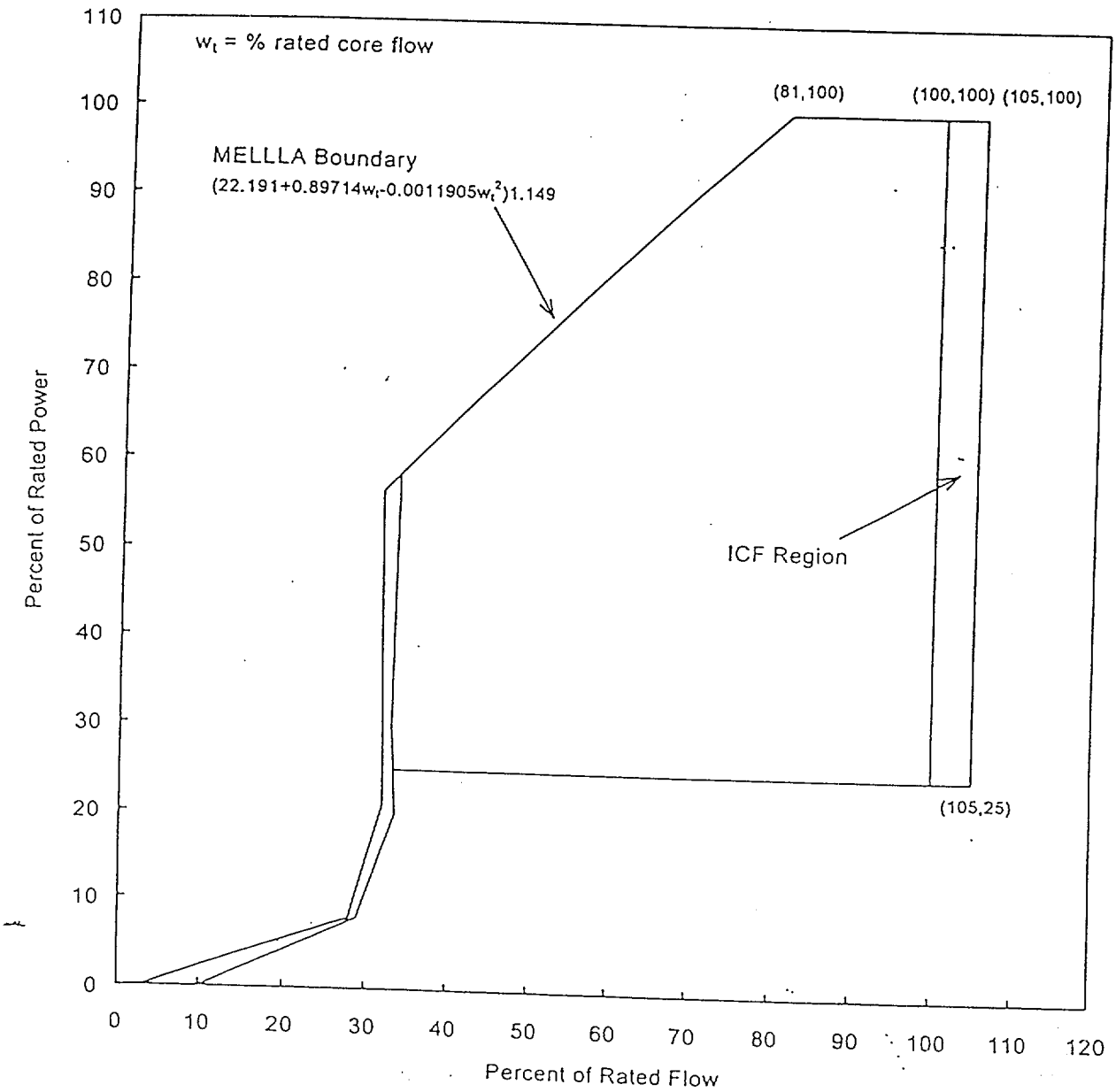
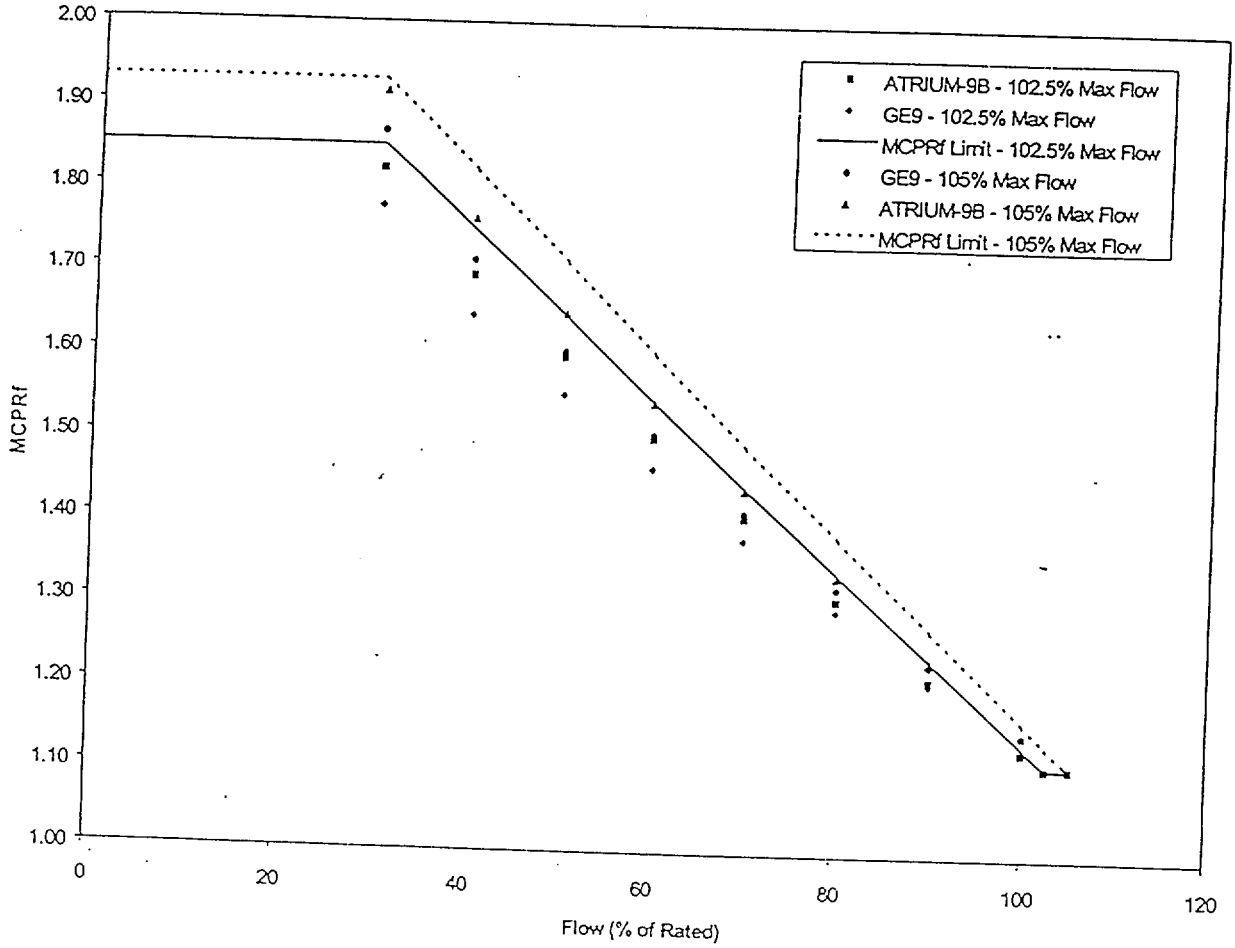
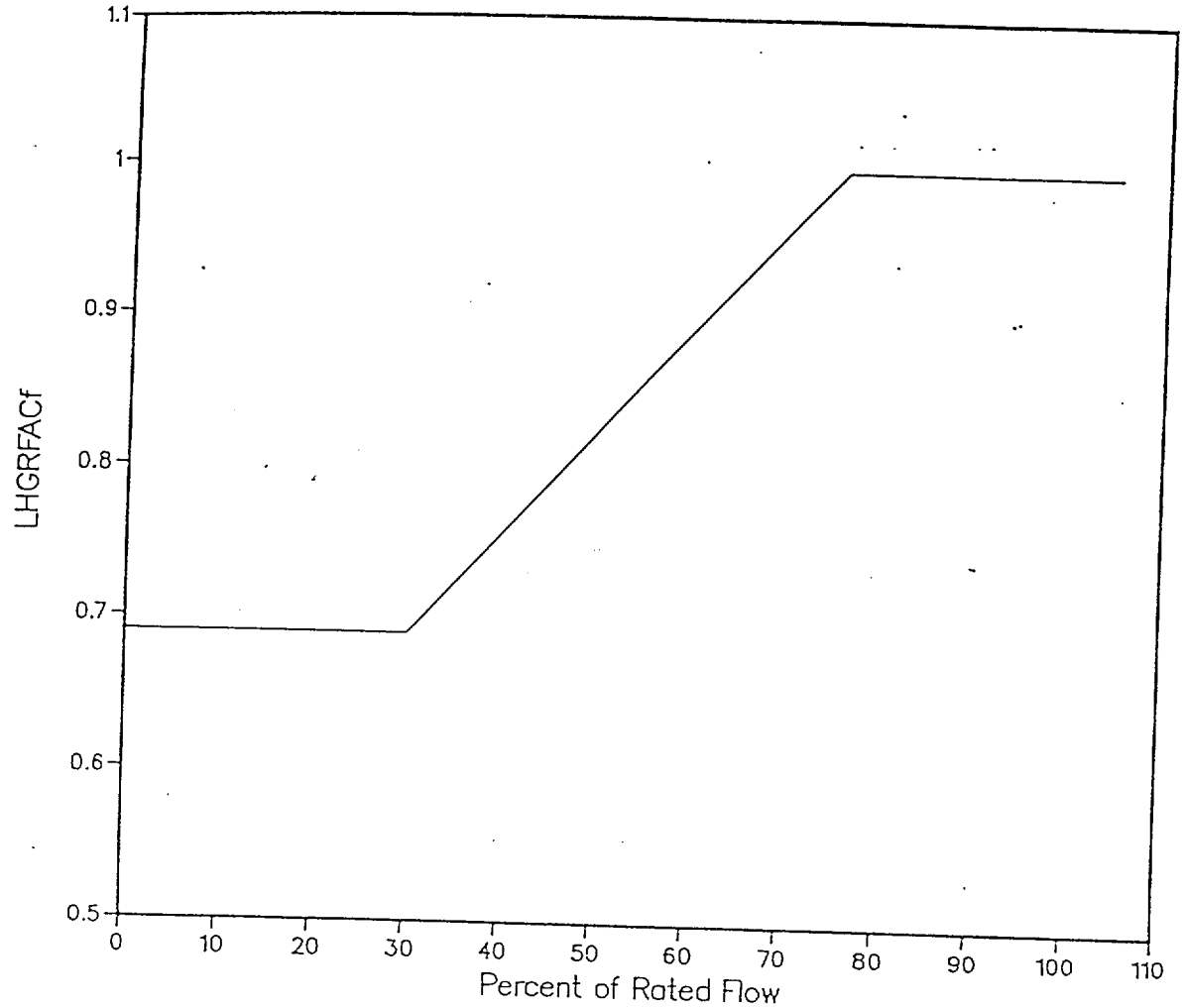


Figure 1.1 LaSalle County Nuclear Station
Power / Flow Map



Flow (% rated)	102.5% Maximum Core Flow		105% Maximum Core Flow	
	$MCPR_f$ ATRIUM-9B	$MCPR_f$ GE9 (penalty included)	$MCPR_f$ ATRIUM-9B	$MCPR_f$ GE9 (penalty included)
0	1.85	1.85	1.93	1.93
30	1.85	1.85	1.93	1.93
102.5	1.11	1.11	1.14	1.14
105	1.11	1.11	1.11	1.11

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



Flow (% rated)	LHGRFACf
0	0.69
30	0.69
76	1.00
105	1.00

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

Table 3.1 LaSalle Unit 1 Plant Conditions at Rated Power and Flow

Reactor Thermal Power	3489 MWth
Total Core Flow	108.5 Mlbm/hr
Core Active Flow	93.8 Mlbm/hr
Core Bypass Flow*	14.7 Mlbm/hr
Core Inlet Enthalpy	523.9 Btu/lbm
Vessel Pressures	
Steam Dome	1001 psia
Core Exit (upper plenum)	1013 psia
Lower Plenum	1038 psia
TCV Inlet 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)	1173 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 conservative results.

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	0.325	1.000	0.362	438.8	123.7
100/81	0.337	1.000	0.377	460.2	126.5
80/105	0.332	1.000	0.368	367.6	98.2
80/57.2	0.377	1.000	0.410	323.7	99.3
60/105	0.319	1.033	0.349	253.1	72.3
60/35.1	0.301	1.098	0.289	135.0	67.1
40/105	0.260**	1.113	0.271	106.0**	45.6**
25/105	0.191**	1.202	0.177**	44.9**	27.0**
23.81/105	0.186**	1.211	0.171**	41.6**	25.6**
20/105 NDS	1.008	0.706	0.980	44.6	38.1
NSS Insertion Times					
100/105	0.304	1.000	0.338	401.1	121.3
100/81	0.288	1.000	0.323	409.5	122.0
80/105	0.317	1.009	0.351	347.5	96.9
80/57.2	0.278	1.014	0.306	256.1	94.2
60/105	0.309	1.038	0.338	245.9	71.6

* Power presented relative to uprated power (3489 MWth).

** The analysis results presented 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	0.299	1.019	0.322	371.3	122.6
100/81	0.280	1.032	0.301	303.1	121.8
80/105	0.355	0.986	0.376	327.2	101.9
80/57.2	0.294	1.063	0.310	203.7	96.0
60/105	0.431**	0.955	0.440	218.3**	79.3**
60/35.1	0.251	1.143	0.252	104.7	67.0
40/105	0.582**	0.891**	0.546**	128.0**	58.8**
25/105	0.884**	0.767**	0.913**	62.5**	43.2**
23.81/105	0.936**	0.750**	0.964**	61.1**	42.2**
20/105 NDS	1.119	0.688	1.029	70.2	43.9
NSS Insertion Times					
100/105	0.280	1.033	0.301	342.9	120.5
80/105	0.341	1.000	0.360	312.3	100.8
60/105	0.417	0.959	0.430	229.7	79.9
40/105	0.570**	0.895**	0.535**	124.6**	58.5**
25/105	0.861**	0.777**	0.871**	76.7**	44.0**
23.81/105	0.901**	0.760**	0.923**	73.8**	42.9**

* Power presented relative to uprated power (3489 MWth).

** The analysis results presented 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	Reference 16	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)	22.7	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)	5232.35	---	---

* 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.

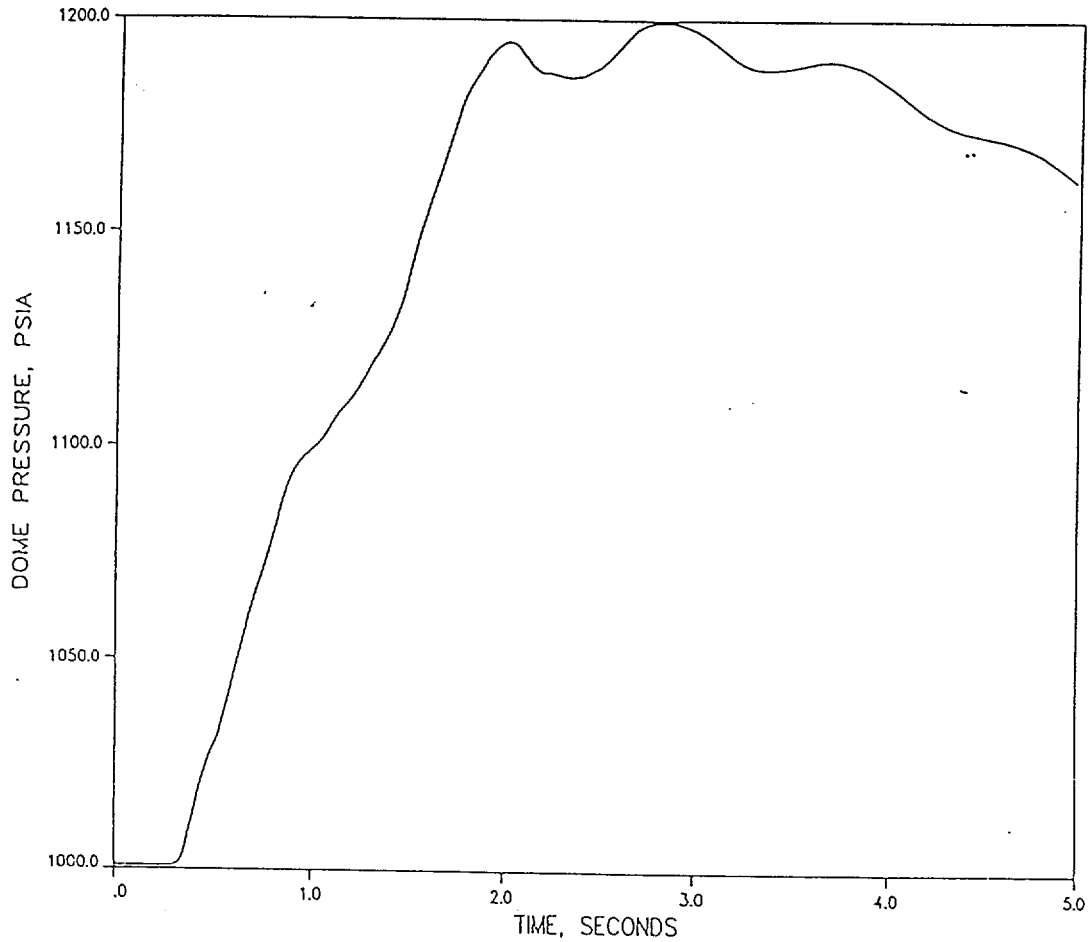


Figure 3.3 EOC Load Rejection No Bypass
at 100/81 – TSSS Dome Pressure

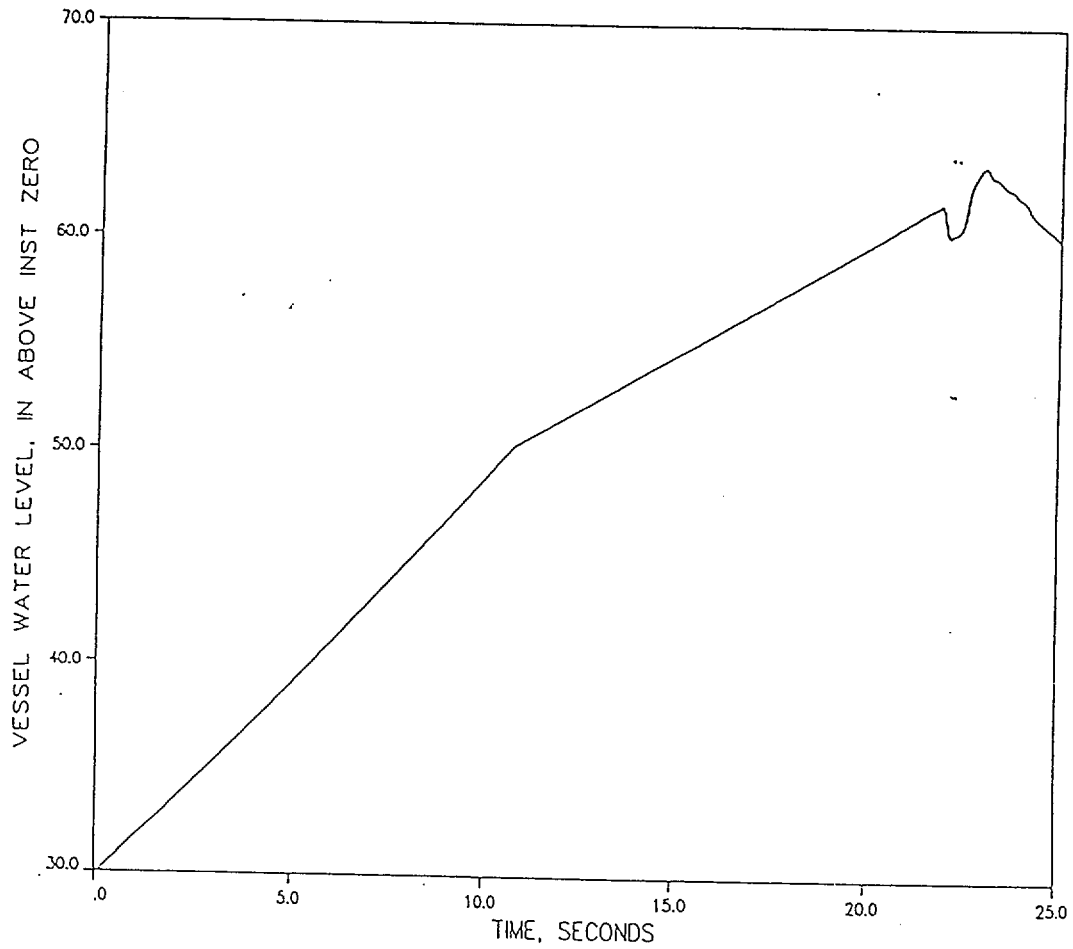


Figure 3.5 EOC Feedwater Controller Failure at 100/105 – TSSS Vessel Water Level

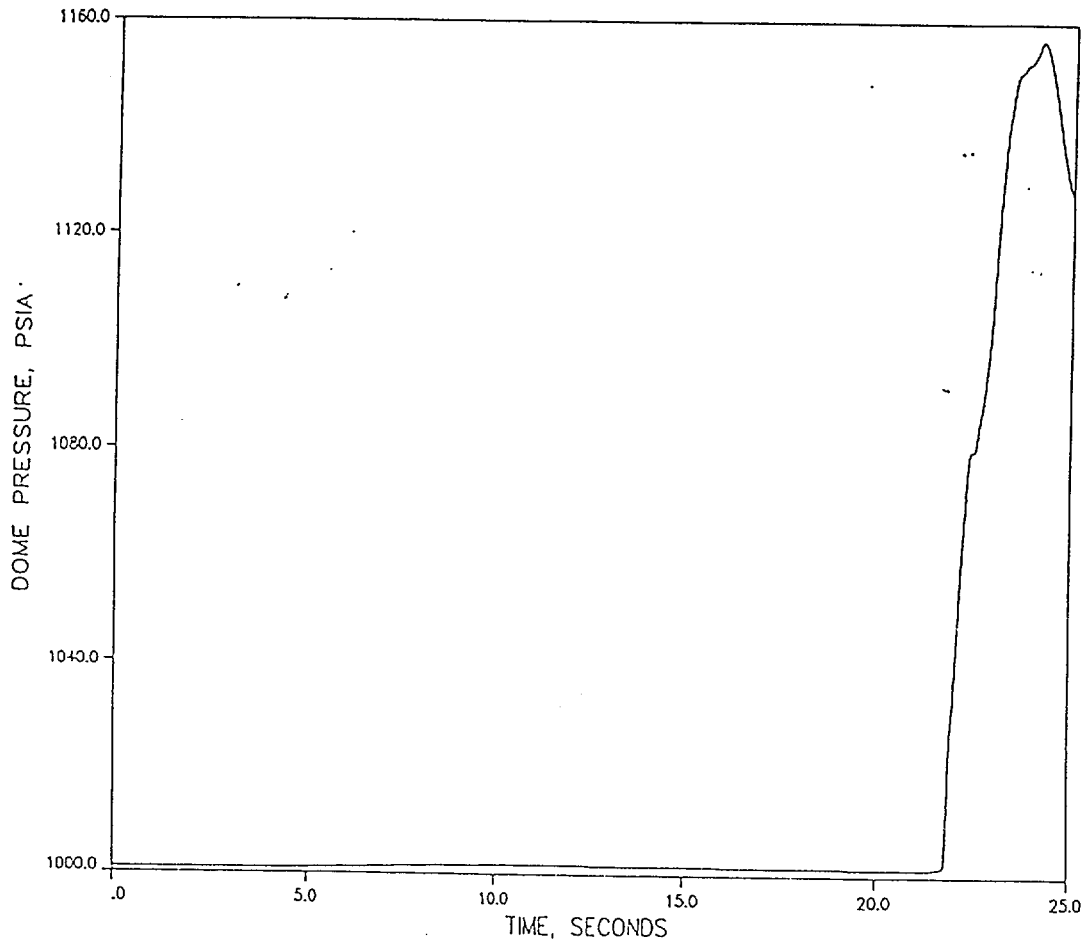


Figure 3.6 EOC Feedwater Controller Failure
at 100/105 – TSSS Dome Pressure

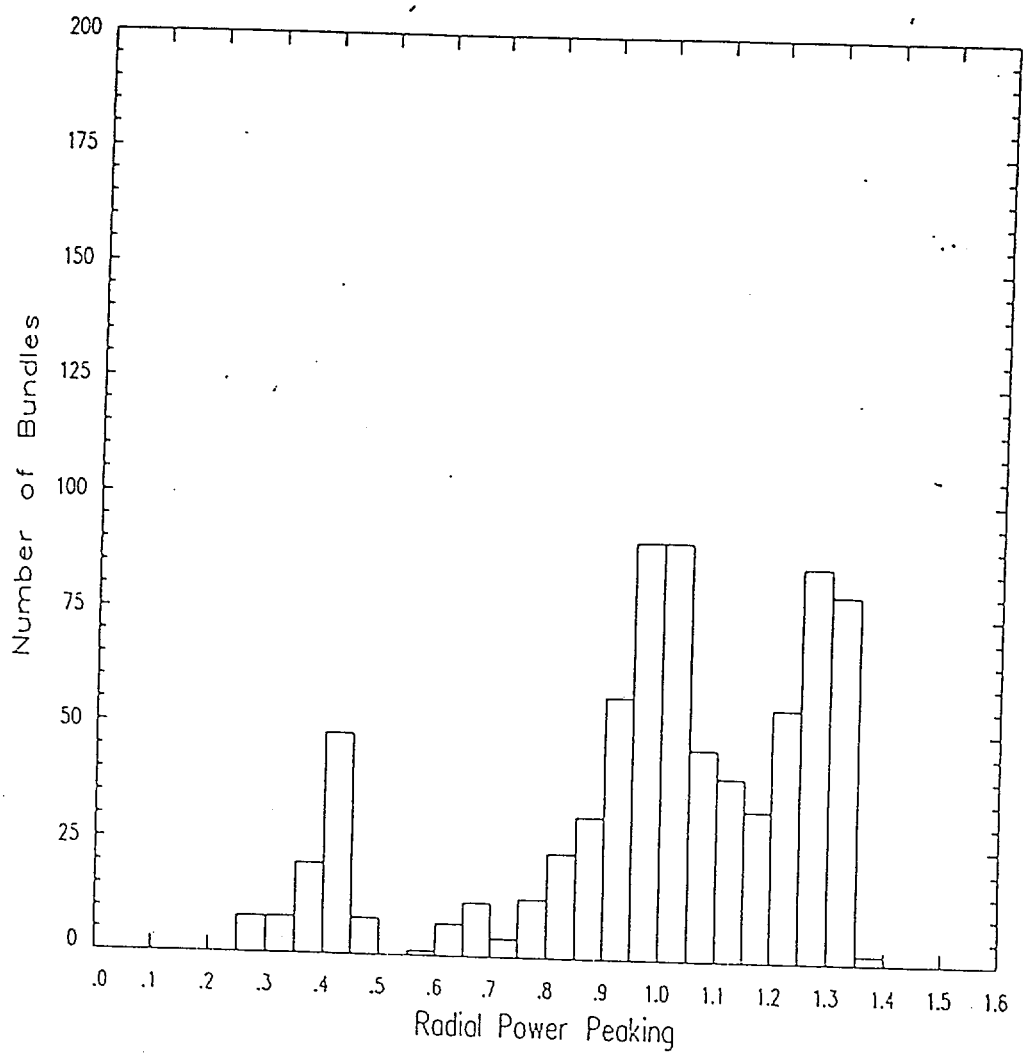


Figure 3.7 Radial Power Distribution for SLMCPR Determination

Control Rod Corner

Control Rod Corner

1.023	1.055	1.068	1.112	1.099	1.102	1.049	1.023	0.977
1.055	0.958	0.894	1.016	0.894	1.007	0.877	0.927	1.002
1.068	0.894	1.031	1.065	1.084	1.056	1.010	0.863	1.011
1.112	1.016	1.065	Internal Water Channel			1.044	0.980	1.051
1.099	0.894	1.084				1.063	0.863	1.038
1.102	1.007	1.056				1.035	0.971	1.041
1.049	0.877	1.010	1.044	1.063	1.035	0.990	0.846	0.992
1.023	0.927	0.863	0.980	0.863	0.971	0.846	0.895	0.970
0.977	1.002	1.011	1.051	1.038	1.041	0.992	0.970	0.931

Figure 3.8 LaSalle Unit 1 Cycle 9
Safety Limit Local Peaking Factors SPCA9-393B-16GZ-100M
With Channel Bow (Assembly Exposure of 22,500 MWd/MTU)

Control Rod Corner

Control Rod Corner

1.013	1.042	1.056	1.110	1.098	1.100	1.037	1.010	0.967
1.042	0.944	1.025	0.879	1.014	0.871	1.005	0.912	0.989
1.056	1.025	1.018	1.064	1.081	1.055	0.997	0.989	0.999
1.110	0.879	1.064	Internal			1.043	0.848	1.047
1.098	1.014	1.081	Water			1.059	0.978	1.035
1.100	0.871	1.055	Channel			1.034	0.840	1.037
1.037	1.005	0.997	1.043	1.059	1.034	0.977	0.968	0.979
1.010	0.912	0.989	0.848	0.978	0.840	0.968	0.881	0.956
0.967	0.989	0.999	1.047	1.035	1.037	0.979	0.956	0.921

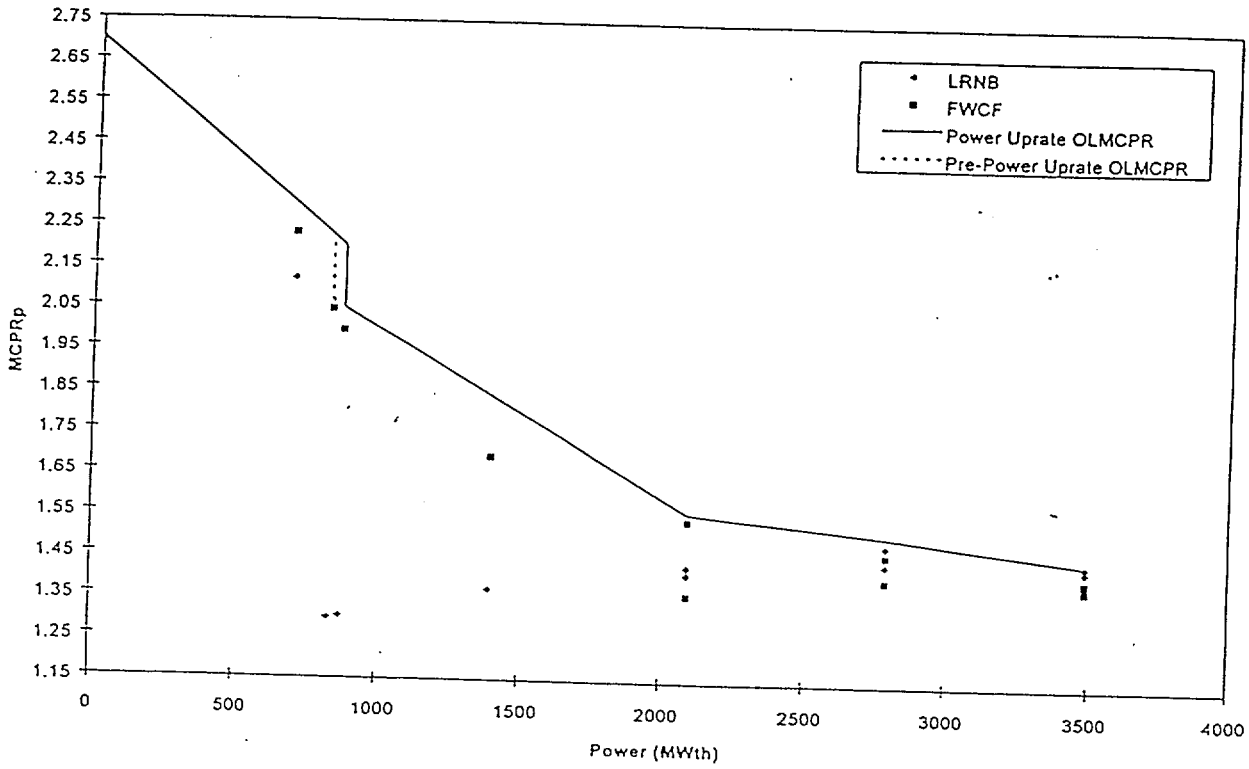
Figure 3.9 LaSalle Unit 1 Cycle 9
Safety Limit Local Peaking Factors SPCA9-396B-12GZB-100M and SPCA9-396B-12GZC-100M
With Channel Bow (Assembly Exposure of 25,000 MWd/MTU)

Control Rod Corner

Control Rod Corner

1.022	1.056	1.061	1.035	1.102	1.028	1.045	1.029	0.982
1.056	0.947	1.018	1.003	0.879	0.997	1.004	0.919	1.011
1.061	1.018	1.001	1.050	1.081	1.048	0.996	0.992	1.012
1.035	1.003	1.050	Internal			0.926	0.983	0.987
1.102	0.879	1.081	Water			1.077	0.853	1.049
1.028	0.997	1.048	Channel			1.040	0.970	0.979
1.045	1.004	0.996	0.926	1.077	1.040	0.859	0.980	0.996
1.029	0.919	0.992	0.983	0.853	0.970	0.980	0.891	0.983
0.982	1.011	1.012	0.987	1.049	0.979	0.996	0.983	0.941

Figure 3.10 LaSalle Unit 1 Cycle 9
Safety Limit Local Peaking Factors SPCA9-384B-11GZ6-80M
With Channel Bow (Assembly Exposure of 20,000 MWdMTU)



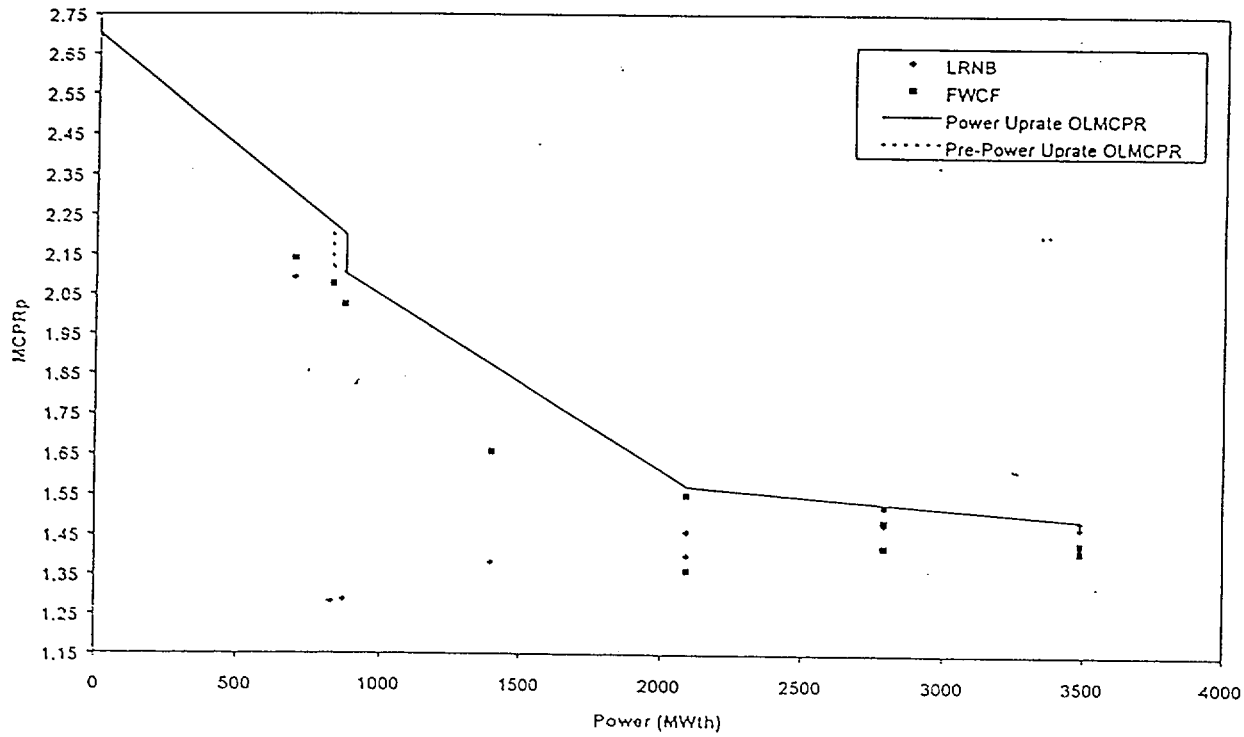
3323 MWth Rated Power

Power (%)	$MCPR_p$ Limit
100	1.46
84	1.51
63	1.56
25	2.07
25	2.22
0	2.70

3489 MWth Rated Power

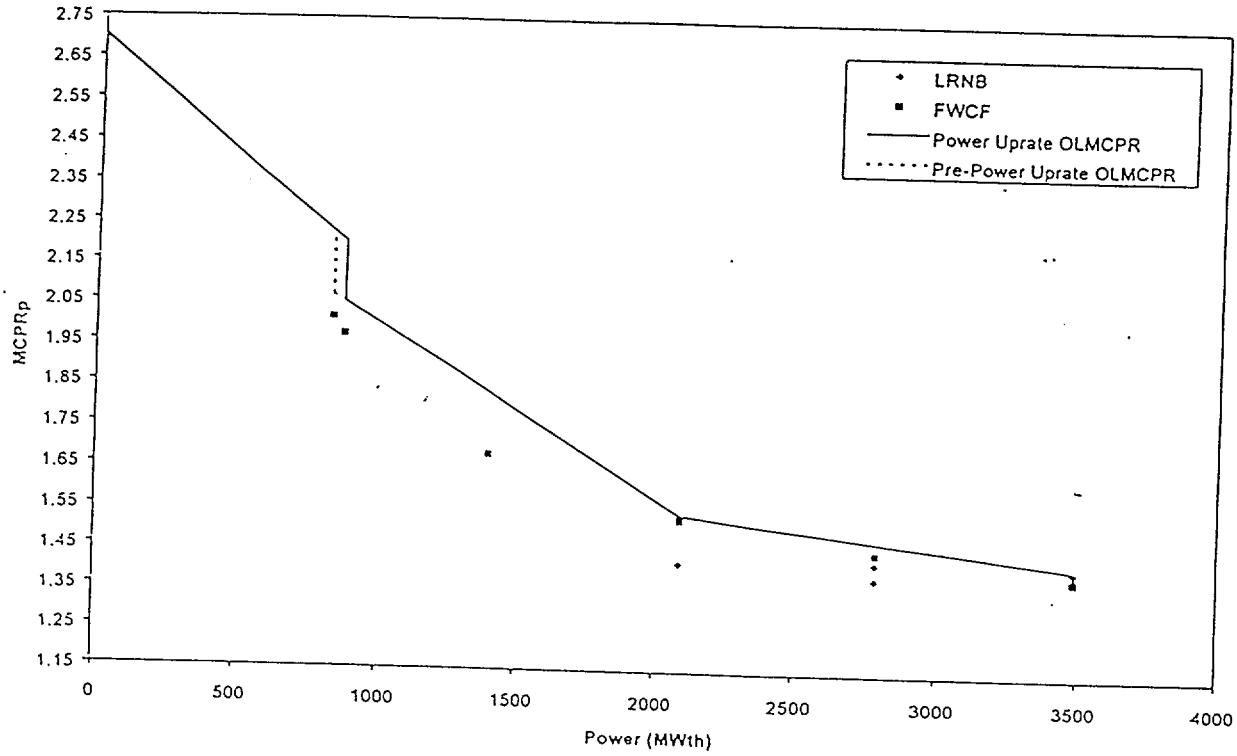
Power (%)	$MCPR_p$ Limit
100	1.45
80	1.51
60	1.56
25	2.05
25	2.20
0	2.70

Figure 3.11 EOC Base Case Power-Dependent MCPR Limits for ATRIUM-9B Fuel – TSSS Insertion Times



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	$MCPR_p$ Limit	Power (%)	$MCPR_p$ Limit
100	1.50	100	1.49
84	1.53	80	1.53
63	1.57	60	1.57
25	2.12	25	2.10
25	2.22	25	2.20
0	2.70	0	2.70

Figure 3.12 EOC Base Case Power-Dependent MCPR Limits for GE9 Fuel – TSSS Insertion Times



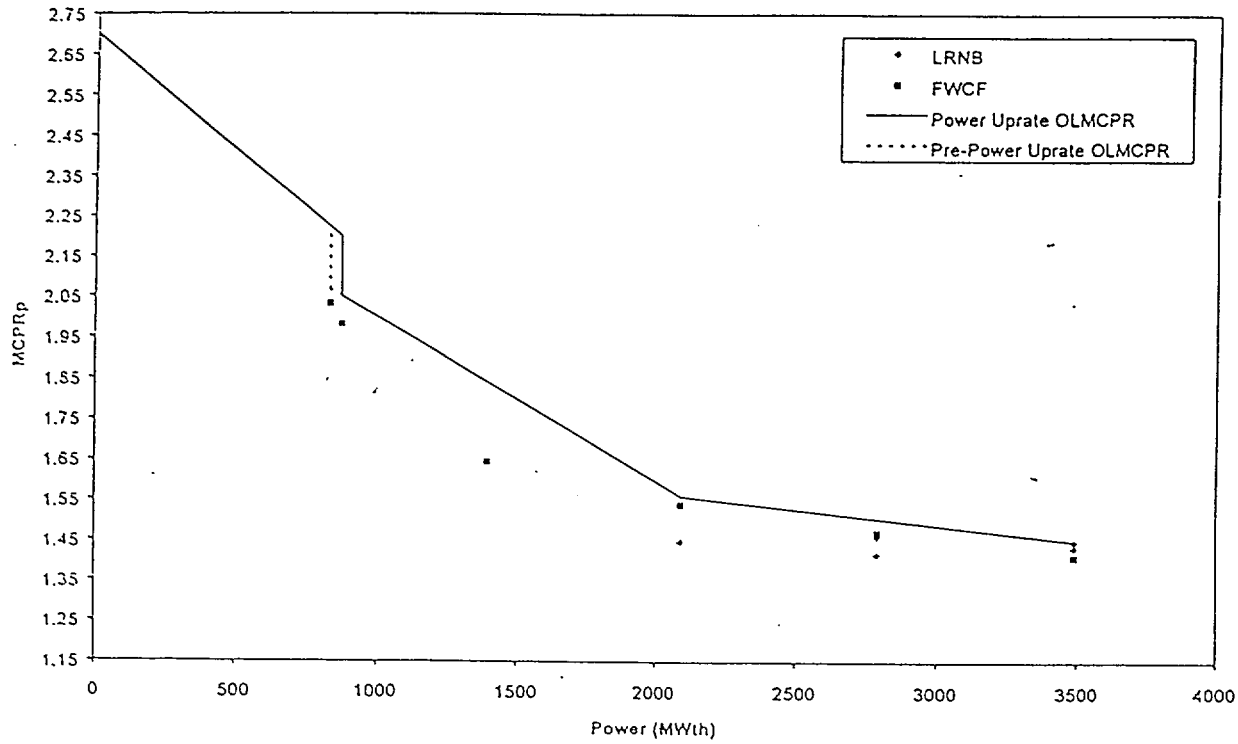
3323 MWth Rated Power

Power (%)	$MCPR_p$ Limit
100	1.43
84	1.48
63	1.54
25	2.07
25	2.22
0	2.70

3489 MWth Rated Power

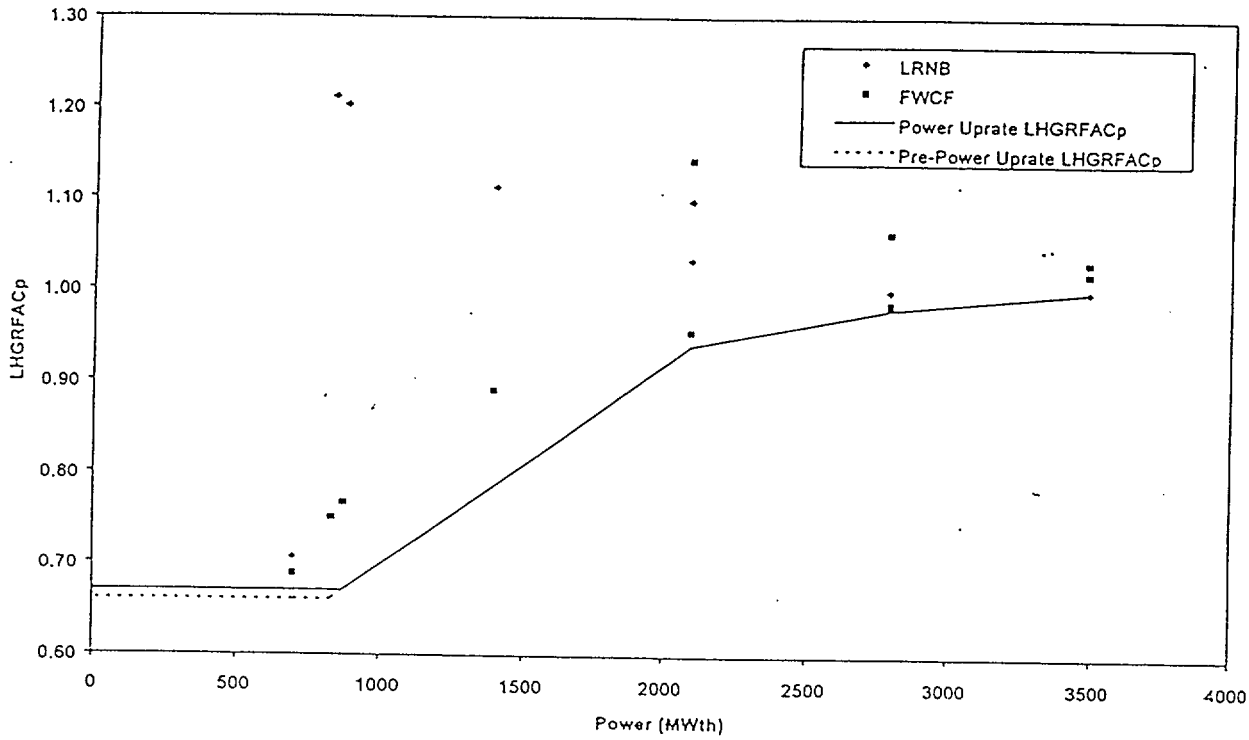
Power (%)	$MCPR_p$ Limit
100	1.42
80	1.48
60	1.54
25	2.05
25	2.20
0	2.70

Figure 3.13 EOC Base Case Power-Dependent MCPR Limits for ATRIUM-9B Fuel – NSS Insertion Times



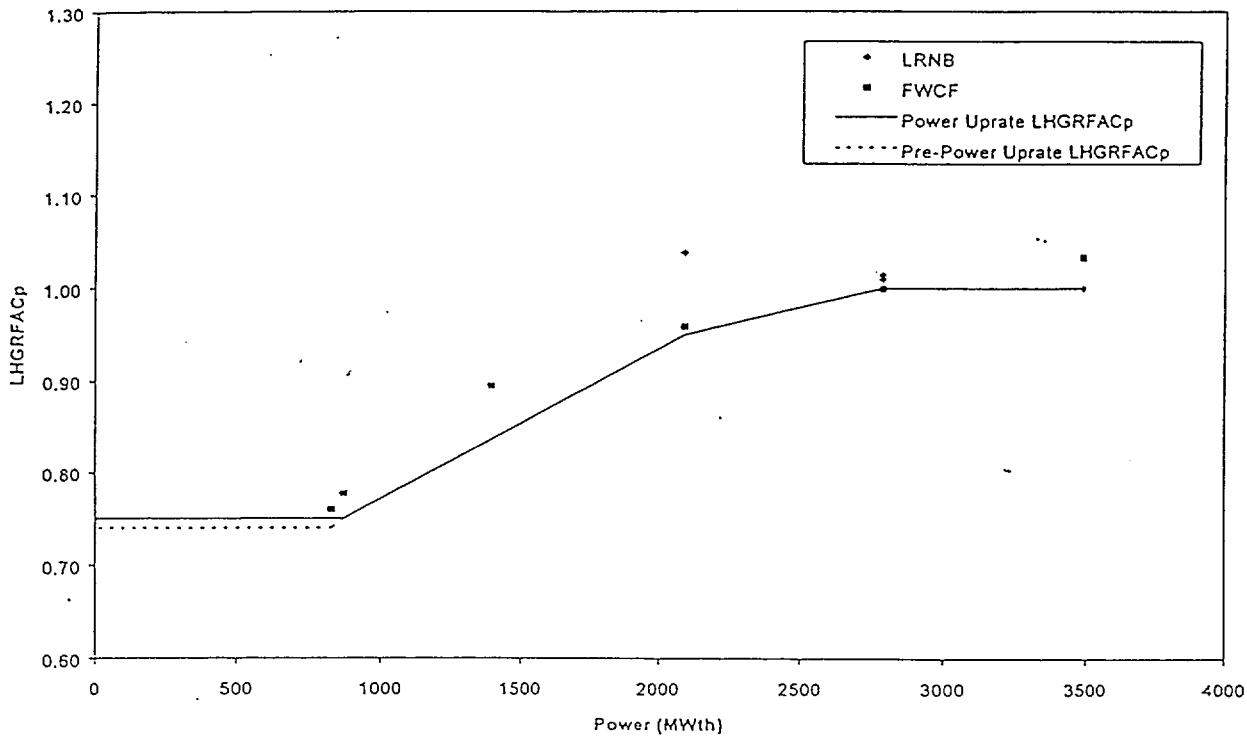
3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	$MCPR_p$ Limit	Power (%)	$MCPR_p$ Limit
100	1.46	100	1.45
84	1.51	80	1.51
63	1.56	60	1.56
25	2.07	25	2.05
25	2.22	25	2.20
0	2.70	0	2.70

Figure 3.14 EOC Base Case Power-Dependent MCPR Limits for GE9 Fuel – NSS Insertion Times



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	LHGRFAC$_p$	Power (%)	LHGRFAC$_p$
100	0.99	100	1.00
84	0.98	80	0.98
63	0.94	60	0.94
25	0.66	25	0.67
25	0.66	25	0.67
0	0.66	0	0.67

Figure 3.15 EOC Base Case Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – TSSS Insertion Times



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	$LHGRFAC_p$	Power (%)	$LHGRFAC_p$
100	1.00	100	1.00
84	1.00	80	1.00
63	0.95	60	0.95
25	0.74	25	0.75
25	0.74	25	0.75
0	0.74	0	0.75

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

Table 5.1 EOC Feedwater Heater Out-of-Service Analysis Results

Event	Power*/Flow (%rated/%rated)	ATRIUM-9B		GE9
		ΔCPR	$LHGRFAC_p$	ΔCPR
FWCF	100/105	0.311	1.000	0.329
FWCF	100/81	0.286	1.034	0.302
FWCF	80/105	0.376	0.968	0.390
FWCF	80/57.2	0.306	1.055	0.320
FWCF	60/105	0.482**	0.927**	0.472
FWCF	60/35.1	0.216	1.123	0.228
FWCF	40/105	0.698**	0.831**	0.677**
FWCF	25/105	1.142**	0.678**	1.156**
FWCF	23.81/105	1.209**	0.662**	1.216**

* Power presented relative to uprated power (3489 MWth).

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

Table 5.2 Abnormal Recirculation Loop Startup Analysis Results

Power*/Flow (%rated/%rated)	FCV Position	ATRIUM-9B	
		ΔCPR**	$LHGRFAC_p$
33.33/47	27% open	1.40	0.425

* Power presented relative to uprated power (3489 MWth).

** ΔCPR results for ATRIUM-9B fuel are conservatively applicable for GE9 fuel.

Table 5.3 EOC Turbine Bypass Valves
Out-of-Service Analysis Results

		ATRIUM-9B		GE9
Event	Power*/Flow (%rated/%rated)	ΔCPR	$LHGRFAC_p$	ΔCPR
FWCF	100/105	0.359	0.968	0.392
FWCF	100/81	0.359	0.947	0.394
FWCF	80/105	0.418	0.942	0.449
FWCF	80/57.2	0.417	0.957	0.447
FWCF	60/105	0.499**	0.917	0.514
FWCF	60/35.1	0.327	1.032	0.332
FWCF	40/105	0.658**	0.859**	0.619
FWCF	25/105	0.962**	0.750**	0.952**
FWCF	23.81/105	1.004**	0.736**	1.002**

* Power presented relative to uprated power (3489 MWth).

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

Table 5.4 EOC Recirculation Pump Trip
Out-of-Service Analysis Results

		ATRIUM-9B		GE9
Event	Power*/Flow (%rated/%rated)	ΔCPR	$LHGRFAC_p$	ΔCPR
LRNB	100/105	0.382	0.909	0.433
LRNB	100/81	0.371	0.868	0.430
LRNB	80/105	0.389	0.923	0.438
LRNB	80/57.2	0.391	0.899	0.439
FWCF	100/105	0.353	0.942	0.391
FWCF	100/81	0.308	0.948	0.349
FWCF	80/105	0.403	0.920	0.438
FWCF	80/57.2	0.295	1.003	0.327
FWCF	60/105	0.466	0.901	0.492
FWCF	60/35.1	0.190	1.120	0.193
FWCF	40/105	0.596**	0.857**	0.581
FWCF	25/105	0.858**	0.757**	0.861**
FWCF	23.81/105	0.896**	0.743**	0.910**

* Power presented relative to uprated power (3489 MWth)

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

Table 5.5 EOC Turbine Control Valve Slow Closure Analysis Results

Event	Slow Valve Characteristics	Power*/Flow (%rated/%rated)	ATRIUM-9B ΔCPR	ATRIUM-9B LHGRFAC$_p$	GE9 ΔCPR
LRNB	1 TCV closing at 2.0 sec	100/105**	0.420	0.902	0.461
LRNB	1 TCV closing at 2.7 sec	100/105**	0.419	0.899	0.461
LRNB	2 TCVs closing at 7.75 sec	100/105**	0.219	1.057	0.233
LRNB	1 TCV closing at 2.0 sec	100/81**	0.369	0.928	0.421
LRNB	2 TCVs closing at 7.75 sec	100/81**	0.199	1.107	0.223
LRNB	1 TCV closing at 2.0 sec	80/105**	0.432	0.911	0.466
LRNB	2 TCVs closing at 2.0 sec	80/105†	0.527	0.882	0.568
LRNB	2 TCVs closing at 7.75 sec	80/105**	0.293	1.014	0.314
LRNB	1 TCV closing at 2.0 sec	80/57.2**	0.504	0.911	0.548
LRNB	2 TCVs closing at 2.0 sec	80/57.2†	0.520	0.928	0.564
LRNB	2 TCVs closing at 7.75 sec, 2 TCVs closing at 2.7 sec	80/57.2**	0.277	1.115	0.305
LRNB	1 TCV closing at 2.0 sec	60/105**	0.432	0.932	0.461
LRNB	2 TCVs closing at 7.75 sec	60/105**	0.346	1.001	0.370
LRNB	1 TCV closing at 2.0 sec	60/35.1**	0.591	0.991	0.585
LRNB	1 TCV closing at 2.0 sec	40/105†	0.828‡	0.759‡	0.824
LRNB	1 TCV closing at 2.0 sec	25/105†	0.992‡	0.707‡	0.984‡
LRNB	1 TCV closing at 2.0 sec	23.81/105†	1.011‡	0.699‡	1.008‡
LRNB	2 TCVs closing at 7.75 sec	23.81/105†	0.977	0.721	0.954
LRNB w/ FHOOS	1 TCV closing at 2.0 sec	100/105**	0.363	0.944	0.396

* Power presented relative to uprated power (3489 MWth).

** Scram initiated by high neutron flux.

† Scram initiated by high dome pressure.

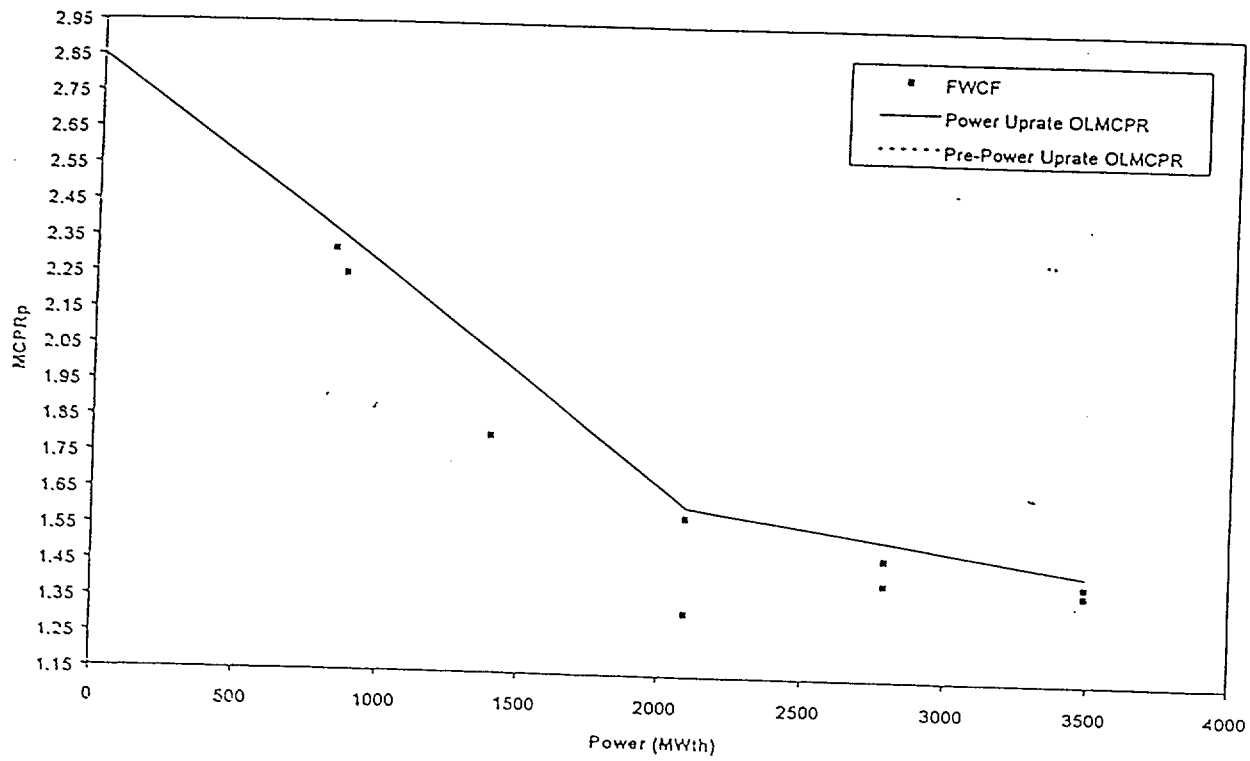
‡ The analysis results presented are from an earlier cycle exposure. The ΔCPR and LHGRFAC$_p$ results are conservatively used to establish the thermal limits.

Table 5.6 EOC Recirculation Pump Trip and Feedwater Heater Out-of-Service Analysis Results

Event	Power*/Flow (%rated/%rated)	ATRIUM-9B		GE9
		ΔCPR	$LHGRFAC_p$	ΔCPR
LRNB	100/105	0.332	0.954	0.375
LRNB	100/81	0.305	0.948	0.354
FWCF	100/105	0.358	0.933	0.391
FWCF	100/81	0.307	0.968	0.342
FWCF	80/105	0.419	0.911	0.448
FWCF	80/57.2	0.300	1.007	0.329
FWCF	60/105	0.508**	0.882	0.523
FWCF	60/35.1	0.212	1.104	0.226
FWCF	40/105	0.705**	0.804**	0.664
FWCF	25/105	1.073**	0.673**	1.092**
FWCF	23.81/105	1.125**	0.658**	1.146**

* Power presented relative to uprated power (3489 MWth).

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



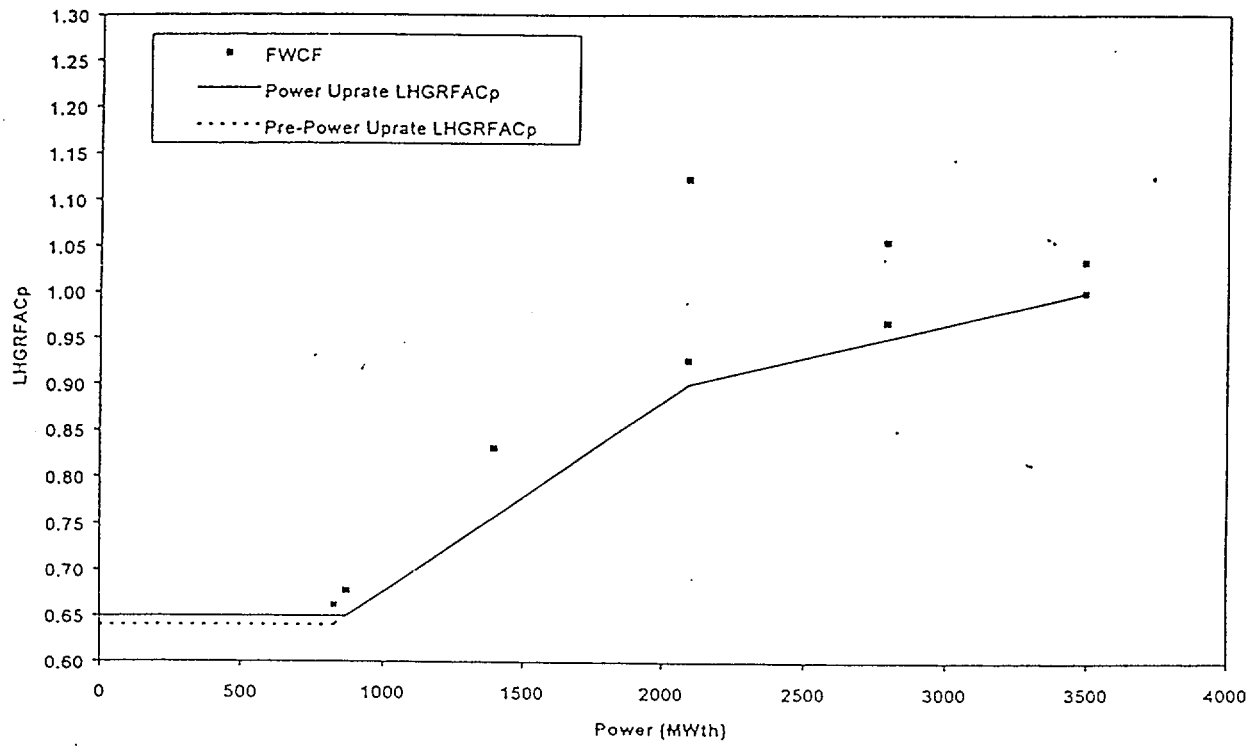
3323 MWth Rated Power

Power (%)	$MCPR_p$ Limit
100	1.47
63	1.62
25	2.38
25	2.38
0	2.85

3489 MWth Rated Power

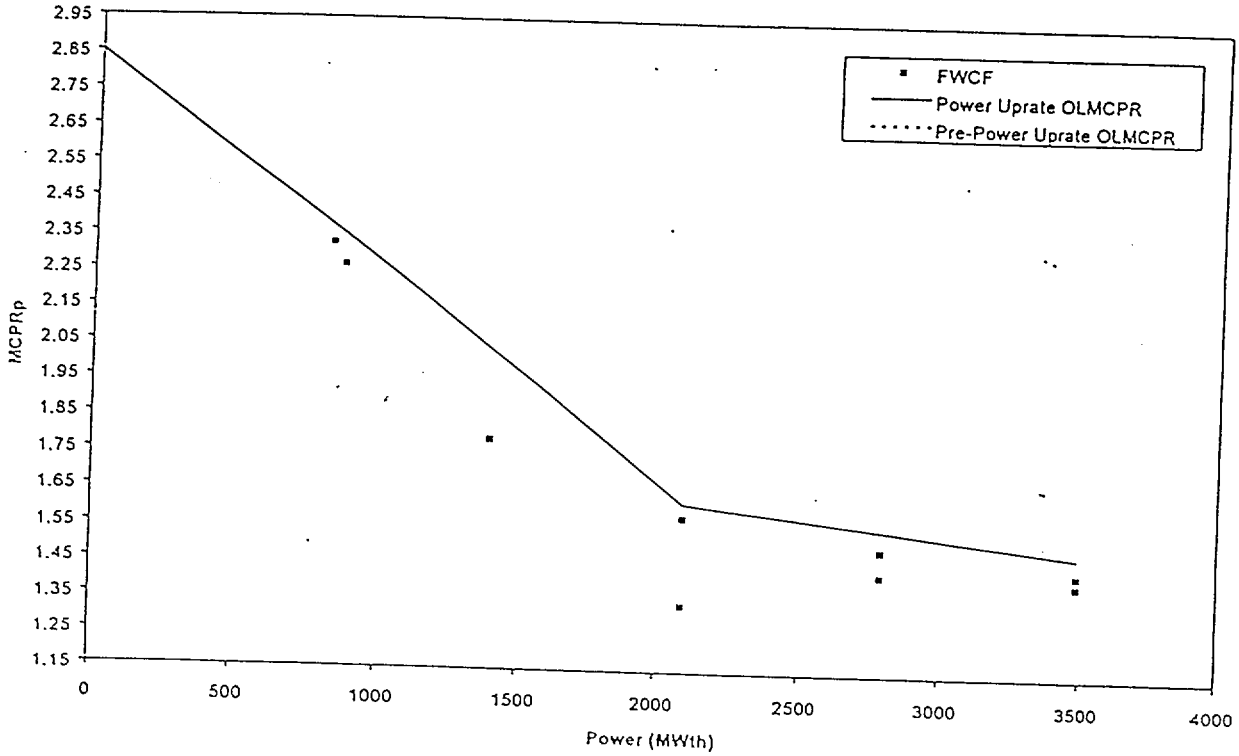
Power (%)	$MCPR_p$ Limit
100	1.45
60	1.62
25	2.35
25	2.35
0	2.85

Figure 5.1 EOC Feedwater Heaters Out-of-Service
Power-Dependent MCPR Limits for ATRIUM-9B Fuel



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	LHGRFAC$_p$	Power (%)	LHGRFAC$_p$
100	0.99	100	1.00
63	0.90	60	0.90
25	0.64	25	0.65
25	0.64	25	0.65
0	0.64	0	0.65

Figure 5.2 EOC Feedwater Heaters Out-of-Service
Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel



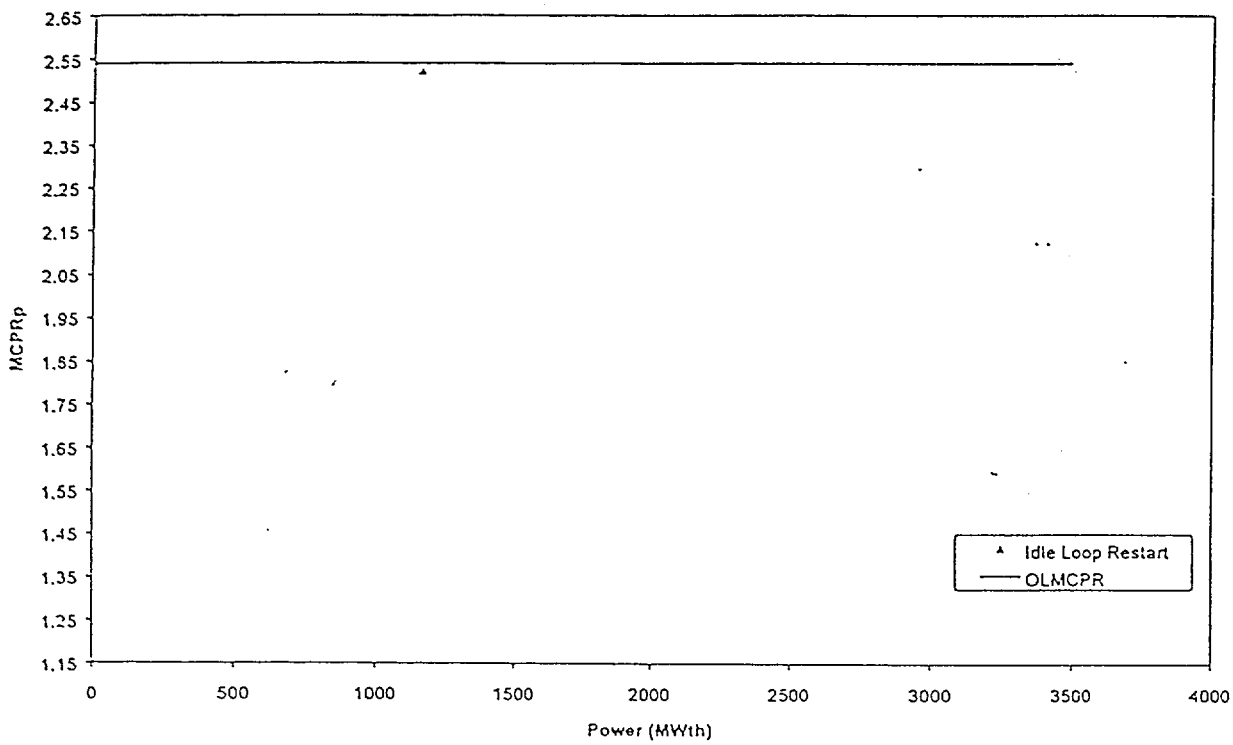
3323 MWth Rated Power

Power (%)	$MCPR_p$ Limit
100	1.51
63	1.62
25	2.38
25	2.38
0	2.85

3489 MWth Rated Power

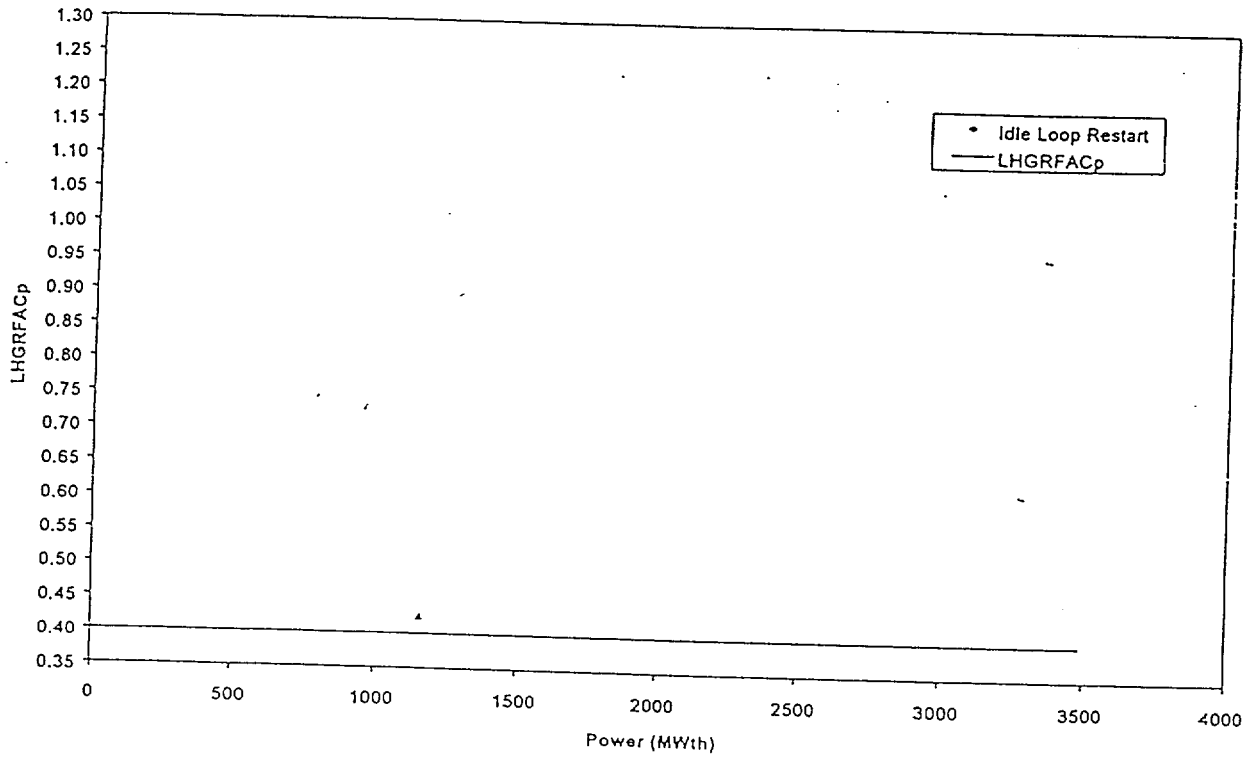
Power (%)	$MCPR_p$ Limit
100	1.49
60	1.62
25	2.35
25	2.35
0	2.85

Figure 5.3 EOC Feedwater Heaters Out-of-Service
Power-Dependent MCPR Limits for GE9 Fuel



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	$MCPR_p$ Limit	Power (%)	$MCPR_p$ Limit
100	2.54	100	2.54
63	2.54	60	2.54
25	2.54	25	2.54
25	2.54	25	2.54
0	2.54	0	2.54

Figure 5.4 Abnormal Idle Recirculation Loop Startup
Power-Dependent MCPR Limits for ATRIUM-9B Fuel



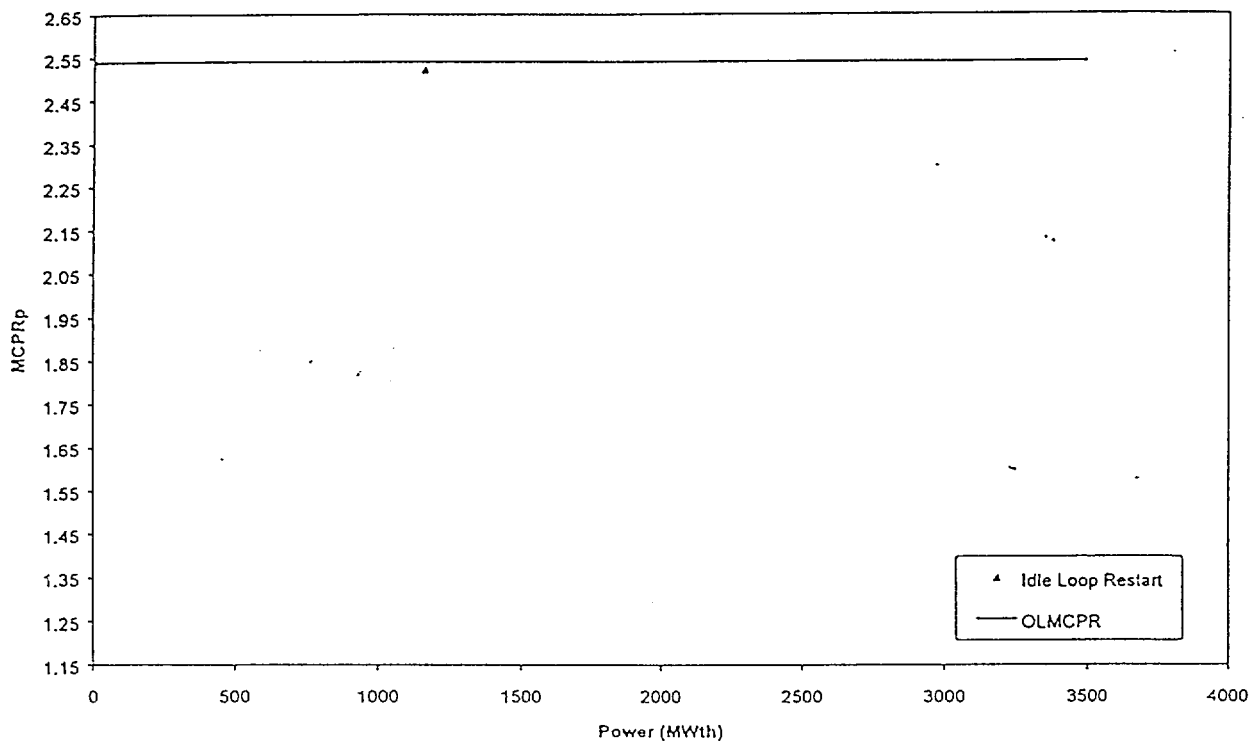
3323 MWth Rated Power

Power (%)	LHGRFAC$_p$
100	0.40
63	0.40
25	0.40
25	0.40
0	0.40

3489 MWth Rated Power

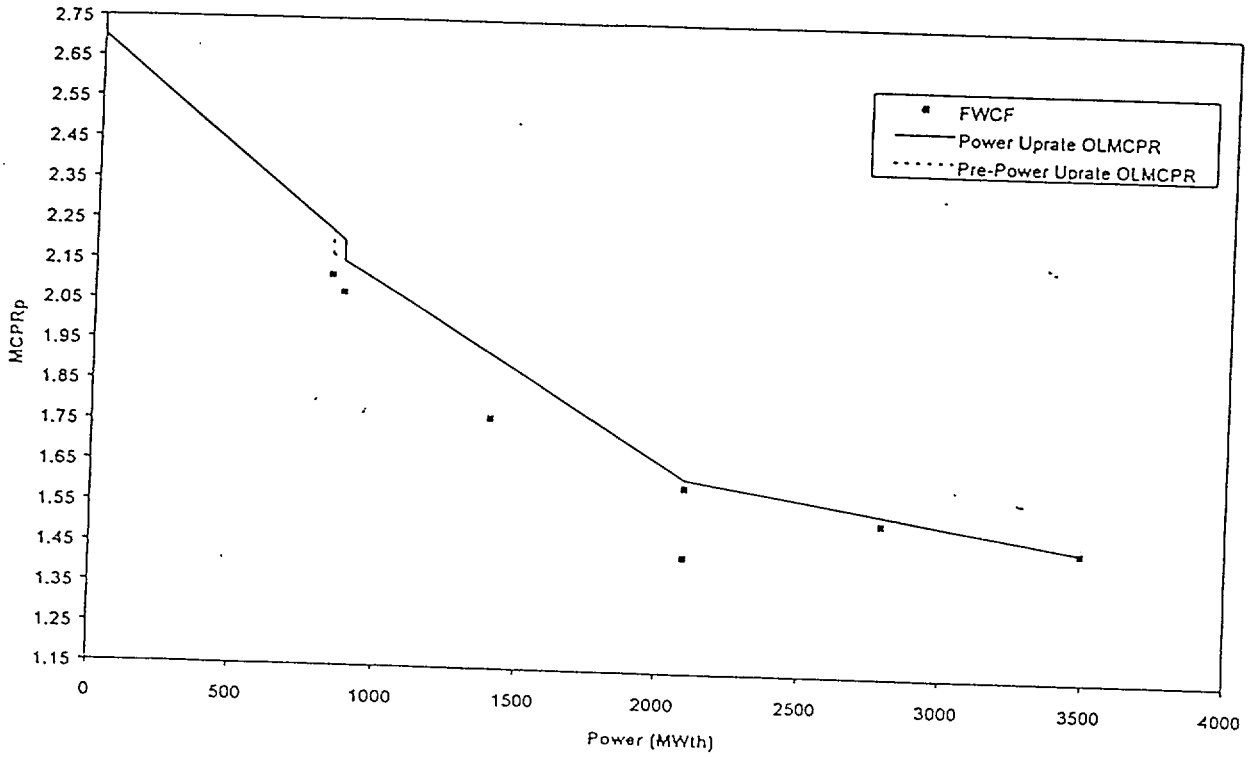
Power (%)	LHGRFAC$_p$
100	0.40
60	0.40
25	0.40
25	0.40
0	0.40

Figure 5.5 Abnormal Idle Recirculation Loop Startup
Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	$MCPR_p$ Limit	Power (%)	$MCPR_p$ Limit
100	2.54	100	2.54
63	2.54	60	2.54
25	2.54	25	2.54
25	2.54	25	2.54
0	2.54	0	2.54

Figure 5.6 Abnormal Idle Recirculation Loop Startup
Power-Dependent MCPR Limits for GE9 Fuel



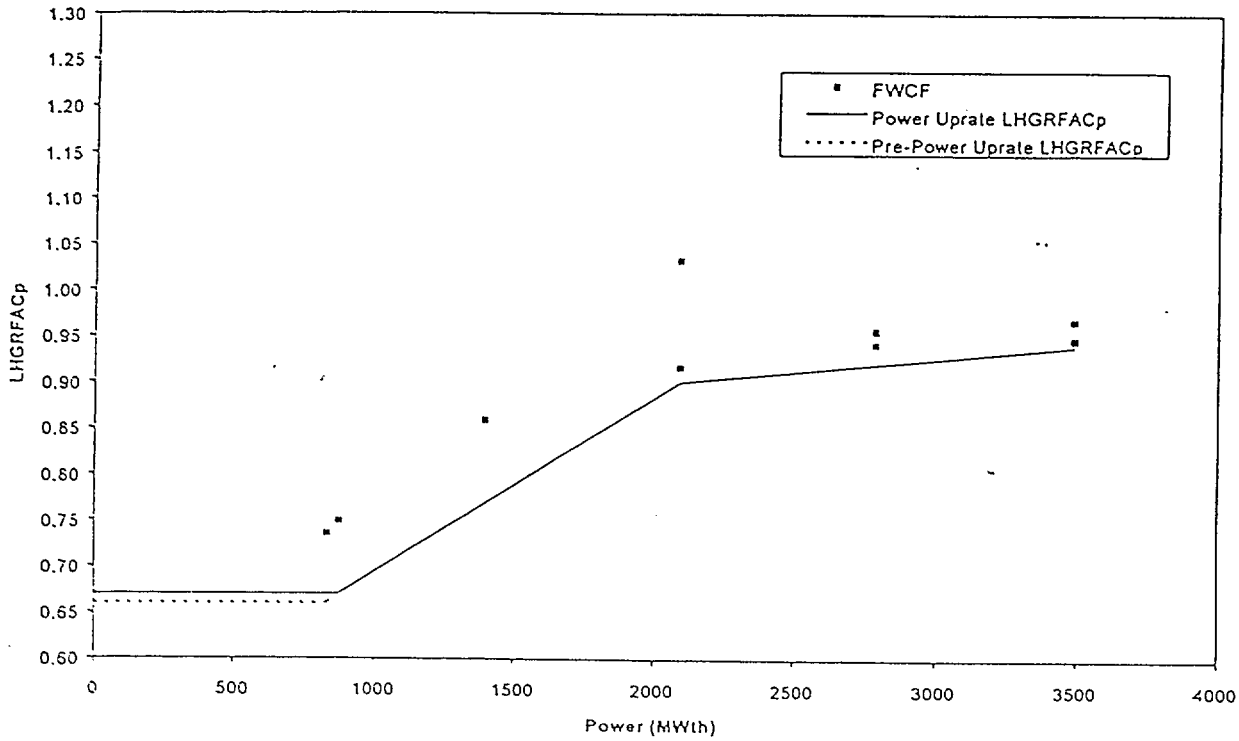
3323 MWth Rated Power

Power (%)	$MCPR_p$ Limit
100	1.49
63	1.63
25	2.17
25	2.22
0	2.70

3489 MWth Rated Power

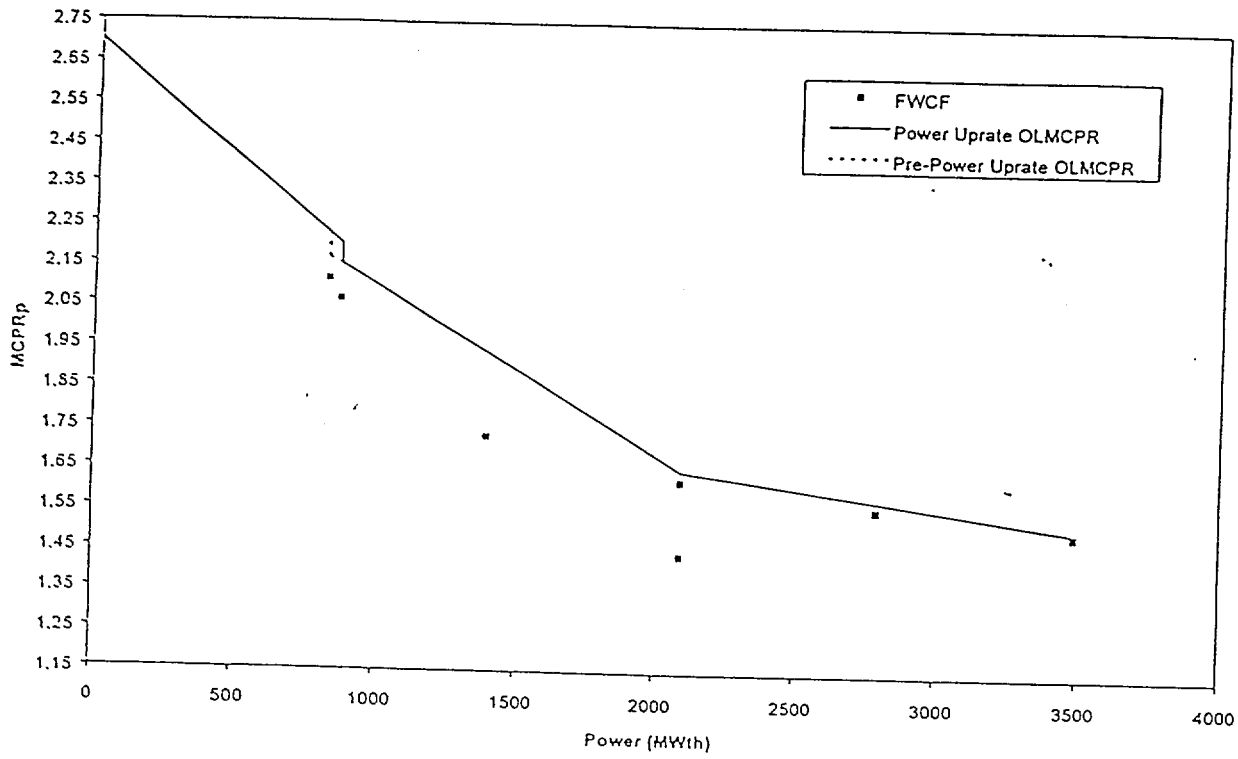
Power (%)	$MCPR_p$ Limit
100	1.47
60	1.63
25	2.15
25	2.20
0	2.70

Figure 5.7 EOC Turbine Bypass Valves Out-of-Service Power-Dependent MCPR Limits for ATRIUM-9B Fuel



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	$LHGRFAC_p$	Power (%)	$LHGRFAC_p$
100	0.94	100	0.94
63	0.90	60	0.90
25	0.66	25	0.67
25	0.66	25	0.67
0	0.66	0	0.67

Figure 5.8 EOC Turbine Bypass Valves Out-of-Service
Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel



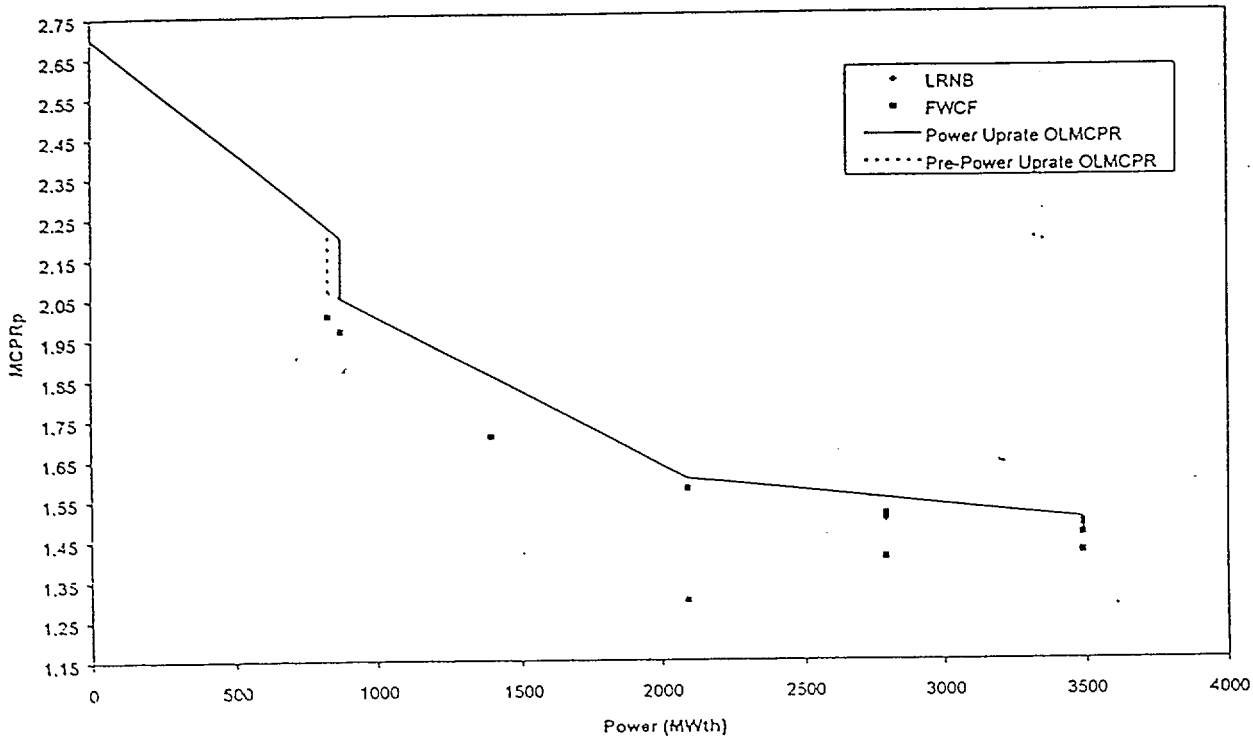
3323 MWth Rated Power

Power (%)	$MCPR_p$ Limit
100	1.53
63	1.65
25	2.17
25	2.22
0	2.70

3489 MWth Rated Power

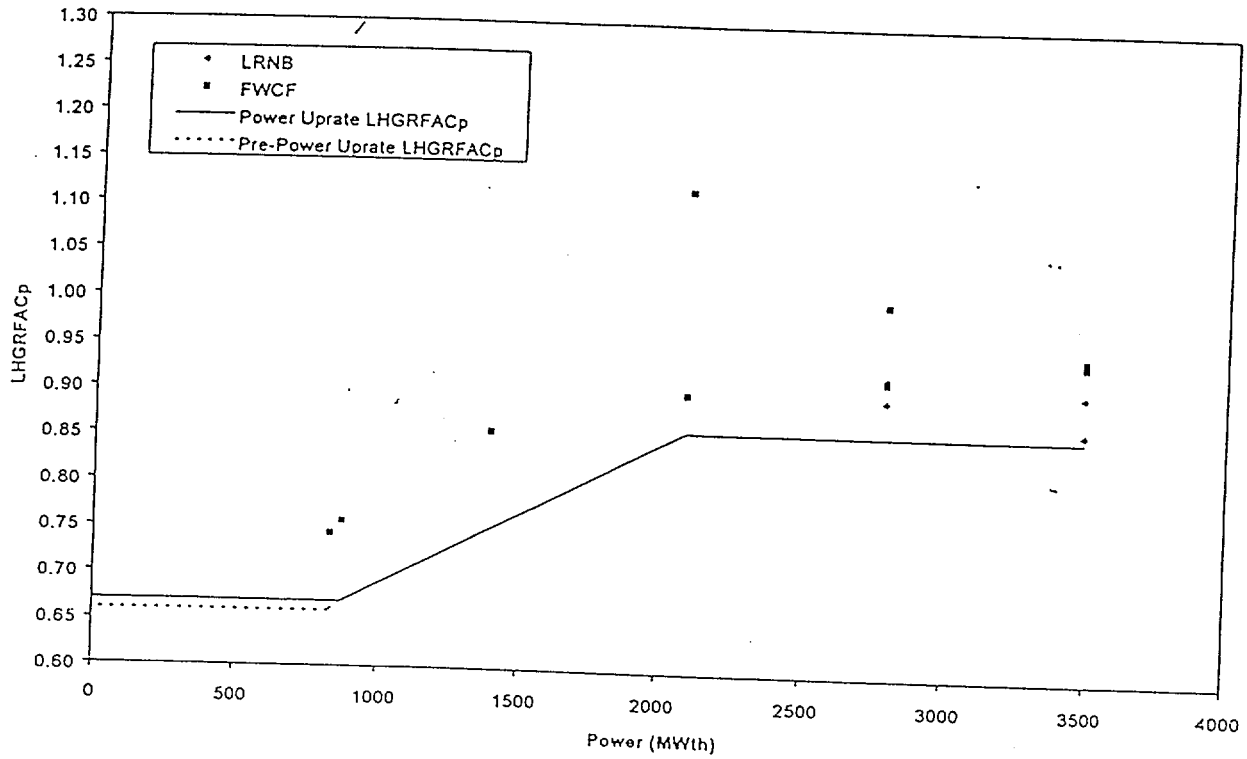
Power (%)	$MCPR_p$ Limit
100	1.51
60	1.65
25	2.15
25	2.20
0	2.70

Figure 5.9 EOC Turbine Bypass Valves Out-of-Service
Power-Dependent MCPR Limits for GE9 Fuel



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	MCPR$_p$ Limit	Power (%)	MCPR$_p$ Limit
100	1.51	100	1.50
63	1.60	60	1.60
25	2.07	25	2.05
25	2.22	25	2.20
0	2.70	0	2.70

Figure 5.10 EOC Recirculation Pump Trip Out-of-Service Power-Dependent MCPR Limits for ATRIUM-9B Fuel



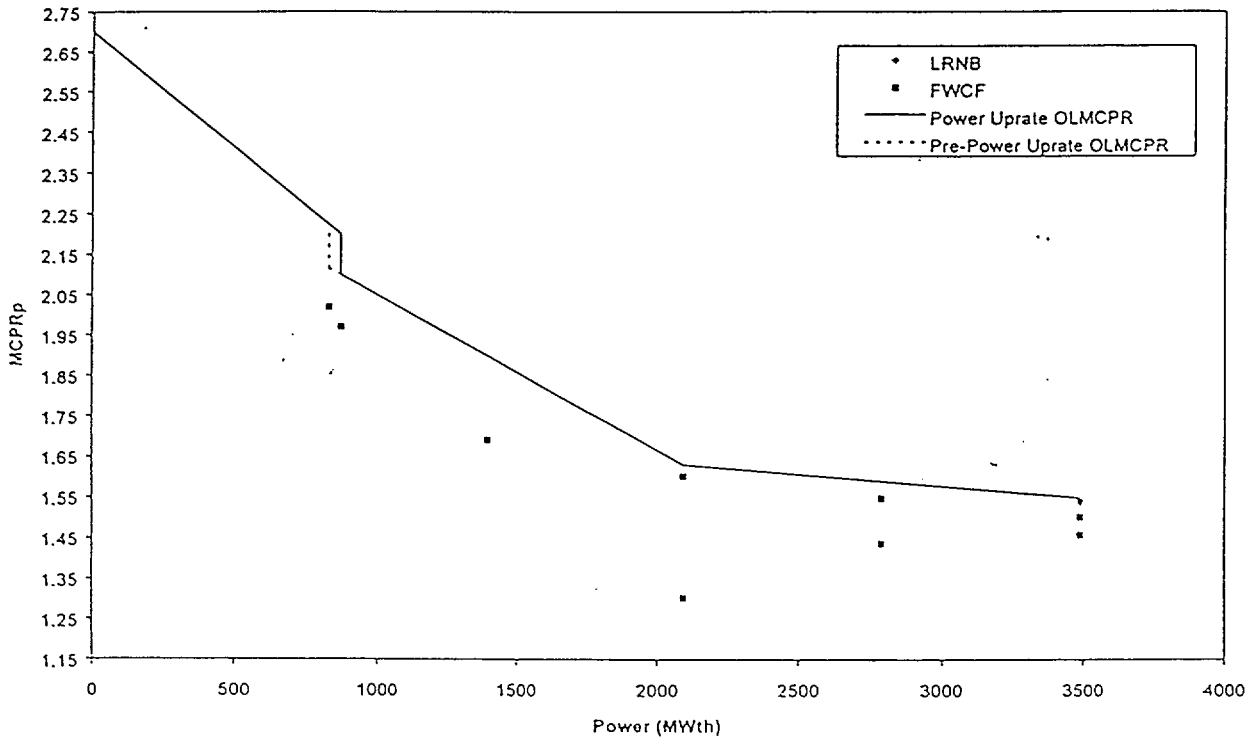
3323 MWth Rated Power

Power (%)	LHGRFAC$_p$
100	0.86
63	0.86
25	0.66
25	0.66
0	0.66

3489 MWth Rated Power

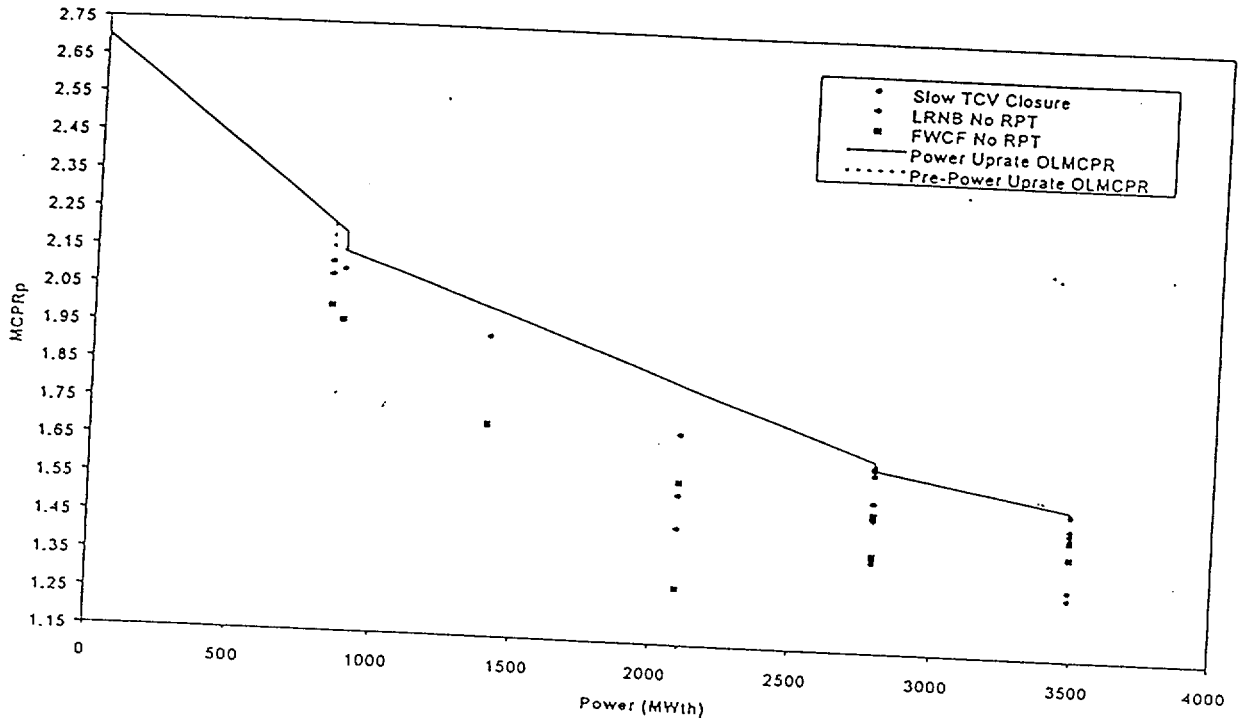
Power (%)	LHGRFAC$_p$
100	0.86
60	0.86
25	0.67
25	0.67
0	0.67

Figure 5.11 EOC Recirculation Pump Trip Out-of-Service Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	$MCPR_p$ Limit	Power (%)	$MCPR_p$ Limit
100	1.56	100	1.55
63	1.63	60	1.63
25	2.12	25	2.10
25	2.22	25	2.20
0	2.70	0	2.70

Figure 5.12 EOC Recirculation Pump Trip Out-of-Service
Power-Dependent MCPR Limits for GE9 Fuel



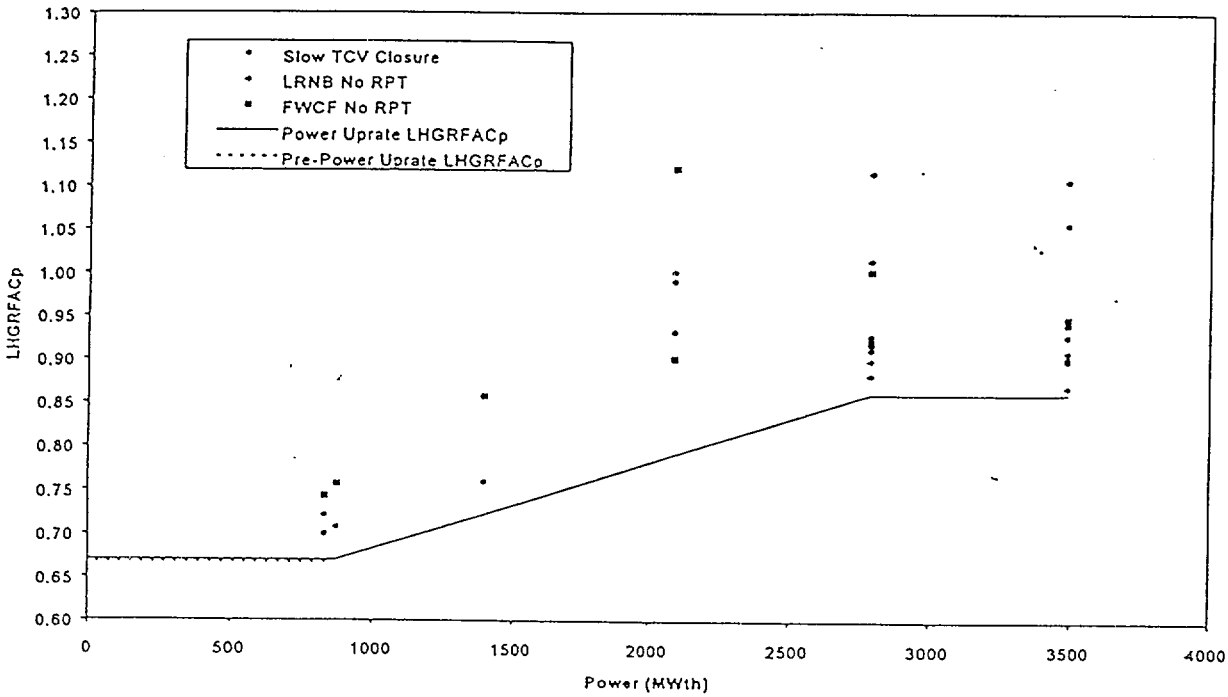
3323 MWth Rated Power

Power (%)	$MCPR_p$ Limit
100	1.56
84	1.63
84	1.65
25	2.16
25	2.22
0	2.70

3489 MWth Rated Power

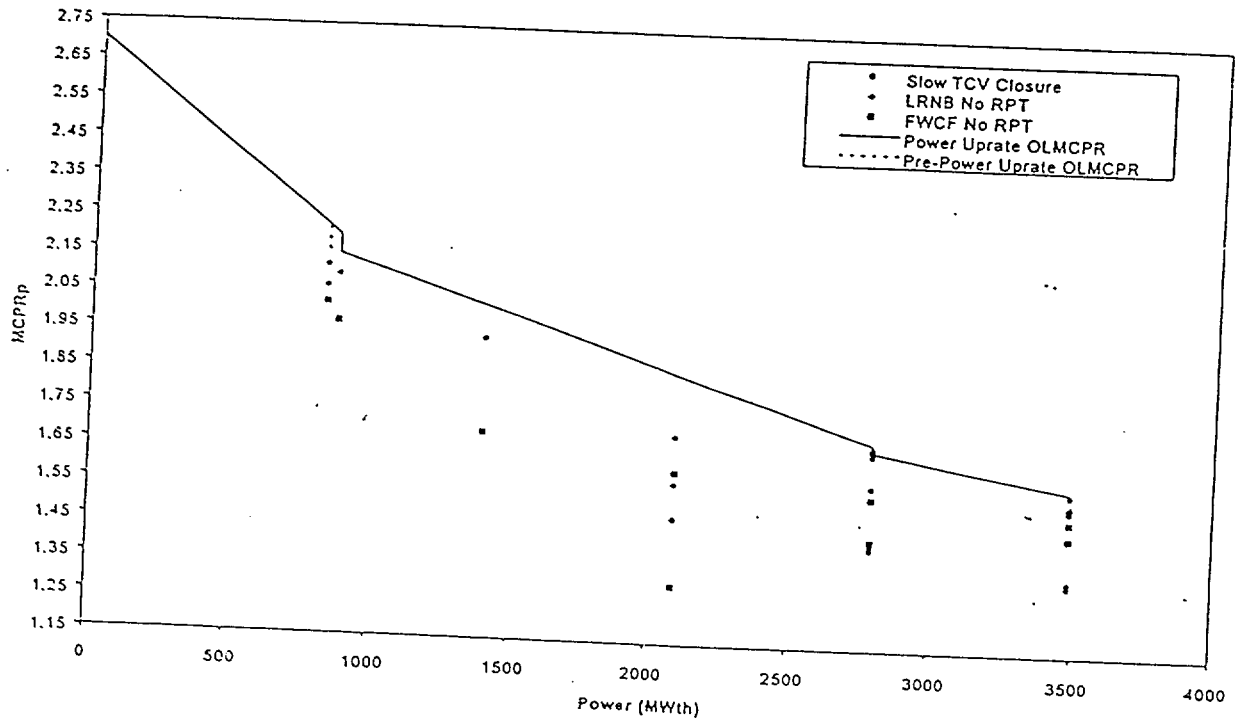
Power (%)	$MCPR_p$ Limit
100	1.54
80	1.63
80	1.65
25	2.15
25	2.20
0	2.70

Figure 5.13 EOC Turbine Control Valve Slow Closure and/or Recirculation Pump Trip Out-of-Service Power-Dependent MCPR Limits for ATRIUM-9B Fuel



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	$LHGRFAC_p$	Power (%)	$LHGRFAC_p$
100	0.86	100	0.86
84	0.86	80	0.86
84	0.86	80	0.86
25	0.66	25	0.67
25	0.66	25	0.67
0	0.66	0	0.67

Figure 5.14 EOC Turbine Control Valve Slow Closure and/or Recirculation Pump Trip Out-of-Service Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel



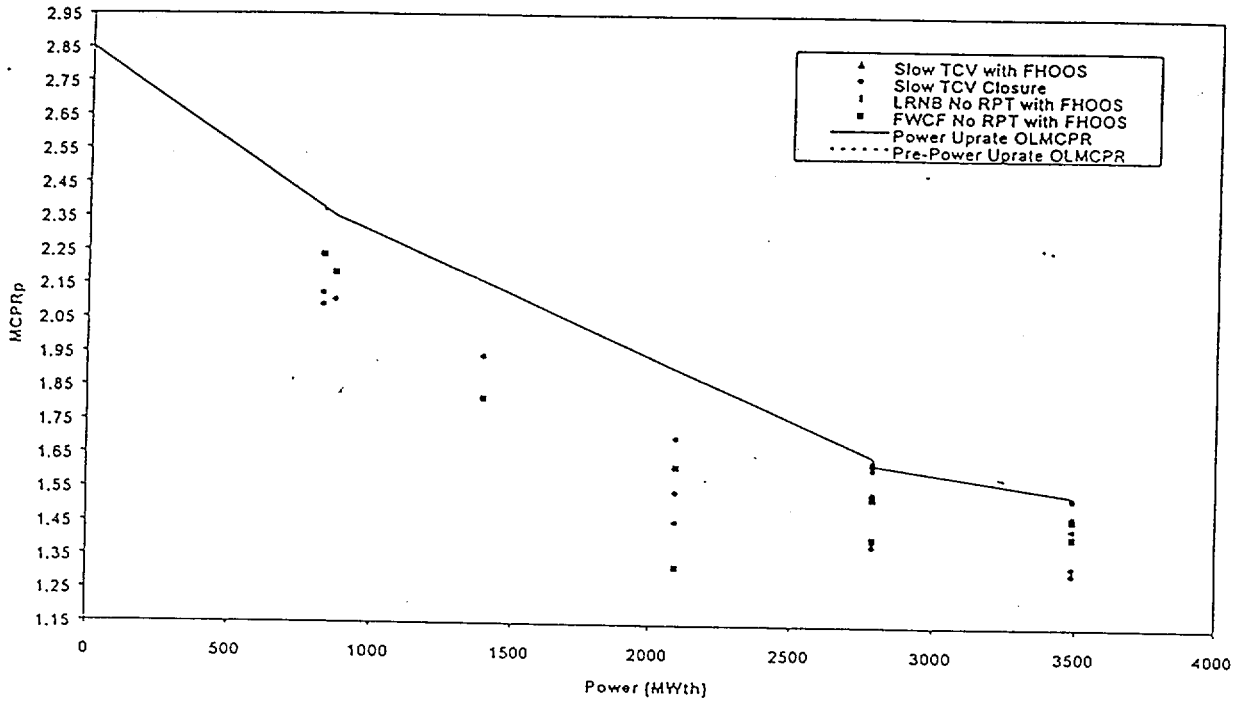
3323 MWth Rated Power

Power (%)	$MCPR_p$ Limit
100	1.60
84	1.67
84	1.69
25	2.16
25	2.22
0	2.70

3489 MWth Rated Power

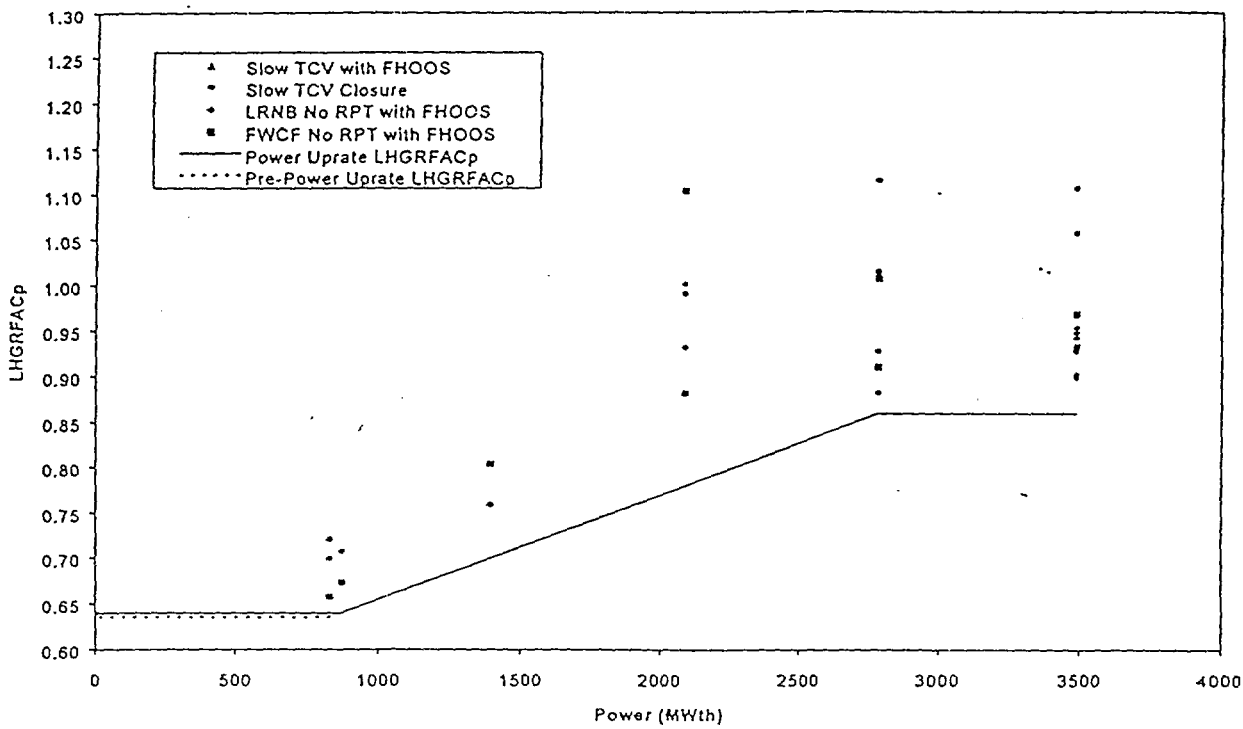
Power (%)	$MCPR_p$ Limit
100	1.58
80	1.67
80	1.69
25	2.15
25	2.20
0	2.70

Figure 5.15 EOC Turbine Control Valve Slow Closure and/or Recirculation Pump Trip Out-of-Service Power-Dependent MCPR Limits for GE9 Fuel



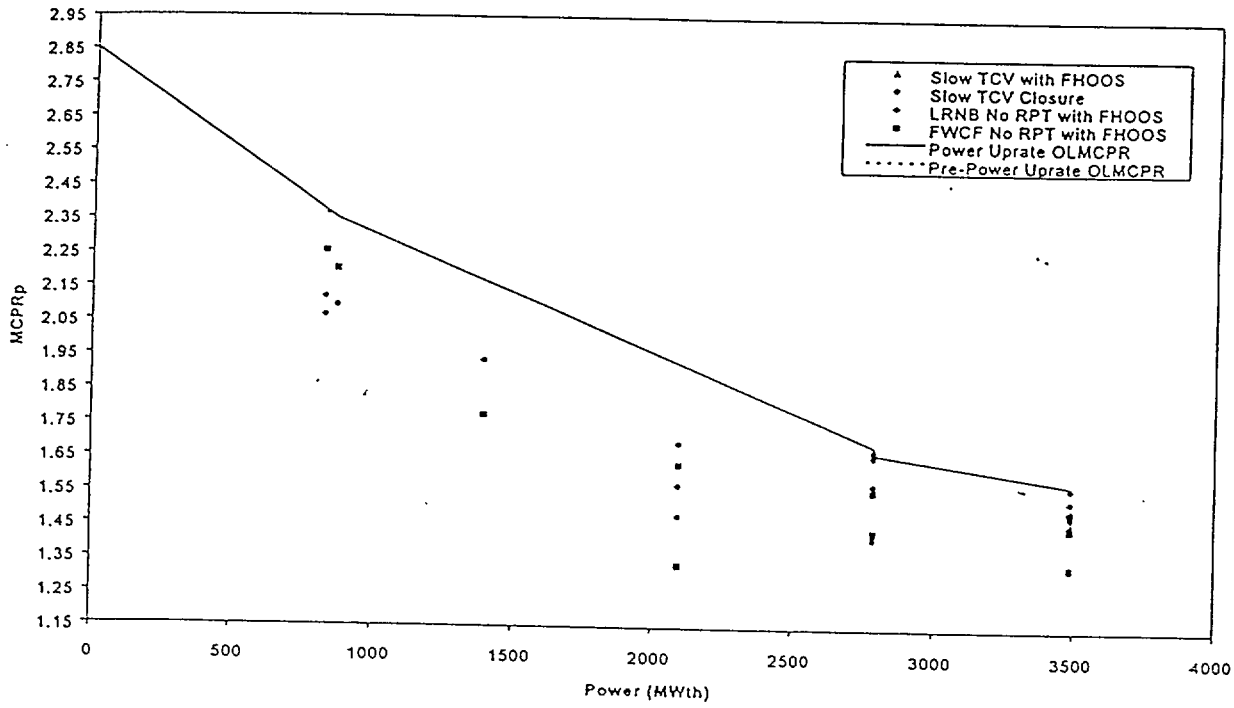
3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	$MCPR_p$ Limit	Power (%)	$MCPR_p$ Limit
100	1.56	100	1.54
84	1.63	80	1.63
84	1.65	80	1.65
25	2.38	25	2.35
25	2.38	25	2.35
0	2.85	0	2.85

Figure 5.16 EOC Turbine Control Valve Slow Closure and/or Recirculation Pump Trip and Feedwater Heaters Out-of-Service Power-Dependent MCPR Limits for ATRIUM-9B Fuel



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	LHGRFAC$_p$	Power (%)	LHGRFAC$_p$
100	0.86	100	0.86
84	0.86	80	0.86
84	0.86	80	0.86
25	0.63	25	0.64
25	0.63	25	0.64
0	0.63	0	0.64

Figure 5.17 EOC Turbine Control Valve Slow Closure and/or Recirculation Pump Trip and Feedwater Heaters Out-of-Service Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel



3323 MWth Rated Power		3489 MWth Rated Power	
Power (%)	$MCPR_p$ Limit	Power (%)	$MCPR_p$ Limit
100	1.60	100	1.58
84	1.67	80	1.67
84	1.69	80	1.69
25	2.38	25	2.35
25	2.38	25	2.35
0	2.85	0	2.85

Figure 5.18 EOC Turbine Control Valve Slow Closure and/or Recirculation Pump Trip and Feedwater Heaters Out-of-Service Power-Dependent MCPR Limits for GE9 Fuel

Table 7.1 ASME Overpressurization Analysis Results
102%P/105%F

Event	Peak Neutron Flux (%rated)	Peak Heat Flux (%rated)	Maximum Vessel Pressure Lower Plenum (psig)	Maximum Dome Pressure (psig)
MSIV	425.43	135.28	1320.26	1291.12
TCV	708.96	142.84	1318.41	1287.56
TSV	710.29	142.85	1318.41	1287.55

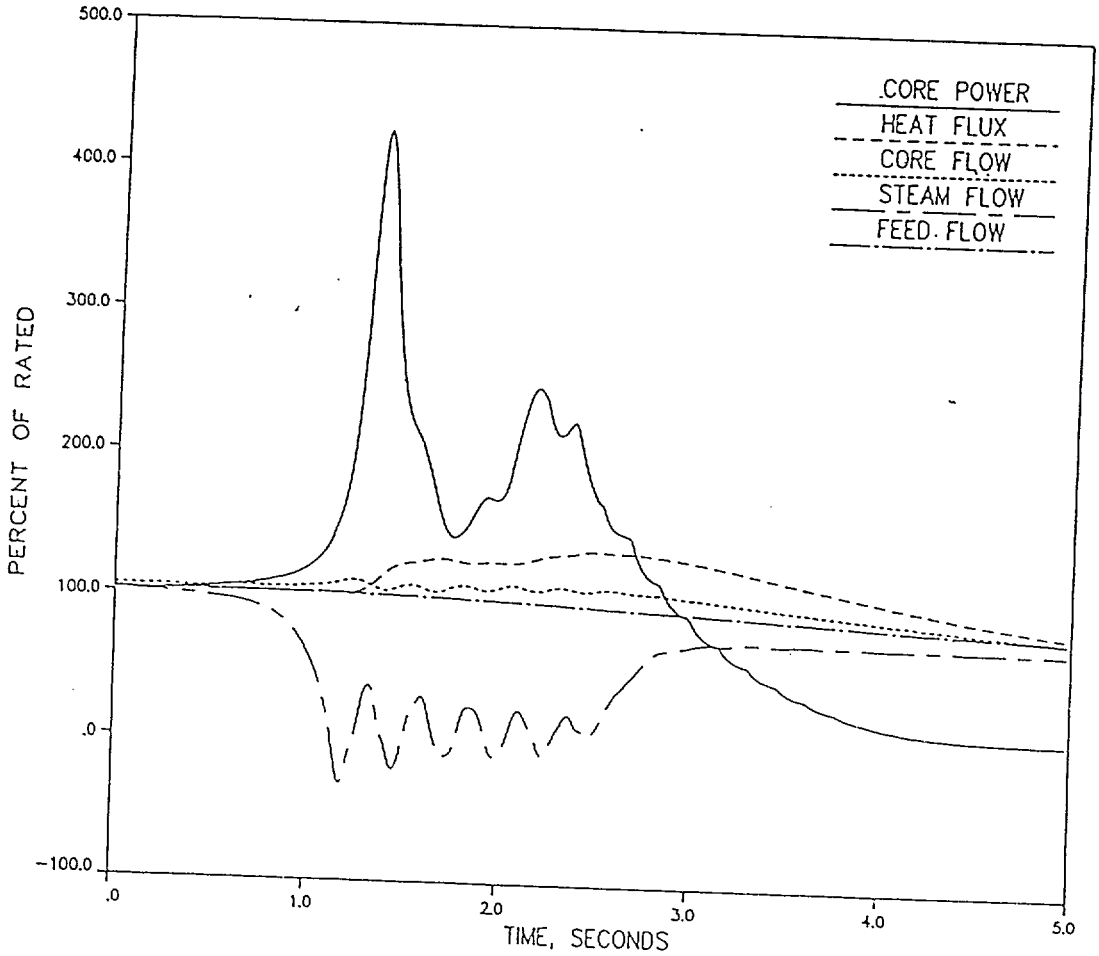


Figure 7.1 Overpressurization Event at 102/105 - MSIV Closure Key Parameters

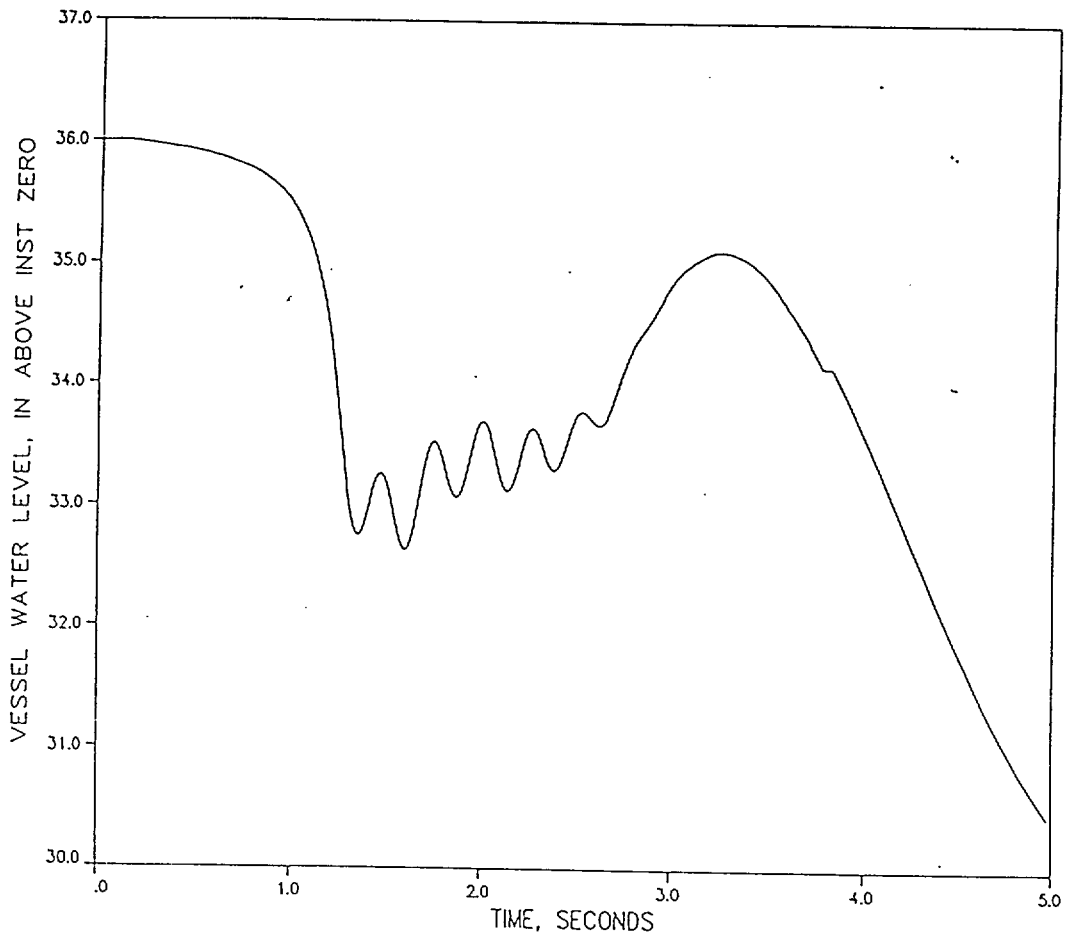


Figure 7.2 Overpressurization Event at 102/105 - MSIV Closure Vessel Water Level

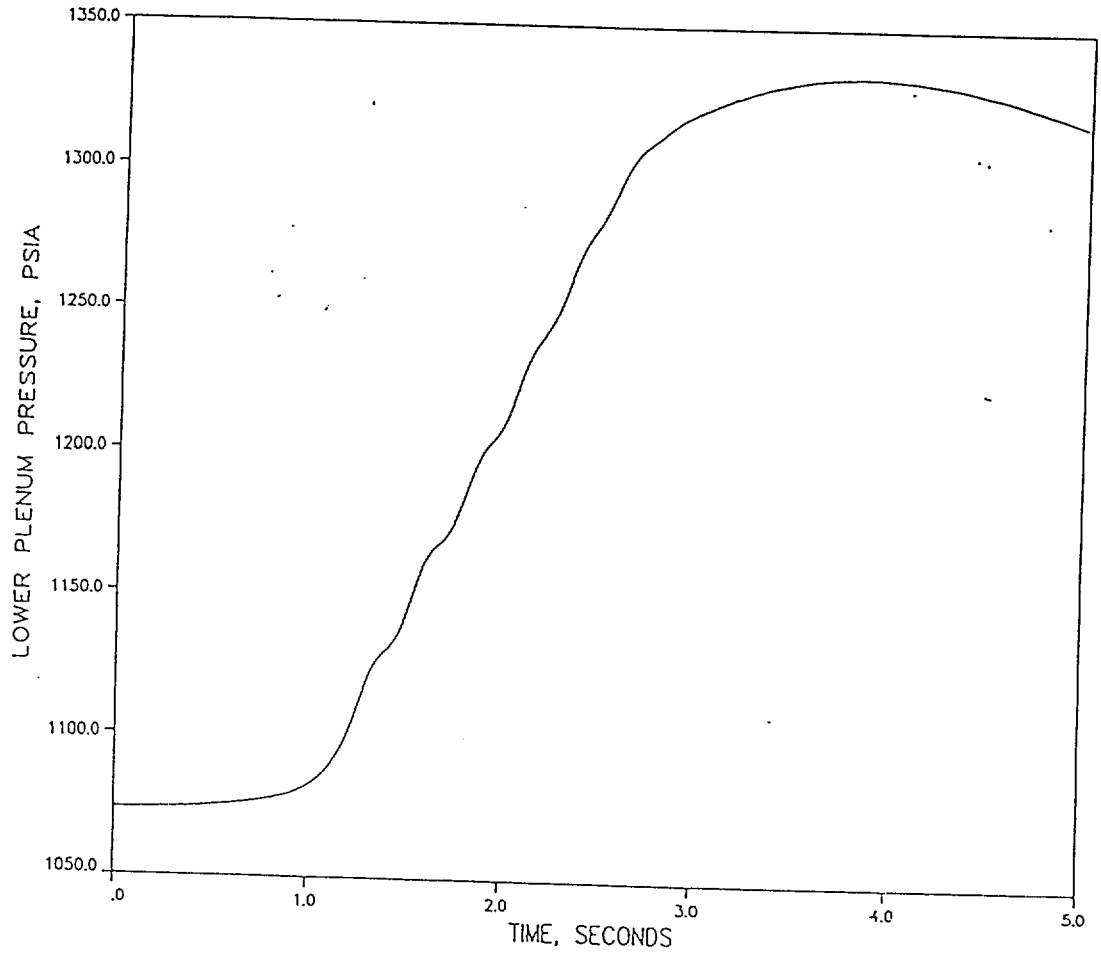


Figure 7.3 Overpressurization Event at 102/105 - MSIV Closure Lower Plenum Pressure

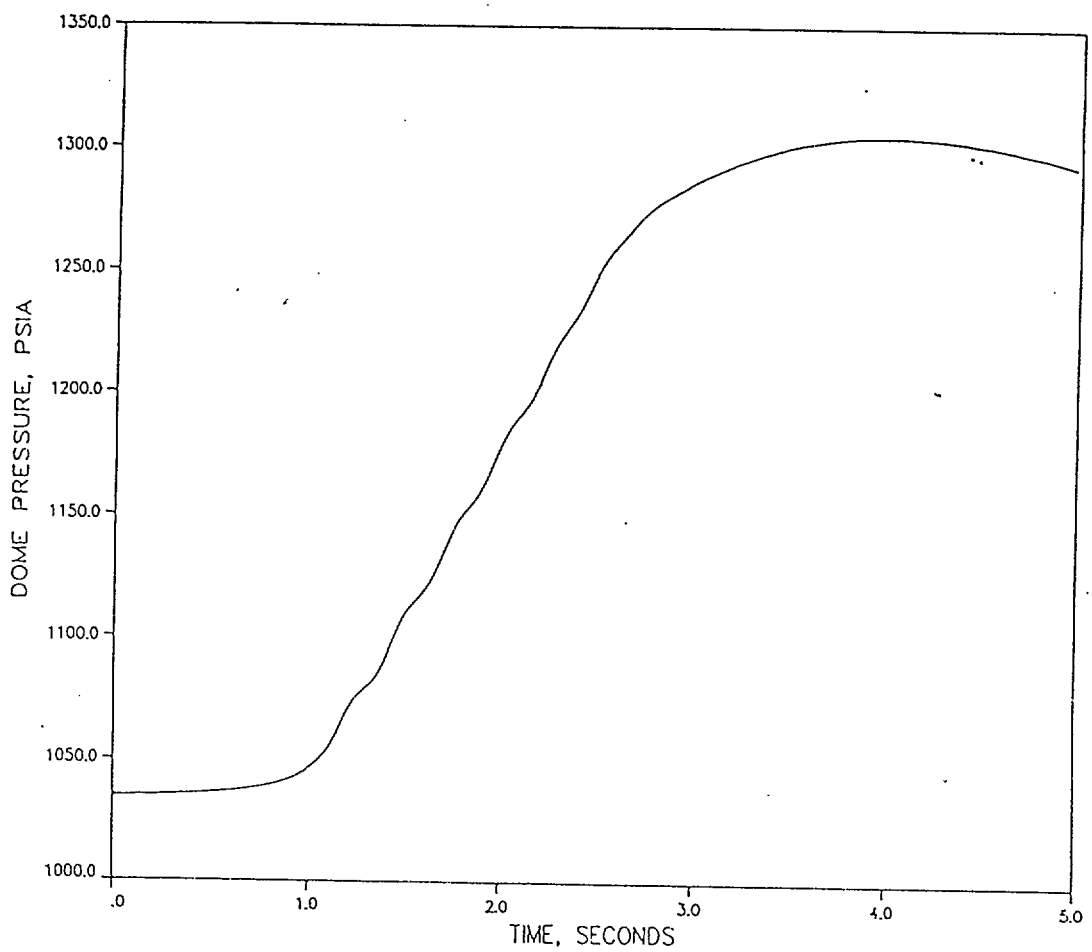


Figure 7.4 Overpressurization Event at 102/105 - MSIV Closure Dome Pressure

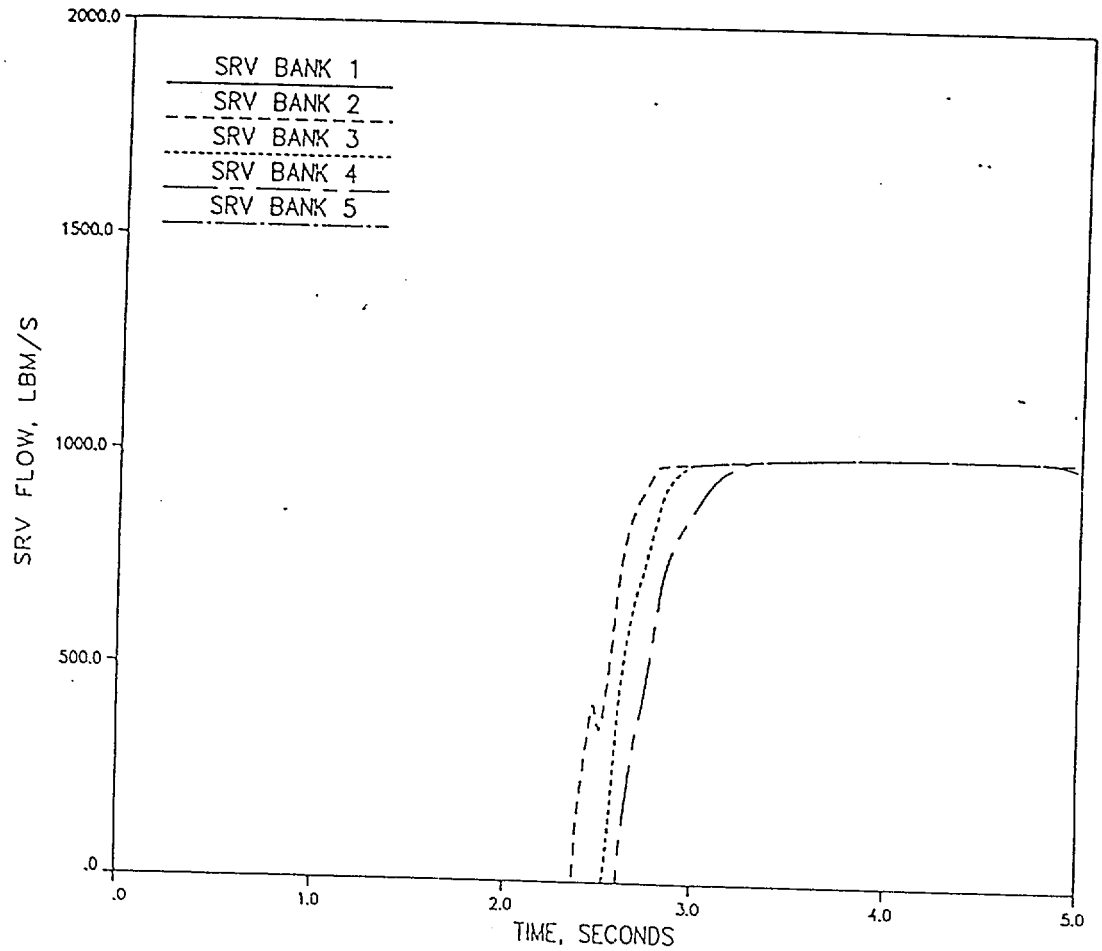


Figure 7.5 Overpressurization Event at 102/105 - MSIV Closure Safety/Relief Valve Flow Rates

Attachment 4

ARTS Improvement Program Analysis, Supplement 1 (Excerpts)

TOP/MOP and $MAPFAC_P$ Requirements

Limiting AOO	Power	Equipment Out of Service	TOP	MOP	Calculated $MAPFAC_P$	Generic $MAPFAC_P$
LRNBP	100	No EOOS	24.9	25.2	1.0	1.0
LRNBP	100	RPT OOS	30.3	30.6	1.0	1.0
FWCF	100	TBV OOS	28.7	30.0	1.0	1.0
FWCF	25	No EOOS	50.1	52.0	0.83	0.61
FWCF	25	RPT OOS	57.1	59.0	0.83	0.61
FWCF	25	TBV OOS	62.7	64.5	0.79	0.61

(a) Based on the GE9/10 LHGR Improvement Report, the MAPFACs are applied to LHGR (Reference 24)

Attachment 5

TCV Slow Closure Analysis (Excerpts)

Table 4. - TOP and MOP Values for the Off-rated Transient Events

	LRNBP, One TCV Slow Closure at 50%/s, 3 TCV Fast Closure	LRNBP, All TCV Slow Closure at 19%/s
Calculated TOP	26.17	49.27
Calculated MOP	26.17	55.30
Adjusted MOP		60.83
Required MOP		38.0
Required MAPFAC		0.62
Limiting MACFAC		0.60 (a)

Note : (a) Based on Figure 3.2-2 in COLR.

(b) Based on the GE9/10 LHGR Improvement Report, the MAPFACs are applied to LHGR (Reference 24)