Attachment 3

LaSalle Unit 1 Cycle 10A

Plant Transient Analysis

FRAMATOME ANP

EMF-2689
Revision 0

LaSalle Unit 1 Cycle 10
Plant Transient Analysis

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Framatome ANP, Inc.

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LaSalle Unit 1 Cycle 10
Plant Transient Analysis

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Nature of Changes

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

Contents

Tables

Figures

Nomenclature

AOO	anticipated operational occurrence
CPR	critical power ratio
EFPH	effective full power hours
EOC	end of cycle
EOD	extended operating domain
EOFP	end of full power
EOOS	equipment out-of-service
FFTR	final feedwater temperature reduction
FHOOS	feedwater heater out-of-service
FRA-ANP	Framatome ANP, Inc.
FWCF	feedwater controller failure
HFR	heat flux ratio
ICF	increased core flow
L1C10	LaSalle Unit 1 Cycle 10
LHGR	linear heat generation rate
$LHGRFAC_f$	flow-dependent linear heat generation rate factors
$LHGRFAC_p$	power-dependent linear heat generation rate factors
LHGROL	linear heat generation rate operating limit
LOFH	loss of feedwater heating
LPRM	local power range monitor
LRNB	generator load rejection with no bypass
$MAPFAC_f$	flow-dependent maximum average planar linear heat generation rate multiplier
$MAPFAC_p$	power-dependent maximum average planar linear heat generation rate multiplier
MCPR	minimum critical power ratio
$MCPR_f$	flow-dependent minimum critical power ratio
$MCPR_p$	power-dependent minimum critical power ratio
MELLLA	maximum extended load line limit analysis
MFC	manual flow control
MSIV	main steam isolation valve
NSS	nominal scram speed
NRC	Nuclear Regulatory Commission, U.S.
PAPT	protection against power transient
RPT	recirculation pump trip

Nomenclature
(Continued)

SLMCPR	safety limit MCPR
SLO	single-loop operation
SRV	safety/relief valve
SRVOOS	safety/relief valve out-of-service
SSLHGR	steady-state LHGR
TBVOOS	turbine bypass valve out-of-service
TCV	turbine control valve
TIP	traversing incore probe
TIPOOS	tip machine(s) out-of-service
TSSS	technical specification scram speed
TSV	turbine stop valve
TTNB	turbine trip with no bypass
ΔCPR	change in critical power ratio

1.0 Introduction

This report presents results of the plant transient analyses performed by Framatome ANP, Inc. (FRA-ANP) as part of the reload safety analyses to support LaSalle Unit 1 Cycle 10 (L1C10) operation. The Cycle 10 core contains 346 fresh ATRIUM™-10* assemblies, 372 previously loaded ATRIUM-9B assemblies, and 46 previously loaded GE9 assemblies (all in peripheral locations). Those portions of the reload safety analysis for which Exelon has responsibility are presented elsewhere. The scope of the transient analyses performed by FRA-ANP is presented in Reference 1.

The analyses reported in this document were performed using the plant transient analysis methodology approved by the Nuclear Regulatory Commission (NRC) for generic application to boiling-water reactors (Reference 2). The transient analyses were performed in accordance with the NRC technical limitations as stated in the methodology (References 3–7, 12). Parameters for the transient analyses are documented in Reference 8.

The Cycle 10 transient analysis consists of the calculation of the limiting transients identified in Reference 9 to support base case operation† for the power/flow map presented in Figure 1.1. Results are also presented to support operation in the extended operating domain (EOD) and equipment out-of-service (EOOS) scenarios identified in Table 1.1. The analysis results are used to establish operating limits to protect against fuel failures. Minimum critical power ratio (MCPR) limits are established to protect the fuel from overheating during normal operation and anticipated operational occurrences (AOOs). Power-dependent MCPR ($MCPR_p$) limits are required in order to provide the necessary protection during operation at reduced power. Flow-dependent MCPR ($MCPR_f$) limits provide protection against fuel failures during flow excursions initiated at reduced flow. Cycle 10 power- and flow-dependent MCPR limits are presented to protect both ATRIUM-10 and ATRIUM-9B fuel. Since the GE9 fuel is in low power peripheral locations for L1C10, the ATRIUM-9B MCPR limits can be used for the GE9 fuel. This conclusion is based on a MCPR evaluation of these assemblies in the design-basis step-through.

* ATRIUM is a trademark of Framatome ANP.

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

Protection against violating the linear heat generation rate (LHGR) limits at rated and off-rated conditions is provided through the application of power- and flow-dependent LHGR factors ($LHGRFAC_p$ and $LHGRFAC_f$, respectively). These factors or multipliers are applied directly to the steady-state LHGR limit to ensure that the LHGR does not exceed the protection against power transient (PAPT) limit during postulated AOOs. Cycle 10 power- and flow-dependent LHGR multipliers are presented for ATRIUM-10 and ATRIUM-9B fuel. In addition, the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

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

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

Table 1.1 EOD and EOOS Operating Conditions

Extended Operating Domain (EOD) Conditions
Increased core flow (ICF)
Maximum extended load line limit analysis (MELLLA)
Coastdown - Currently not supported for L1C10
Final feedwater temperature reduction (FFTR) - Currently not supported for L1C10
Combined FFTR/coastdown - Currently not supported for L1C10
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)
EOC recirculation pump trip out-of-service (no RPT)
Turbine control valve (TCV) slow closure and/or no RPT
Safety relief valve out-of-service (SRVOOS)
Up to 2 TIP machines out-of-service or the equivalent number of TIP channels (100% available at startup)
Up to 50% of the LPRMs out-of-service
TCV slow closure, FHOOS, and/or no RPT
1 stuck closed turbine control valve

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

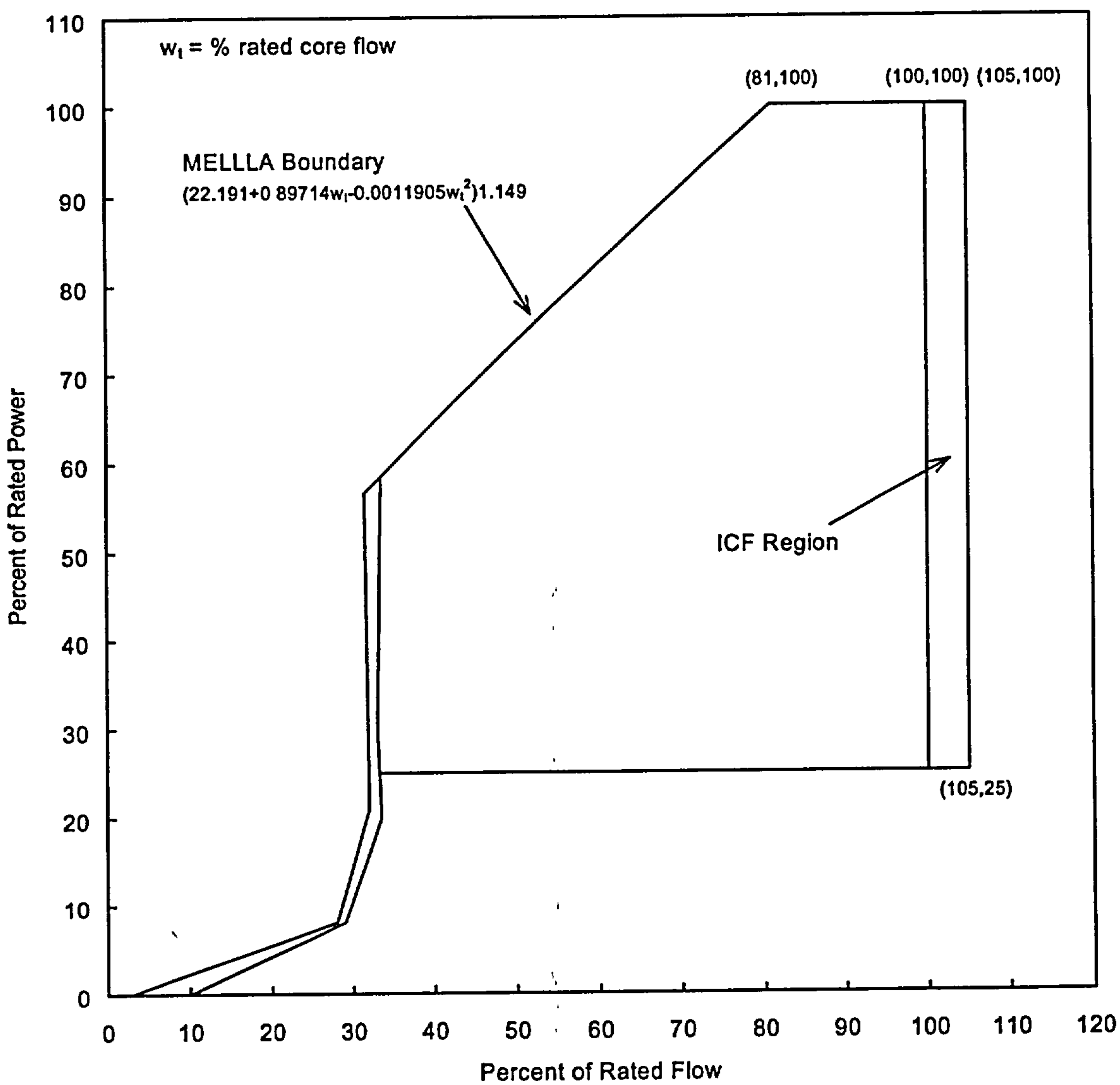


Figure 1.1 LaSalle County Nuclear Station Power / Flow Map

2.0 Summary

The determination of the thermal limits (MCPR limits and LHGRFAC multipliers) for LaSalle Unit 1 Cycle 10 is based on analyses of the limiting operational transients identified in Reference 9. The transients evaluated are the generator load rejection with no bypass (LRNB), feedwater controller failure to maximum demand (FWCF), control rod withdrawal error (CRWE) and loss of feedwater heating (LOFH). Thermal limits identified for Cycle 10 operation include both MCPR limits and LHGRFAC multipliers. The MCPR operating limits are established so that less than 0.1% of the fuel rods in the core are expected to experience boiling transition during an AOO initiated from rated or off-rated conditions and are based on a two-loop operation MCPR safety limit of 1.11. Even so, the results of the analysis support a two-loop operation MCPR safety limit of 1.09 and a single-loop operation MCPR safety limit of 1.10 for all fuel types in the Cycle 10 core. LHGRFAC multipliers are applied directly to the LHGR limits at reduced power and/or flow conditions to protect against fuel melting and overstraining of the cladding during an AOO. Exposure dependent operating limits are established to support operation from beginning of cycle (BOC) to 15,000 MWd/MTU and from 15,000 MWd/MTU to EOC. EOC for LaSalle Unit 1 Cycle 10 is defined as a core exposure of 31,495.1 MWd/MTU. Operating limits are established to support both base case operation and the EOOS scenarios presented in Table 1.1. Operating limits are also established for the EOD and combined EOD/EOOS conditions presented in Table 1.1.

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

Cycle 10 $MCPR_p$ limits and $LHGRFAC_p$ multipliers for ATRIUM-10 and ATRIUM-9B fuel that support base case operation and operation in the EOD, EOOS and combined EOD/EOOS scenarios are presented in Tables 2.1–2.4. Tables 2.1 and 2.2 present the limits and multipliers for nominal scram speed (NSS) insertion times and Technical Specifications scram speed (TSSS) insertion times for the Cycle 10 BOC–15,000 MWd/MTU exposure range. Tables 2.3 and 2.4 present the NSS and TSSS limits and multipliers for the Cycle 10 15,000 MWd/MTU–EOC exposure range. Operating limits for the EOOS conditions are divided into three different scenarios. EOOS Case 1 limits support operation with FHOOS or with the turbine bypass valves inoperable. Case 1 limits also support operation with FHOOS and 1 stuck closed TCV. EOOS Case 2 limits support operation with any combination of TCV slow closure, no RPT or

FHOOS. The Case 2 limits also support the same EOOS scenarios in combination with 1 stuck closed TCV. A third set of EOOS limits are provided to support operation with the turbine bypass valves inoperable in conjunction with 1 stuck closed TCV. Limits for single-loop operation with the same EOOS conditions are also provided.

$MCPR_f$ limits for both ATRIUM-10 and ATRIUM-9B that protect against fuel failures during a slow flow excursion event in manual flow control are presented in Figure 2.1. Automatic flow control is not supported for L1C10. The $MCPR_f$ limits presented are applicable for all EOD and EOOS conditions presented in Table 1.1.

The Cycle 10 $LHGRFAC_f$ multipliers for ATRIUM-10 and ATRIUM-9B fuel are presented in Figure 2.2 and are applicable in all the EOD and EOOS scenarios presented in Table 1.1.

The power excursion experienced by low-power peripheral fuel assemblies during an anticipated operational occurrence is very mild compared to centrally orificed fuel assemblies. Since GE9 fuel will only be in peripheral locations, the MCPR safety limit will not be challenged by the GE9 fuel assemblies and using the ATRIUM-9B MCPR limits for the GE9 fuel provides the necessary protection. In addition, the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable. This conclusion is based on an evaluation of these assemblies in the design-basis step-through.

The results of the maximum overpressurization analyses show that the requirements of the ASME code regarding overpressure protection are met for Cycle 10. The analysis shows that the dome pressure limit of 1325 psig is not exceeded and the vessel pressure does not exceed the limit of 1375 psig. The results of the maximum overpressurization analyses are presented in Table 7.1.

Table 2.1 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times BOC to 15,000 MWd/MTU*,†

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Base case operation‡	0	2.70	0.75	2.70	0.77
	25	2.20	0.75	2.20	0.77
	25	2.07	0.75	1.95	0.77
	60	1.52	1.00	1.50	1.00
	100	1.43	1.00	1.42	1.00
EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.86	0.66	2.70	0.69
	25	2.36	0.66	2.20	0.69
	25	2.36	0.66	2.15	0.69
	60	1.59	0.94	1.58	0.90
	80	—	0.94	—	0.90
	100	1.47	0.95	1.45	0.90
EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.86	0.65	2.70	0.67
	25	2.36	0.65	2.20	0.67
	25	2.36	0.65	2.15	0.67
	80	1.81	0.88	1.86	0.79
	80	1.74	0.88	1.67	0.79
	100	1.54	0.89	1.52	0.79
TBVOOS with 1 stuck closed TCV	0	2.86	0.66	2.70	0.69
	25	2.36	0.66	2.20	0.69
	25	2.36	0.66	2.15	0.69
	60	1.59	0.77	1.58	0.77
	80	—	0.77	—	0.77
	100	1.47	0.83	1.45	0.80

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

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 2.1 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times BOC to 15,000 MWd/MTU*,†
(Continued)

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Single-loop operation‡ (SLO)	0	2.71	0.75	2.71	0.77
	25	2.21	0.75	2.21	0.77
	25	2.08	0.75	1.96	0.77
	60	1.53	1.00	1.51	1.00
	100	1.44	1.00	1.43	1.00
SLO with EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.87	0.66	2.71	0.69
	25	2.37	0.66	2.21	0.69
	25	2.37	0.66	2.16	0.69
	60	1.60	0.94	1.59	0.90
	80	---	0.94	---	0.90
	100	1.48	0.95	1.46	0.90
SLO with EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.87	0.65	2.71	0.67
	25	2.37	0.65	2.21	0.67
	25	2.37	0.65	2.16	0.67
	80	1.82	0.88	1.87	0.79
	80	1.75	0.88	1.68	0.79
	100	1.55	0.89	1.53	0.79
SLO with TBVOOS AND 1 stuck closed TCV	0	2.87	0.66	2.71	0.69
	25	2.37	0.66	2.21	0.69
	25	2.37	0.66	2.16	0.69
	60	1.60	0.77	1.59	0.77
	80	---	0.77	---	0.77
	100	1.48	0.83	1.46	0.80

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

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 2.2 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times BOC to 15,000 MWd/MTU*,†

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Base case operation‡	0	2.70	0.74	2.70	0.76
	25	2.20	0.74	2.20	0.76
	25	2.15	0.74	1.96	0.76
	60	1.55	1.00	1.54	1.00
	100	1.46	1.00	1.44	1.00
EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.95	0.64	2.70	0.69
	25	2.45	0.64	2.20	0.69
	25	2.45	0.64	2.19	0.69
	60	1.62	0.94	1.62	0.89
	80	---	0.94	---	0.91
	100	1.51	0.95	1.48	0.92
EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.95	0.64	2.70	0.67
	25	2.45	0.64	2.20	0.67
	25	2.45	0.64	2.19	0.67
	80	1.82	0.87	1.86	0.76
	80	1.74	0.87	1.73	0.76
	100	1.59	0.87	1.59	0.76
TBVOOS with 1 stuck closed TCV	0	2.95	0.64	2.70	0.69
	25	2.45	0.64	2.20	0.69
	25	2.45	0.64	2.19	0.69
	40	---	0.77	---	0.77
	60	1.62	0.77	1.62	0.77
	80	---	0.77	---	0.77
	100	1.51	0.83	1.48	0.80

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

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 2.2 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times BOC to 15,000 MWd/MTU*,†
(Continued)

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Single-loop operation‡ (SLO)	0	2.71	0.74	2.71	0.76
	25	2.21	0.74	2.21	0.76
	25	2.16	0.74	1.97	0.76
	60	1.56	1.00	1.55	1.00
	100	1.47	1.00	1.45	1.00
SLO with EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.96	0.64	2.71	0.69
	25	2.46	0.64	2.21	0.69
	25	2.46	0.64	2.20	0.69
	60	1.63	0.94	1.63	0.89
	80	---	0.94	---	0.91
	100	1.52	0.95	1.49	0.92
SLO with EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.96	0.64	2.71	0.67
	25	2.46	0.64	2.21	0.67
	25	2.46	0.64	2.20	0.67
	80	1.83	0.87	1.87	0.76
	80	1.75	0.87	1.74	0.76
	100	1.60	0.87	1.60	0.76
SLO with TBVOOS AND 1 stuck closed TCV	0	2.96	0.64	2.71	0.69
	25	2.46	0.64	2.21	0.69
	25	2.46	0.64	2.20	0.69
	40	---	0.77	---	0.77
	60	1.63	0.77	1.63	0.77
	80	---	0.77	---	0.77
	100	1.52	0.83	1.49	0.80

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

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 2.3 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times 15,000 MWd/MTU to EOC*,†

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Base case operation‡	0	2.70	0.75	2.70	0.76
	25	2.20	0.75	2.20	0.76
	25	2.07	0.75	1.95	0.76
	60	1.52	1.00	1.50	1.00
	100	1.47	1.00	1.43	1.00
EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.86	0.66	2.70	0.69
	25	2.36	0.66	2.20	0.69
	25	2.36	0.66	2.15	0.69
	60	1.59	0.94	1.58	0.90
	80	---	0.94	---	0.90
	100	1.47	0.95	1.45	0.90
EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.86	0.65	2.70	0.67
	25	2.36	0.65	2.20	0.67
	25	2.36	0.65	2.15	0.67
	80	1.81	0.84	1.86	0.79
	80	1.74	0.84	1.67	0.79
	100	1.59	0.84	1.58	0.79
TBVOOS with 1 stuck closed TCV	0	2.86	0.65	2.70	0.69
	25	2.36	0.65	2.20	0.69
	25	2.36	0.65	2.15	0.69
	60	1.59	0.77	1.58	0.77
	80	---	0.77	---	0.77
	100	1.47	0.83	1.45	0.80

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

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 2.3 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for NSS Insertion Times 15,000 MWd/MTU to EOC*,†
(Continued)

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Single-loop operation‡ (SLO)	0	2.71	0.75	2.71	0.76
	25	2.21	0.75	2.21	0.76
	25	2.08	0.75	1.96	0.76
	60	1.53	1.00	1.51	1.00
	100	1.48	1.00	1.44	1.00
SLO with EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.87	0.66	2.71	0.69
	25	2.37	0.66	2.21	0.69
	25	2.37	0.66	2.16	0.69
	60	1.60	0.94	1.59	0.90
	80	---	0.94	---	0.90
	100	1.48	0.95	1.46	0.90
SLO with EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.87	0.65	2.71	0.67
	25	2.37	0.65	2.21	0.67
	25	2.37	0.65	2.16	0.67
	80	1.82	0.84	1.87	0.79
	80	1.75	0.84	1.68	0.79
	100	1.60	0.84	1.59	0.79
SLO with TBVOOS AND 1 stuck closed TCV	0	2.87	0.65	2.71	0.69
	25	2.37	0.65	2.21	0.69
	25	2.37	0.65	2.16	0.69
	60	1.60	0.77	1.59	0.77
	80	---	0.77	---	0.77
	100	1.48	0.83	1.46	0.80

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

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

Table 2.4 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times 15,000 MWd/MTU to EOC*,†

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Base case operation‡	0	2.70	0.74	2.70	0.76
	25	2.20	0.74	2.20	0.76
	25	2.15	0.74	1.96	0.76
	60	1.55	1.00	1.54	1.00
	100	1.50	1.00	1.44	1.00
EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.95	0.64	2.70	0.69
	25	2.45	0.64	2.20	0.69
	25	2.45	0.64	2.19	0.69
	60	1.62	0.94	1.62	0.89
	80	---	0.94	---	0.91
	100	1.51	0.95	1.48	0.92
EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.95	0.64	2.70	0.67
	25	2.45	0.64	2.20	0.67
	25	2.45	0.64	2.19	0.67
	80	1.82	0.82	1.86	0.76
	80	1.74	0.82	1.73	0.76
	100	1.64	0.82	1.65	0.76
TBVOOS with 1 stuck closed TCV	0	2.95	0.64	2.70	0.69
	25	2.45	0.64	2.20	0.69
	25	2.45	0.64	2.19	0.69
	40	---	0.77	---	0.77
	60	1.62	0.77	1.62	0.77
	80	---	0.77	---	0.77
	100	1.51	0.83	1.48	0.80

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

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

‡ With or without 1 stuck closed TCV.

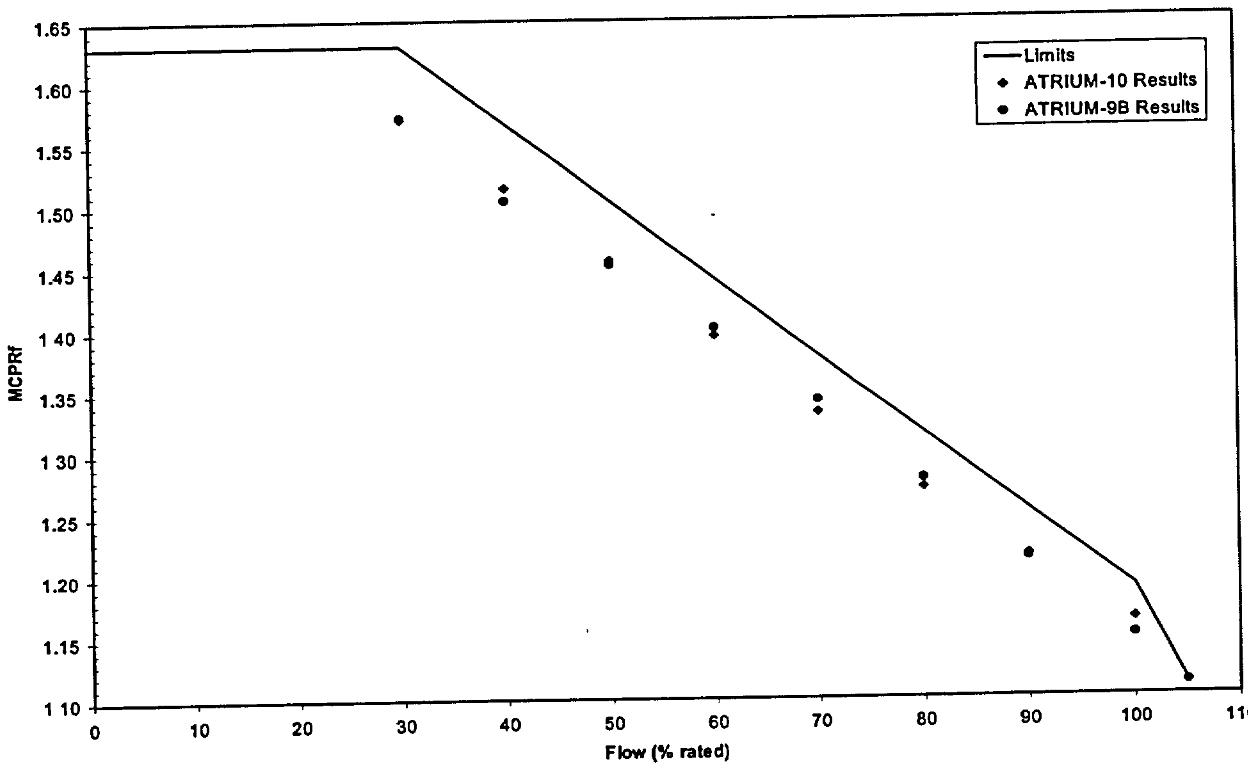
Table 2.4 Base Case and EOOS $MCPR_p$ Limits and $LHGRFAC_p$ Multipliers for TSSS Insertion Times 15,000 MWd/MTU to EOC*,†
(Continued)

EOOS Condition	Power (% rated)	ATRIUM-10 Fuel		ATRIUM-9B Fuel	
		$MCPR_p$	$LHGRFAC_p$	$MCPR_p$	$LHGRFAC_p$
Single-loop operation‡ (SLO)	0	2.71	0.74	2.71	0.76
	25	2.21	0.74	2.21	0.76
	25	2.16	0.74	1.97	0.76
	60	1.56	1.00	1.55	1.00
	100	1.51	1.00	1.45	1.00
SLO with EOOS Case 1 (FHOOS‡ OR TBVOOS)	0	2.96	0.64	2.71	0.69
	25	2.46	0.64	2.21	0.69
	25	2.46	0.64	2.20	0.69
	60	1.63	0.94	1.63	0.89
	80	---	0.94	---	0.91
	100	1.52	0.95	1.49	0.92
SLO with EOOS Case 2‡ (Any combination of TCV slow closure, no RPT OR FHOOS)	0	2.96	0.64	2.71	0.67
	25	2.46	0.64	2.21	0.67
	25	2.46	0.64	2.20	0.67
	80	1.83	0.82	1.87	0.76
	80	1.75	0.82	1.74	0.76
	100	1.65	0.82	1.66	0.76
SLO with TBVOOS AND 1 stuck closed TCV	0	2.96	0.64	2.71	0.69
	25	2.46	0.64	2.21	0.69
	25	2.46	0.64	2.20	0.69
	40	---	0.77	---	0.77
	60	1.63	0.77	1.63	0.77
	80	---	0.77	---	0.77
	100	1.52	0.83	1.49	0.80

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

† GE9 fuel assemblies will use the ATRIUM-9B MCPR limits and the GE9 $MAPFAC_f$ and $MAPFAC_p$ multipliers used in Cycle 9 remain applicable.

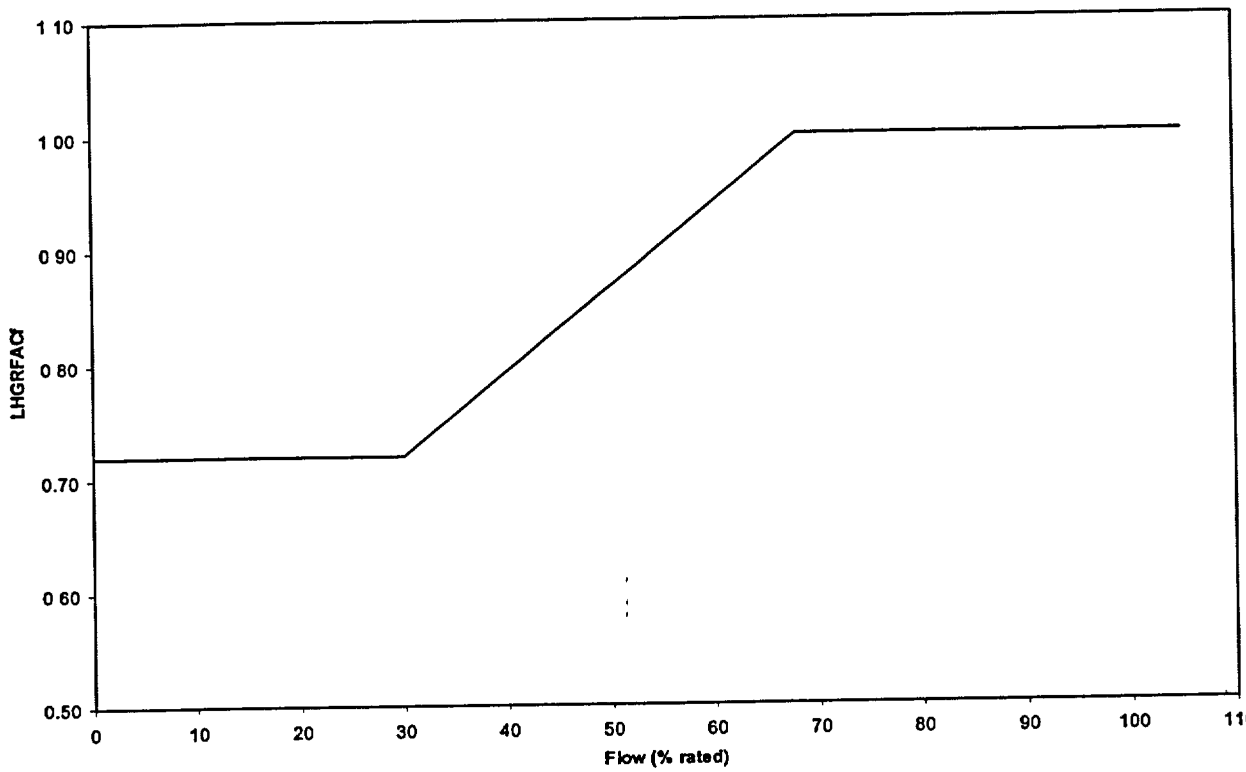
‡ With or without 1 stuck closed TCV.



Flow (% of rated)	$MCPR_f$ ATRIUM-10	$MCPR_f$ ATRIUM-9B*
0	1.63	1.63
30	1.63	1.63
100	1.19	1.19
105	1.11	1.11

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

* GE9 fuel assemblies will use the ATRIUM-9B MCPR limits.



Flow (% rated)	LHGRFAC$_f$*
0	0.72
30	0.72
68	1.00
105	1.00

Figure 2.2 Flow-Dependent LHGRFAC Multipliers for ATRIUM-10 and ATRIUM-9B Fuel

* GE9 MAPFAC$_f$ and MAPFAC$_p$ multipliers used in Cycle 9 remain applicable.

3.0 Transient Analysis for Thermal Margin - Base Case Operation

This section describes the analyses performed to determine the power- and flow-dependent MCPR and LHGR operating limits for base case operation at LaSalle Unit 1 Cycle 10.

COTRANSA2 (Reference 4), XCOBRA-T (Reference 11), XCOBRA (Reference 7), and CASMO-3G/MICROBURN-B (Reference 3) are the major codes used in the thermal limits analyses as described in FRA-ANP's THERMEX methodology report (Reference 7) and neutronics methodology report (Reference 3). COTRANSA2 is a system transient simulation code, which includes an axial one-dimensional neutronics model that captures the effects of axial power shifts associated with the system transients. XCOBRA-T is a transient thermal-hydraulics code used in the analysis of thermal margins for the limiting fuel assembly. XCOBRA is used in steady-state analyses. The ANFB critical power correlation (Reference 6) is used to evaluate the thermal margin of the ATRIUM-9B fuel assemblies and the SPCB critical power correlation (Reference 12) is used for the ATRIUM-10 fuel. Fuel pellet-to-cladding gap conductance values are based on RODEX2 (Reference 13) calculations for the LaSalle Unit 1 Cycle 10 core configuration.

3.1 *System Transients*

System transient calculations have been performed to establish thermal limits to support L1C10 operation. Reference 9 identifies the potential limiting events that need to be evaluated on a cycle-specific basis. The potentially limiting transients evaluated for Cycle 10 include the LRNB, FWCF, CRWE, and LOFH events. Other transient events are bound by the consequences of one of the limiting transients.

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

The limiting exposure for rated power pressurization transients is typically at end of full power (EOFP) when the control rods are fully withdrawn. To provide additional margin to the operating limits earlier in the cycle, analyses were also performed to establish operating limits at 15,000 MWd/MTU. Off-rated power analyses were performed at cycle exposures prior to EOC to ensure that the operating limits provide the necessary protection.

All pressurization transients assumed only the 11 highest set point safety relief valves (SRVs) were operable, consistent with the discussion in Section 7.0. In order to support operation with 1 SRV out-of-service, the pressurization transient analyses were performed with the lowest set point SRV out-of-service, which makes a total of 10 SRVs available.

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

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

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

3.1.1 Load Rejection No Bypass

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

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

LRNB analyses were performed for several power/flow conditions to support generation of the thermal limits. Tables 3.3 and 3.4 present the LRNB transient results for both TSSS and NSS insertion times for Cycle 10. For illustration, Figures 3.1–3.3 are presented to show the responses of various reactor and plant parameters during the LRNB event initiated at 100% of rated power and 105% of rated core flow with TSSS insertion times.

3.1.2 Feedwater Controller Failure

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

FWCF analyses were performed for several power/flow conditions to support generation of the thermal limits. Tables 3.5 and 3.6 present the base case FWCF transient results for both TSSS and NSS insertion times for Cycle 10. For illustration, Figures 3.4–3.6 are presented to show the responses of various reactor and plant parameters during the FWCF event initiated at 100% of rated power and 105% of rated core flow with TSSS insertion times.

3.1.3 Loss of Feedwater Heating

During the loss of feedwater heating (LOFH) event, there is an assumed 145°F decrease in the feedwater temperature. The result is an increase in core inlet subcooling, which collapses voids thereby increasing the core power and shifting the axial power distribution toward the bottom of the core. As a result of the axial power shift and increased core power, voids begin to build up at the bottom of the core, acting as negative feedback to the void collapse process. The negative feedback moderates the core power increase. The MICROBURN-B code is used to determine the change in MCPR and LHGR during the event. Analyses were performed for several cycle exposures to ensure that appropriate limits are set. Although there is a substantial increase in core thermal power during the event, the increase in steam flow is much less because a large part of the added power is used to overcome the increase in inlet subcooling. The increase in steam flow is accommodated by the pressure control system via the TCVs or the turbine bypass valves so no pressurization occurs. The LOFH results are presented in Table 3.7. The PAPT LHGR limit was not exceeded in any of the analyses. PAPT LHGR limits are presented in References 21 and 22.

3.1.4 Control Rod Withdrawal Error

The control rod withdrawal error (CRWE) transient is hypothesized as an inadvertent reactor operator initiated withdrawal of a control rod. This withdrawal increases local power and core thermal power. This results in lowering the core MCPR. The CRWE transient is typically terminated by control rod blocks initiated by the rod block monitor, however, in determination of the limiting ΔCPR for L1C10, no credit was taken for the rod block monitor. The limiting CRWE ΔCPR is 0.19 and the limiting fraction of LHGR is 1.22. A limiting fraction of LHGR less than 1.35 ensures that the PAPT LHGR limits for ATRIUM-10 and ATRIUM-9B fuel are not exceeded.

3.2 *MCPR Safety Limit*

The MCPR safety limit is defined as the minimum value of the critical power ratio at which the fuel can be operated, with the expected number of rods in boiling transition not exceeding 0.1% of the fuel rods in the core. The MCPR safety limit for all fuel in the LaSalle Unit 1 Cycle 10 core was determined using the methodology described in Reference 5. The effects of channel bow on core limits are determined using a statistical procedure. The mean channel bow is determined from the exposure of the fuel channels and measured channel bow data. CASMO-3G is used to determine the effect on the local peaking factor distribution. Once the channel bow effects on the local peaking factors are determined, the impact on the core limits is determined in the MCPR safety limit analysis. Further discussion of how the effects of channel bow are accounted for is presented in Reference 5. The main input parameters and uncertainties used in the safety limit analysis are listed in Table 3.8. The radial power uncertainty includes the effects of up to 2 TIPOOS or the equivalent number (42% of the total number of channels) of TIP channels (100% available at startup), up to 50% of the LPRMs out-of-service, and an LPRM calibration interval of 2500 EFPH as discussed in References 16 and 19. The channel bow local peaking uncertainty is a function of the nominal and bowed local peaking factors and the standard deviation of the measured bow data.

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

- Cycle 10 will not contain channels used for more than one fuel bundle lifetime.
- The channel exposure at discharge will not exceed 50,000 MWd/MTU based on the fuel bundle average exposure.
- The Cycle 10 core contains all CarTech-supplied channels.

Analyses were performed with input parameters (including the radial power and local peaking factor distributions) consistent with each exposure step in the design-basis step-through. The analysis that produced the highest number of rods in boiling transition corresponds to a Cycle 10 exposure of 500 MWd/MTU. The radial power distribution corresponding to a Cycle 10 exposure of 500 MWd/MTU is shown in Figure 3.7. Eight fuel types were represented in the LaSalle Unit 1 Cycle 10 safety limit analysis: two ATRIUM-10 fuel types loaded in Cycle 10 (A10-4039B-15GV75 and A10-4037B-16GV75); four ATRIUM-9B fuel types loaded in Cycle 9 (SPCA9-384B-11GZ-80M, SPCA9-393B-16GZ-100M, SPCA9-396B-12GZB-100M, and SPCA9-396B-12GZC-100M); and two GE9 fuel types loaded in Cycle 8 (GE9B-P8CWB343-12GZ-80M-150 and GE9B-P8CWB342-10GZ-80M-150).

The local power peaking factors, including the effects of channel bow, at 70% void and assembly exposures consistent with a Cycle 10 exposure of 500 MWd/MTU are presented in Figures 3.8 and 3.9 for the Cycle 10 ATRIUM-10 fuel. The bowed local peaking factor data used in the MCPR safety limit analysis for fuel type A10-4039B-15GV75 is at an assembly average exposure of 1000 MWd/MTU. The data for fuel type A10-4037B-16GV75 is at an assembly average exposure of 500 MWd/MTU.

The results of the analysis support a two-loop operation MCPR safety limit of 1.09 and a single-loop operation MCPR safety limit of 1.10 for all fuel types in the Cycle 10 core. However, the TLO and SLO MCPR safety limits used to establish the MCPR operating limits are 1.11 and 1.12 respectively, since they are the values currently in the Technical Specifications. These results are applicable for all EOD and EOOS conditions presented in Table 1.1. A MCPR safety limit of 1.10 is needed to support startup with uncalibrated LPRMs for an exposure range of BOC to 500 MWd/MTU in both TLO and SLO.

3.3 *Power-Dependent MCPR and LHGR Limits*

Figures 3.10 and 3.11 present the base case operation NSS ATRIUM-10 and ATRIUM-9B $MCPR_p$ limits for Cycle 10 for the BOC to 15,000 MWd/MTU exposure range. Figures 3.12 and 3.13 present the ATRIUM-10 and ATRIUM-9B $MCPR_p$ limits for base case operation with TSSS insertion times for the BOC to 15,000 MWd/MTU exposure range. The 15,000 MWd/MTU to EOC $MCPR_p$ for ATRIUM-10 and ATRIUM-9B fuel are presented in Figures 3.14 and 3.15 for NSS insertion times and Figures 3.16 and 3.17 for TSSS insertion times. The limits are based on the ΔCPR results from the limiting system transient analyses discussed above and a MCPR safety limit of 1.11.

The pressurization transient analyses provide the necessary information to determine appropriate multipliers on the fuel design LHGR limit for ATRIUM-10 and ATRIUM-9B fuel to support off-rated power operation. Application of the $LHGRFAC_p$ multipliers to the steady-state

LHGR limit ensures that the LHGR during AOOs initiated at reduced power does not exceed the PAPT limits. The method used to calculate the $LHGRFAC_p$ multipliers is presented in Appendix A. The results of the LRNB and FWCF analyses discussed above were used to determine the base case $LHGRFAC_p$ multipliers. The base case ATRIUM-10 and ATRIUM-9B $LHGRFAC_p$ multipliers for BOC to 15,000 MWd/MTU are presented in Figures 3.18 and 3.19 for NSS insertion times and Figures 3.20 and 3.21 for TSSS insertion times. The 15,000 MWd/MTU to EOC $LHGRFAC_p$ multipliers for ATRIUM-10 and ATRIUM-9B fuel are presented in Figures 3.22 and 3.23 for NSS insertion times and Figures 3.24 and 3.25 for TSSS insertion times.

In order to support operation of POWERPLEX®-II CMSS* below 25% core thermal power, representative limits are provided and have no impact on licensing since there is no requirement to monitor limits below 25% power.

3.4 *Flow-Dependent MCPR and LHGR Limits*

Flow-dependent MCPR and LHGR limits are established to support operation at off-rated core flow conditions. The limits are based on the CPR and heat flux changes experienced by the fuel during slow flow excursions. The slow flow excursion event assumes a failure of the recirculation flow control system such that the core flow increases slowly to the maximum flow physically attainable by the equipment. An uncontrolled increase in flow creates the potential for a significant increase in core power and heat flux. A conservatively steep flow run-up path was determined starting at a low-power/low-flow state point of 56.2%P/30%F increasing to the high-power/high-flow state point of 124.2%P/105%F.

$MCPR_f$ limits are determined for the manual flow control (MFC) mode of operation for both ATRIUM-10 and ATRIUM-9B fuel. XCOBRA is used to calculate the change in critical power ratio during a two-loop flow run-up to the maximum flow rate. The $MCPR_f$ limit is set so that the increase in core power resulting from the maximum increase in core flow is such that the MCPR safety limit of 1.11 is not violated. Calculations were performed for several initial flow rates to determine the corresponding MCPR values that put the limiting assembly on the MCPR safety limit at the high-flow condition at the end of the flow excursion.

* POWERPLEX is a trademark of Framatome ANP registered in the United States and various other countries.

Results of the MFC flow run-up analysis are presented in Table 3.9 for both ATRIUM-10 and ATRIUM-9B fuel. $MCPR_f$ limits that provide the required protection during MFC operation are presented in Figure 2.1. The Cycle 10 $MCPR_f$ limits were established such that they support base case operation and operation in the EOD, EOOS, and combined EOD/EOOS scenarios. The $MCPR_f$ limits are valid for all exposure conditions during Cycle 10. Since a low- to high-speed pump upshift is required to attain high-flow rates, for initial core flows less than 30% of rated, the limit is conservatively set equal to the 30% flow value.

FRA-ANP has performed $LHGRFAC_f$ analyses with the CASMO-3G/MICROBURN-B core simulator codes. The analysis assumes that the recirculation flow increases slowly along the limiting rod line to the maximum flow physically attainable by the equipment. A series of flow excursion analyses were performed at several exposures throughout the cycle starting from different initial power/flow conditions. Xenon is assumed to remain constant during the event. The $LHGRFAC_f$ multipliers were established to ensure that the LHGR during the flow run-up does not violate the PAPT LHGR limit. Since a low- to high-speed pump upshift is required to attain high-flow rates, for initial core flows less than 30% of rated, the $LHGRFAC_f$ multiplier is conservatively set equal to the 30% flow value. The $LHGRFAC_f$ values as a function of core flow for the ATRIUM-10 and ATRIUM-9B fuel are presented in Figure 2.2. The Cycle 10 $LHGRFAC_f$ multipliers were established to support base case operation and operation in the EOD, EOOS, and combined EOD/EOOS scenarios for all Cycle 10 exposure conditions.

3.5 *Nuclear Instrument Response*

The impact of loading ATRIUM-10 fuel into the LaSalle core will not affect the nuclear instrument response. The neutron lifetime is an important parameter affecting the time response of the incore detectors. The neutron lifetime is a function of the nuclear and mechanical design of the fuel assembly, the in-channel void fraction, and the fuel exposure. The neutron lifetimes are similar for the FRA-ANP fuel types with typical values of $39(10^{-6})$ to $40(10^{-6})$ seconds for the ATRIUM-9B lattices and $37(10^{-6})$ to $43(10^{-6})$ seconds for the ATRIUM-10 bottom and top lattices, respectively, as calculated with the CASMO-3G code. Therefore, the neutron lifetimes are essentially equivalent as the core transitions to ATRIUM-10 fuel.

Table 3.1 LaSalle Unit 1 Plant Parameters for the System Transient Analyses at Rated Power and Flow

Reactor thermal power (MWt)	3489
Total core flow (Mlbm/hr)	108.5
Core active flow*	94.8
Core bypass flow*, †	13.7
Core inlet enthalpy* (Btu/lbm)	523.9
Vessel pressures (psia)	
Steam dome	1001
Core exit (upper-plenum)*	1013
Lower-plenum*	1038
Turbine pressure (psia)	957
Feedwater/steam flow (Mlbm/hr)	15.145
Feedwater enthalpy* (Btu/lbm)	406.6
Recirculating pump flow (per pump) (Mlbm/hr)	15.83
Core average gap coefficient (EOC)* (Btu/hr-ft^2-°F)	1959

* Calculated values.

† Includes water channel flow.

Table 3.2 Scram Speed Insertion Times

Control Rod Position (notch)	TSSS Time (sec)	NSS Time (sec)
48 (*full-out*)	0.00	0.00
48*	0.20*	0.20*
45	0.53	0.38
39	0.85	0.68
25	1.90	1.68
5	3.45	2.68
0 (*full-in*)	7.00	7.00

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

Table 3.3 15,000 MWd/MTU Base Case
LRNB Transient Results

Power/ Flow	ATRIUM-10 ΔCPR	ATRIUM-10 $LHGRFAC_p$	ATRIUM-9B ΔCPR	ATRIUM-9B $LHGRFAC_p$	Peak Neutron Flux (% rated)	Peak Heat Flux (% rated)
TSSS Insertion Times						
100 / 105	0.35	1.03	0.33	1.00	415	122
100 / 100	0.34	1.02	0.33	1.00	390	122
100 / 81	0.35	1.03	0.31	1.00	318	121
80 / 105	0.35	1.04	0.34	1.00	335	97
80 / 57.2	0.37	1.07	0.32	1.00	217	95
60 / 105	0.32	1.07	0.33	1.00	219	72
60 / 35.1	0.18	1.16	0.23	1.11	108	66
40 / 105	0.25	1.14	0.26	1.08	99	46
25 / 105	0.19	1.22	0.18	1.19	42	27
NSS Insertion Times						
100 / 105	0.32	1.03	0.31	1.00	306	120
100 / 100	0.31	1.02	0.30	1.00	323	120
100 / 81	0.29	1.03	0.23	1.00	308	117
80 / 105	0.32	1.06	0.30	1.00	284	94
80 / 57.2	0.25	1.12	0.18	1.06	169	89
60 / 105	0.30	1.08	0.30	1.00	195	70
60 / 35.1	0.09	1.23	0.10	1.20	79	61
40 / 105	0.24	1.15	0.24	1.10	94	45
25 / 105	0.18	1.22	0.17	1.20	41	27

Table 3.4 EOC Base Case
LRNB Transient Results

Power/ Flow	ATRIUM-10 ΔCPR	ATRIUM-10 $LHGRFAC_p$	ATRIUM-9B ΔCPR	ATRIUM-9B $LHGRFAC_p$	Peak Neutron Flux (% rated)	Peak Heat Flux (% rated)
TSSS Insertion Times						
100 / 105	0.35*	1.00	0.33	1.00	415*	122*
100 / 100	0.34	1.00	0.33	1.00	460	132
100 / 81	0.39	1.00	0.33	1.00	516	135
80 / 105	0.35*	1.02	0.34*	1.00	335*	97*
80 / 57.2	0.39	1.00	0.36	1.00	313	105
60 / 105	0.32*	1.06	0.33*	1.00	219*	72*
60 / 35.1	0.34	1.06	0.31	1.07	163	74
40 / 105	0.25*	1.14*	0.26*	1.08*	99*	46*
25 / 105	0.20	1.22*	0.18*	1.19*	42	28
NSS Insertion Times						
100 / 105	0.33	1.00	0.32	1.00	435	128
100 / 100	0.34	1.00	0.32	1.00	439	129
100 / 81	0.36	1.00	0.32	1.00	513	132
80 / 105	0.32*	1.03	0.30*	1.00	284*	94*
80 / 57.2	0.34	1.03	0.30	1.00	277	101
60 / 105	0.30*	1.07	0.30*	1.00*	195*	70*
60 / 35.1	0.27	1.09	0.23	1.09	138	70
40 / 105	0.24*	1.15*	0.24*	1.10*	94*	45*
25 / 105	0.18*	1.22*	0.17*	1.20*	41*	27*

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

Table 3.5 15,000 MWd/MTU Base Case FWCF Transient Results

Power/ Flow	ATRIUM-10 ΔCPR	ATRIUM-10 $LHGRFAC_p$	ATRIUM-9B ΔCPR	ATRIUM-9B $LHGRFAC_p$	Peak Neutron Flux (% rated)	Peak Heat Flux (% rated)
TSSS Insertion Times						
100 / 105	0.33	1.06	0.30	1.00	342	122
100 / 100	0.32	1.07	0.29	1.00	321	121
100 / 81	0.31	1.09	0.27	1.03	221	117
80 / 105	0.37	1.03	0.35	1.00	268	101
80 / 57.2	0.32	1.13	0.24	1.09	149	92
60 / 105	0.44	1.00	0.43	1.00	184	80
60 / 35.1	0.12	1.20	0.16	1.18	85	65
40 / 105	0.60*	0.91*	0.57	0.88	88*	57*
25 / 105	1.04*	0.74*	0.85	0.76	59*	44*
NSS Insertion Times						
100 / 105	0.29	1.09	0.25	1.03	266	117
100 / 100	0.28	1.09	0.24	1.03	245	116
100 / 81	0.25	1.10	0.20	1.03	209	113
80 / 105	0.34	1.05	0.31	1.00	226	98
80/ 57.2	0.20	1.16	0.17	1.15	118	87
60 / 105	0.41	1.01	0.39	1.00	165	78
60 / 35.1	0.12	1.23	0.12	1.22	65	63
40 / 105	0.56	0.93	0.55	0.89	101	59
25 / 105	0.96*	0.75*	0.84	0.77	55*	43*

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

Table 3.6 EOC Base Case FWCF Transient Results

Power/ Flow	ATRIUM-10 ΔCPR	ATRIUM-10 $LHGRFAC_p$	ATRIUM-9B ΔCPR	ATRIUM-9B $LHGRFAC_p$	Peak Neutron Flux (% rated)	Peak Heat Flux (% rated)
TSSS Insertion Times						
100 / 105	0.33*	1.05	0.30*	1.00*	342*	122*
100 / 100	0.32*	1.06	0.29*	1.00*	321*	121*
100 / 81	0.31*	1.05	0.27*	1.03	221*	117*
80 / 105	0.37*	1.03*	0.35*	1.00*	268*	101*
80 / 57.2	0.34	1.08	0.30	1.07	217	100
60 / 105	0.44*	1.00*	0.43*	1.00	184*	80*
40 / 105	0.60*	0.91*	0.57*	0.88*	88*	57*
25 / 105	1.04*	0.74*	0.85*	0.76*	59*	44*
NSS Insertion Times						
100 / 105	0.29	1.06	0.27	1.03	366	126
100 / 100	0.29	1.06	0.26	1.03	345	125
100 / 81	0.28	1.05	0.24	1.03	273	123
80 / 105	0.34*	1.05	0.31*	1.00*	226*	98*
80 / 57.2	0.29	1.10	0.25	1.08	192	97
60 / 105	0.41*	1.01*	0.39*	1.00*	165*	78*
40 / 105	0.56*	0.93*	0.55*	0.89*	101*	59*
25 / 105	0.96*	0.75*	0.84*	0.77*	55*	43*

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

**Table 3.7 Loss of Feedwater Heating
Base Case Transient Analysis Results**

Power (% rated)	ΔCPR (ATRIUM-10 and ATRIUM-9B Fuel)
100	0.21
90	0.22
80	0.23
70	0.24
60	0.26
50	0.29
40	0.33
25	0.45

Table 3.8 Input for MCPR Safety Limit Analysis

Fuel-Related Uncertainties		
Parameter	Source Document	Statistical Treatment
Critical power correlation* ATRIUM-10 ATRIUM-9B	 Reference 12 Reference 17	 Convoluted Convoluted
Radial power	References 10 and 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)	23.6	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)	5446.6	—	—

* Additive constant uncertainties values are used.

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

Table 3.9 Flow-Dependent MCPR Results

Core Flow (% rated)	105% Maximum Core Flow	
	ATRIUM-10	ATRIUM-9B
30	1.58	1.58
40	1.52	1.51
50	1.46	1.46
60	1.40	1.41
70	1.34	1.35
80	1.27	1.28
90	1.22	1.22
100	1.17	1.15
105	1.11	1.11

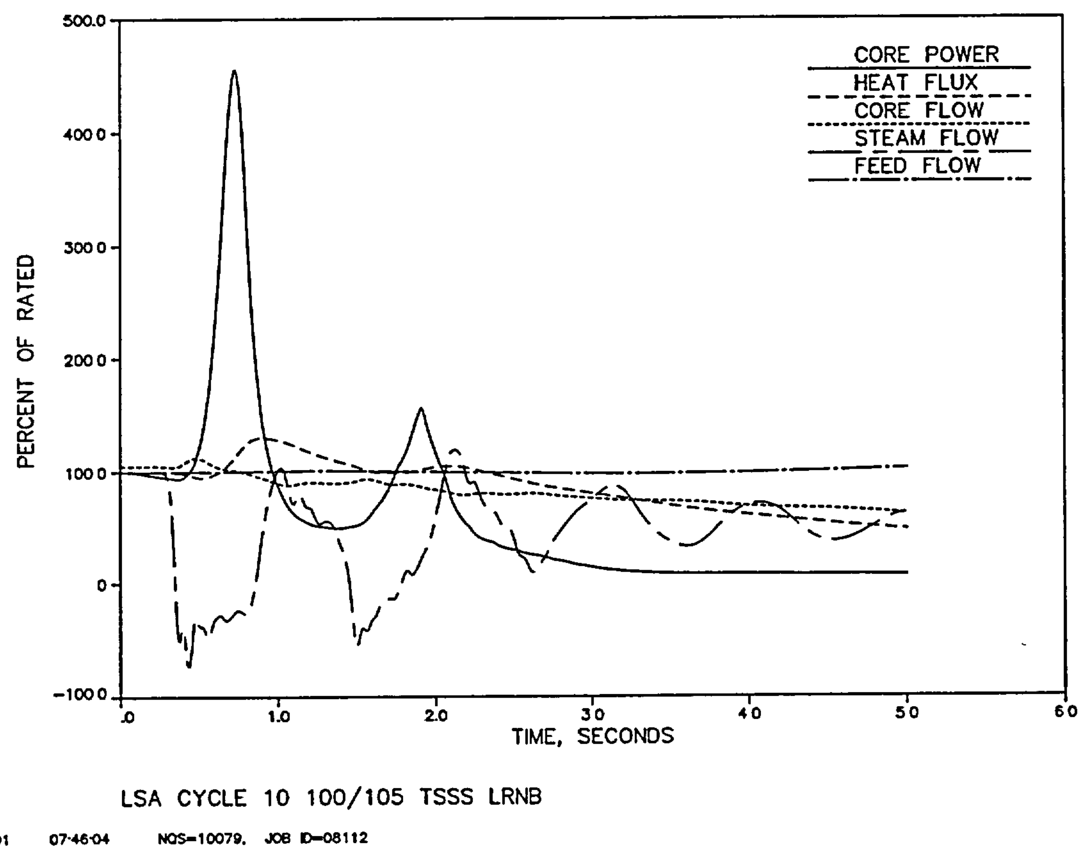


Figure 3.1 EOC Load Rejection No Bypass at 100/105 – TSSS Key Parameters

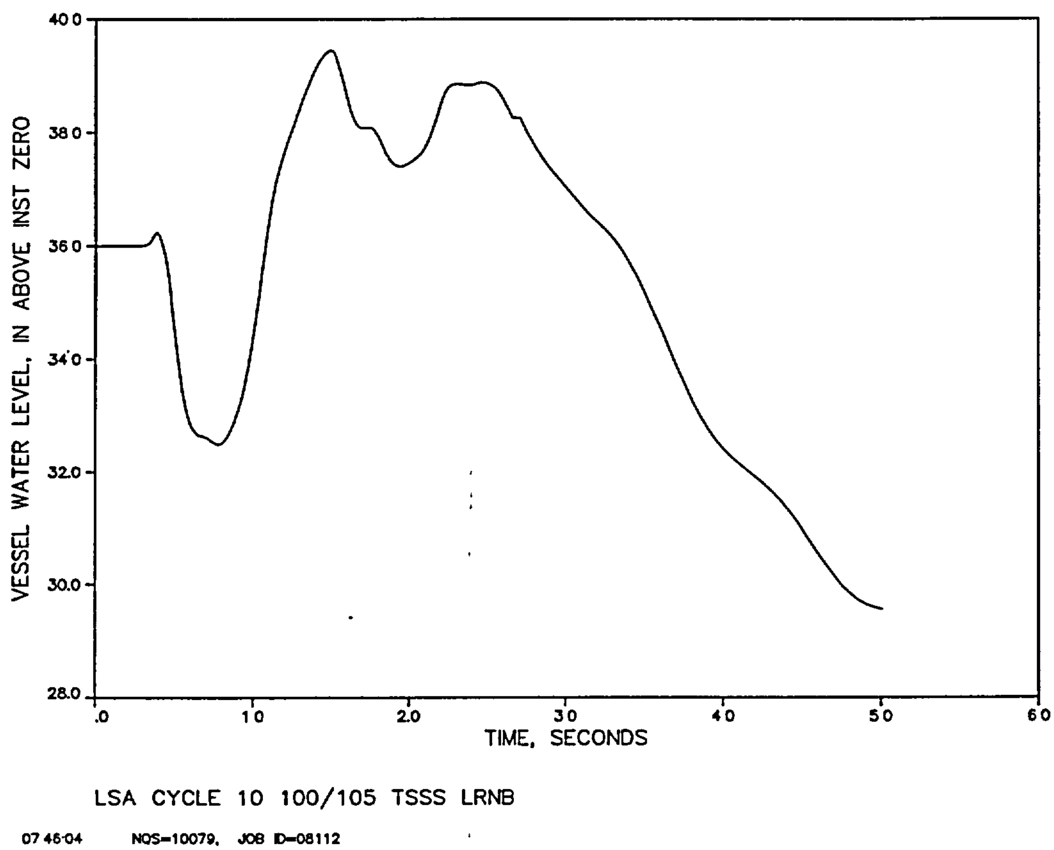


Figure 3.2 EOC Load Rejection No Bypass at 100/105 – TSSS Vessel Water Level

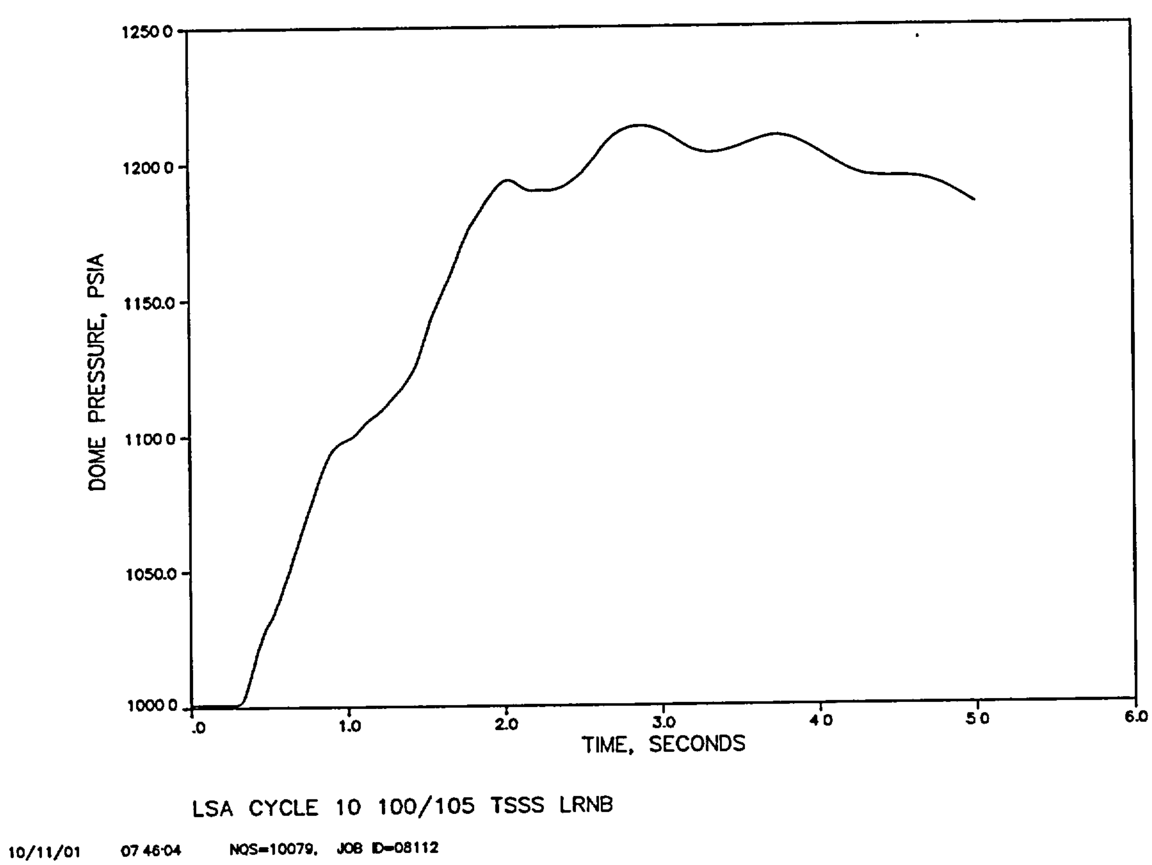


Figure 3.3 EOC Load Rejection No Bypass at 100/105 – TSSS Dome Pressure

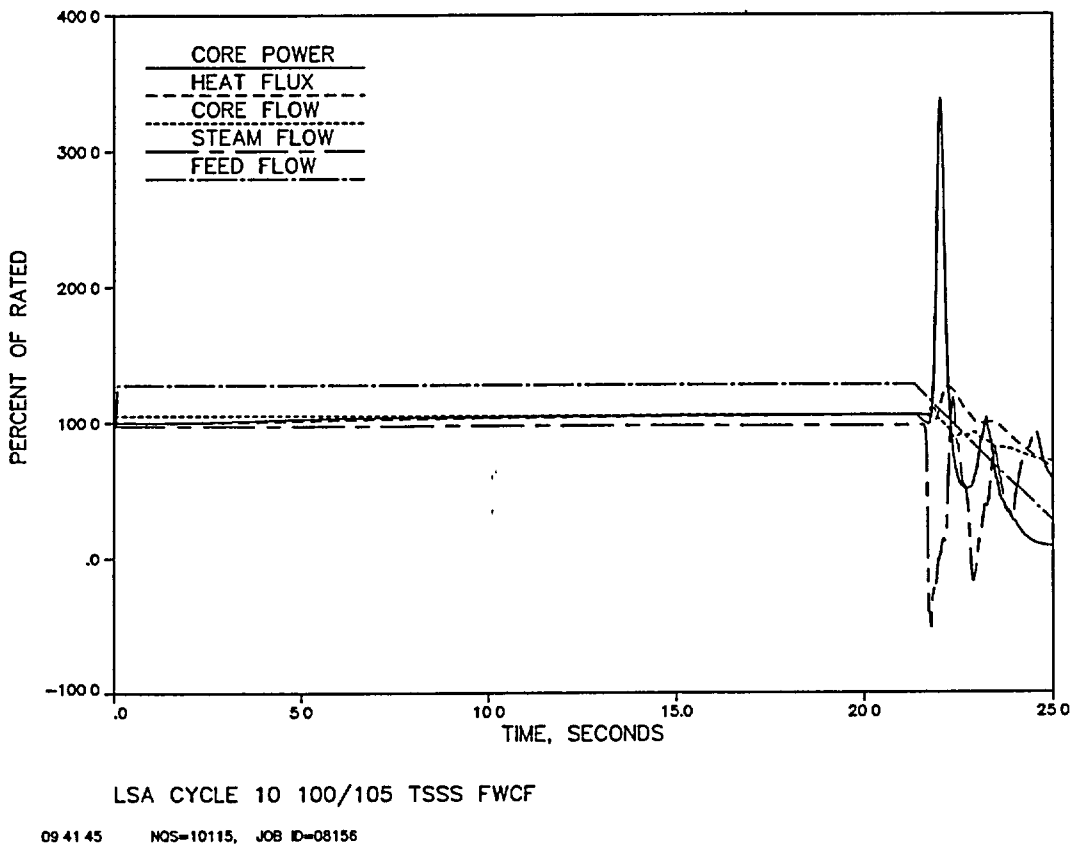


Figure 3.4 EOC Feedwater Controller Failure at 100/105 – TSSS Key Parameters

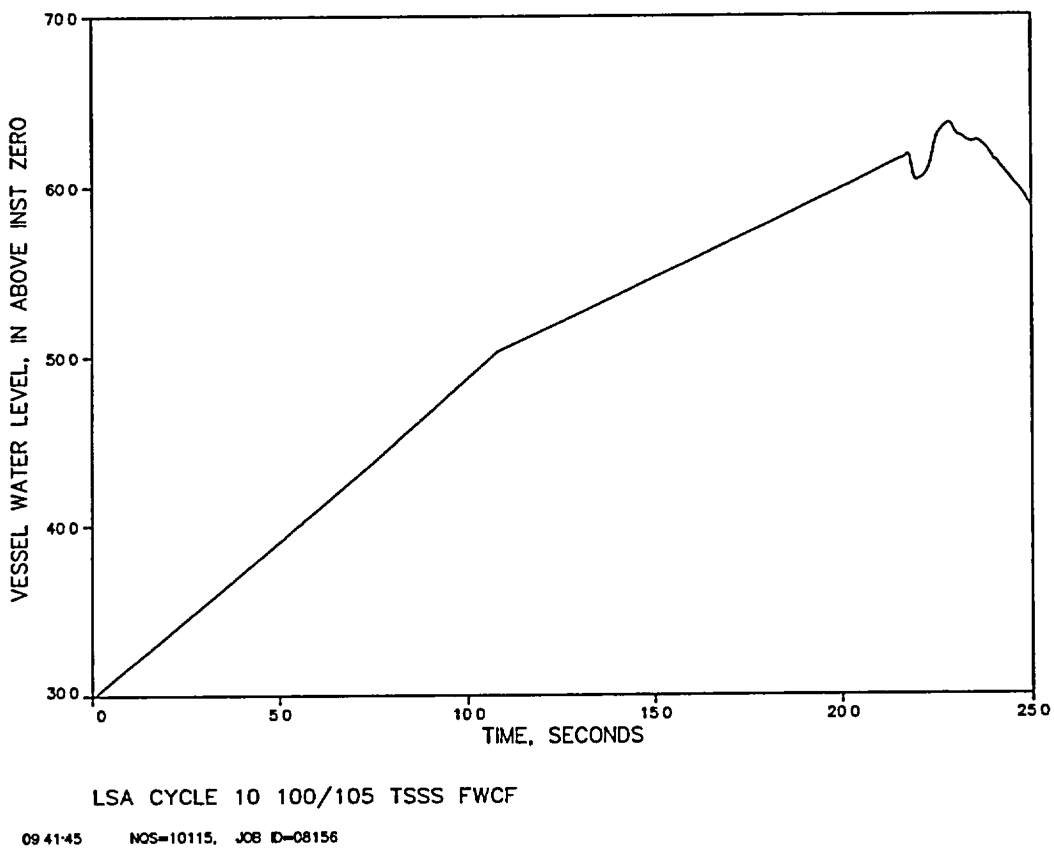


Figure 3.5 EOC Feedwater Controller Failure at 100/105 – TSSS Vessel Water Level

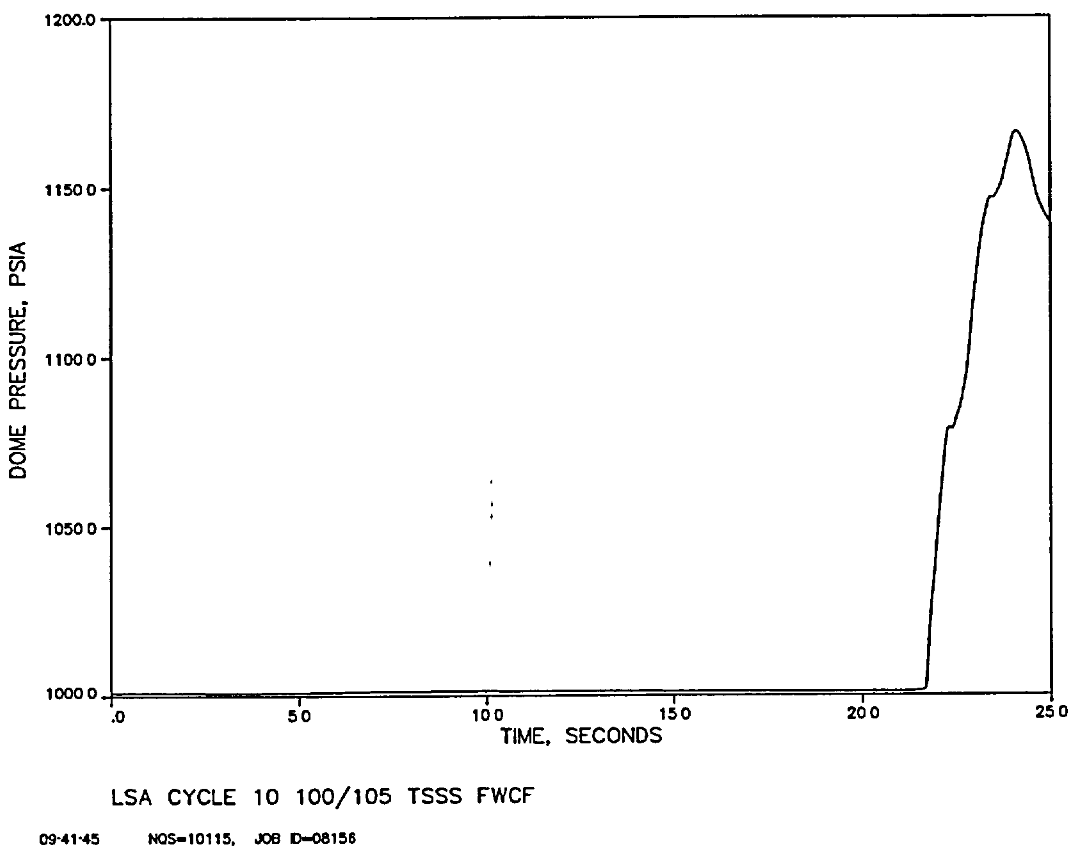


Figure 3.6 EOC Feedwater Controller Failure at 100/105 – TSSS Dome Pressure

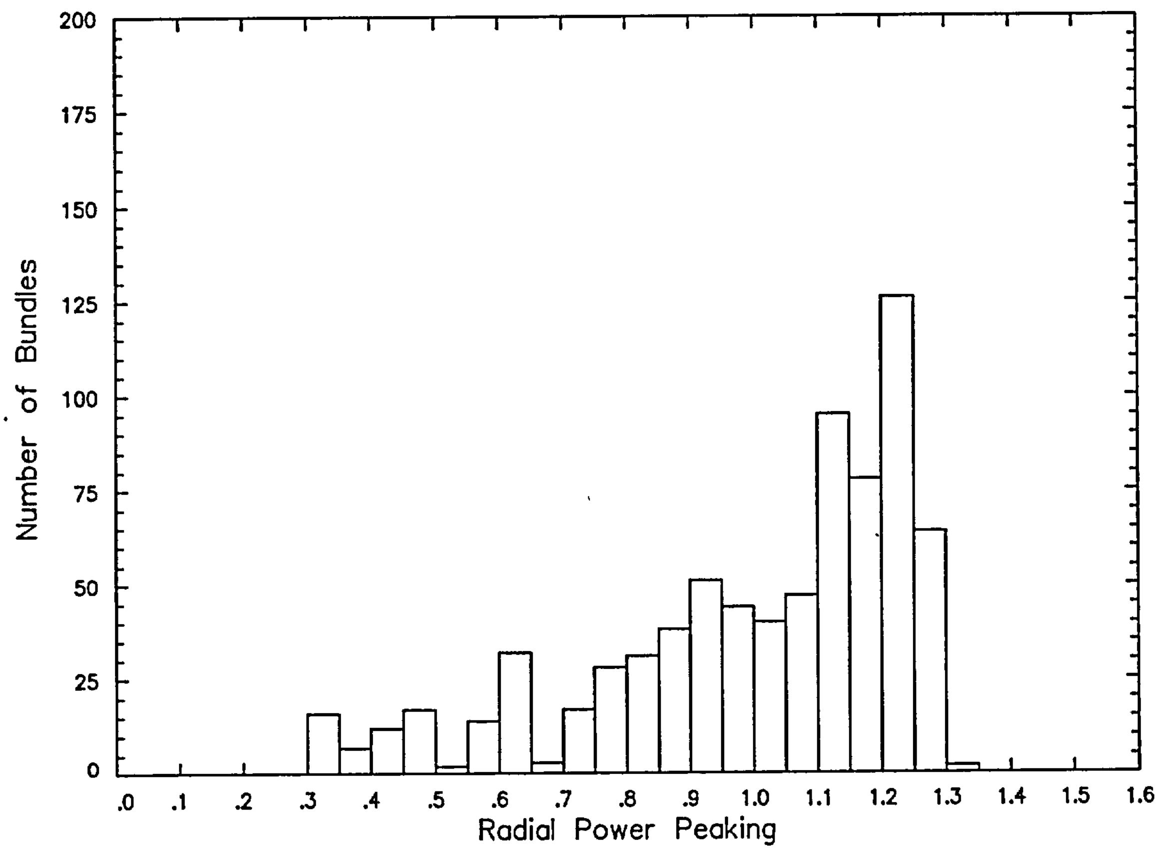


Figure 3.7 Radial Power Distribution for SLMCPR Determination

CONTROL ROD CORNER

CONTROL ROD CORNER

1.057	1.212	1.130	1.268	1.225	1.252	1.226	1.234	1.172	1.013
1.212	0.000	0.540	1.036	0.000	0.512	0.971	0.536	0.000	1.156
1.130	0.540	0.901	0.904	0.499	0.892	0.948	0.920	0.538	1.214
1.268	1.036	0.904	0.924	1.058	1.151	1.121	1.003	0.999	1.134
1.225	0.000	0.499	1.058				1.114	0.529	1.248
1.252	0.512	0.892	1.151		Internal Water Channel		1.203	0.000	1.152
1.226	0.971	0.948	1.121				1.066	0.541	1.167
1.234	0.536	0.920	1.003	1.114	1.203	1.066	0.534	1.162	1.151
1.172	0.000	0.538	0.999	0.529	0.000	0.541	1.162	0.000	1.084
1.013	1.156	1.214	1.134	1.248	1.152	1.167	1.151	1.084	1.022

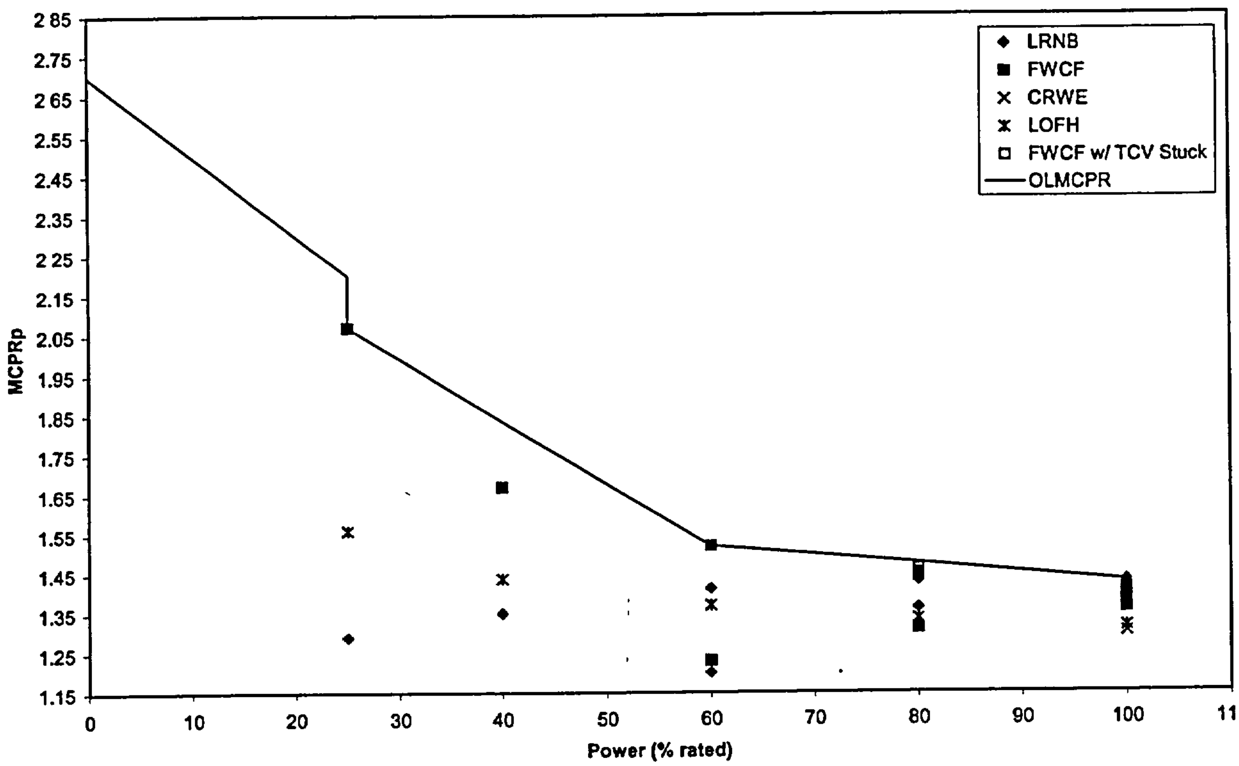
Figure 3.8 LaSalle Unit 1 Cycle 10
Safety Limit Local Peaking Factors
A10-4039B-15GV75 With Channel Bow
(Assembly Exposure of 1000 MWd/MTU)

CONTROL ROD CORNER

1.061	1.225	1.141	1.282	1.240	1.271	1.246	1.255	1.191	1.021
1.225	0.000	0.526	1.030	.000	0.504	0.983	0.528	0.000	1.176
1.141	0.526	0.868	0.844	0.487	0.891	0.955	0.928	0.530	1.238
1.282	1.030	0.844	0.482	1.003	1.143	1.127	1.014	1.013	1.155
1.240	0.000	0.487	1.003	Internal Water Channel			1.126	0.522	1.273
1.271	0.504	0.891	1.143				1.217	0.000	1.173
1.246	0.983	0.955	1.127				1.076	0.533	1.189
1.255	0.528	0.928	1.014	1.126	1.217	1.076	0.527	1.183	1.173
1.191	0.000	0.530	1.013	0.522	0.000	0.533	1.183	0.000	1.103
1.021	1.176	1.238	1.155	1.273	1.173	1.189	1.173	1.103	1.033

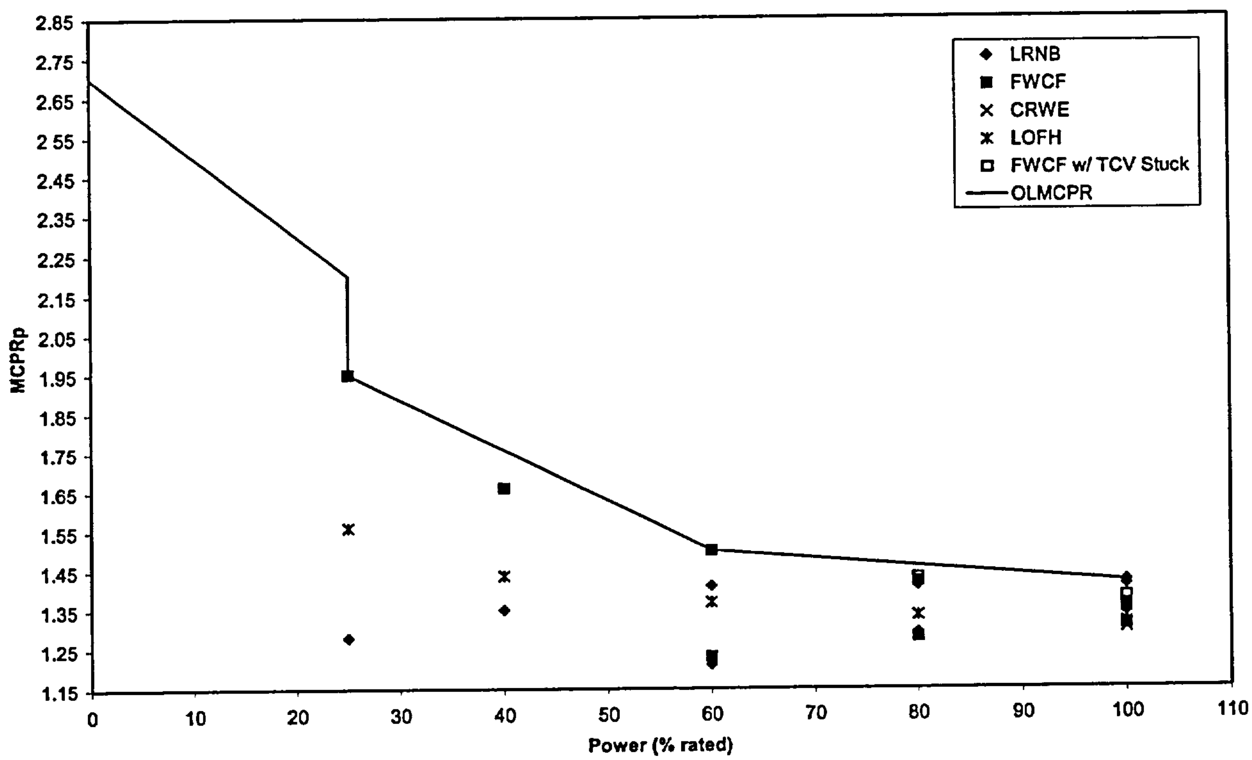
CONTROL ROD CORNER (vertical label along left edge)

**Figure 3.9 LaSalle Unit 1 Cycle 10
Safety Limit Local Peaking Factors
A10-4037B-16GV75 With Channel Bow
(Assembly Exposure of 500 MWd/MTU)**



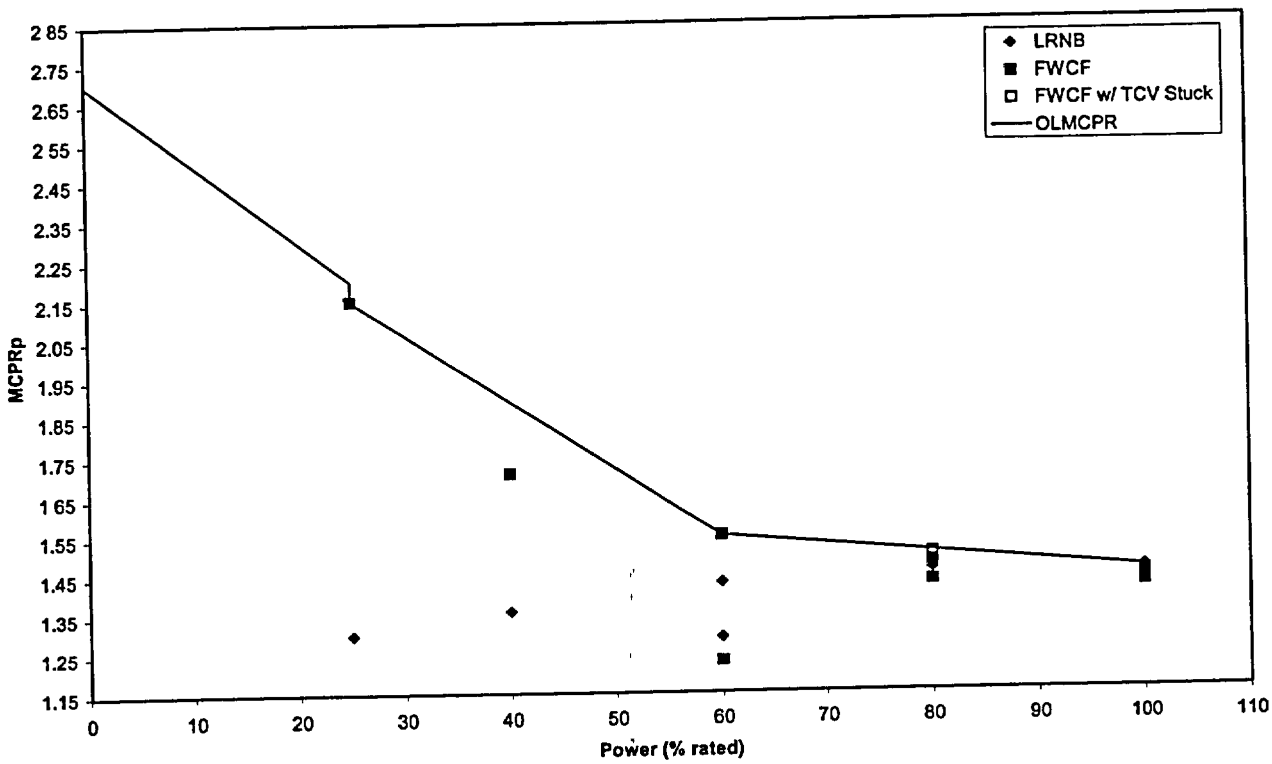
Power (%)	$MCPR_p$ Limit
100	1.43
60	1.52
25	2.07
25	2.20
0	2.70

Figure 3.10 BOC to 15,000 MWd/MTU Base Case Power-Dependent MCPR Limits for ATRIUM-10 Fuel – NSS Insertion Times



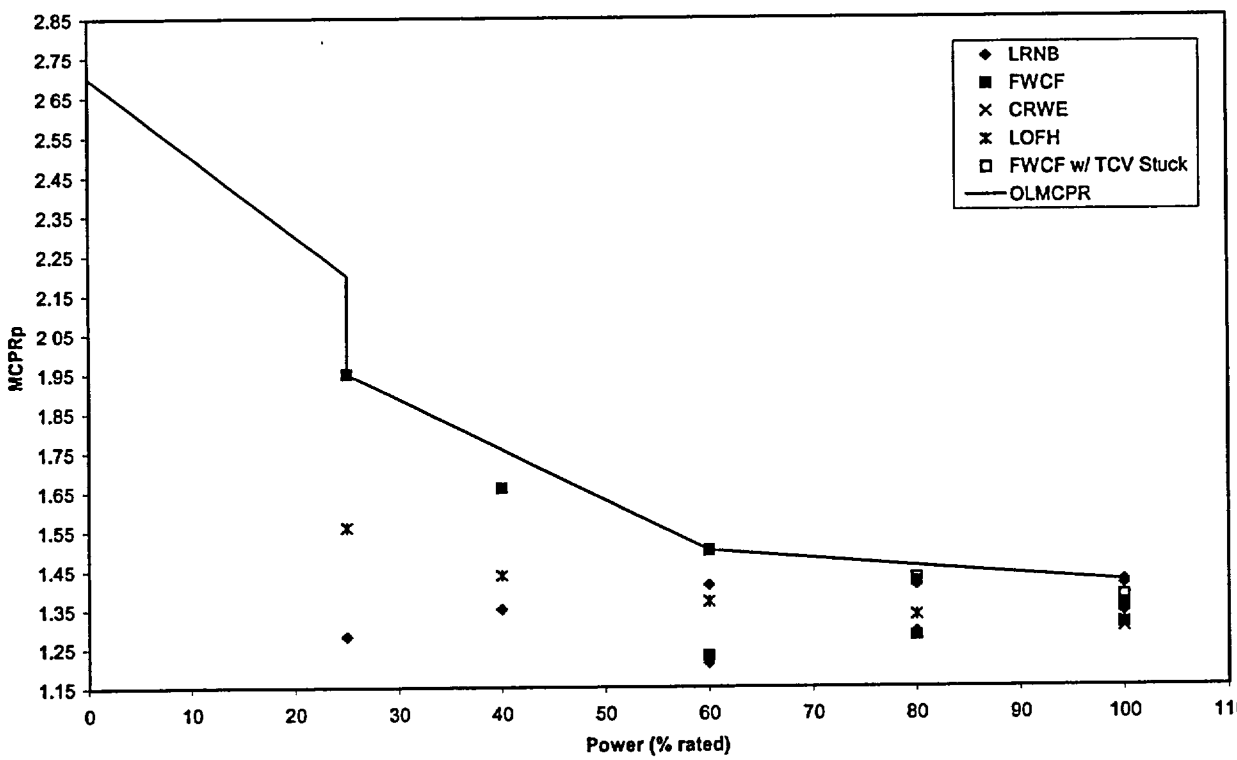
Power (%)	$MCPR_p$ Limit
100	1.42
60	1.50
25	1.95
25	2.20
0	2.70

Figure 3.11 BOC to 15,000 MWd/MTU Base Case Power-Dependent MCPR Limits for ATRIUM-9B Fuel – NSS Insertion Times



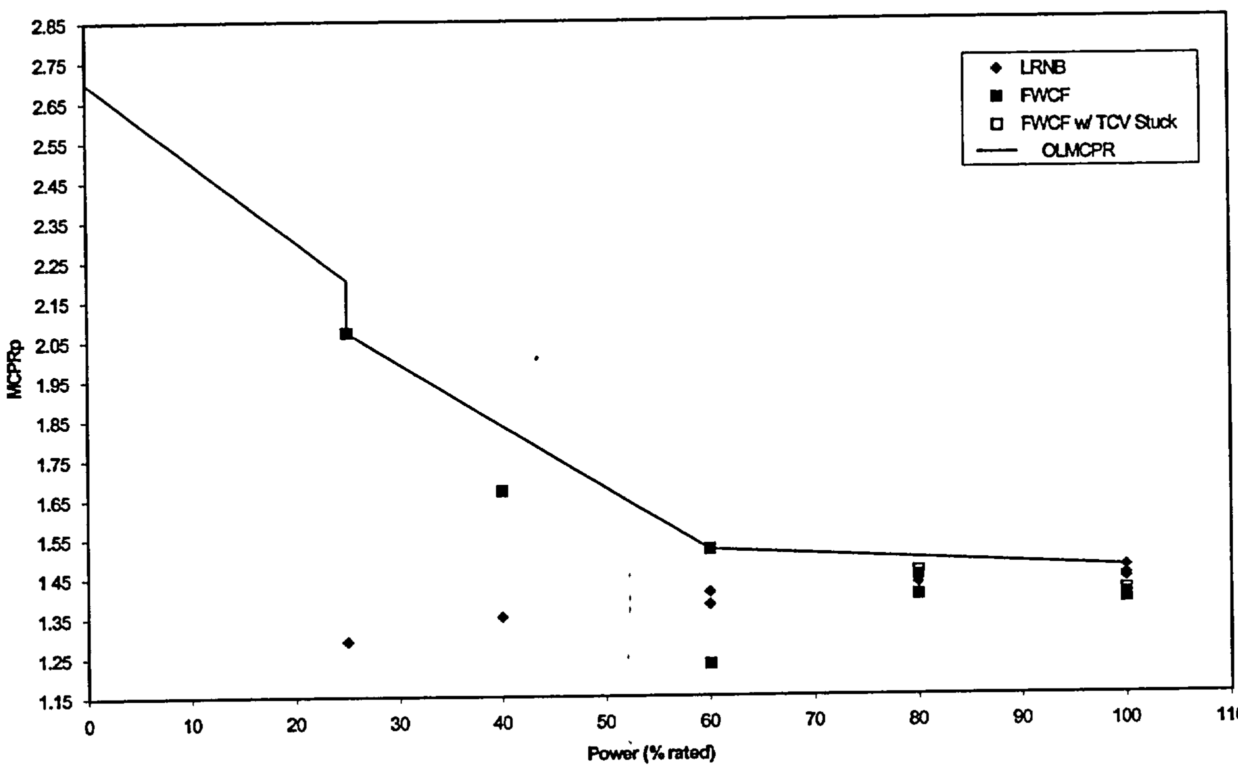
Power (%)	$MCPR_p$ Limit
100	1.46
60	1.55
25	2.15
25	2.20
0	2.70

Figure 3.12 BOC to 15,000 MWd/MTU Base Case Power-Dependent MCPR Limits for ATRIUM-10 Fuel – TSSS Insertion Times



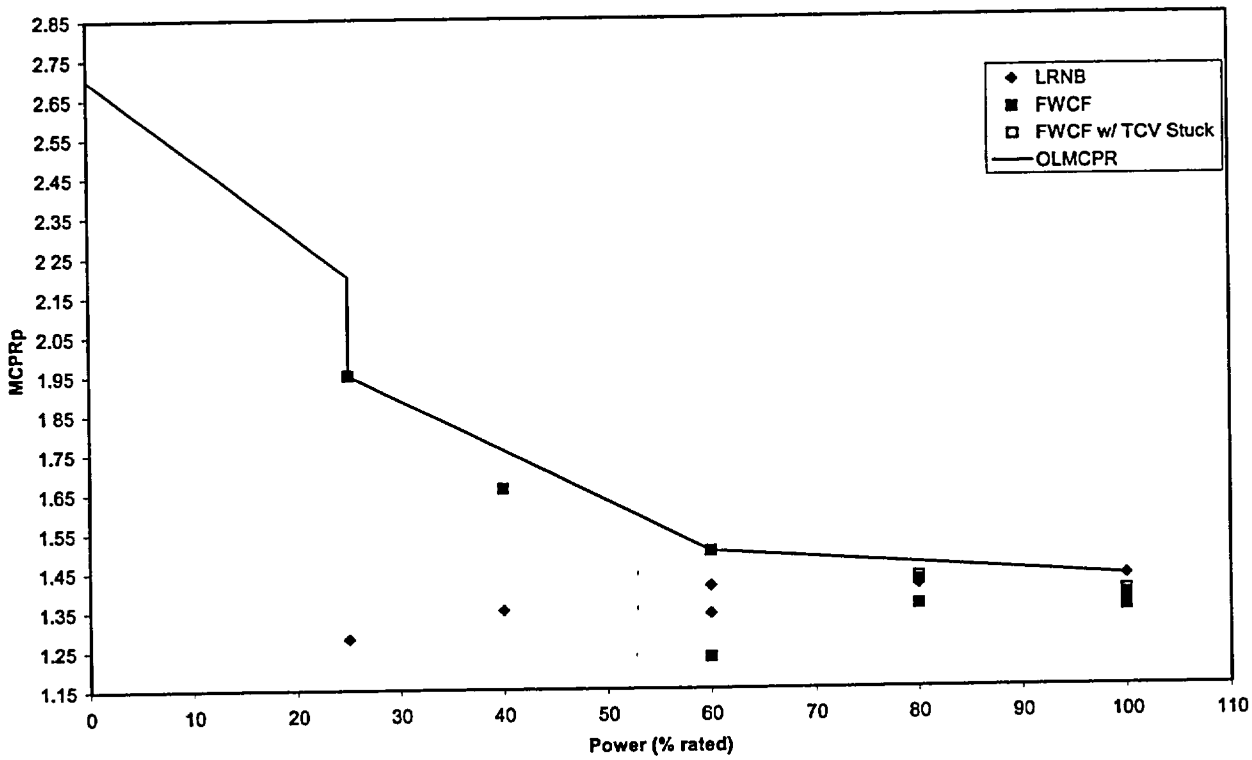
Power (%)	$MCPR_p$ Limit
100	1.44
60	1.54
25	1.96
25	2.20
0	2.70

Figure 3.13 BOC to 15,000 MWd/MTU Base Case Power-Dependent MCPR Limits for ATRIUM-9B Fuel – TSSS Insertion Times



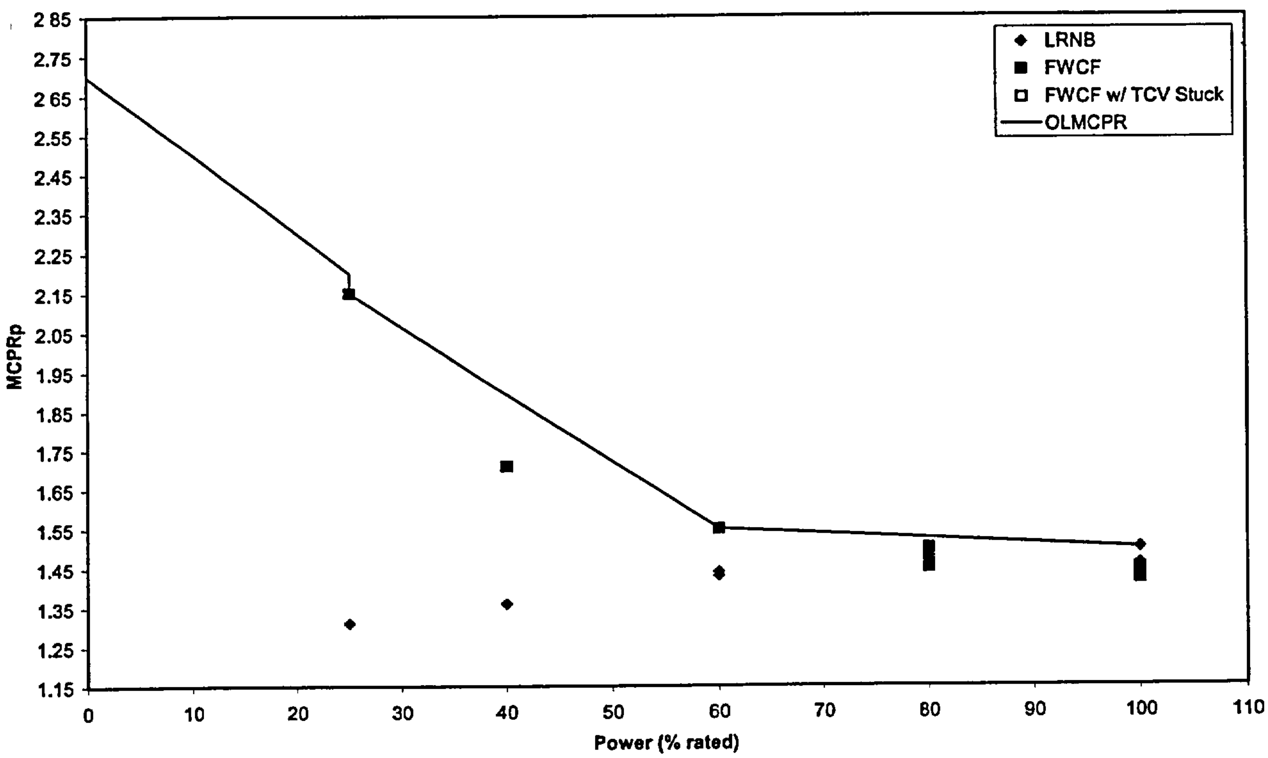
Power (%)	$MCPR_p$ Limit
100	1.47
60	1.52
25	2.07
25	2.20
0	2.70

Figure 3.14 15,000 MWd/MTU to EOC Base Case Power-Dependent MCPR Limits for ATRIUM-10 Fuel – NSS Insertion Times



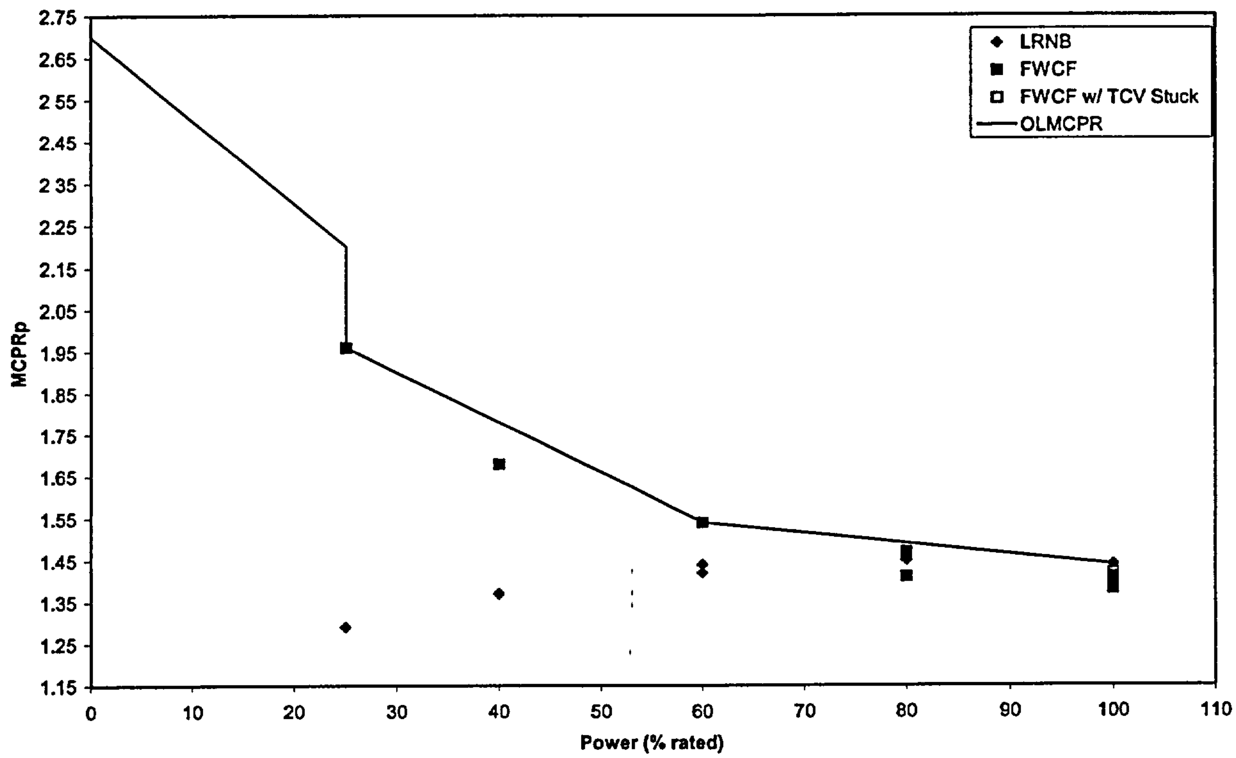
Power (%)	$MCPR_p$ Limit
100	1.43
60	1.50
25	1.95
25	2.20
0	2.70

Figure 3.15 15,000 MWd/MTU to EOC Base Case Power-Dependent MCPR Limits for ATRIUM-9B Fuel – NSS Insertion Times



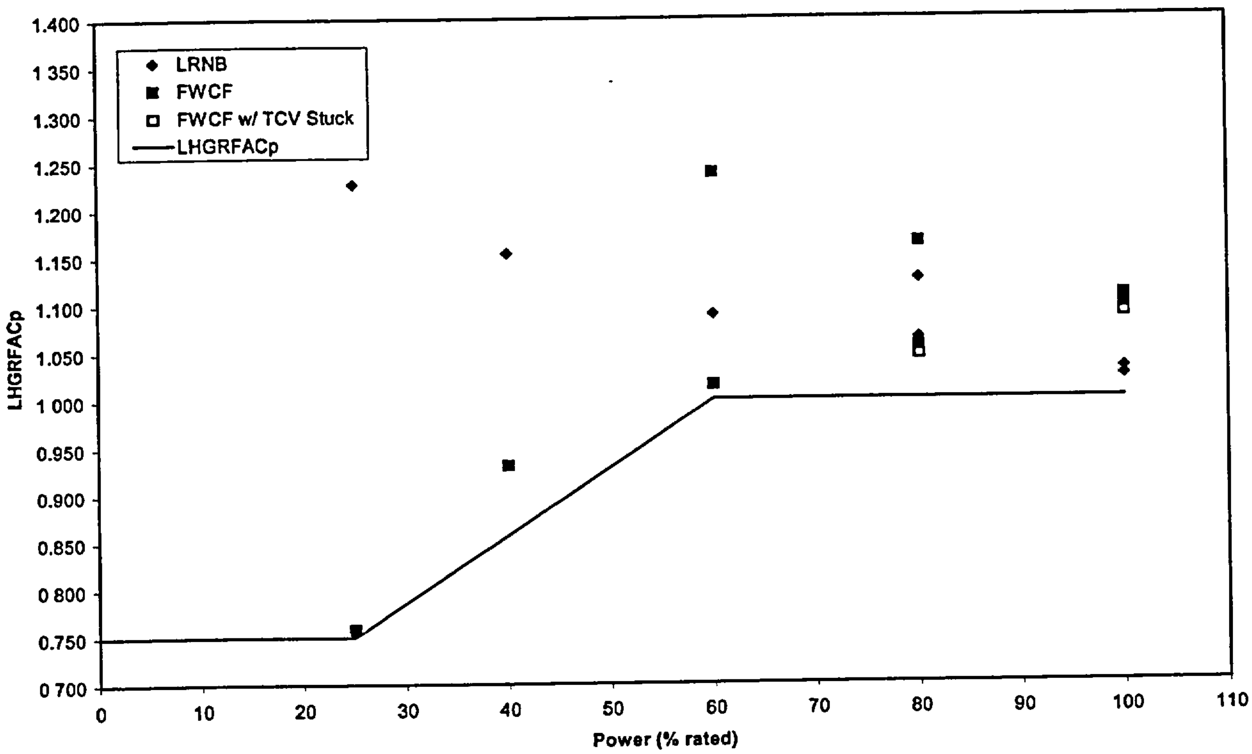
Power (%)	$MCPR_p$ Limit
100	1.50
60	1.55
25	2.15
25	2.20
0	2.70

Figure 3.16 15,000 MWd/MTU to EOC Base Case Power-Dependent MCPR Limits for ATRIUM-10 Fuel – TSSS Insertion Times



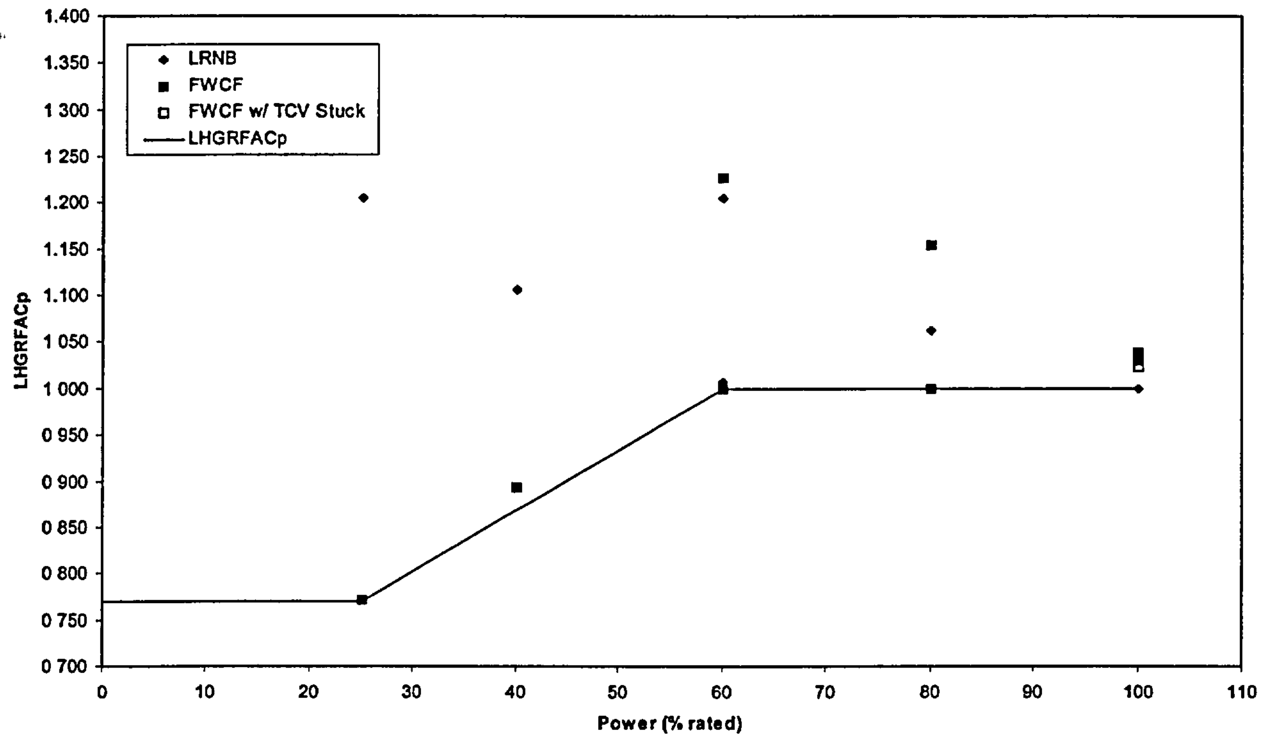
Power (%)	$MCPR_p$ Limit
100	1.44
60	1.54
25	1.96
25	2.20
0	2.70

Figure 3.17 15,000 MWd/MTU to EOC Base Case Power-Dependent MCPR Limits for ATRIUM-9B Fuel – TSSS Insertion Times



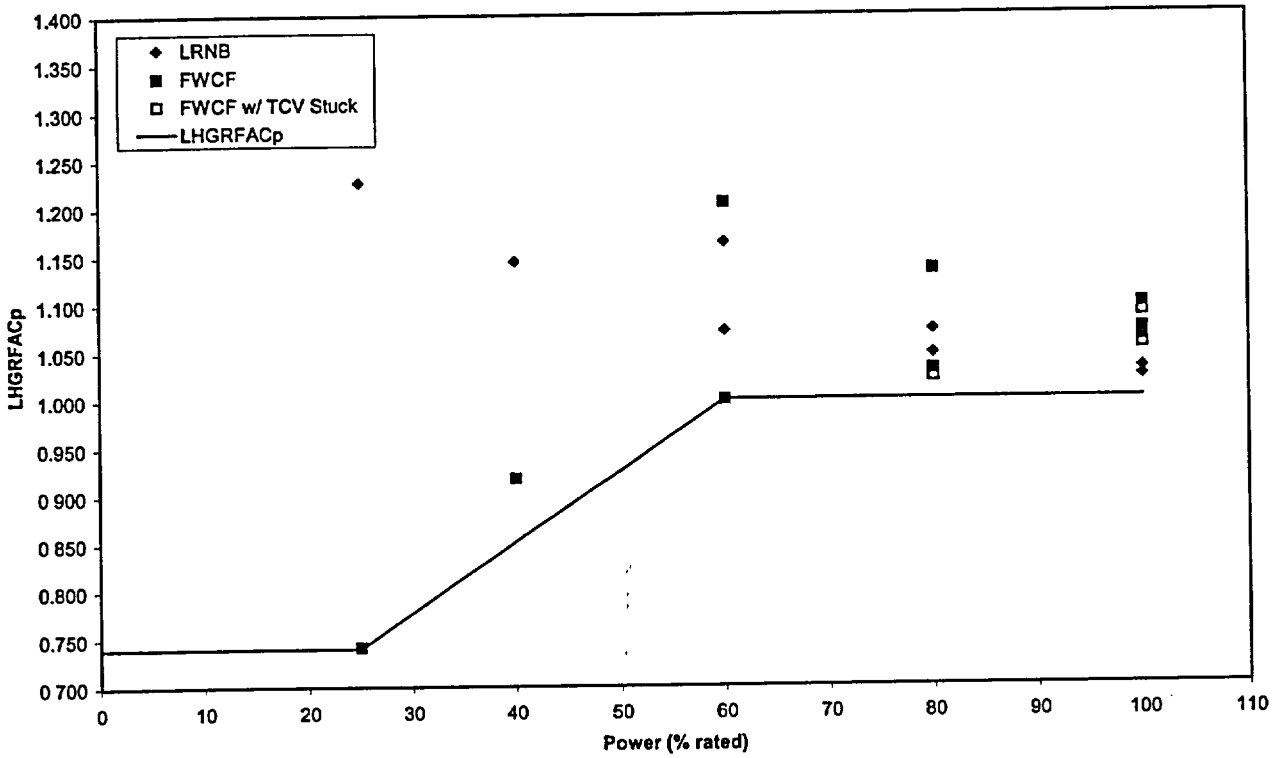
Power (%)	$LHGRFAC_p$ Multiplier
100	1.00
60	1.00
25	0.75
0	0.75

Figure 3.18 BOC to 15,000 MWd/MTU Base Case Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – NSS Insertion Times



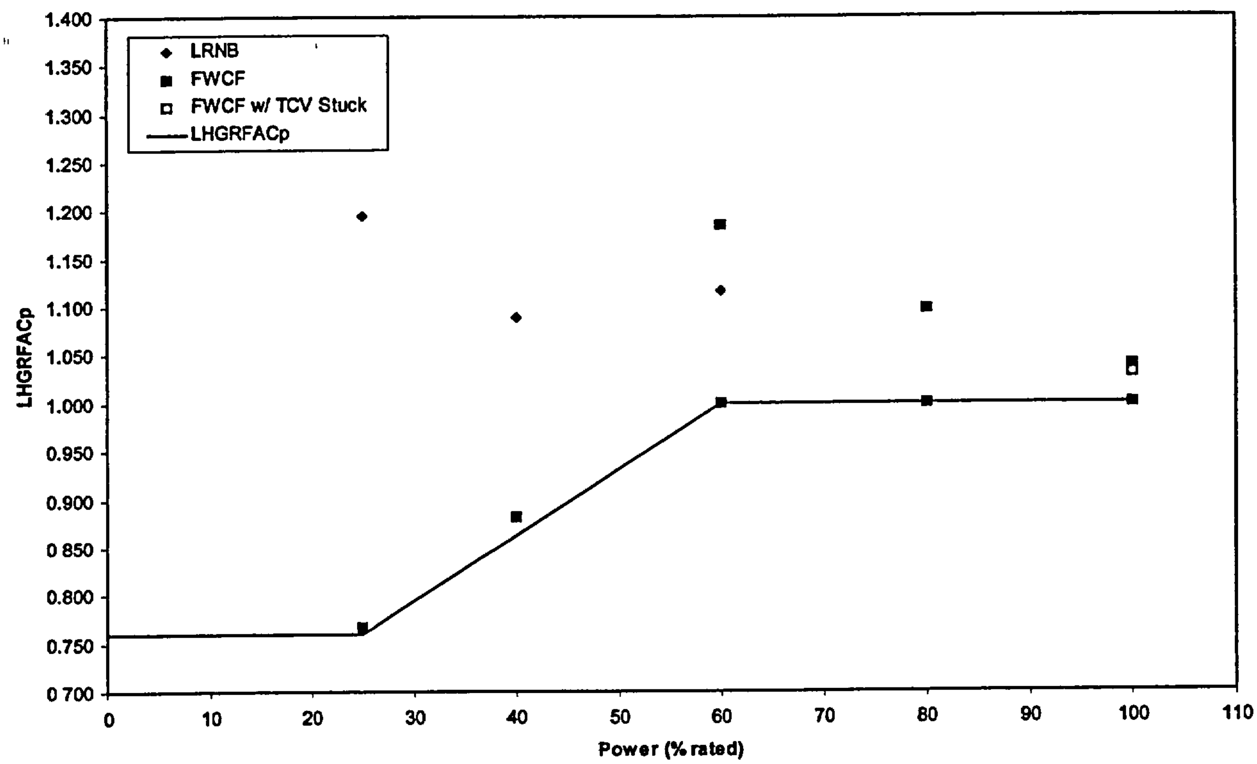
Power (%)	$LHGRFAC_p$ Multiplier
100	1.00
60	1.00
25	0.77
0	0.77

Figure 3.19 BOC to 15,000 MWd/MTU Base Case Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – NSS Insertion Times



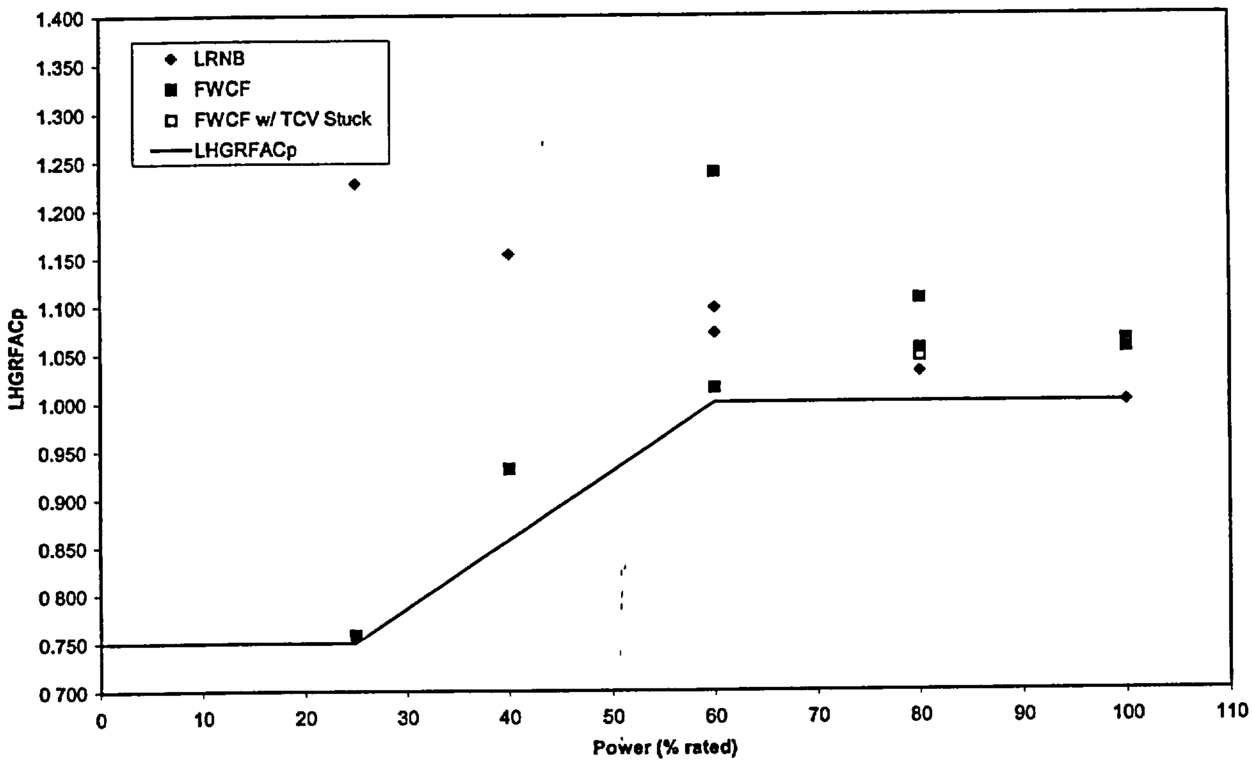
Power (%)	$LHGRFAC_p$ Multiplier
100	1.00
60	1.00
25	0.74
0	0.74

Figure 3.20 BOC to 15,000 MWd/MTU Base Case Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – TSSS Insertion Times



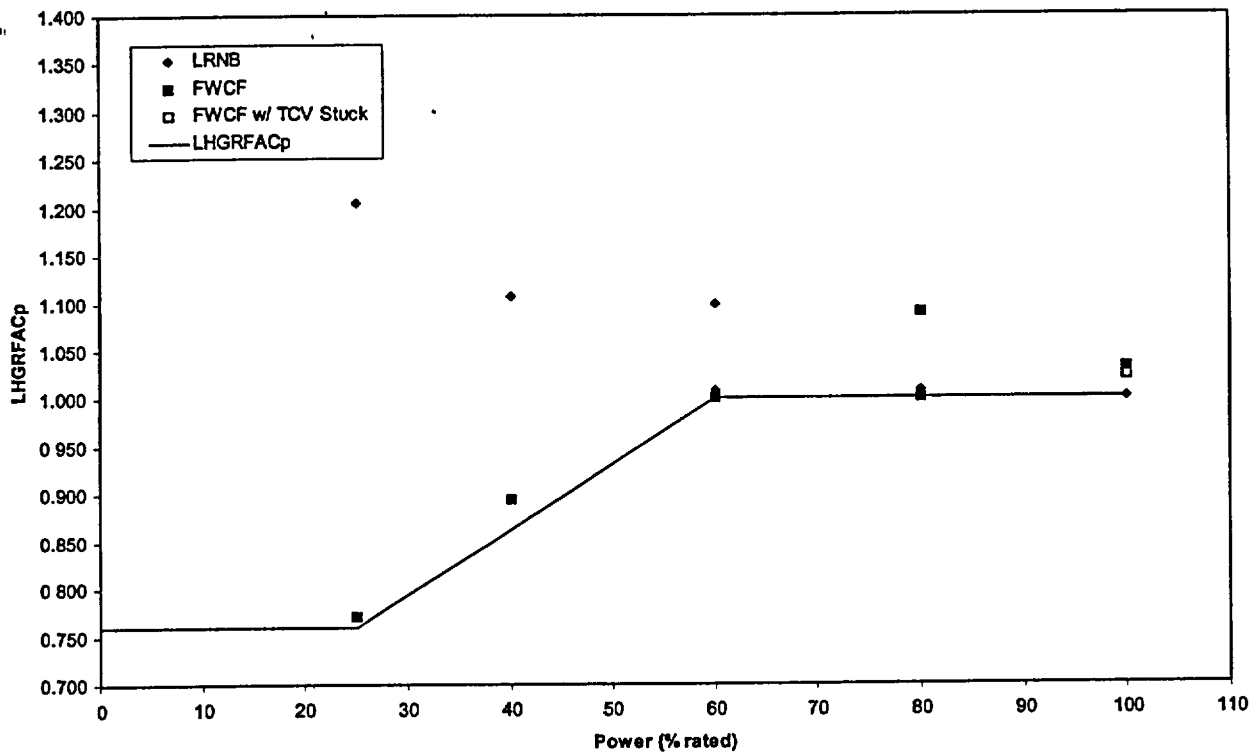
Power (%)	$LHGRFAC_p$ Multiplier
100	1.00
60	1.00
25	0.76
0	0.76

Figure 3.21 BOC to 15,000 MWd/MTU Base Case Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – TSSS Insertion Times



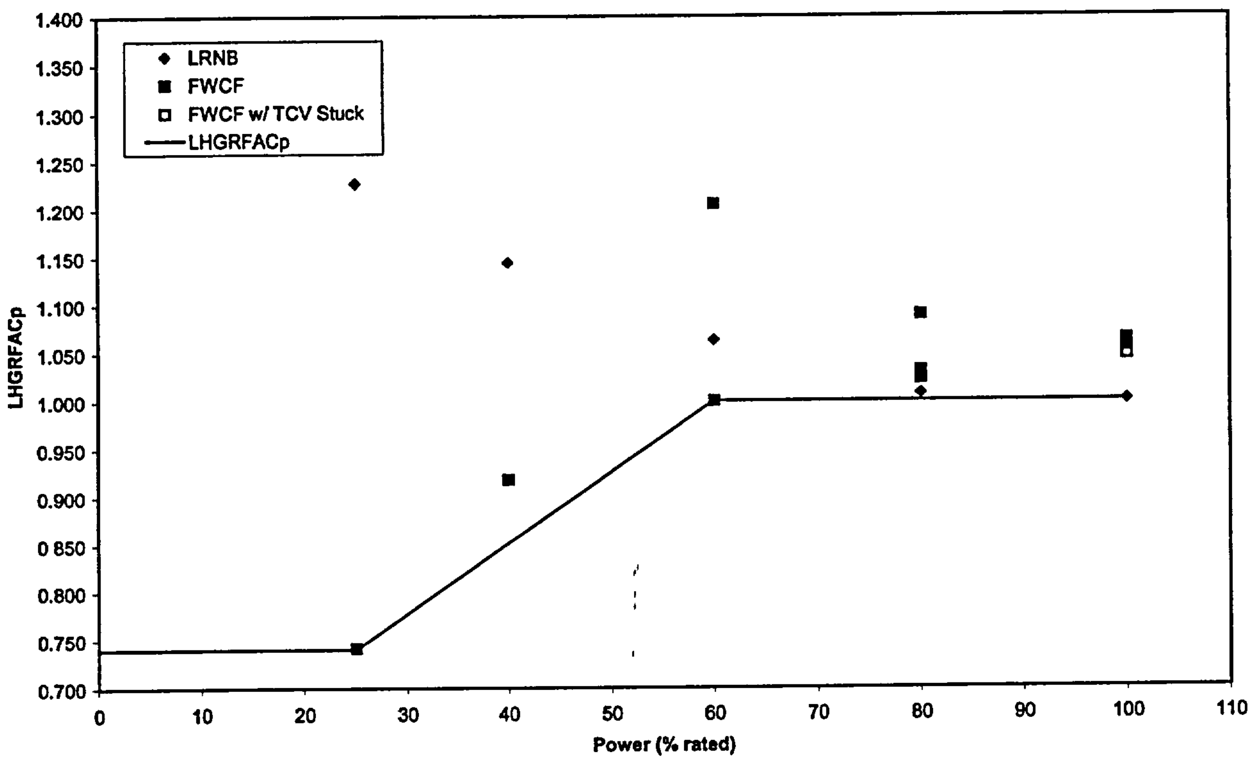
Power (%)	$LHGRFAC_p$ Multiplier
100	1.00
60	1.00
25	0.75
0	0.75

Figure 3.22 15,000 MWd/MTU to EOC Base Case Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – NSS Insertion Times



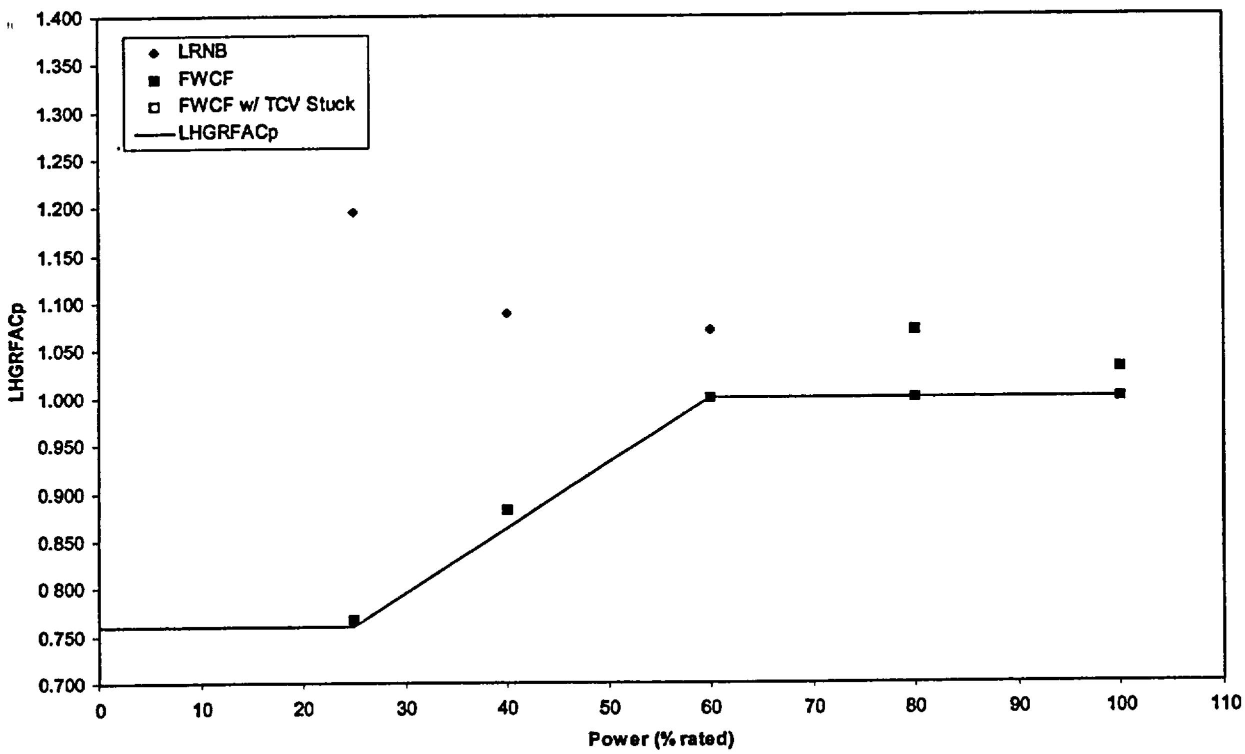
Power (%)	$LHGRFAC_p$ Multiplier
100	1.00
60	1.00
25	0.76
0	0.76

Figure 3.23 15,000 MWd/MTU to EOC Base Case Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – NSS Insertion Times



Power (%)	$LHGRFAC_p$ Multiplier
100	1.00
60	1.00
25	0.74
0	0.74

Figure 3.24 15,000 MWd/MTU to EOC Base Case Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – TSSS Insertion Times



Power (%)	$LHGRFAC_p$ Multiplier
100	1.00
60	1.00
25	0.76
0	0.76

Figure 3.25 15,000 MWd/MTU to EOC Base Case Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – TSSS Insertion Times

4.0 Transient Analysis for Thermal Margin - Extended Operating Domain

This section describes the development of the MCPR and LHGR limits to support operation in the following extended operating domains:

- Increased core flow (ICF) to 105% of rated flow.
- MELLLA power operation (refer to Figure 1.1).
- Coastdown is currently not supported for LaSalle Unit 1 Cycle 10.
- Final feedwater temperature reduction (FFTR) is currently not supported for LaSalle Unit 1 Cycle 10.

Results of the limiting transient analyses are used to determine appropriate $MCPR_p$ limits and $LHGRFAC_p$ multipliers for ATRIUM-10 and ATRIUM-9B fuel to support operation in the EOD scenarios. $MCPR_p$ limits and $LHGRFAC_p$ multipliers are established for both ATRIUM-10 and ATRIUM-9B.

As presented in Reference 9, the MCPR safety limit analysis for the base case remains valid for operation in the EODs discussed below. Also, the flow-dependent MCPR and LHGR analyses described in Section 3.4 were performed such that the results are applicable for all the EODs.

4.1 *Increased Core Flow*

The base case analyses presented in Section 3.0 were performed to support operation in the power/flow domain presented in Figure 1.1, which includes operation in the ICF region. As a result, the analyses performed for the base case support operation in the ICF extended operating domain.

4.2 *MELLLA Operations*

The base case analyses presented in Section 3.0 were performed to support operation in the power/flow domain presented in Figure 1.1, which includes operation in the MELLLA region. As a result, the analyses performed for the base case support operation in the MELLLA operating domain.

4.3 *Coastdown Analysis*

Coastdown operation is currently not supported for LaSalle Unit 1 Cycle 10.

4.4 *Combined Final Feedwater Temperature Reduction/Coastdown*

Combined FFTR/coastdown operation is currently not supported for LaSalle Unit 1 Cycle 10.

5.0 Transient Analysis for Thermal Margin - Equipment Out-of-Service

This section describes the development of the MCPR and LHGR operating limits to support operation in the following EOOS scenarios:

- Feedwater heaters out-of-service (FHOOS) – 100°F feedwater temperature reduction.
- Turbine bypass system out-of-service (TBVOOS).
- Recirculation pump trip out-of-service (no RPT).
- Slow closure of 1 or more turbine control valves.
- 1 stuck closed TCV.
- 1 recirculation pump loop (SLO).

Operation with 1 SRV out-of-service, up to 2 TIPOOS (or the equivalent number of TIP channels) and up to 50% of the LPRMs out-of-service is supported by the base case thermal limits presented in Section 3.0. No further discussion for these EOOS scenarios is presented in this section. The EOOS analyses presented in this section also include the same EOOS scenarios protected by the base case limits.

The base case MCPR safety limit for two-loop operation remains applicable for operation in the EOOS scenarios discussed below with the exception of single-loop operation. Also, the flow-dependent MCPR and LHGR analyses described in Section 3.4 were performed such that the results are applicable in all the EOOS scenarios.

Most of the equipment out of service scenarios are divided into two cases. The limits provided for EOOS Case 1 are applicable for operation with FHOOS or TBVOOS. The limits for EOOS Case 2 support operation with any combination of TCV slow closure, no RPT or FHOOS. Analyses for the limiting events and EOOS conditions for the two cases were performed to ensure that the limits provide the necessary protection. One TCV stuck closed is supported in combination with the other EOOS scenarios and is discussed separately. SLO with and without the other EOOS conditions is also discussed separately.

Results of the limiting transient analyses are used to establish appropriate $MCPR_p$ limits and $LHGRFAC_p$ multipliers to support operation in the EOOS scenarios. All EOOS analyses were performed with both NSS and TSSS insertion times.

5.1 *EOOS Case 1*

The EOOS Case 1 limits are applicable for operation with FHOOS or TBVOOS. The limits also support operation with FHOOS combined with 1 TCV stuck closed (See Section 5.4). The $MCPR_p$ limits and $LHGRFAC_p$ multipliers for ATRIUM-10 and ATRIUM-9B fuel for the EOOS Case 1 scenarios are presented in Figures 5.1–5.8 for 15,000 MWd/MTU and Figures 5.9–5.16 for EOC.

5.1.1 Feedwater Heaters Out-of-Service (FHOOS)

The FHOOS scenario assumes a 100°F reduction in the feedwater temperature. Operation with FHOOS is similar to operation with FFTR except that the reduction in feedwater temperature due to FHOOS can occur at any time during the cycle. The effect of the reduced feedwater temperature is an increase in the core subcooling which can change the power shape and core void fraction. Previous analysis (Reference 23) has verified that the LRNB event is less severe with FHOOS due to the decrease in steam flow and is nonlimiting. However, the FWCF event can get worse due to the increase in core inlet subcooling. FWCF analyses were performed for Cycle 10 to determine thermal limits to support operation with FHOOS. The ΔCPR and $LHGRFAC_p$ results used to develop the 15,000 MWd/MTU operating limits with FHOOS are presented in Table 5.1. The ΔCPR and $LHGRFAC_p$ results used to develop the EOC operating limits with FHOOS are presented in Table 5.2.

5.1.2 Turbine Bypass Valves Out-of-Service (TBVOOS)

The effect of operation with TBVOOS is a reduction in the system pressure relief capacity, which makes the pressurization events more severe. While the base case LRNB event is analyzed assuming the turbine bypass system out-of-service, operation with TBVOOS has an effect on the FWCF event. The FWCF event was evaluated for LaSalle Unit 1 Cycle 10 to support operation with TBVOOS. The ΔCPR and $LHGRFAC_p$ results used to develop the 15,000 MWd/MTU operating limits with TBVOOS are presented in Table 5.1. The ΔCPR and $LHGRFAC_p$ results used to develop the EOC operating limits with TBVOOS are presented in Table 5.2.

The TBVOOS condition can also affect the response of the loss of feedwater heating event. During the event, the colder feedwater results in an increase in the inlet subcooling as well as an increase in the thermal power. Although there is a substantial increase in core thermal power, the increase in steam flow is much less because a large part of the added power is used to overcome the increase in inlet subcooling. However, there can be a small increase in steam flow. The turbine control valves will open to accommodate any increase in steam flow. If the steam flow increases beyond the total capacity of the turbine control valves, the turbine bypass valves open to provide pressure relief. With the turbine bypass valves inoperable, the system would pressurize if the steam flow were to increase above the total capacity of the TCVs. A review of the maximum steam flow obtained in the base case LOFH analyses showed that in some of the rated power cases, the steam flow did increase above the TCV total capacity. As a result, LOFH analyses were performed using the transient methodology (COTRANSA2 /XCOBRAT) to account for the effects of pressurization. Analyses were performed only at high power levels (100% and 80% of rated) since at lower power levels, the TCVs have sufficient capacity to accommodate the increase in steam flow. The LOFH ΔCPR and $LHGRFAC_p$ results used to develop the 15,000 MWd/MTU operating limits with TBVOOS are presented in Table 5.1. Since the limiting exposure for the LOFH event is early in the cycle, the same results were used to develop the EOC operating limits with TBVOOS.

5.2 *EOOS Case 2*

The EOOS Case 2 limits are applicable for operation with any combination of TCV slow closure, no RPT or FHOOS. The limits also support operation with the same EOOS conditions combined with 1 TCV stuck closed (See Section 5.4). The spectrum of power/flow points and events performed to establish the EOOS Case 2 limits is based on previous analyses (Reference 20). The $MCPR_p$ limits and $LHGRFAC_p$ multipliers for ATRIUM-10 and ATRIUM-9B fuel for the EOOS Case 2 scenarios are presented in Figures 5.17–5.24 for 15,000 MWd/MTU and Figures 5.25–5.32 for EOC.

5.2.1 Recirculation Pump Trip Out-of-Service (No RPT)

This section summarizes the development of the thermal limits to support operation with the EOC RPT inoperable. When RPT is inoperable, no credit for tripping the recirculation pump on TSV position or TCV fast closure is assumed. The function of the RPT feature is to reduce the severity of the core power excursion caused by the pressurization transient. The RPT accomplishes this by helping revoid the core, thereby reducing the magnitude of the reactivity insertion resulting from the pressurization transient. Failure of the RPT feature can result in higher operating limits because of the higher positive reactivity in the core at the time of control rod insertion.

Analyses were performed for LRNB and FWCF events assuming no RPT. The ΔCPR and $LHGRFAC_p$ results used to develop the 15,000 MWd/MTU operating limits with no RPT are presented in Table 5.3. The ΔCPR and $LHGRFAC_p$ results used to develop the EOC operating limits to support no RPT operation are presented in Table 5.4.

5.2.2 Slow Closure of the Turbine Control Valve

LRNB analyses were performed to evaluate the impact of a TCV slow closure. Analyses were performed closing 3 valves in the normal fast closure mode and 1 valve in 2.0 seconds. Results provided in Reference 20 demonstrate that performing the analyses with 1 TCV closing in 2.0 seconds protects operation with up to 4 TCVs closing slowly. Sensitivity analyses below 80% power have shown that the pressure relief provided by all 4 TCVs closing slowly can be sufficient to preclude the high-flux scram set point from being exceeded. Therefore, credit for high-flux scram is not taken for analyses at 80% power and below. The 80% power TCV slow closure analyses were performed both with and without high-flux scram credited. The ΔCPR and $LHGRFAC_p$ TCV slow closure analysis results used to establish the EOOS Case 2 operating limits at 15,000 MWd/MTU and EOC are presented in Tables 5.3 and 5.4, respectively.

The $MCPR_p$ limits are established with a step change at 80% power. At 80% power, the lower-bound $MCPR_p$ limits are based on the analyses which credit high-flux scram; the upper-bound $MCPR_p$ limits are based on analyses which do not credit high-flux scram. The EOOS Case 2 limits protect the scenario of all 4 TCVs closing slowly.

5.2.3 Combined FHOOS/TCV Slow Closure and/or No RPT

The EOOS Case 2 limits were established to support operation with any combination of FHOOS, TCV slow closure or no RPT. The TCV slow closure ΔCPR and $LHGRFAC_p$ results with FHOOS become less limiting than the TCV slow closure event with nominal feedwater temperature since the initial steam flow with FHOOS is lower and produces a less severe pressurization event. Subsequently, no TCV slow closure with FHOOS analyses were performed. Analyses were performed for the FWCF event with FHOOS and no RPT as the analysis results are potentially limiting, especially at low power levels. The ΔCPR and

$LHGRFAC_p$ FWCF with FHOOS and no RPT analysis results used to establish the EOOS Case 2 operating limits at 15,000 MWd/MTU and EOC are presented in Tables 5.3 and 5.4, respectively.

5.3 *Single-Loop Operation (SLO)*

The impact of SLO at LaSalle on MCPR limits and $LHGRFAC_p$ multipliers was presented in Reference 9. The base case ΔCPRs and $LHGRFAC_p$ multipliers remain applicable. The only impact is on the MCPR safety limit. As presented in Section 3.2, the single-loop operation safety limit is 0.01 greater than the two-loop operating limit (1.12 compared to 1.11). The net result is an increase to the base case $MCPR_p$ limits of 0.01 as a result of the increase in the MCPR safety limit. The same situation is true for the EOOS scenarios. Adding 0.01 to the corresponding TLO EOOS MCPR limits results in SLO MCPR limits for the EOOS conditions. The TLO EOOS $LHGRFAC_p$ multipliers remain applicable in SLO.

5.4 *1 Stuck Closed Turbine Control Valve*

With 1 of the turbine control valves assumed stuck closed, the other 3 TCVs will be further open when operating at a given power level. In addition, the highest attainable power is decreased because of the decreased steam flow capacity of the TCVs. With the valves further open, TCV closure events such as the LRNB and slow closure events, are less severe than with the valves further closed because the pressurization occurs over a longer time. While the FWCF event is not impacted during the turbine stop valve closure portion of the event, it may be impacted during the overcooling phase. At some power level between 80% and 100% of rated, the TCVs will be in the full open position with no ability to accommodate an increase in steam flow during the overcooling phase. The result is an increase in pressure prior to the turbine stop valve closure and a more severe event. Operation of the turbine bypass valves during the overcooling phase is not credited. Operation with 1 stuck closed TCV is supported in conjunction with the other EOOS conditions. As a result, FWCF analyses with 1 stuck TCV were performed for base case operation and the EOOS conditions where the FWCF is the limiting event (i.e. FHOOS, TBVOOS, no RPT and FHOOS with no RPT). Analyses are only performed at 80% and 100% power since at lower power levels, the initial TCV position is such that there is enough capacity left to accommodate the increase in steam flow during the overcooling phase. The ΔCPR and $LHGRFAC_p$ analysis results for the FWCF with 1 stuck TCV closed for base case and the EOOS conditions at 15,000 MWd/MTU and EOC are presented in Tables 5.5 and 5.6, respectively.

The 1 stuck closed turbine control valve condition may also impact the loss of feedwater heating event when combined with the TBVOOS condition. Any increase in steam flow causes the system to pressurize making the event more severe. LOFH analyses were performed to support operation with 1 TCV stuck closed and TBVOOS for 80% and 100% of rated power. Analyses are only performed at 80% and 100% power since at lower power levels, the initial TCV position is such that there is enough capacity left to accommodate the increase in steam flow. The ΔCPR and $LHGRFAC_p$ LOFH with 1 stuck TCV closed and TBVOOS analysis at 15,000 MWd/MTU and EOC are presented in Tables 5.5 and 5.6, respectively.

In most cases, the results in Tables 5.5 and 5.6 were used in establishing the base case, EOOS Case 1 and EOOS Case 2 operating limits. The inclusion of the 1 TCV stuck closed condition with other limits has little or no impact, with one exception being the combined 1 TCV stuck closed and TBVOOS scenario. Results for 1 TCV stuck closed are included with the base case limits presented in Figures 3.10–3.25. Results for EOOS Case 1 with 1 TCV stuck closed are presented in Figures 5.1–5.16. Results for EOOS Case 2 with 1 TCV stuck closed are presented in Figures 5.17–5.32. The EOOS Case 1 $MCPR_p$ limits protect the combined 1 TCV stuck closed with TBVOOS MCPR results. However, the $LHGRFAC_p$ results for the combined 1 TCV stuck closed and TBVOOS are much lower than the TBVOOS results. Therefore, separate sets of operating limits were established. The $LHGRFAC_p$ multipliers for ATRIUM-10 and ATRIUM-9B fuel for the 1 TCV stuck closed with TBVOOS condition are presented in Figures 5.33–5.36 for 15,000 MWd/MTU and Figures 5.37–5.40 for EOC.

Table 5.1 EOOS Case 1 Analysis Results – 15,000 MWd/MTU

Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
		FHOOS With NSS Insertion Times			
FWCF	100 / 105	0.30	1.07	0.27	1.01
	100 / 81	0.25	1.10	0.22	1.08
	80 / 105	0.37	1.02	0.34	0.97
	80 / 57.2	0.24	1.09	0.19	1.08
	60 / 105	0.47	0.96	0.45	0.92
	40 / 105	0.69*	0.86*	0.66	0.83
	25 / 105	1.25*	0.66*	1.04	0.69
		FHOOS With TSSS Insertion Times			
FWCF	100 / 105	0.34	1.04	0.31	0.97
	100 / 81	0.32	1.08	0.28	1.03
	80 / 105	0.40	1.00	0.37	0.95
	80 / 57.2	0.35	1.09	0.26	1.08
	60 / 105	0.49	0.95	0.48	0.91
	40 / 105	0.76*	0.83*	0.69	0.82
	25 / 105	1.34*	0.64*	1.08*	0.69
		TBVOOS With NSS Insertion Times			
FWCF	100 / 105	0.34	1.03	0.33	0.93
	100 / 81	0.33	1.00	0.28	0.90
	80 / 105	0.40	1.01	0.38	0.94
	80 / 57.2	0.28	1.10	0.22	1.04
	60 / 105	0.48	0.97	0.47	0.91
	25 / 105	0.92	0.77	0.92	0.74

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

Table 5.1 EOOS Case 1 Analysis Results – 15,000 MWd/MTU
(Continued)

Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
TBVOOS With TSSS Insertion Times					
FWCF	100 / 105	0.38	1.02	0.36	0.93
	100 / 81	0.39	1.01	0.34	0.92
	80 / 105	0.43	0.99	0.42	0.91
	80 / 57.2	0.41	1.06	0.35	0.99
	60 / 105	0.51	0.95	0.51	0.89
	25 / 105	0.95	0.77	0.94	0.74
LOFH	100 / 105	0.23*	1.01*	0.22*	1.01*
	100 / 81	0.23*	0.95*	0.23*	0.95*
	80 / 105	0.25*	1.05*	0.24*	1.05*
	80 / 57.2	0.28*	0.94*	0.27*	0.94*

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

Table 5.2 EOOS Case 1 Analysis Results – EOC

Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
FHOOS With NSS Insertion Times					
FWCF	100 / 105	0.30	1.06	0.28	1.01*
	100 / 81	0.28	1.09	0.25	1.06
	80 / 105	0.37*	1.02*	0.34*	0.97*
	80 / 57.2	0.30	1.09*	0.26	1.08*
	60 / 105	0.47*	0.96*	0.45*	0.92*
	40 / 105	0.69*	0.86*	0.66*	0.83*
	25 / 105	1.25*	0.66*	1.04*	0.69*
FHOOS With TSSS Insertion Times					
FWCF	100 / 105	0.34*	1.04*	0.31*	0.97*
	100 / 81	0.32*	1.08*	0.28*	1.03*
	80 / 105	0.40*	1.00*	0.37*	0.95*
	80 / 57.2	0.35*	1.09*	0.30	1.07
	60 / 105	0.49*	0.95*	0.48*	0.91*
	40 / 105	0.76*	0.83*	0.69*	0.82*
	25 / 105	1.34*	0.64*	1.08*	0.69*
TBVOOS With NSS Insertion Times					
FWCF	100 / 105	0.34	1.00	0.33	0.93*
	100 / 81	0.36	0.95	0.33	0.90*
	80 / 105	0.40*	1.00	0.38*	0.94*
	80 / 57.2	0.38	1.00	0.34	0.99
	60 / 105	0.48*	0.97*	0.47	0.91*

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

Table 5.2 EOOS Case 1 Analysis Results – EOC
(Continued)

Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
TBVOOS With TSSS Insertion Times					
FWCF	100 / 105	0.38*	1.00	0.36*	0.93*
	100 / 81	0.39	0.95	0.34	0.92*
	80 / 105	0.43*	0.99*	0.42*	0.91*
	80 / 57.2	0.43	1.00	0.39	0.98
	60 / 105	0.51*	0.95*	0.51*	0.89*
LOFH	100 / 105	0.23*	1.01*	0.22*	1.01*
	100 / 81	0.23*	0.95*	0.23*	0.95*
	80 / 105	0.25*	1.05*	0.24*	1.05*
	80 / 57.2	0.28*	0.94*	0.27*	0.94*

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

Table 5.3 EOOS Case 2 Analysis Results – 15,000 MWd/MTU

Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
		TCV Slow Closure With NSS Insertion Times			
LRNB	100 / 105†	0.43	0.90	0.41	0.81
	100 / 100†	0.42	0.89	0.40	0.80
	100 / 81†	0.39	0.91	0.41	0.82
	80 / 105†	0.39	0.95	0.41	0.88
	80 / 57.2†	0.63*	0.98	0.56	0.90
	80 / 105‡	0.59*	0.88*	0.62	0.82
	80 / 57.2‡	0.70*	0.91	0.75	0.83
	60 / 105‡	0.68	0.84	0.71	0.79
	60 / 35.1‡	0.59	0.93	0.69	0.88
	40 / 105‡	0.84	0.77	0.84	0.75
	25 / 105‡	1.19*	0.67*	1.02	0.69
		TCV Slow Closure With TSSS Insertion Times			
LRNB	100 / 105†	0.48	0.88	0.48	0.78
	100 / 100†	0.48	0.87	0.48	0.77
	100 / 81†	0.43	0.87	0.45	0.76
	80 / 105†	0.45	0.93	0.44	0.85
	80 / 57.2†	0.63*	0.97	0.62	0.88
	80 / 105‡	0.59*	0.88	0.62	0.82
	80 / 57.2‡	0.71*	0.90	0.75	0.83
	60 / 105‡	0.69	0.84	0.71	0.79
	60 / 35.1‡	0.64	0.90	0.75	0.86
	40 / 105‡	0.85	0.77	0.86	0.74
	25 / 105‡	1.19*	0.67*	1.03	0.68

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

† Scram initiated on high neutron flux.

‡ Scram initiated on high dome pressure.

Table 5.3 EOOS Case 2 Analysis Results – 15,000 MWd/MTU
(Continued)

Event	Power / Flow (% rated / % rated)	ATRIUM-10 ΔCPR	ATRIUM-10 $LHGRFAC_p$	ATRIUM-9B ΔCPR	ATRIUM-9B $LHGRFAC_p$
No RPT With NSS Insertion Times					
LRNB	100 / 105	0.37	0.95	0.39	0.84
	100 / 81	0.30	0.91	0.34	0.79
	80 / 105	0.35	0.99	0.37	0.89
	80 / 57.2	0.24	1.05	0.22	0.97
FWCF	100 / 105	0.32	1.01	0.32	0.92
No RPT With TSSS Insertion Times					
LRNB	100 / 105	0.41	0.89	0.40	0.81
	100 / 81	0.35	0.93	0.36	0.81
	80 / 105	0.39	0.95	0.40	0.87
	80 / 57.2	0.37	1.01	0.35	0.93
FWCF	100 / 105	0.37	0.96	0.36	0.90
FHOOS/No RPT With NSS Insertion Times					
FWCF	100 / 105	0.33	1.01	0.32	0.93
	80 / 105	0.39	0.97	0.38	0.91
	25 / 105	1.22*	0.65*	1.04	0.67
FHOOS/No RPT With TSSS Insertion Times					
FWCF	100 / 105	0.37	0.97	0.36	0.90
	80 / 105	0.42	0.95	0.42	0.88
	25 / 105	1.26*	0.64*	1.06	0.67

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

Table 5.4 EOOS Case 2 Analysis Results – EOC

Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
TCV Slow Closure With NSS Insertion Times					
LRNB	100 / 105†	0.48	0.90*	0.47	0.81*
	100 / 81†	0.47	0.84	0.42	0.81
	80 / 105†	0.45	0.94	0.43	0.88*
	80 / 57.2†	0.63*	0.92	0.56	0.90*
	80 / 105‡	0.59*	0.88*	0.62*	0.82*
	80 / 57.2‡	0.70*	0.86	0.75*	0.83*
	60 / 105‡	0.68*	0.84*	0.71*	0.79*
	60 / 35.1‡	0.59*	0.93*	0.69*	0.88*
	40 / 105‡	0.84*	0.77*	0.84*	0.75*
	25 / 105‡	1.19*	0.67*	1.02*	0.69*
TCV Slow Closure With TSSS Insertion Times					
LRNB	100 / 105†	0.50	0.88*	0.49	0.78*
	100 / 81†	0.47	0.84	0.45	0.76*
	80 / 105†	0.46	0.93*	0.45	0.85*
	80 / 57.2†	0.63*	0.94	0.62*	0.88*
	80 / 105‡	0.59*	0.88*	0.62*	0.82*
	80 / 57.2‡	0.71*	0.86	0.75*	0.83*
	60 / 105‡	0.69*	0.84*	0.71*	0.79*
	60 / 35.1‡	0.64*	0.90*	0.75*	0.86*
	40 / 105‡	0.85*	0.77*	0.86*	0.74*
	25 / 105‡	1.19*	0.67*	1.03*	0.68*

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

† Scram initiated on high neutron flux.

‡ Scram initiated on high dome pressure.

Table 5.4 EOOS Case 2 Analysis Results – EOC
(Continued)

Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
No RPT With NSS Insertion Times					
LRNB	100 / 105	0.48	0.87	0.47	0.84*
	100 / 81	0.41	0.84	0.41	0.79*
	80 / 105	0.43	0.91	0.42	0.89*
	80 / 57.2	0.35	0.93	0.30	0.90
FWCF	100 / 105	0.38	0.93	0.34	0.91
No RPT With TSSS Insertion Times					
LRNB	100 / 105	0.53	0.84	0.54	0.81*
	100 / 81	0.49	0.82	0.42	0.80
	80 / 105	0.47	0.89	0.48	0.87
	80 / 57.2	0.39	0.92	0.35	0.90
FWCF	100 / 105	0.43	0.90	0.42	0.88
FHOOS/No RPT With NSS Insertion Times					
FWCF	100 / 105	0.37	0.93	0.35	0.92
	80 / 105	0.39*	0.97*	0.39	0.91
	25 / 105	1.22*	0.65*	1.04*	0.67
FHOOS/No RPT With TSSS Insertion Times					
FWCF	100 / 105	0.41	0.92	0.40	0.90*
	80 / 105	0.42*	0.95*	0.42*	0.88*
	25 / 105	1.26*	0.64*	1.06*	0.67*

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

Table 5.5 1 TCV Stuck Closed Analysis Results – 15,000 MWd/MTU

Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
Base Case/1 TCV Stuck Closed With NSS Insertion Times					
FWCF	100 / 105	0.30	1.08	0.27	1.02
	80 / 105	0.35	1.04	0.32	1.00
Base Case/1 TCV Stuck Closed With TSSS Insertion Times					
FWCF	100 / 105	0.34	1.05	0.31	1.00
	100 / 81	0.31	1.08	0.27	1.03
	80 / 105	0.39	1.02	0.36	1.00
	80 / 57.2	0.32	1.13	0.24	1.09
FHOOS/1 TCV Stuck Closed With NSS Insertion Times					
FWCF	100 / 105	0.33	1.05	0.29	1.00
	100 / 81	0.26	1.10	0.24	1.06
	80 / 105	0.39	1.00	0.36	0.95
	80 / 57.2	0.26	1.15	0.21	1.12
FHOOS/1 TCV Stuck Closed With TSSS Insertion Times					
FWCF	100 / 105	0.36	1.02	0.33	0.96
	100 / 81	0.33	1.06	0.29	1.01
	80 / 105	0.42	0.98	0.39	0.93
	80 / 57.2	0.36	1.09	0.28	1.05

Table 5.5 1 TCV Stuck Closed Analysis Results – 15,000 MWd/MTU
(Continued)

Event	Power / Flow (% rated / % rated)	ATRIUM-10 ΔCPR	ATRIUM-10 $LHGRFAC_p$	ATRIUM-9B ΔCPR	ATRIUM-9B $LHGRFAC_p$
TBVOOS/1 TCV Stuck Closed With NSS Insertion Times					
FWCF	100 / 105	0.36	1.02	0.34	0.93
	100 / 81	0.33	1.00	0.28	0.90
	80 / 105	0.41	1.00	0.39	0.93
	80 / 57.2	0.29	1.10	0.22	1.04
LOFH	80 / 57.2	0.42*	0.90*	0.35*	0.91*
TBVOOS/1 TCV Stuck Closed With TSSS Insertion Times					
FWCF	100 / 105	0.40	1.01	0.37	0.93
	100 / 81	0.39	1.01	0.34	0.92
	80 / 105	0.45	0.98	0.43	0.90
	80 / 57.2	0.41	1.06	0.35	0.99
LOFH	100 / 105	0.36*	0.95*	0.32*	0.95*
	100 / 81	0.36*	0.83	0.31	0.80
	80 / 105	0.42*	0.93*	0.38*	0.93*
	80 / 57.2	0.44*	0.77	0.37*	0.77
No RPT/1 TCV Stuck Closed With NSS Insertion Times					
FWCF	100 / 105	0.34	1.01	0.33	0.93
	80 / 105	0.38	0.99	0.38	0.91
No RPT/1 TCV Stuck Closed With TSSS Insertion Times					
FWCF	100 / 105	0.38	0.98	0.37	0.89
	80 / 105	0.42	0.96	0.42	0.88

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

Table 5.5 1 TCV Stuck Closed Analysis Results – 15,000 MWd/MTU
(Continued)

Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
FHOOS/No RPT/1 TCV Stuck Closed With NSS Insertion Times					
FWCF	100 / 105	0.35	0.99	0.34	0.92
	80 / 105	0.41	0.95	0.41	0.89
FHOOS/No RPT/1 TCV Stuck Closed With TSSS Insertion Times					
FWCF	100 / 105	0.39	0.97	0.38	0.88
	80 / 105	0.44	0.93	0.44	0.87

Table 5.6 1 TCV Stuck Closed Analysis Results – EOC

Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
		Base Case/1 TCV Stuck Closed With NSS Insertion Times			
FWCF	100 / 105	0.30	1.05	0.28	1.02*
	80 / 105	0.35*	1.04*	0.32*	1.00*
		Base Case/1 TCV Stuck Closed With TSSS Insertion Times			
FWCF	100 / 105	0.34*	1.04	0.31*	1.00*
	100 / 81	0.31	1.05	0.27*	1.03*
	80 / 105	0.39*	1.02*	0.36*	1.00*
	80 / 57.2	0.34	1.08	0.30	1.07
		FHOOS/1 TCV Stuck Closed With NSS Insertion Times			
FWCF	100 / 105	0.33*	1.05*	0.30	1.00*
	100 / 81	0.29	1.08	0.27	1.05
	80 / 105	0.39*	1.00*	0.36*	0.95*
	80 / 57.2	0.31	1.11	0.27	1.08
		FHOOS/1 TCV Stuck Closed With TSSS Insertion Times			
FWCF	100 / 105	0.36*	1.02*	0.33*	0.96*
	100 / 81	0.33*	1.06*	0.29*	1.01*
	80 / 105	0.42*	0.98*	0.39*	0.93*
	80 / 57.2	0.36*	1.09*	0.30	1.05*

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

Table 5.6 1 TCV Stuck Closed Analysis Results – EOC
(Continued)

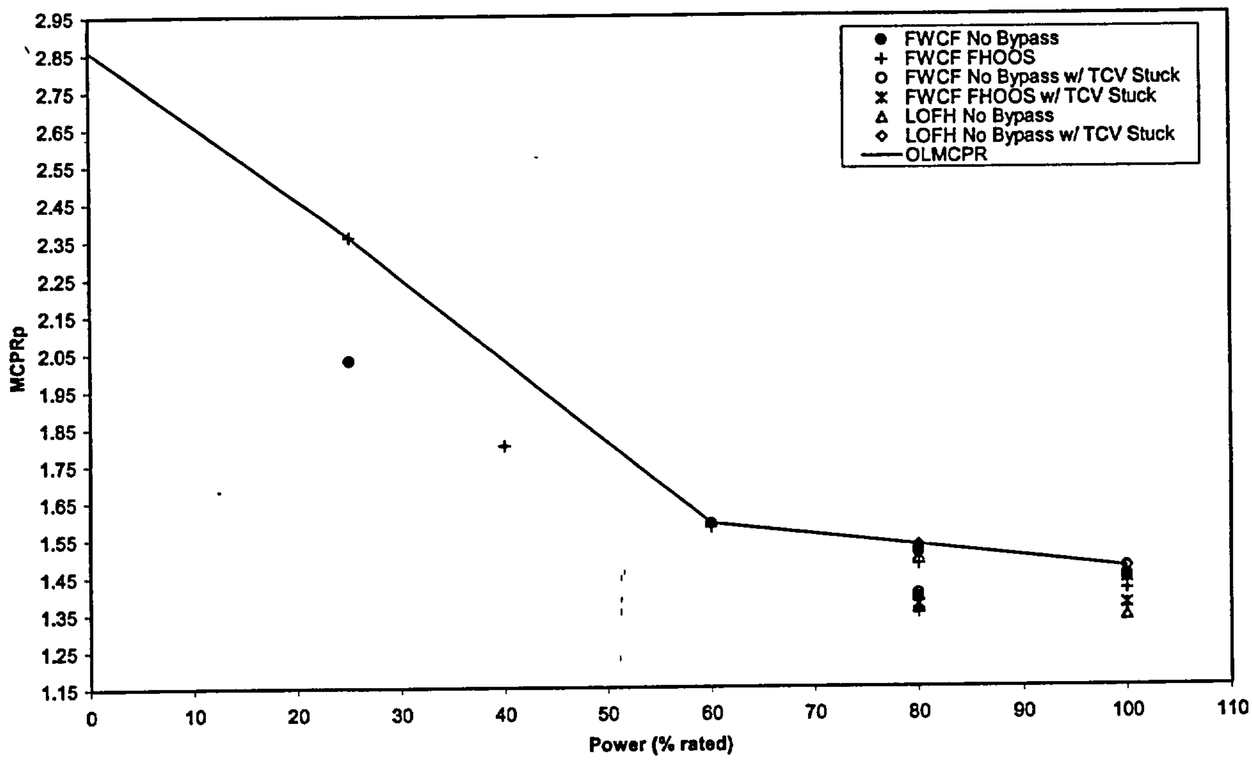
Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
TBVOOS/1 TCV Stuck Closed With NSS Insertion Times					
FWCF	100 / 105	0.36*	1.00	0.34*	0.93*
	100 / 81	0.36	0.95	0.33	0.90*
	80 / 105	0.41*	1.00*	0.39*	0.93*
	80 / 57.2	0.38	1.02	0.34	1.00
TBVOOS/1 TCV Stuck Closed With TSSS Insertion Times					
FWCF	100 / 105	0.40*	1.01*	0.37*	0.93*
	100 / 81	0.39	0.95	0.34	0.92*
	80 / 105	0.45*	0.98*	0.43*	0.90*
	80 / 57.2	0.43	1.00	0.39	0.99*
LOFH	100 / 105	0.36*	0.95*	0.32*	0.95*
	100 / 81	0.36*	0.83*	0.31*	0.80*
	80 / 105	0.42*	0.93*	0.38*	0.93*
	80 / 57.2	0.44*	0.77*	0.37*	0.77*
No RPT/1 TCV Stuck Closed With NSS Insertion Times					
FWCF	100 / 105	0.38	0.93	0.35	0.91
	80 / 105	0.38*	0.97	0.39	0.91*
No RPT/1 TCV Stuck Closed With TSSS Insertion Times					
FWCF	100 / 105	0.43	0.90	0.43	0.88
	80 / 105	0.42*	0.95	0.42*	0.88*

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

Table 5.6 1 TCV Stuck Closed Analysis Results – EOC
(Continued)

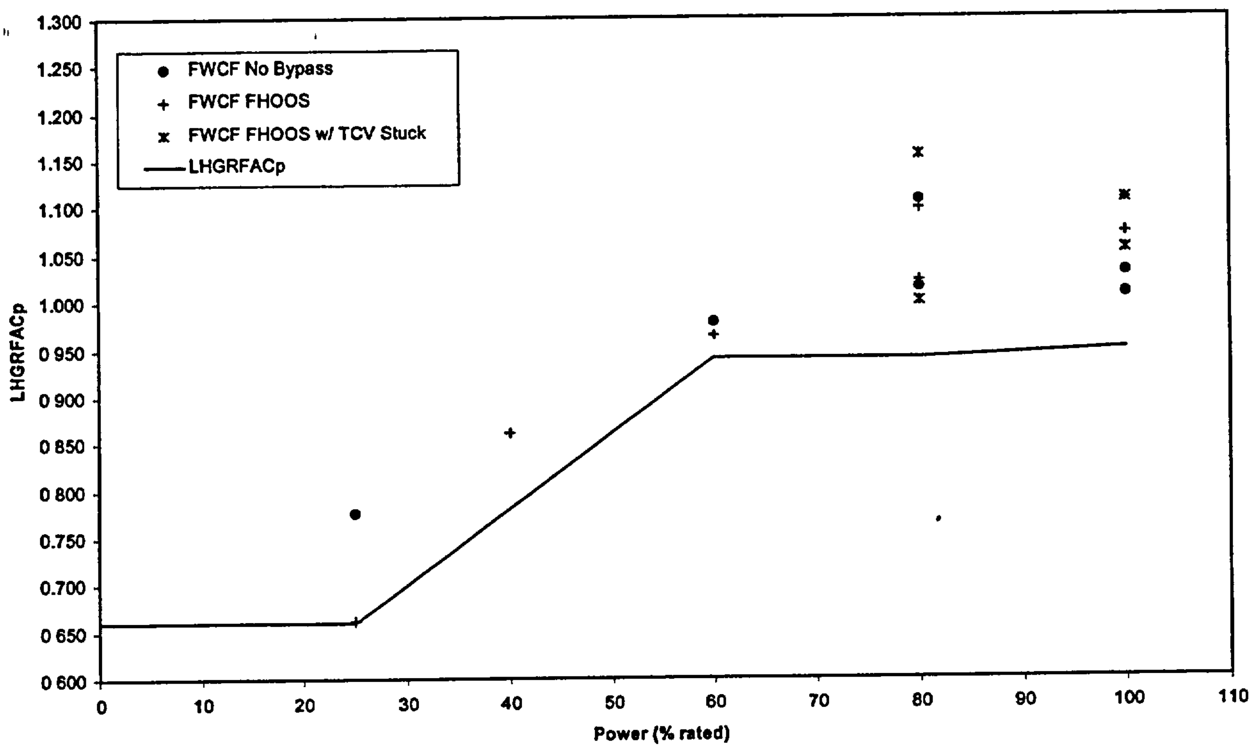
Event	Power / Flow (% rated / % rated)	ATRIUM-10		ATRIUM-9B	
		ΔCPR	$LHGRFAC_p$	ΔCPR	$LHGRFAC_p$
FHOOS/No RPT/1 TCV Stuck Closed With NSS Insertion Times					
FWCF	100 / 105	0.38	0.93	0.36	0.91
	80 / 105	0.41*	0.95*	0.41*	0.89*
FHOOS/No RPT/1 TCV Stuck Closed With TSSS Insertion Times					
FWCF	100 / 105	0.42	0.92	0.41	0.88*
	100 / 81	0.35	0.95	0.31	0.93
	80 / 105	0.44*	0.93*	0.44*	0.87*
	80 / 57.2	0.33	1.05	0.29	1.03

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



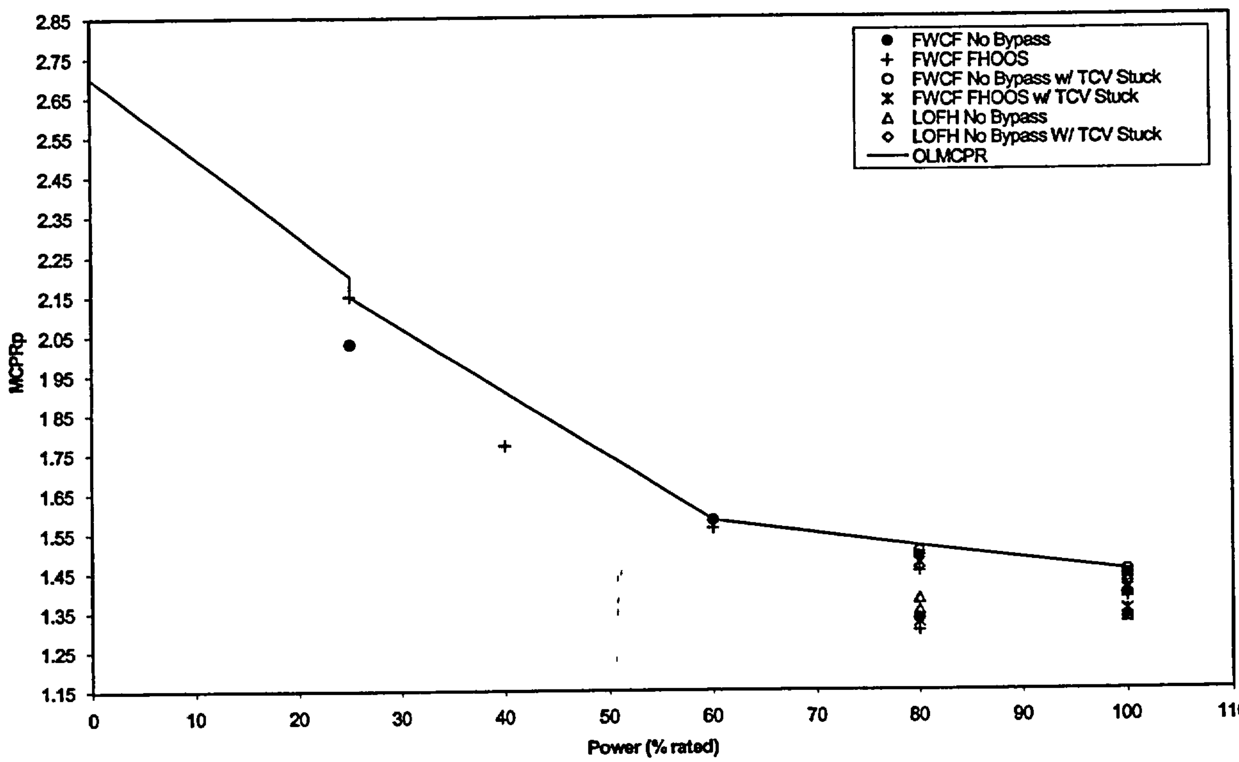
Power (%)	$MCPR_p$ Limit
100	1.47
60	1.59
25	2.36
25	2.36
0	2.86

Figure 5.1 BOC to 15,000 MWd/MTU EOOS Case 1 Power-Dependent MCPR Limits for ATRIUM-10 Fuel – NSS Insertion Times



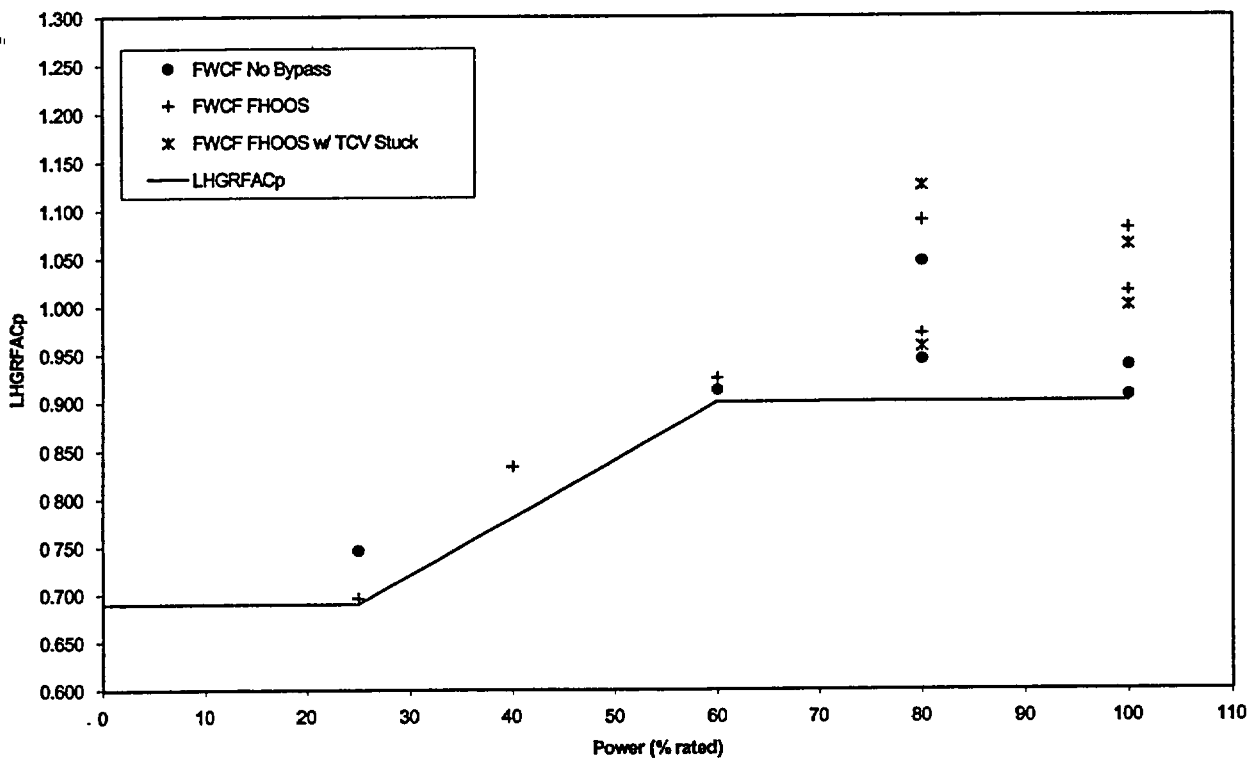
Power (%)	LHGRFAC$_p$ Multiplier
100	0.95
80	0.94
60	0.94
25	0.66
25	0.66
0	0.66

Figure 5.2 BOC to 15,000 MWd/MTU EOOS Case 1 Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – NSS Insertion Times



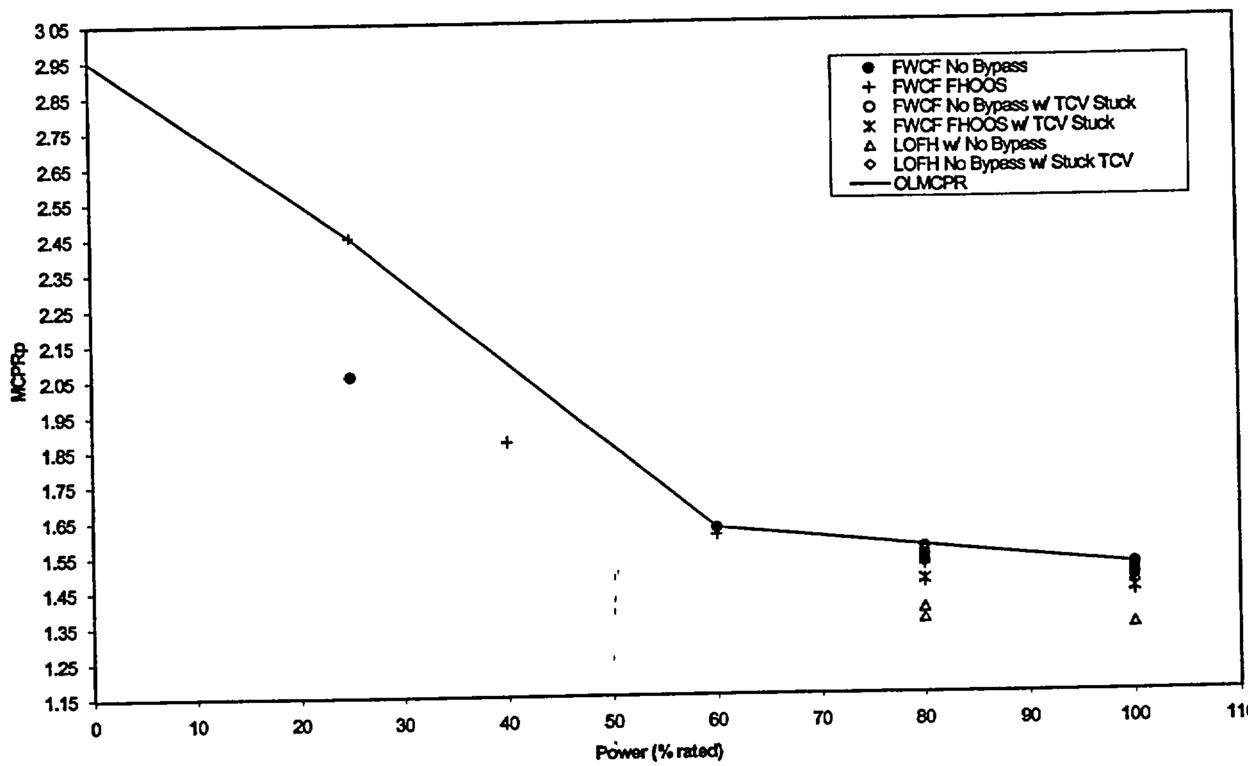
Power (%)	$MCPR_p$ Limit
100	1.45
60	1.58
25	2.15
25	2.20
0	2.70

Figure 5.3 BOC to 15,000 MWd/MTU EOOS Case 1 Power-Dependent MCPR Limits for ATRIUM-9B Fuel – NSS Insertion Times



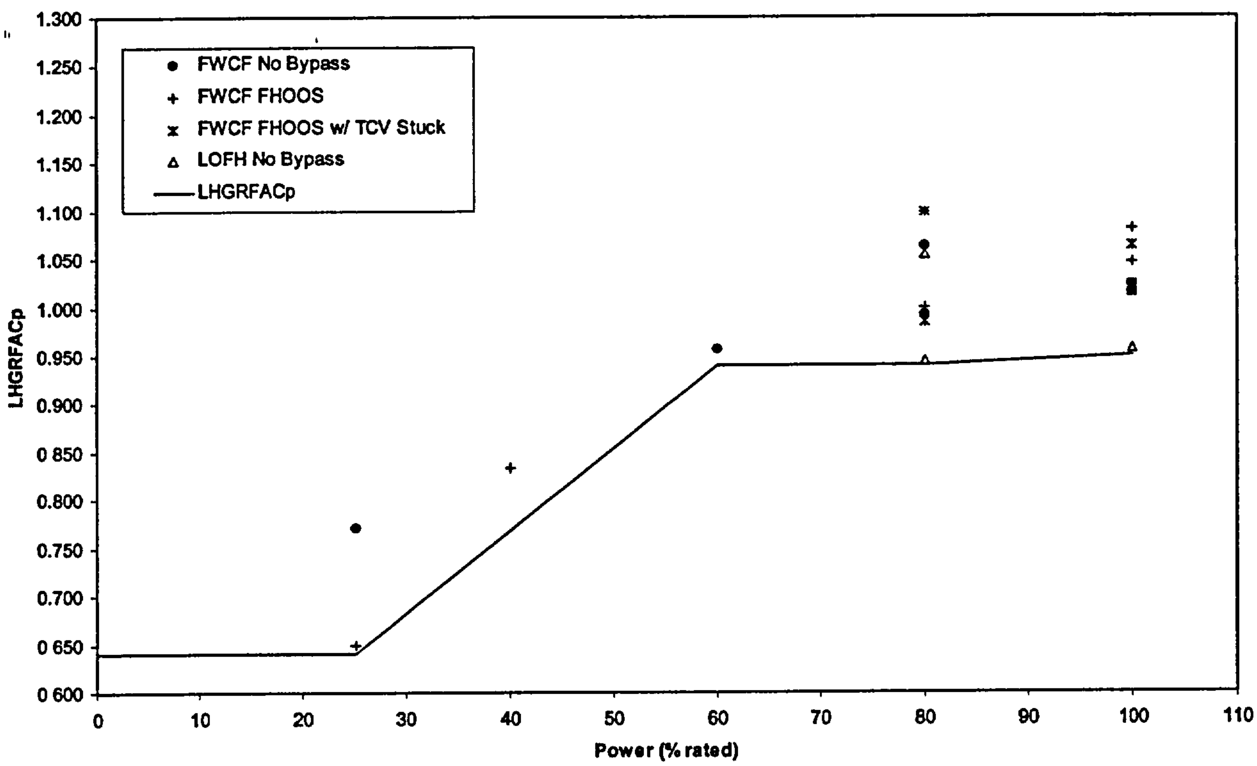
Power (%)	$LHGRFAC_p$ Multiplier
100	0.90
60	0.90
25	0.69
25	0.69
0	0.69

Figure 5.4 BOC to 15,000 MWd/MTU EOOS Case 1 Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – NSS Insertion Times



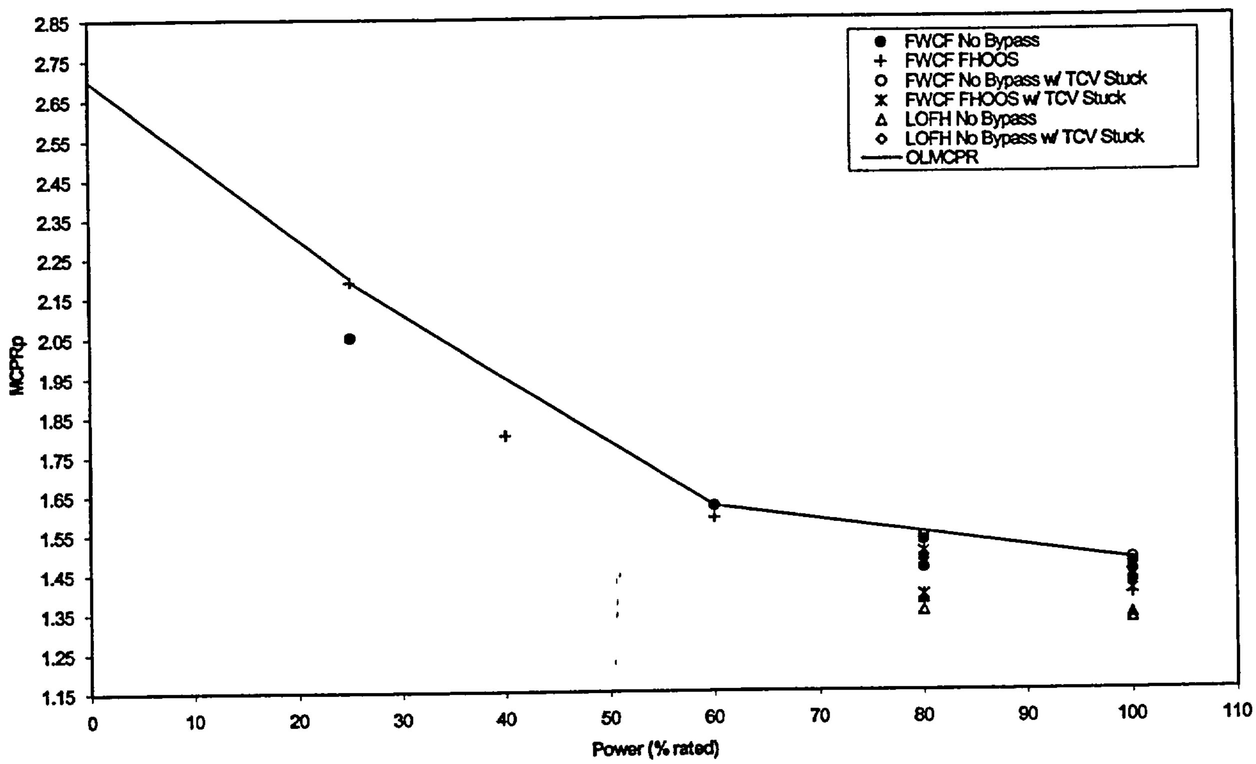
Power (%)	$MCPR_p$ Limit
100	1.51
60	1.62
25	2.45
25	2.45
0	2.95

Figure 5.5 BOC to 15,000 MWd/MTU EOOS Case 1 Power-Dependent MCPR Limits for ATRIUM-10 Fuel – TSSS Insertion Times



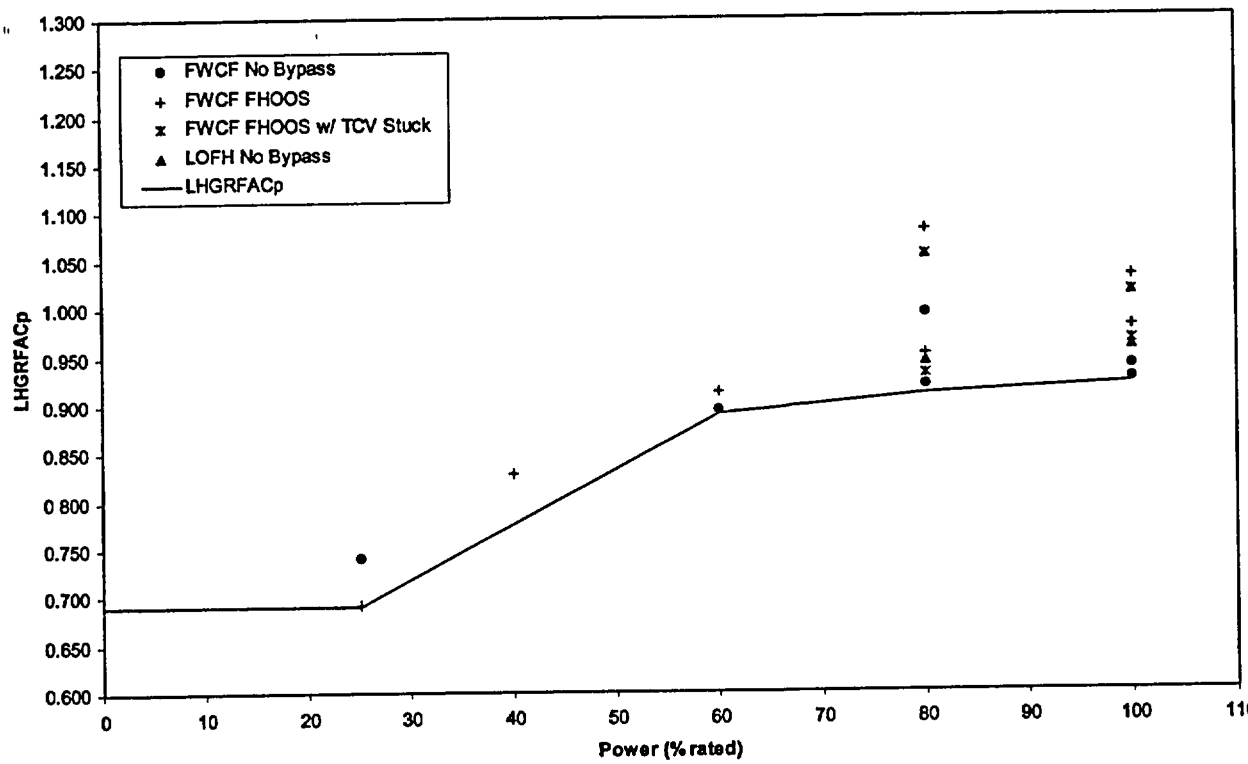
Power (%)	$LHGRFAC_p$ Multiplier
100	0.95
80	0.94
60	0.94
25	0.64
25	0.64
0	0.64

Figure 5.6 BOC to 15,000 MWd/MTU EOOS Case 1 Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – TSSS Insertion Times



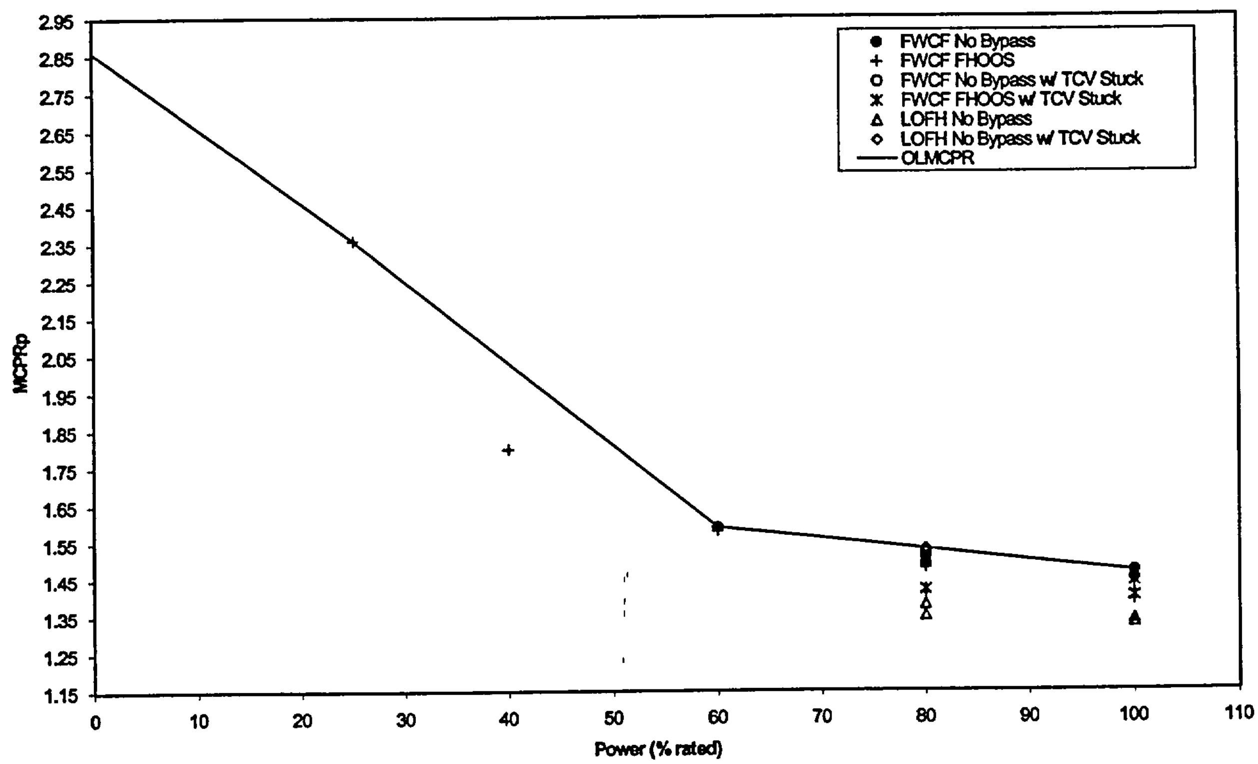
Power (%)	$MCPR_p$ Limit
100	1.48
60	1.62
25	2.19
25	2.20
0	2.70

Figure 5.7 BOC to 15,000 MWd/MTU EOOS Case 1 Power-Dependent MCPR Limits for ATRIUM-9B Fuel – TSSS Insertion Times



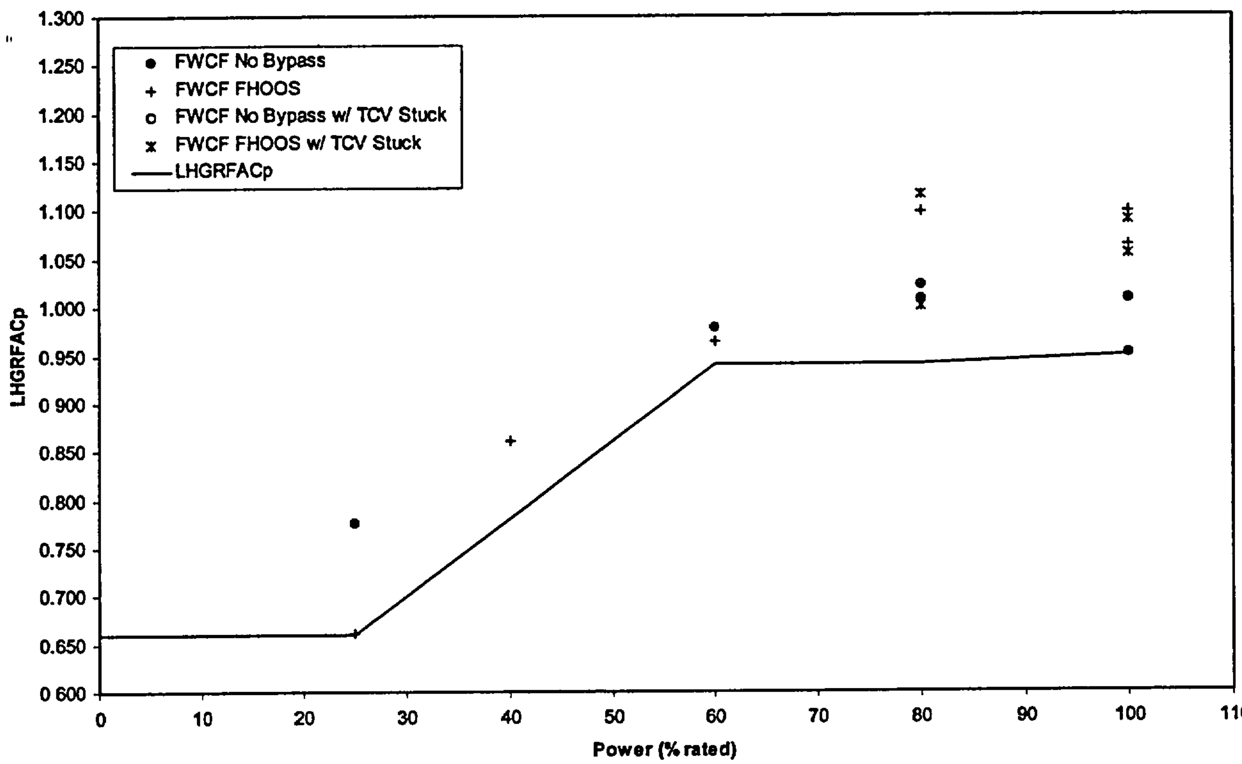
Power (%)	$LHGRFAC_p$ Multiplier
100	0.92
80	0.91
60	0.89
25	0.69
25	0.69
0	0.69

Figure 5.8 BOC to 15,000 MWd/MTU EOOS Case 1 Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – TSSS Insertion Times



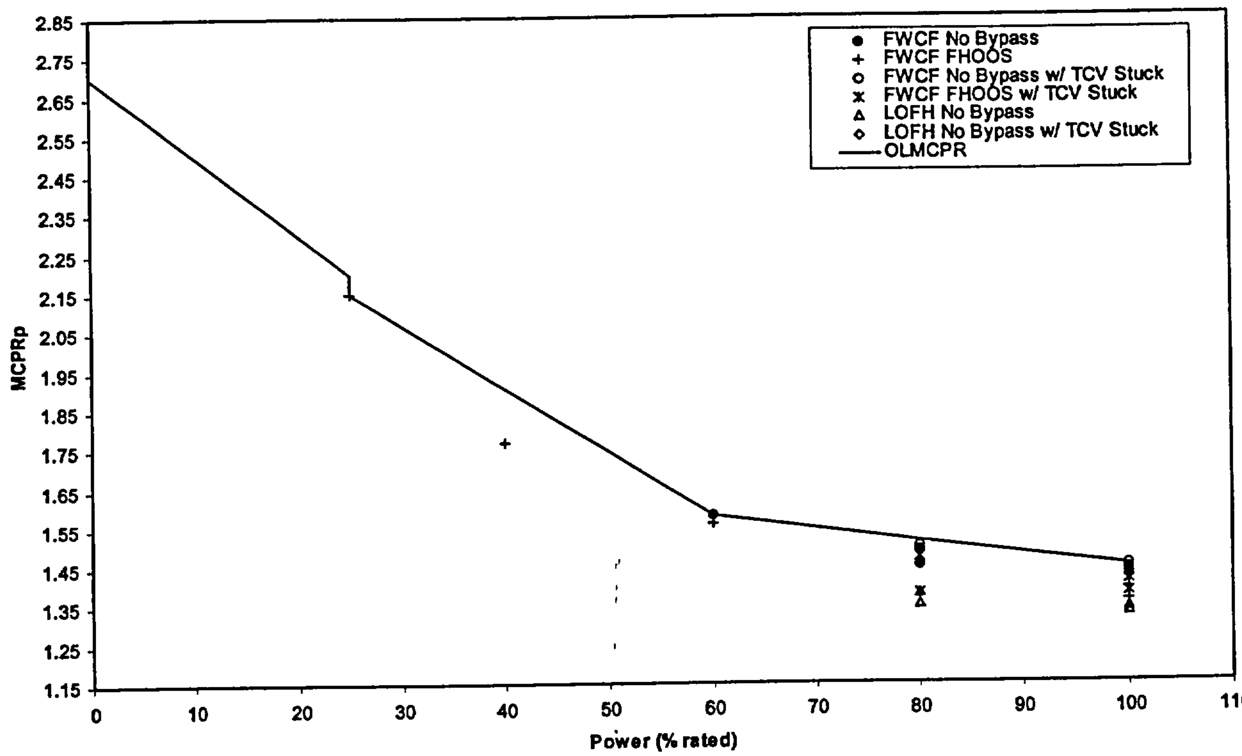
Power (%)	$MCPR_p$ Limit
100	1.47
60	1.59
25	2.36
25	2.36
0	2.86

Figure 5.9 15,000 MWd/MTU to EOC EOOS Case 1 Power-Dependent MCPR Limits for ATRIUM-10 Fuel – NSS Insertion Times



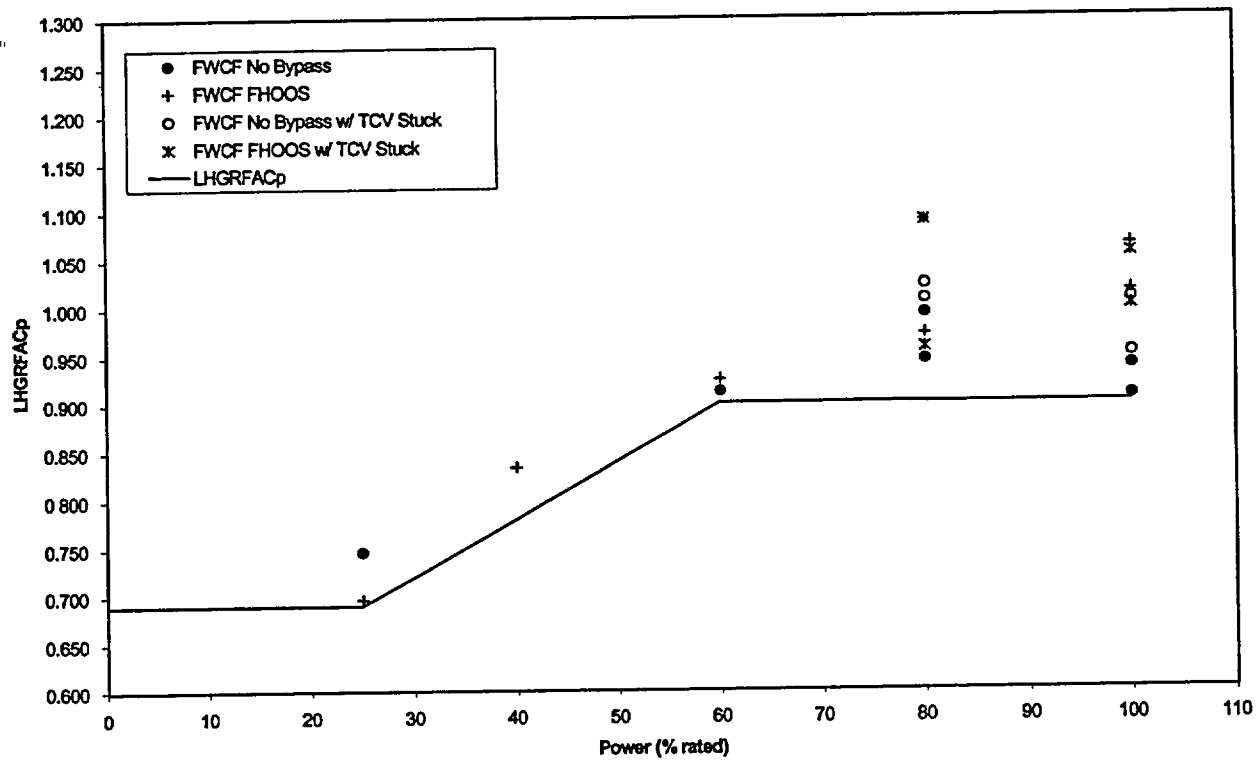
Power (%)	$LHGRFAC_p$ Multiplier
100	0.95
80	0.94
60	0.94
25	0.66
25	0.66
0	0.66

Figure 5.10 15,000 MWd/MTU to EOC EOOS Case 1 Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – NSS Insertion Times



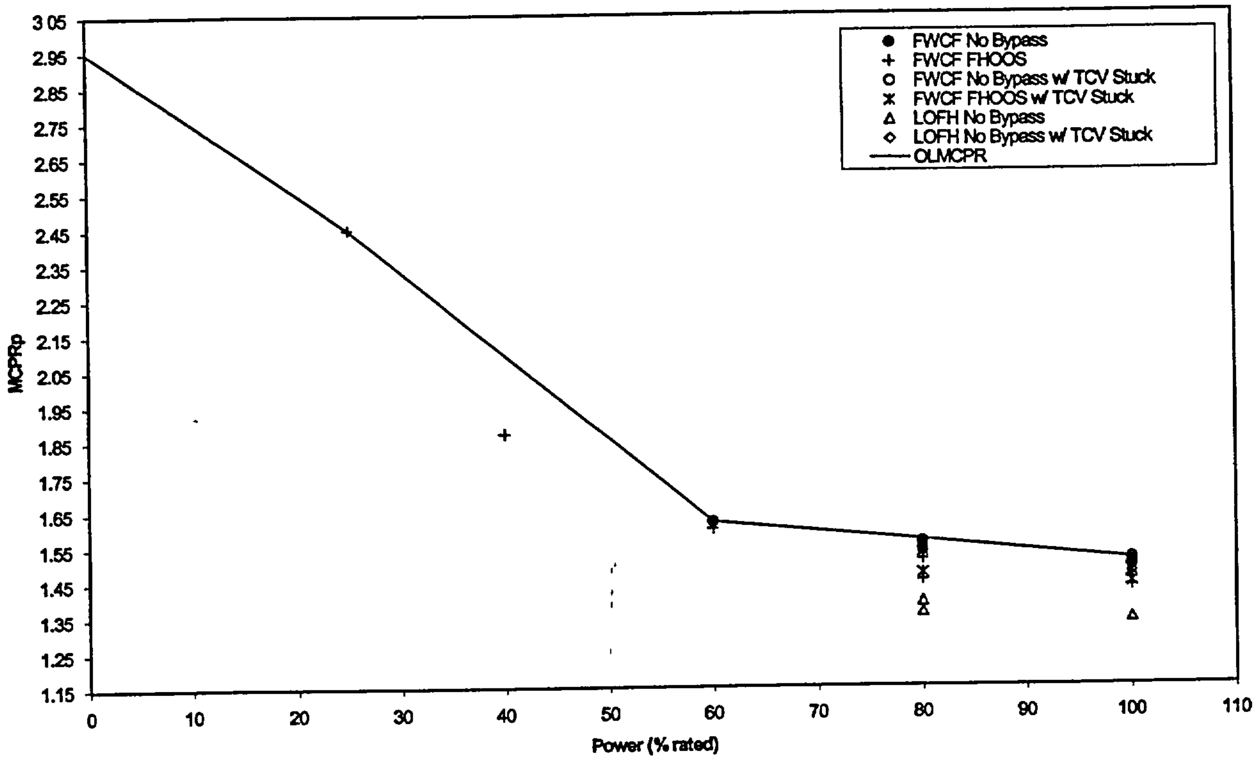
Power (%)	$MCPR_p$ Limit
100	1.45
60	1.58
25	2.15
25	2.20
0	2.70

Figure 5.11 15,000 MWd/MTU to EOC EOOS Case 1 Power-Dependent MCPR Limits for ATRIUM-9B Fuel – NSS Insertion Times



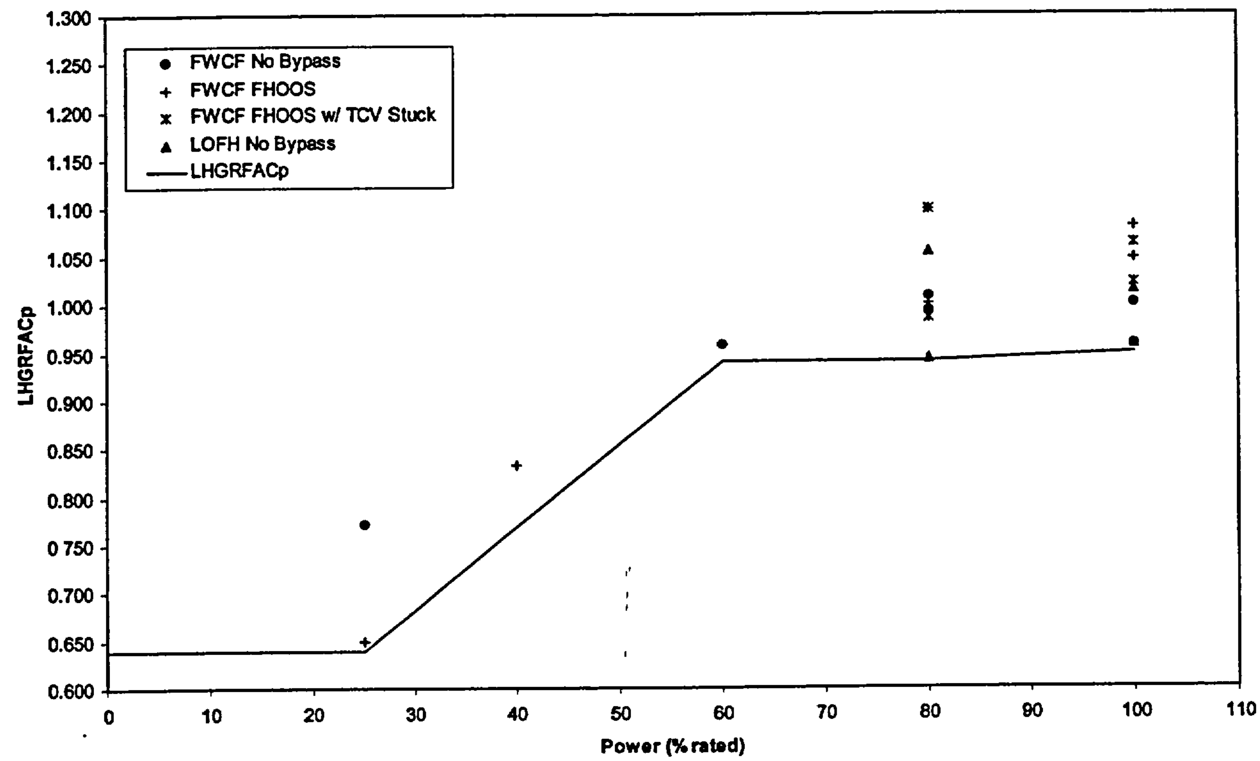
Power (%)	$LHGRFAC_p$ Multiplier
100	0.90
80	0.90
60	0.90
25	0.69
25	0.69
0	0.69

Figure 5.12 15,000 MWd/MTU to EOC EOOS Case 1 Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – NSS Insertion Times



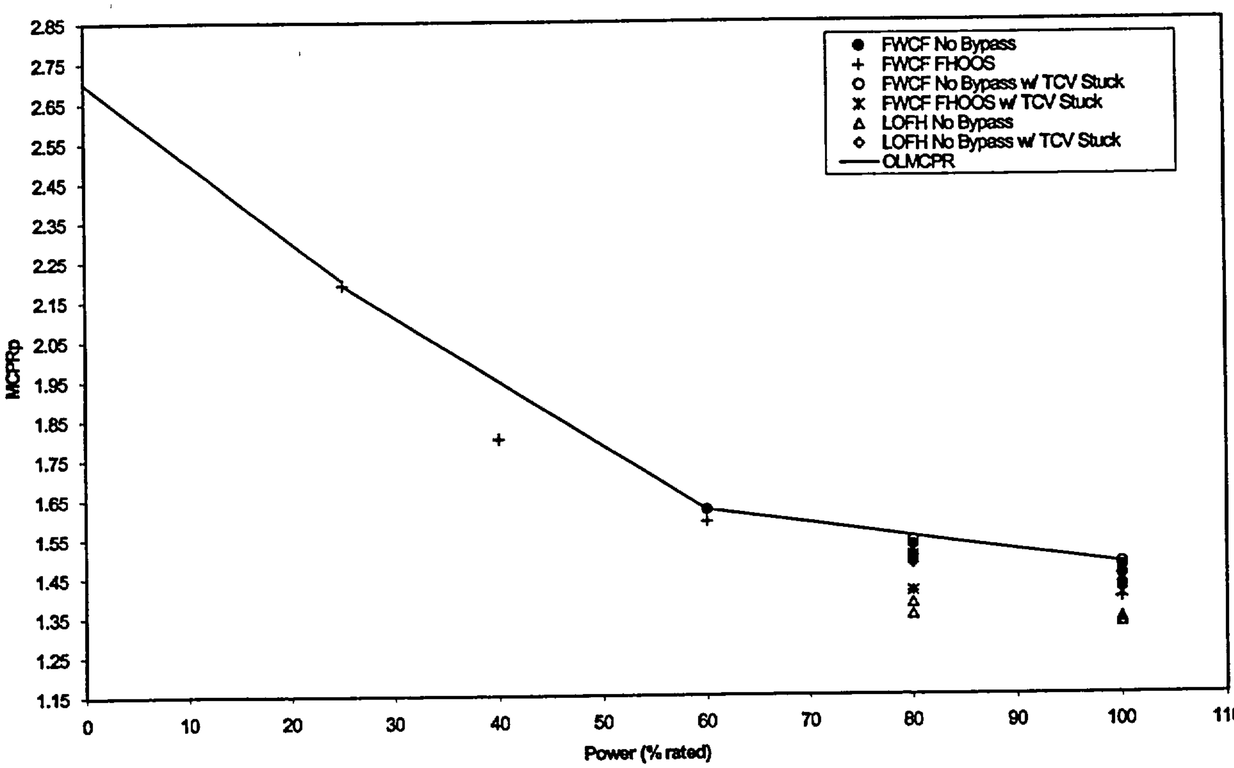
Power (%)	$MCPR_p$ Limit
100	1.51
60	1.62
25	2.45
25	2.45
0	2.95

Figure 5.13 15,000 MWd/MTU to EOC EOOS Case 1 Power-Dependent MCPR Limits for ATRIUM-10 Fuel – TSSS Insertion Times



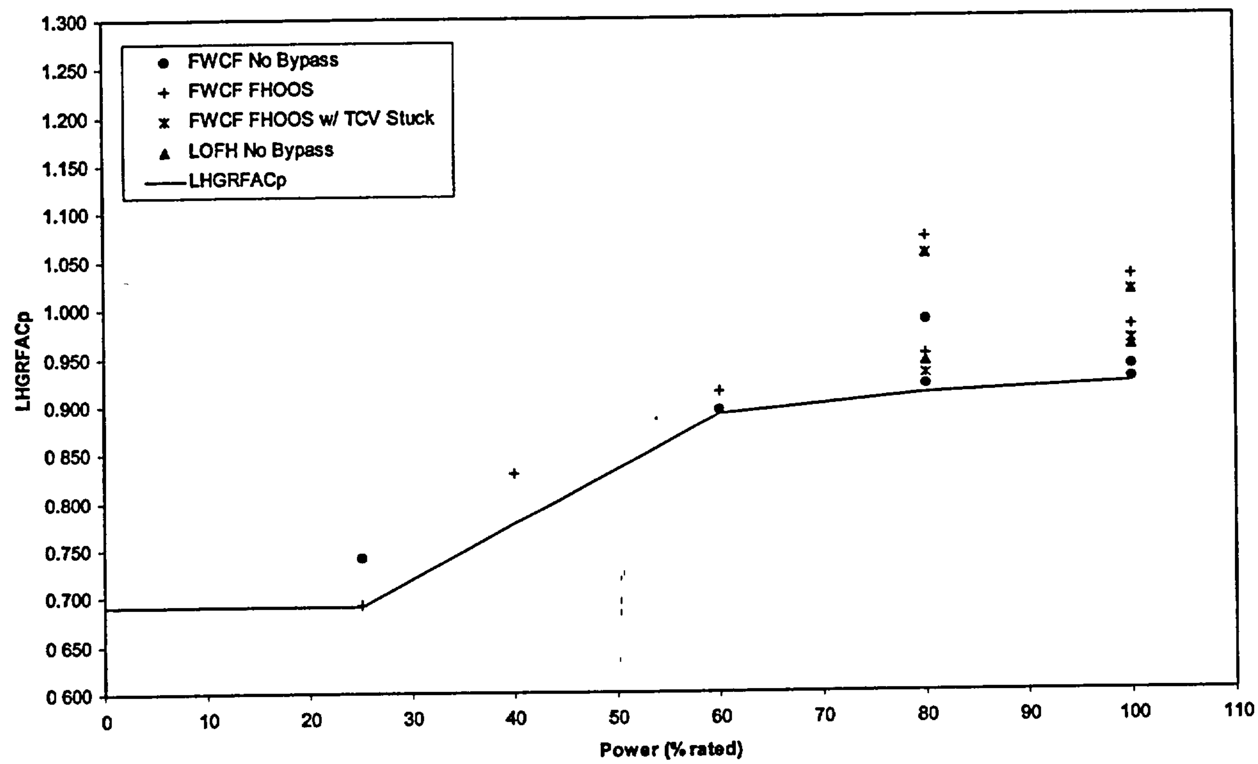
Power (%)	$LHGRFAC_p$ Multiplier
100	0.95
80	0.94
60	0.94
25	0.64
25	0.64
0	0.64

Figure 5.14 15,000 MWd/MTU to EOC EOOS Case 1 Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – TSSS Insertion Times



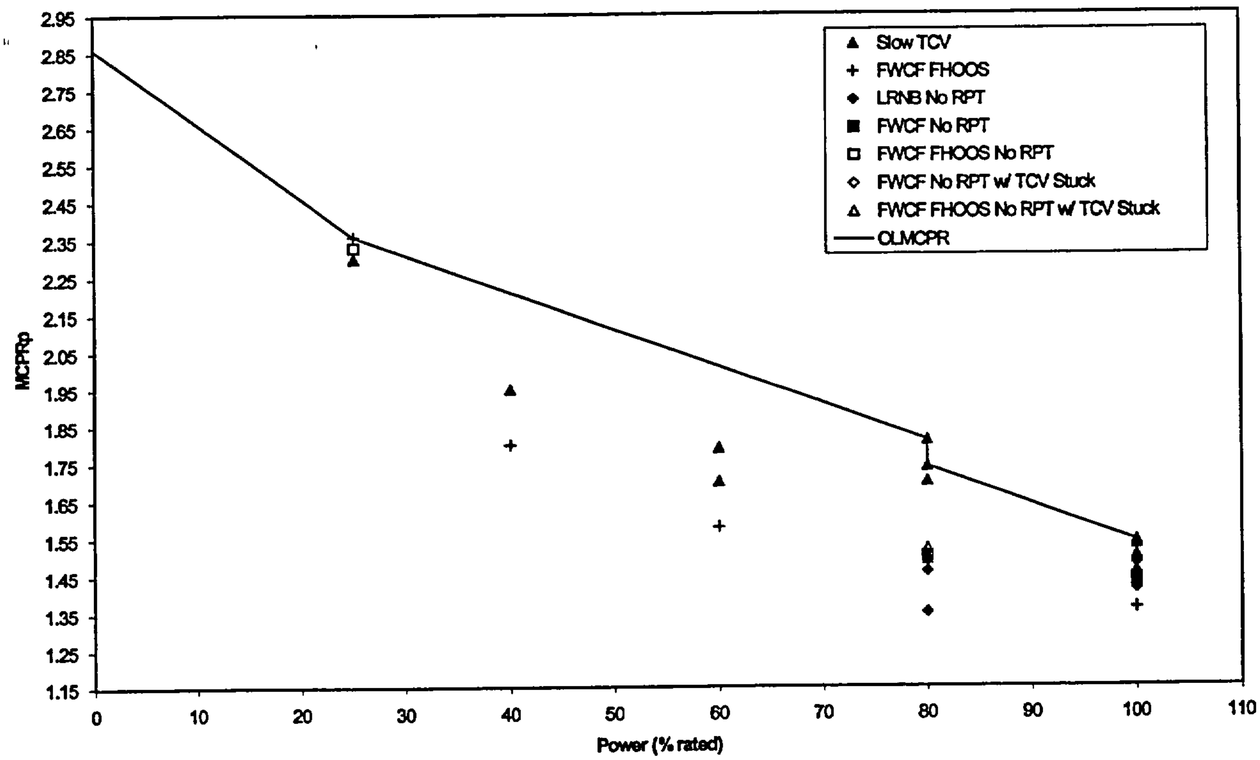
Power (%)	$MCPR_p$ Limit
100	1.48
60	1.62
25	2.19
25	2.20
0	2.70

Figure 5.15 15,000 MWd/MTU to EOC EOOS Case 1 Power-Dependent MCPR Limits for ATRIUM-9B Fuel – TSSS Insertion Times



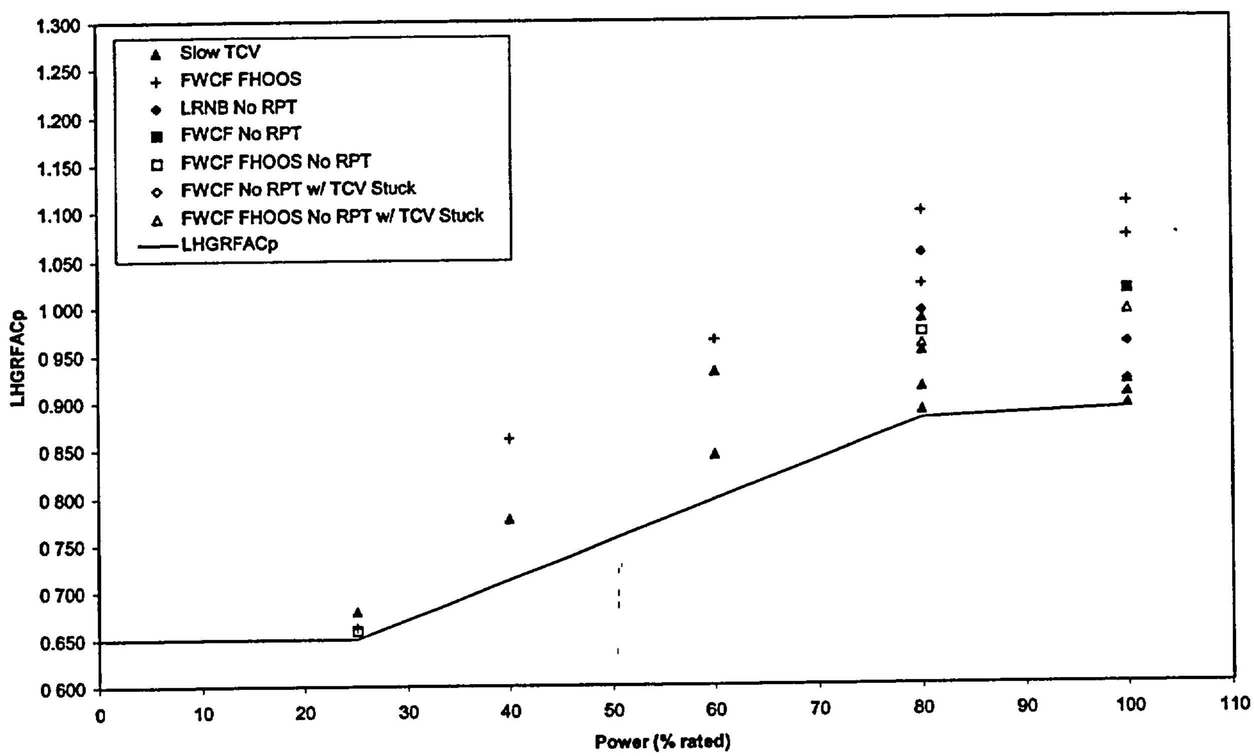
Power (%)	LHGRFAC$_p$ Multiplier
100	0.92
80	0.91
60	0.89
25	0.69
25	0.69
0	0.69

Figure 5.16 15,000 MWd/MTU to EOC EOOS Case 1 Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – TSSS Insertion Times



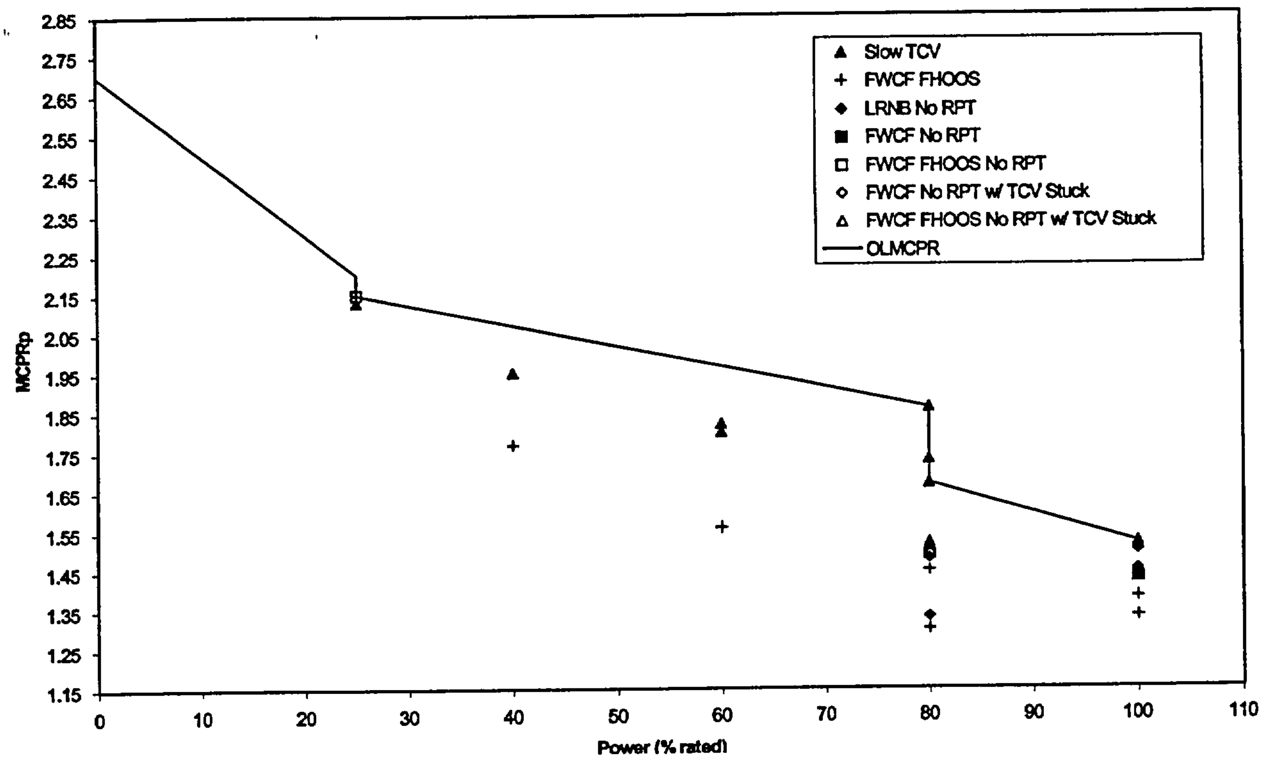
Power (%)	$MCPR_p$ Limit
100	1.54
80	1.74
80	1.81
25	2.36
25	2.36
0	2.86

Figure 5.17 BOC to 15,000 MWd/MTU EOOS Case 2 Power-Dependent MCPR Limits for ATRIUM-10 Fuel – NSS Insertion Times



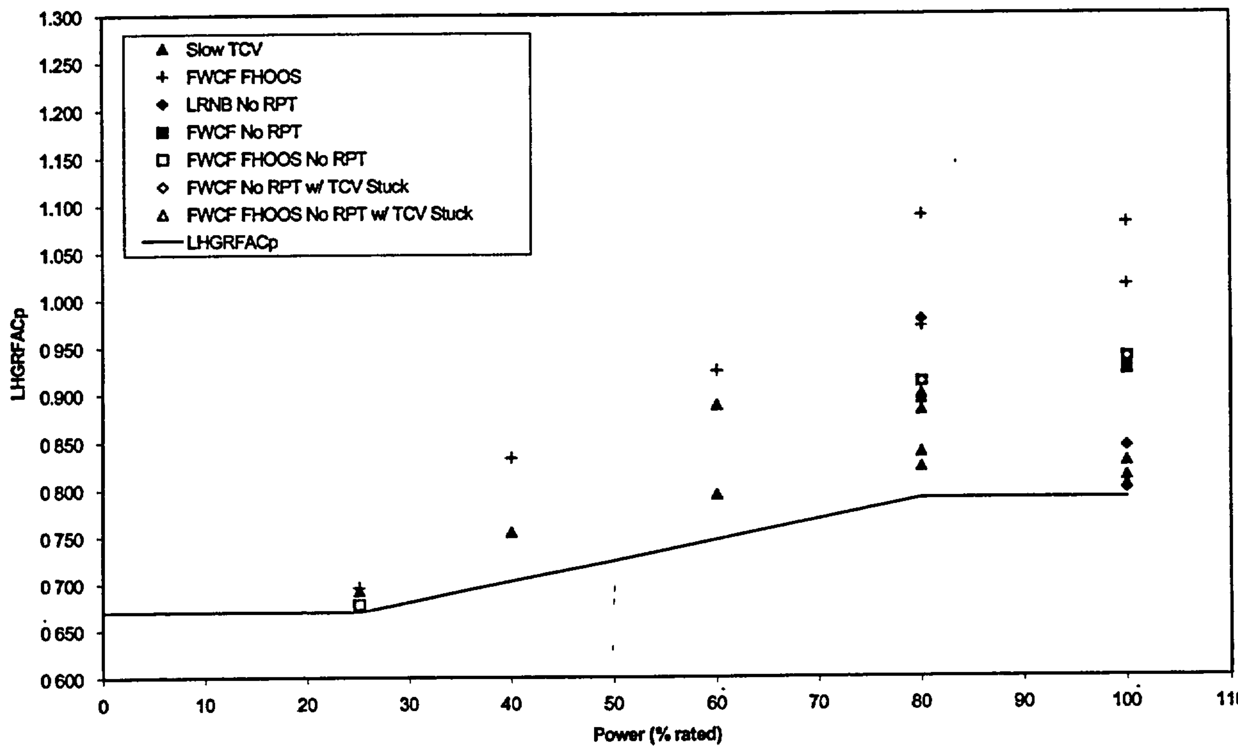
Power (%)	$LHGRFAC_p$ Multiplier
100	0.89
60	0.88
25	0.65
25	0.65
0	0.65

Figure 5.18 BOC to 15,000 MWd/MTU EOOS Case 2 Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – NSS Insertion Times



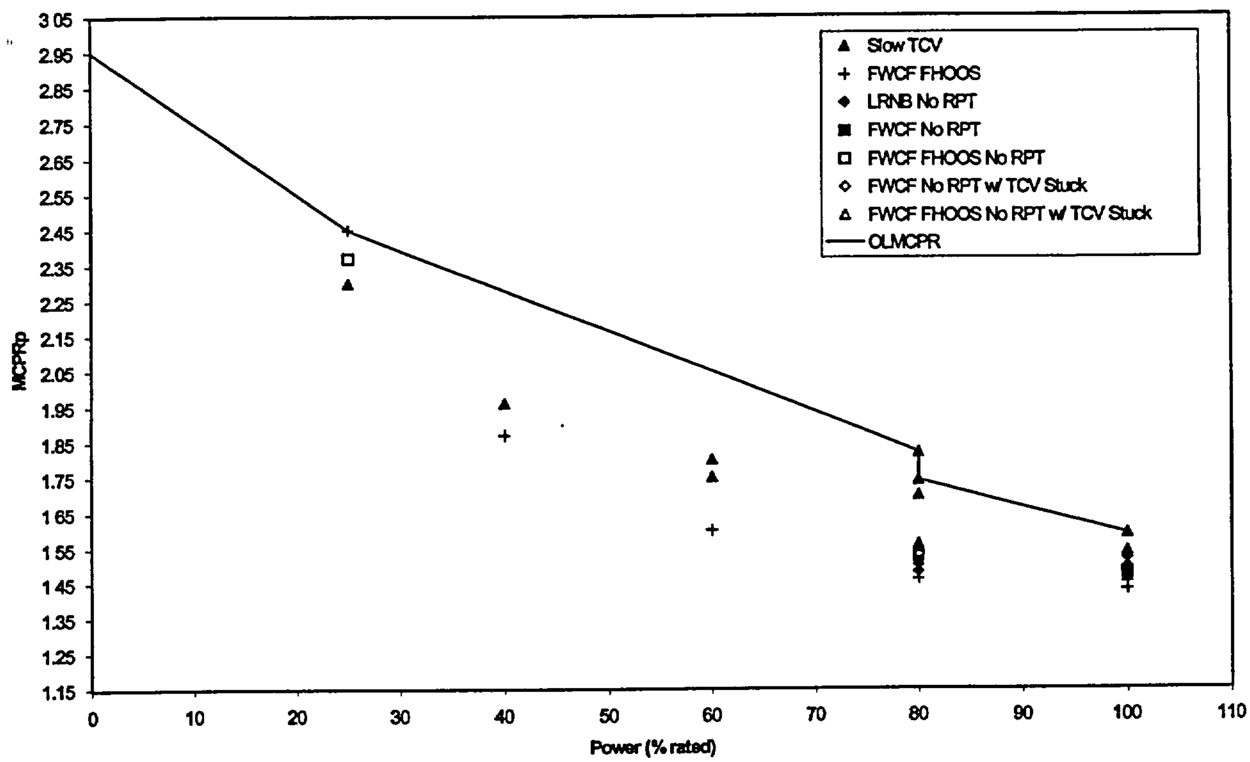
Power (%)	$MCPR_p$ Limit
100	1.52
80	1.67
80	1.86
25	2.15
25	2.20
0	2.70

Figure 5.19 BOC to 15,000 MWd/MTU EOOS Case 2 Power-Dependent MCPR Limits for ATRIUM-9B Fuel – NSS Insertion Times



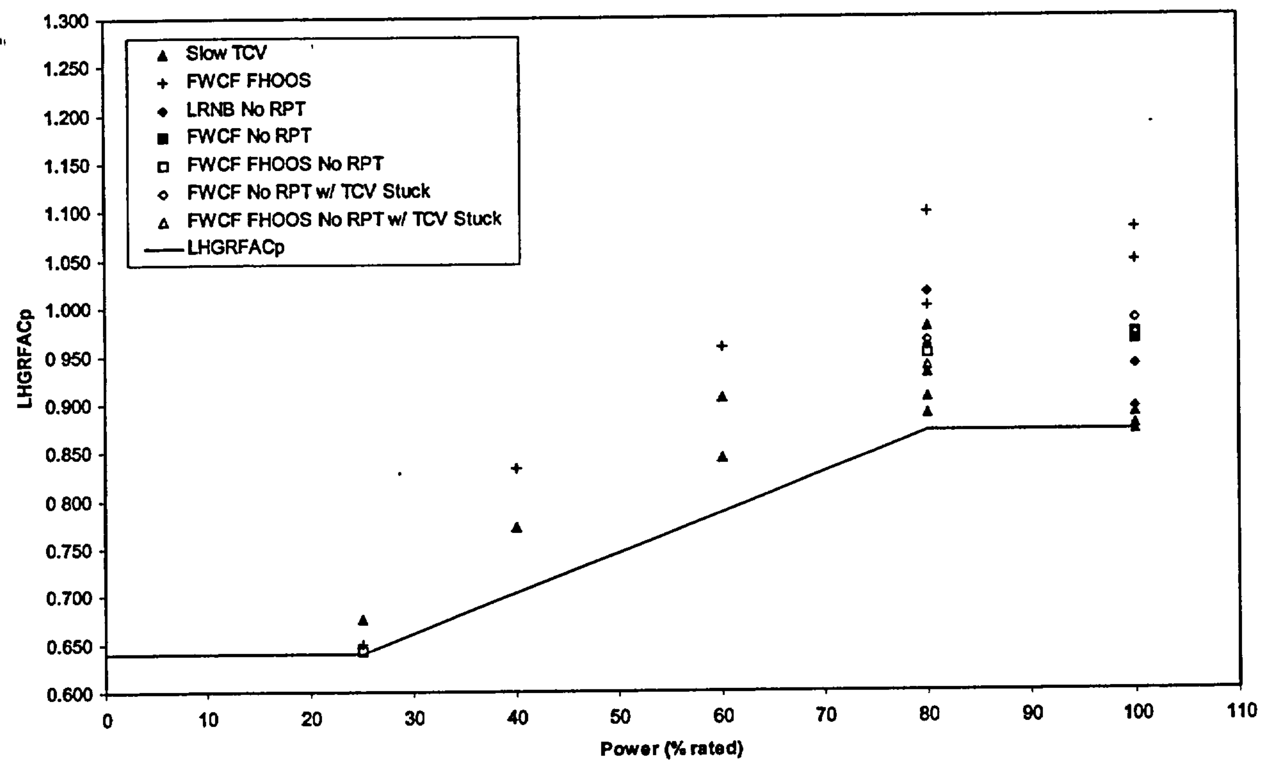
Power (%)	$LHGRFAC_p$ Multiplier
100	0.79
80	0.79
25	0.67
25	0.67
0	0.67

Figure 5.20 BOC to 15,000 MWd/MTU EOOS Case 2 Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – NSS Insertion Times



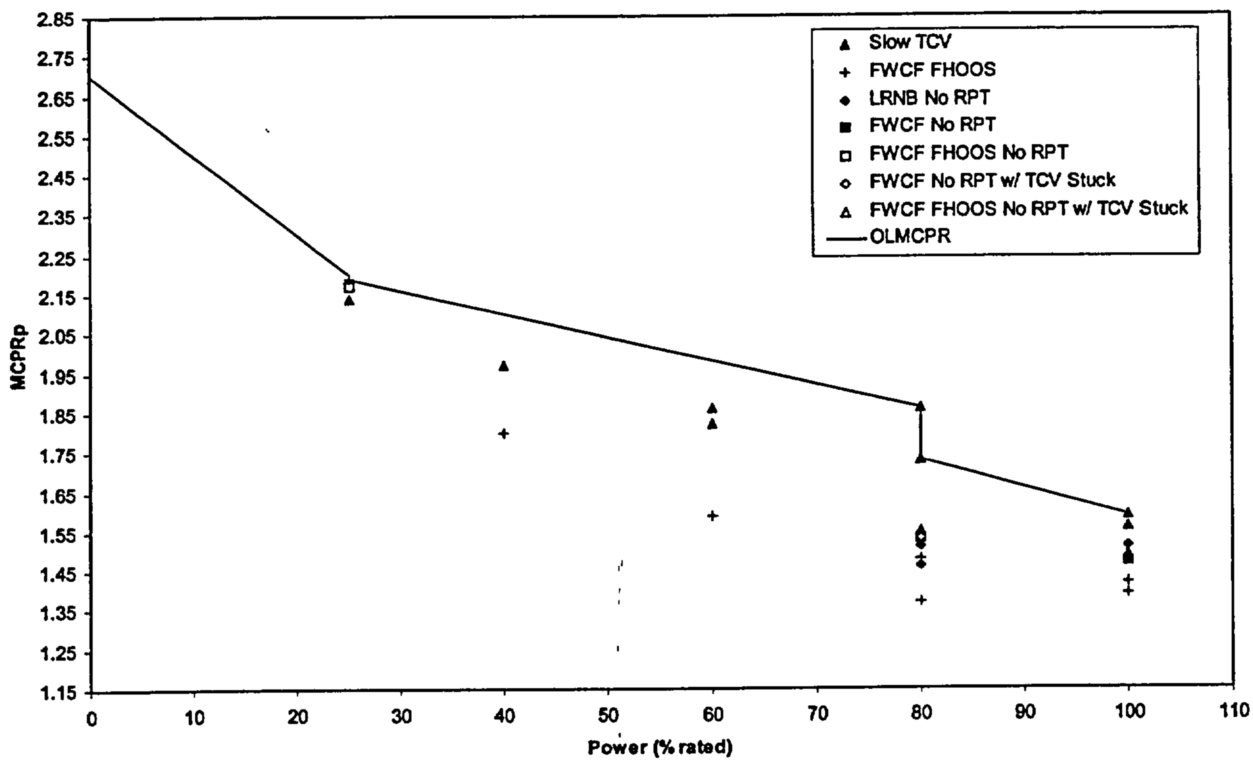
Power (%)	$MCPR_p$ Limit
100	1.59
80	1.74
80	1.82
25	2.45
25	2.45
0	2.95

Figure 5.21 BOC to 15,000 MWd/MTU EOOS Case 2 Power-Dependent MCPR Limits for ATRIUM-10 Fuel – TSSS Insertion Times



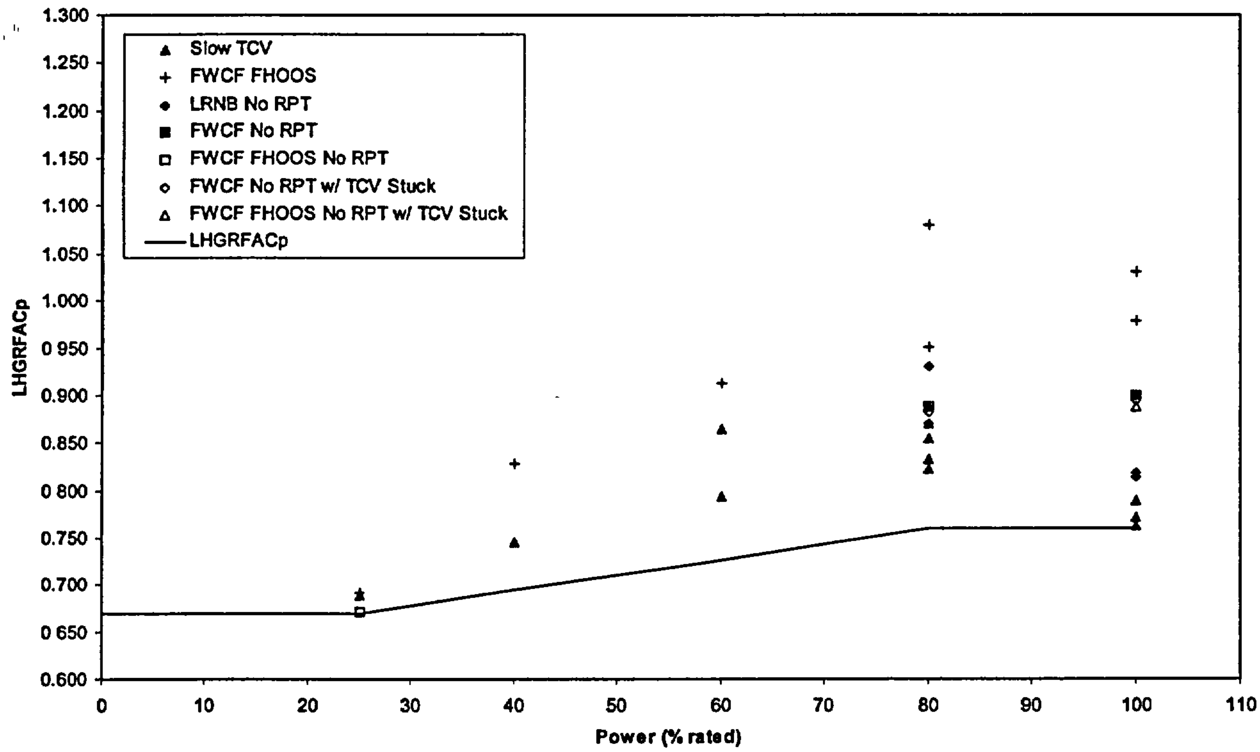
Power (%)	$LHGRFAC_p$ Multiplier
100	0.87
80	0.87
25	0.64
25	0.64
0	0.64

Figure 5.22 BOC to 15,000 MWd/MTU EOOS Case 2 Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – TSSS Insertion Times



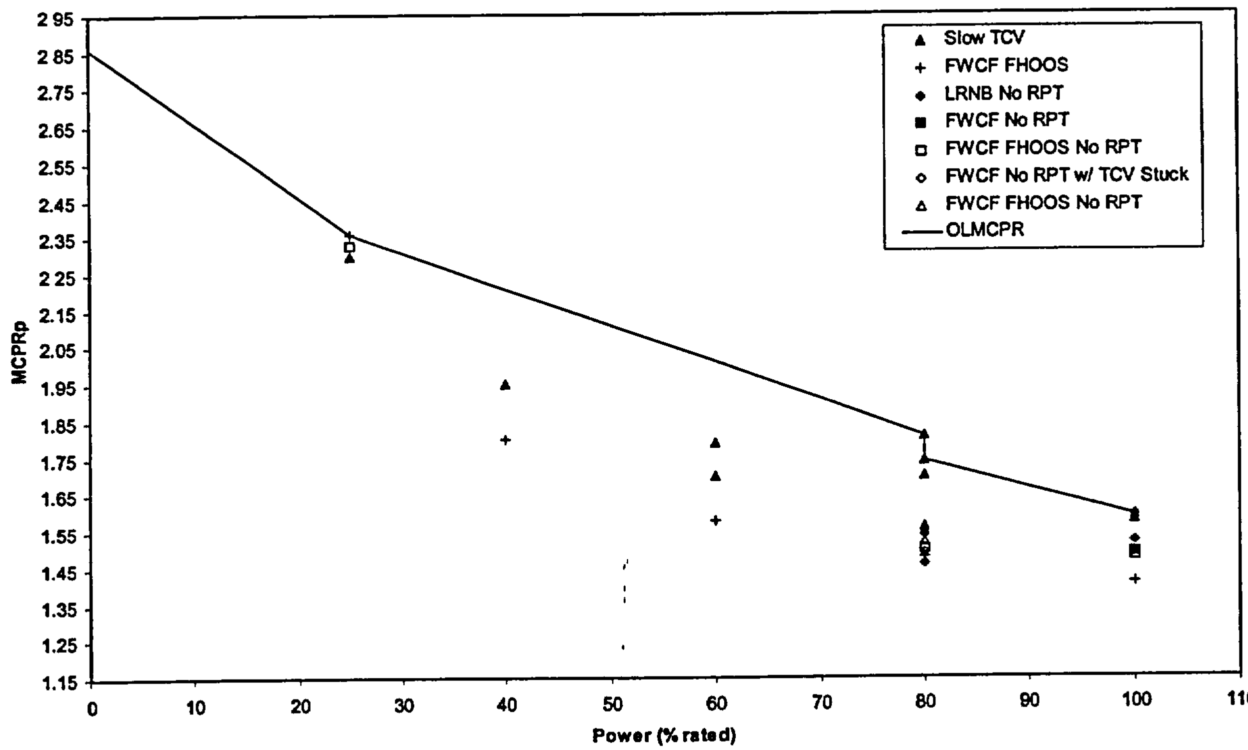
Power (%)	$MCPR_p$ Limit
100	1.59
80	1.73
80	1.86
25	2.19
25	2.20
0	2.70

Figure 5.23 BOC to 15,000 MWd/MTU EOOS Case 2 Power-Dependent MCPR Limits for ATRIUM-9B Fuel – TSSS Insertion Times



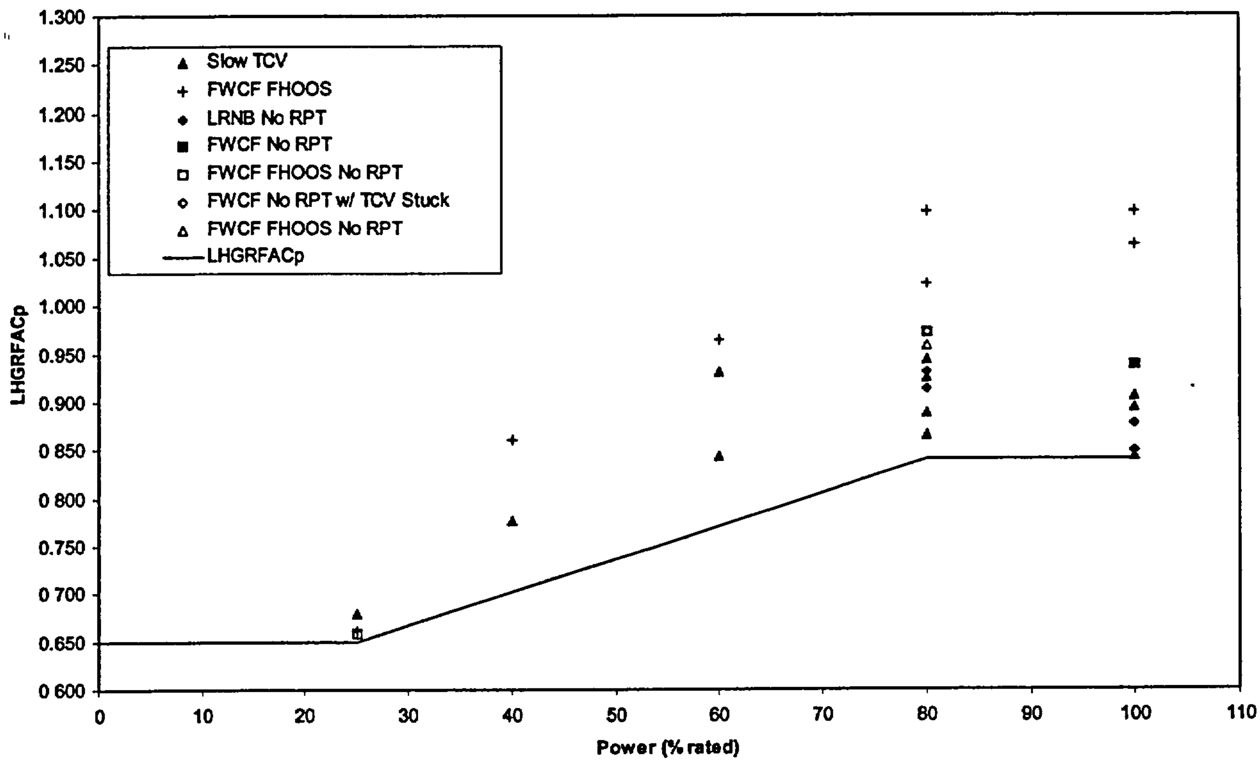
Power (%)	$LHGRFAC_p$ Multiplier
100	0.76
80	0.76
25	0.67
25	0.67
0	0.67

Figure 5.24 BOC to 15,000 MWd/MTU EOOS Case 2 Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – TSSS Insertion Times



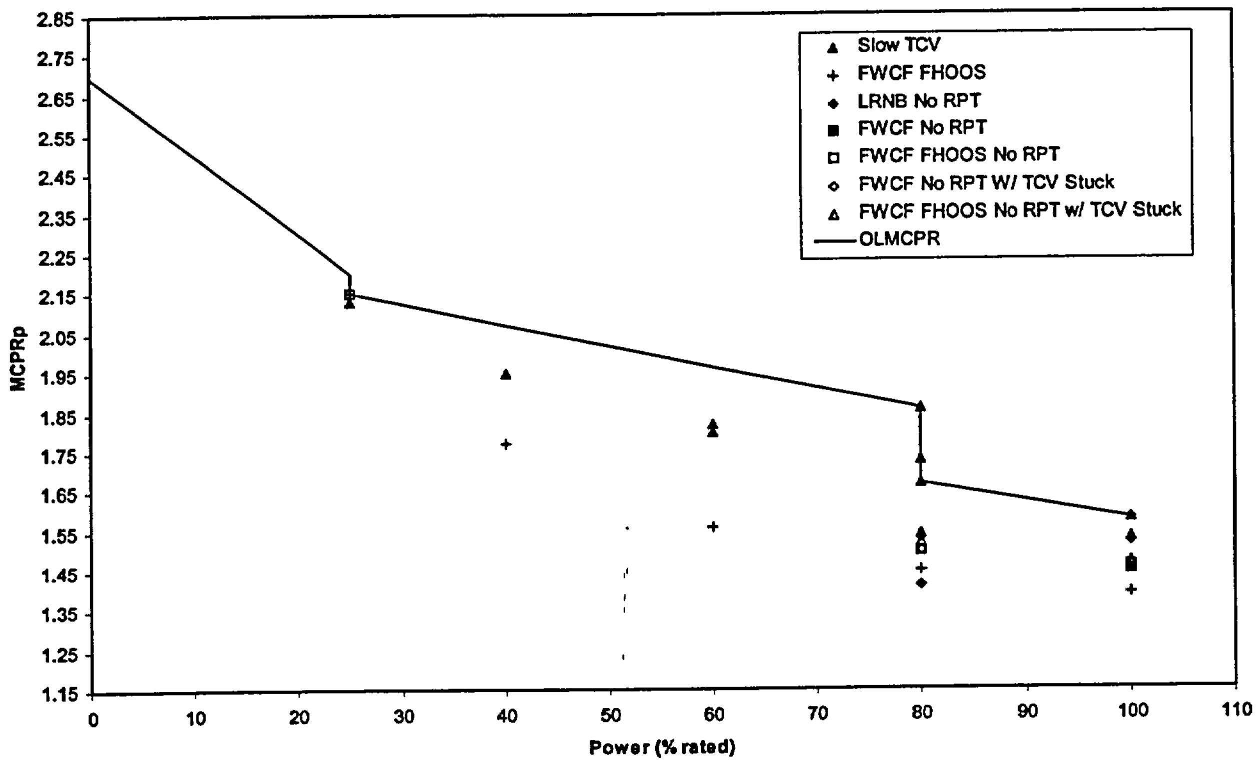
Power (%)	$MCPR_p$ Limit
100	1.59
80	1.74
80	1.81
25	2.36
25	2.36
0	2.86

Figure 5.25 15,000 MWd/MTU to EOC EOOS Case 2 Power-Dependent MCPR Limits for ATRIUM-10 Fuel – NSS Insertion Times



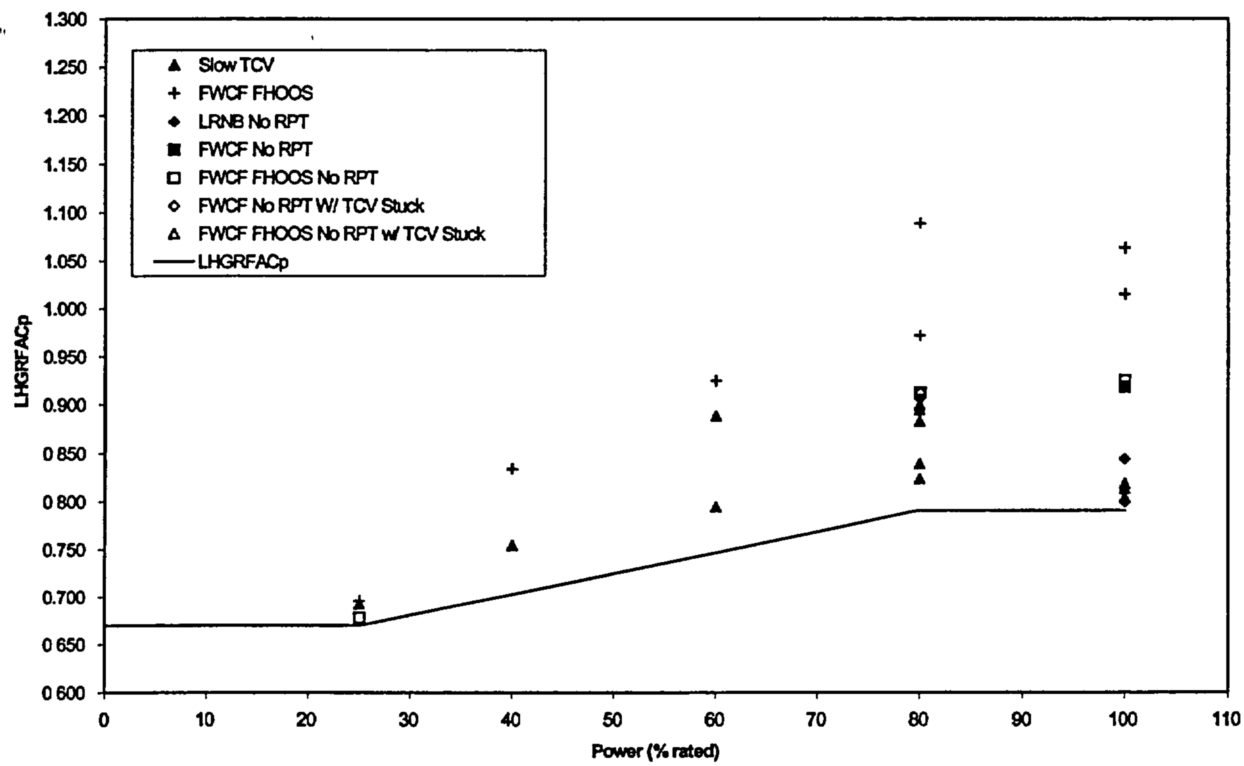
Power (%)	$LHGRFAC_p$ Multiplier
100	0.84
80	0.84
25	0.65
25	0.65
0	0.65

Figure 5.26 15,000 MWd/MTU to EOC EOOS Case 2 Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – NSS Insertion Times



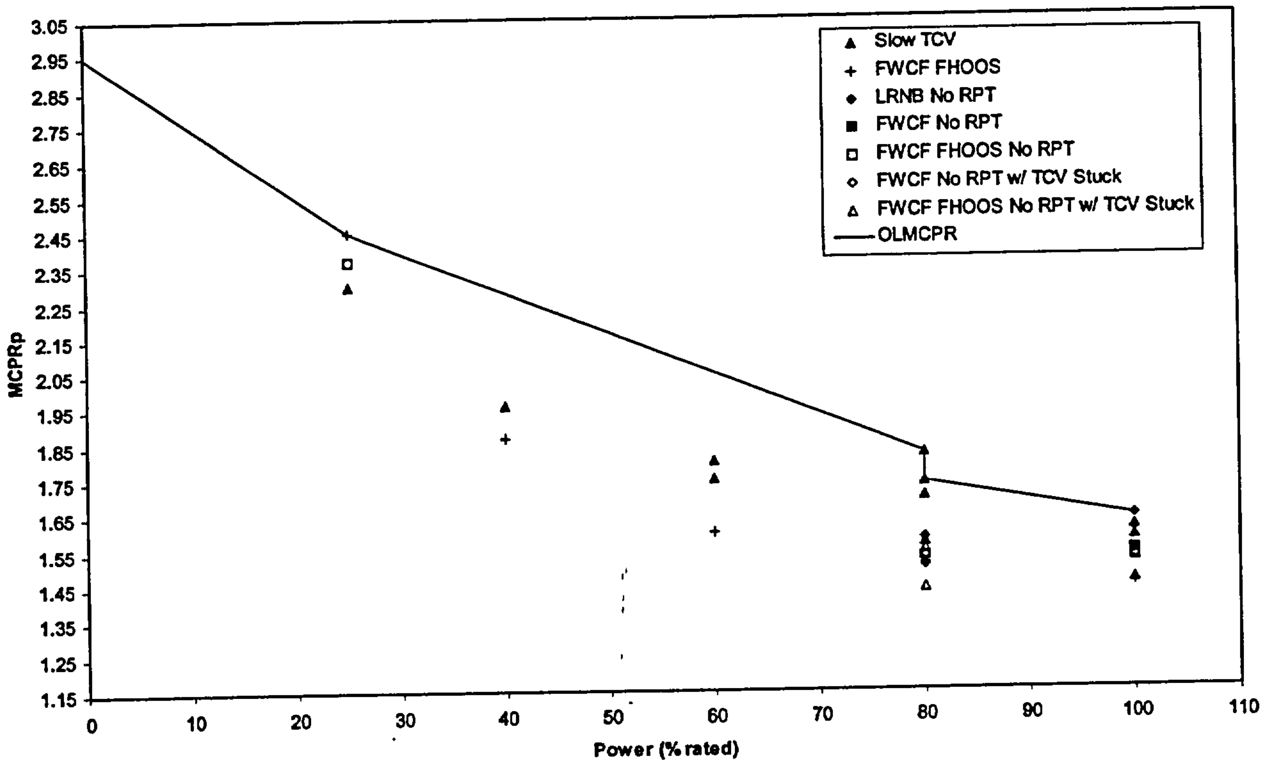
Power (%)	$MCPR_p$ Limit
100	1.58
80	1.67
80	1.86
25	2.15
25	2.20
0	2.70

Figure 5.27 15,000 MWd/MTU to EOC EOOS Case 2 Power-Dependent MCPR Limits for ATRIUM-9B Fuel – NSS Insertion Times



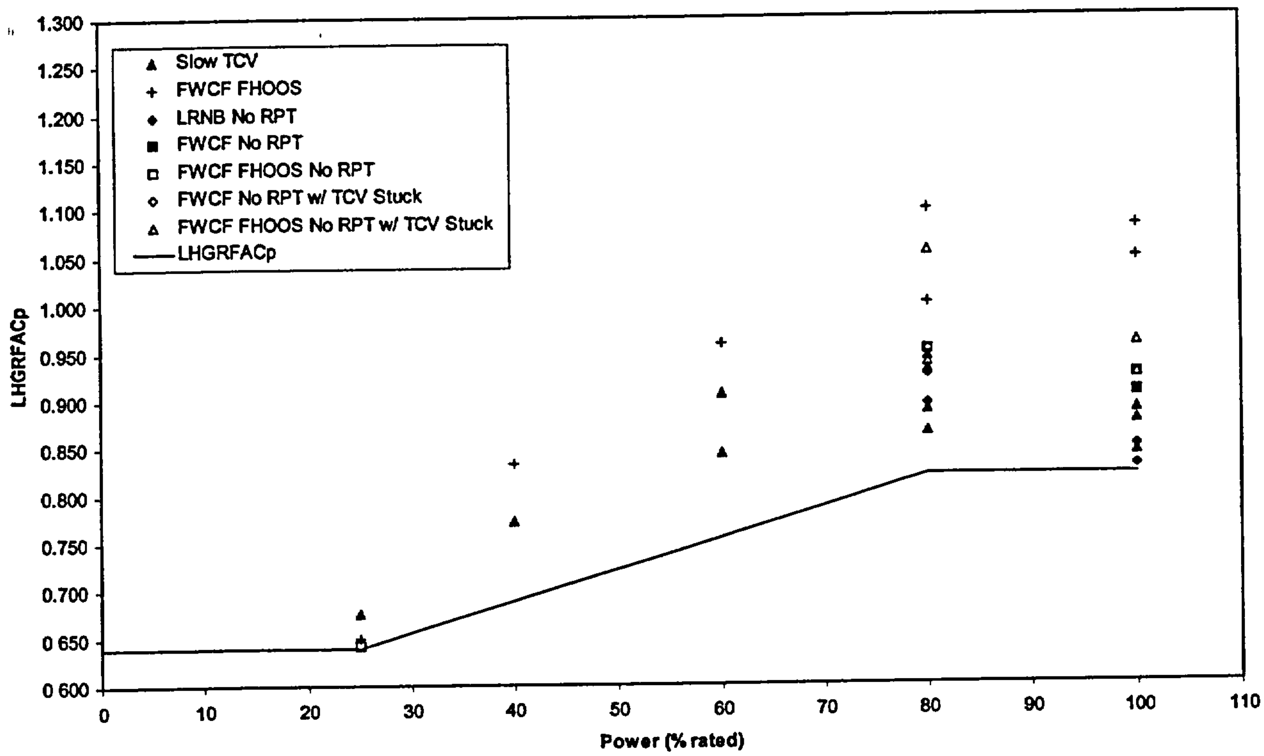
Power (%)	$LHGRFAC_p$ Multiplier
100	0.79
80	0.79
25	0.67
25	0.67
0	0.67

Figure 5.28 15,000 MWd/MTU to EOC EOOS Case 2 Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – NSS Insertion Times



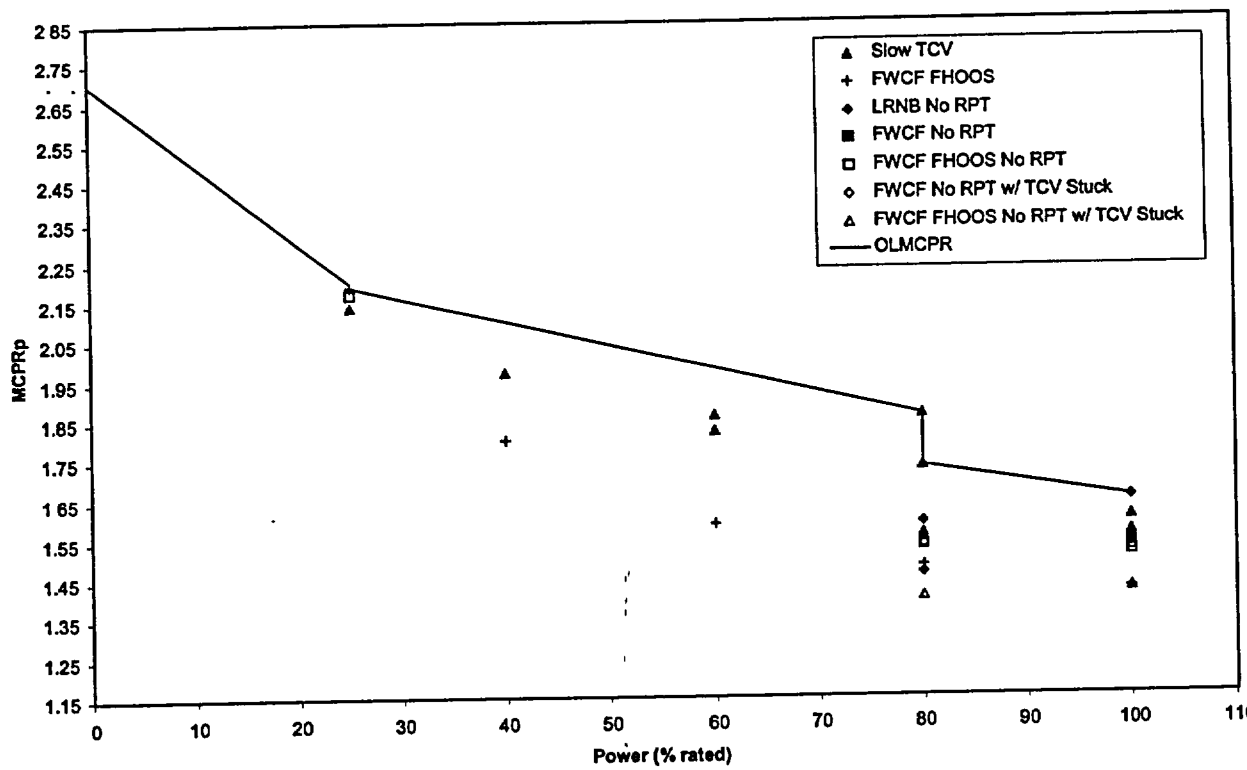
Power (%)	$MCPR_p$ Limit
100	1.64
80	1.74
80	1.82
25	2.45
25	2.45
0	2.95

Figure 5.29 15,000 MWd/MTU to EOC EOOS Case 2 Power-Dependent MCPR Limits for ATRIUM-10 Fuel – TSSS Insertion Times



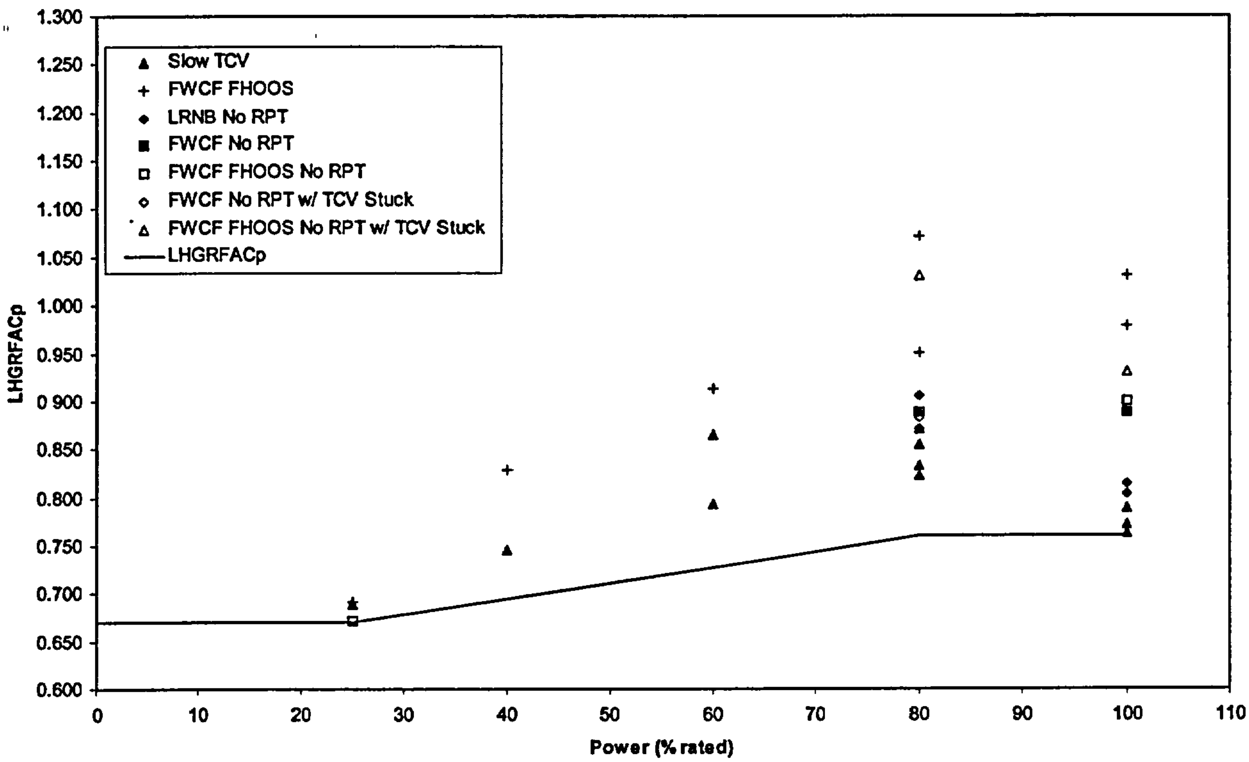
Power (%)	$LHGRFAC_p$ Multiplier
100	0.82
80	0.82
25	0.64
25	0.64
0	0.64

Figure 5.30 15,000 MWd/MTU to EOC EOOS Case 2 Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – TSSS Insertion Times



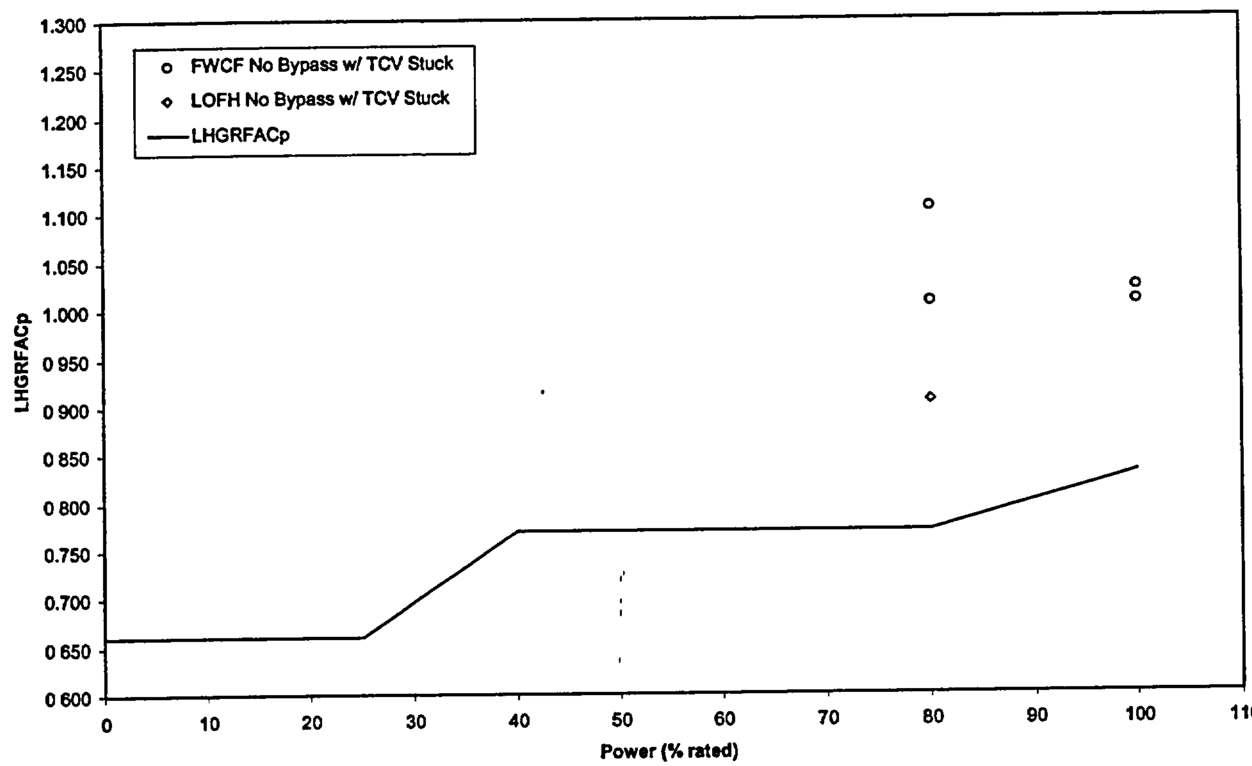
Power (%)	$MCPR_p$ Limit
100	1.65
80	1.73
80	1.86
25	2.19
25	2.20
0	2.70

Figure 5.31 15,000 MWd/MTU to EOC EOOS Case 2 Power-Dependent MCPR Limits for ATRIUM-9B Fuel – TSSS Insertion Times



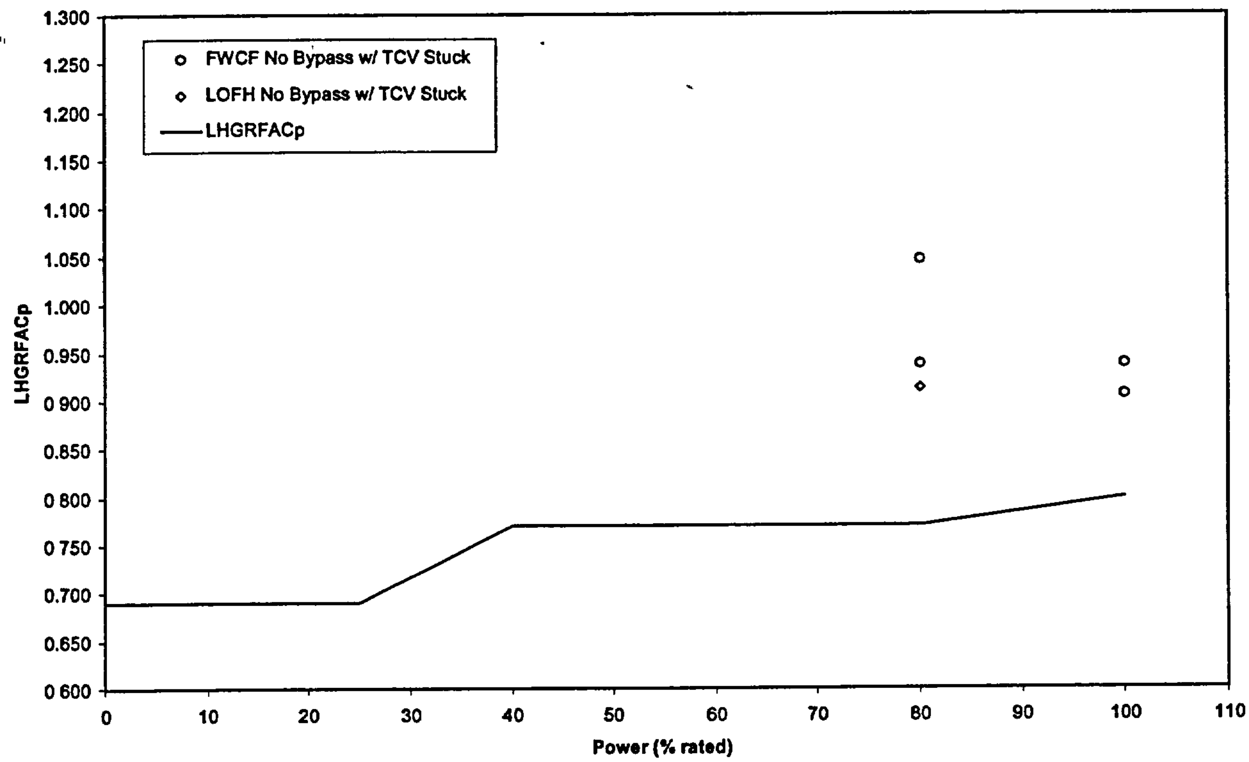
Power (%)	$LHGRFAC_p$ Multiplier
100	0.76
80	0.76
25	0.67
25	0.67
0	0.67

Figure 5.32 15,000 MWd/MTU to EOC EOOS Case 2 Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – TSSS Insertion Times



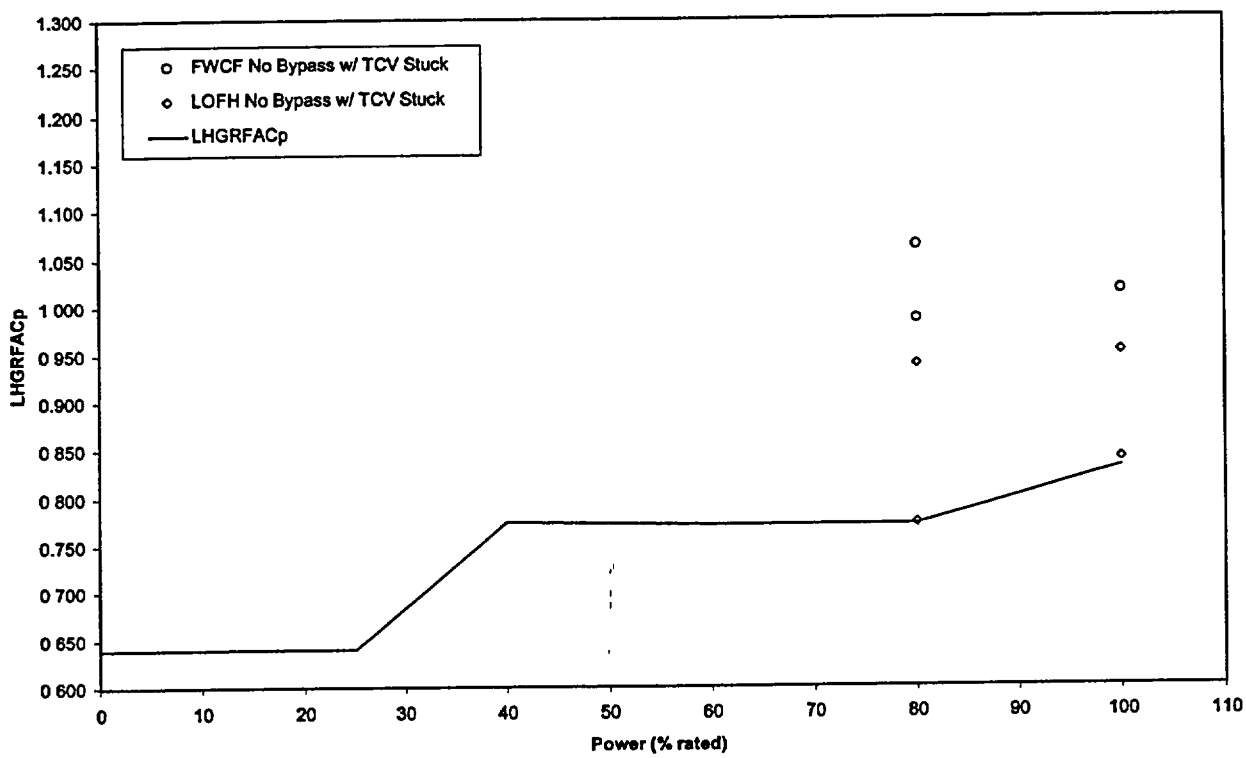
Power (%)	$LHGRFAC_p$ Multiplier
100	0.83
80	0.77
40	0.77
25	0.66
25	0.66
0	0.66

Figure 5.33 BOC to 15,000 MWd/MTU 1 TCV Stuck Closed With TBVOOS Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – NSS Insertion Times



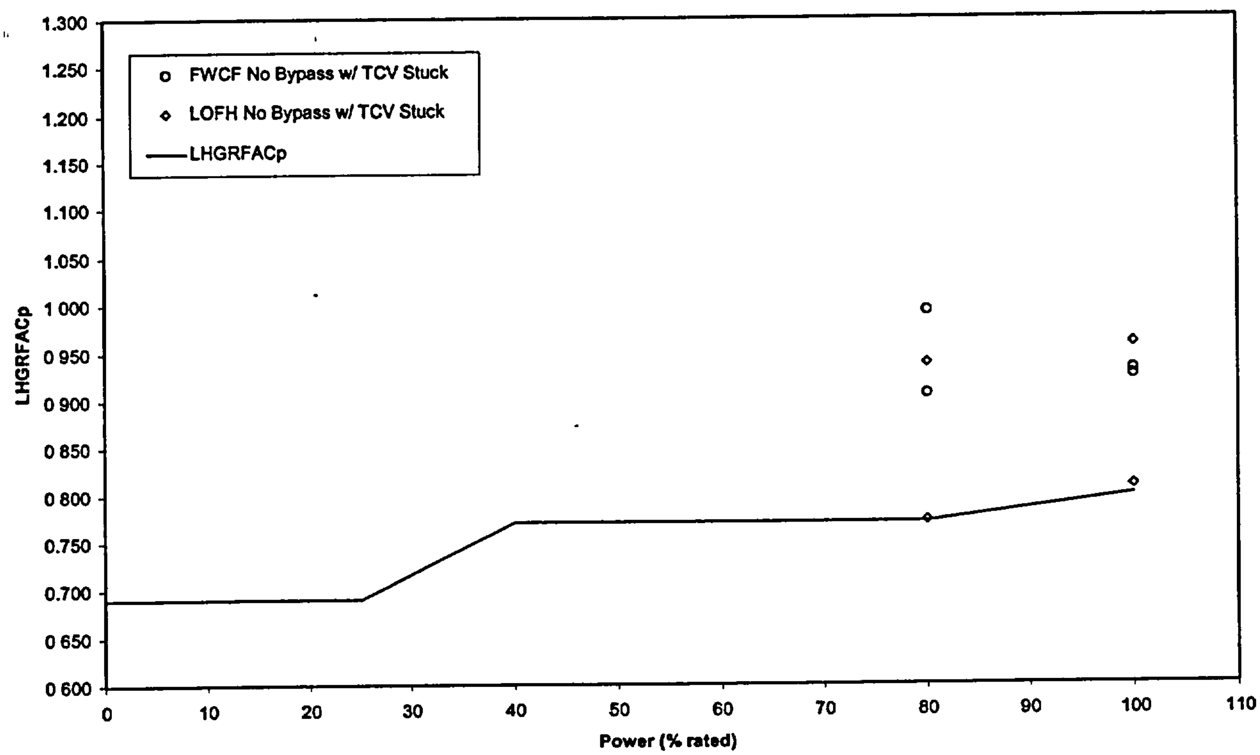
Power (%)	$LHGRFAC_p$ Multiplier
100	0.80
80	0.77
40	0.77
25	0.69
25	0.69
0	0.69

Figure 5.34 BOC to 15,000 MWd/MTU 1 TCV Stuck Closed With TBVOOS Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – NSS Insertion Times



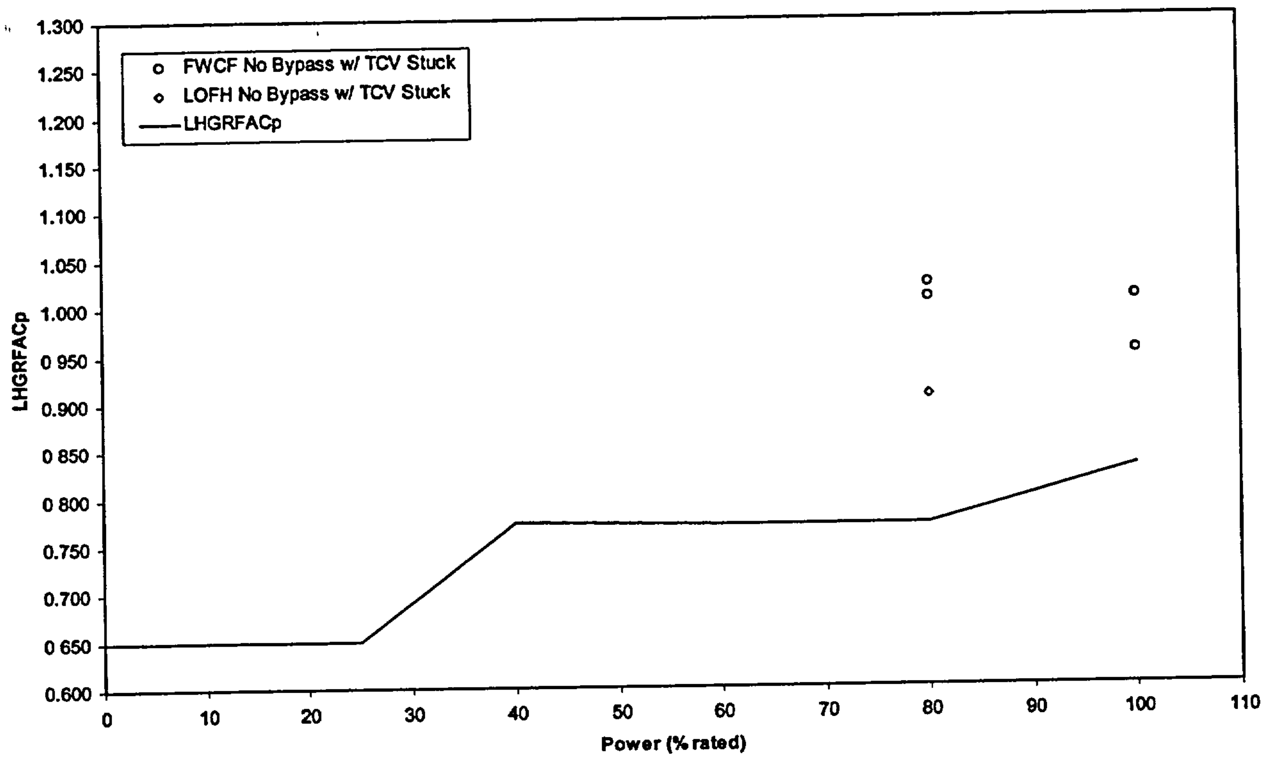
Power (%)	$LHGRFAC_p$ Multiplier
100	0.83
80	0.77
40	0.77
25	0.64
25	0.64
0	0.64

Figure 5.35 BOC to 15,000 MWd/MTU 1 TCV Stuck Closed With TBVOOS Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – TSSS Insertion Times



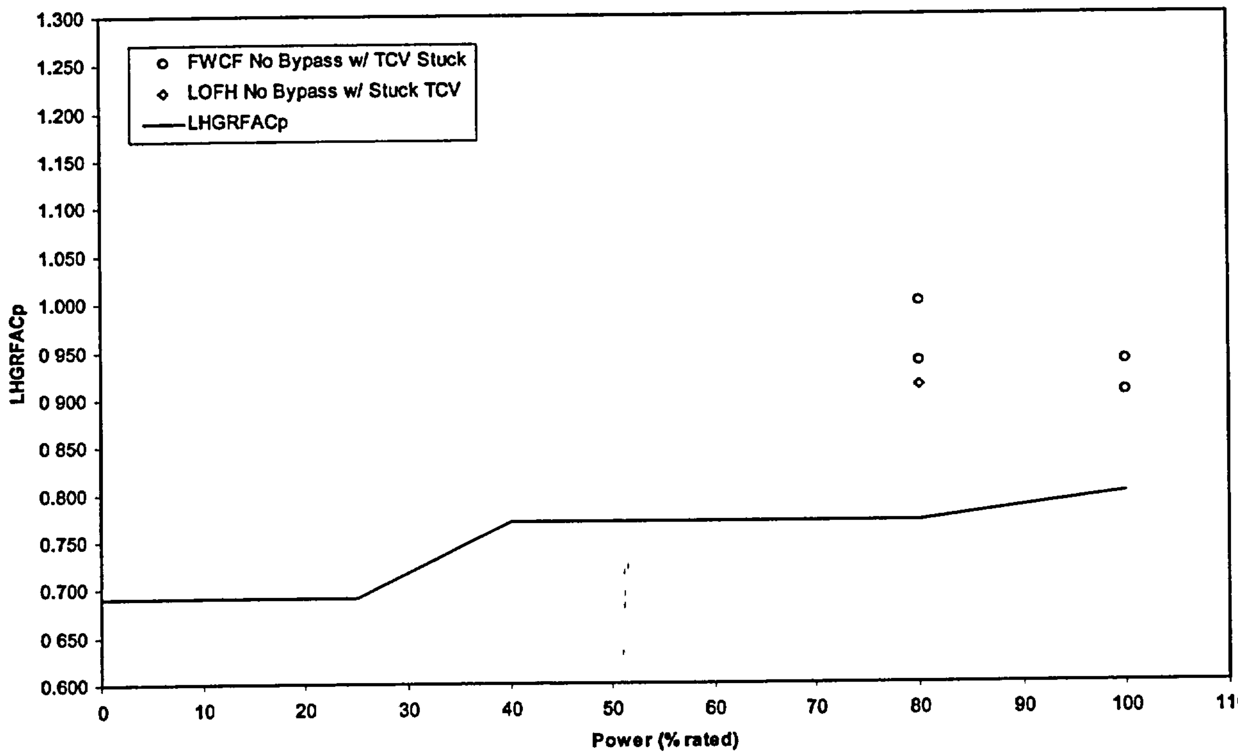
Power (%)	$LHGRFAC_p$ Multiplier
100	0.80
80	0.77
40	0.77
25	0.69
25	0.69
0	0.69

Figure 5.36 BOC to 15,000 MWd/MTU 1 TCV Stuck Closed With TBVOOS Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – TSSS Insertion Times



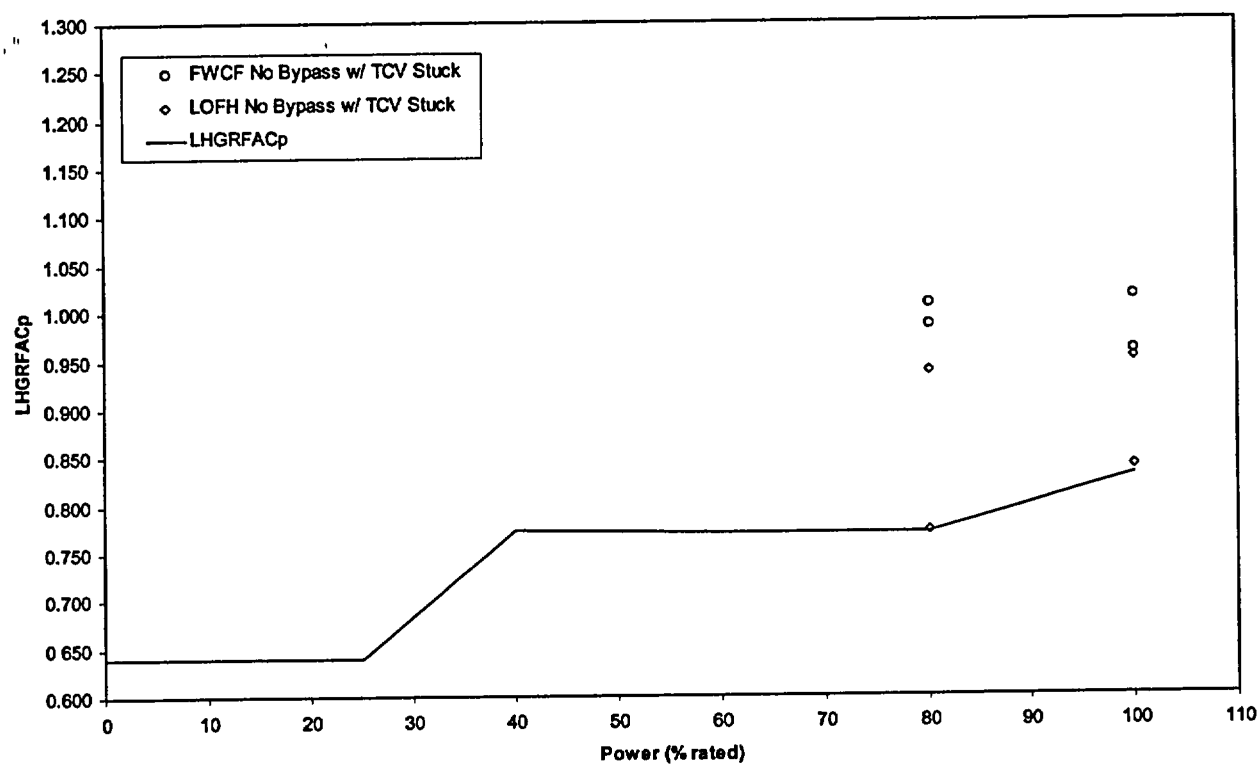
Power (%)	$LHGRFAC_p$ Multiplier
100	0.83
80	0.77
40	0.77
25	0.65
25	0.65
0	0.65

Figure 5.37 15,000 MWd/MTU to EOC 1 TCV Stuck Closed With TBVOOS Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – NSS Insertion Times



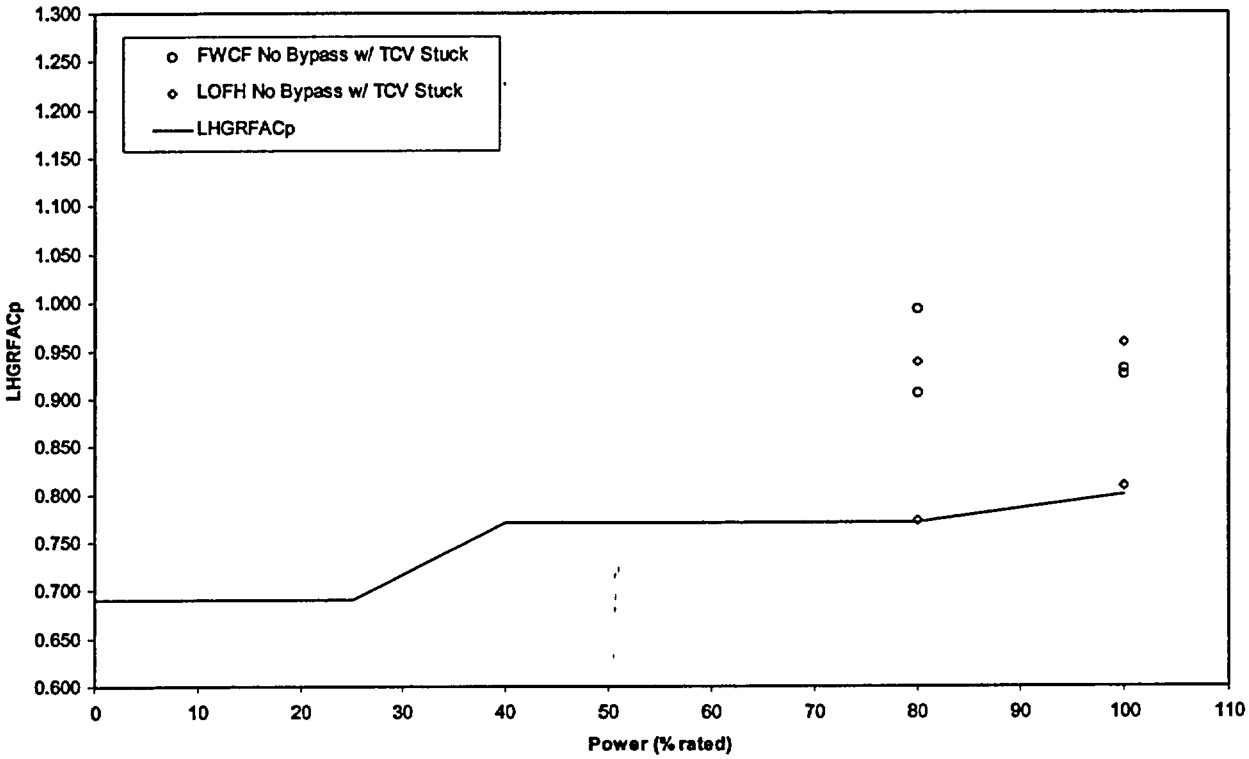
Power (%)	$LHGRFAC_p$ Multiplier
100	0.80
80	0.77
40	0.77
25	0.69
25	0.69
0	0.69

Figure 5.38 15,000 MWd/MTU to EOC 1 TCV Stuck Closed With TBVOOS Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – NSS Insertion Times



Power (%)	LHGRFAC$_p$ Multiplier
100	0.83
80	0.77
40	0.77
25	0.64
25	0.64
0	0.64

Figure 5.39 15,000 MWd/MTU to EOC 1 TCV Stuck Closed With TBVOOS Power-Dependent LHGR Multipliers for ATRIUM-10 Fuel – TSSS Insertion Times



Power (%)	LHGRFAC$_p$ Multiplier
100	0.80
80	0.77
40	0.77
25	0.69
25	0.69
0	0.69

Figure 5.40 15,000 MWd/MTU to EOC 1 TCV Stuck Closed With TBVOOS Power-Dependent LHGR Multipliers for ATRIUM-9B Fuel – TSSS Insertion Times

6.0 Transient Analysis for Thermal Margin - EOD/EOOS Combinations

The limits presented in Section 5.0 support operation with ICF in conjunction with the EOOS scenarios presented in Table 1.1. Operation in the other EOD conditions (i.e. coastdown and FFTR/coastdown) is currently not supported for LaSalle Unit 1 Cycle 10.

7.0 Maximum Overpressurization Analysis

This section describes the maximum overpressurization analyses performed to demonstrate compliance with the ASME Boiler and Pressure Vessel Code. The analysis shows that the safety/relief valves at LaSalle Unit 1 have sufficient capacity and performance to prevent the pressure from reaching the pressure safety limit of 110% of the design pressure.

7.1 *Design Basis*

The MSIV closure analysis was performed with the FRA-ANP plant simulator code COTRANSA2 (Reference 4) at a power/flow state point of 102% of rated power/105% flow. As indicated in Reference 1, the overpressurization analysis was performed at a cycle exposure of EOC + 1000 MWd/MTU. The following assumptions were made in the analysis.

- The most critical active component (direct scram on valve position) was assumed to fail. However, scram on high-neutron flux and high-dome pressure is available.
- At Exelon's request, analyses were performed to determine the minimum number of the highest set-point SRVs required to meet the ASME and Technical Specification pressure limits. It was determined that having the 10 highest set-point SRVs operable will meet the ASME and Technical Specification pressure limits. In order to support operation with 1 SRV out-of-service, the plant configuration needs to include at least 11 SRVs. As per ASME requirements, the SRVs are assumed to operate in the safety mode.
- TSSS insertion times were used.
- The initial dome pressure was set at the maximum allowed by the Technical Specifications (1035 psia).
- An MSIV closure time of 1.1 seconds was assumed in the analysis.
- EOC RPT is assumed inoperable; ATWS (high-dome pressure) RPT is available.

7.2 *Pressurization Transients*

Results of analysis for the MSIV closure event initiated at 102% power/105% flow are presented in Table 7.1. Figures 7.1–7.5 show the response of various reactor plant parameters to the MSIV closure event. The maximum pressure of 1346 psig occurs in the lower plenum at approximately 4.3 seconds. The maximum dome pressure of 1321 psig occurs at 4.4 seconds. The results demonstrate that the maximum vessel pressure limit of 1375 psig and dome pressure limit of 1325 psig are not exceeded.

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 closure	340	138	1346	1321

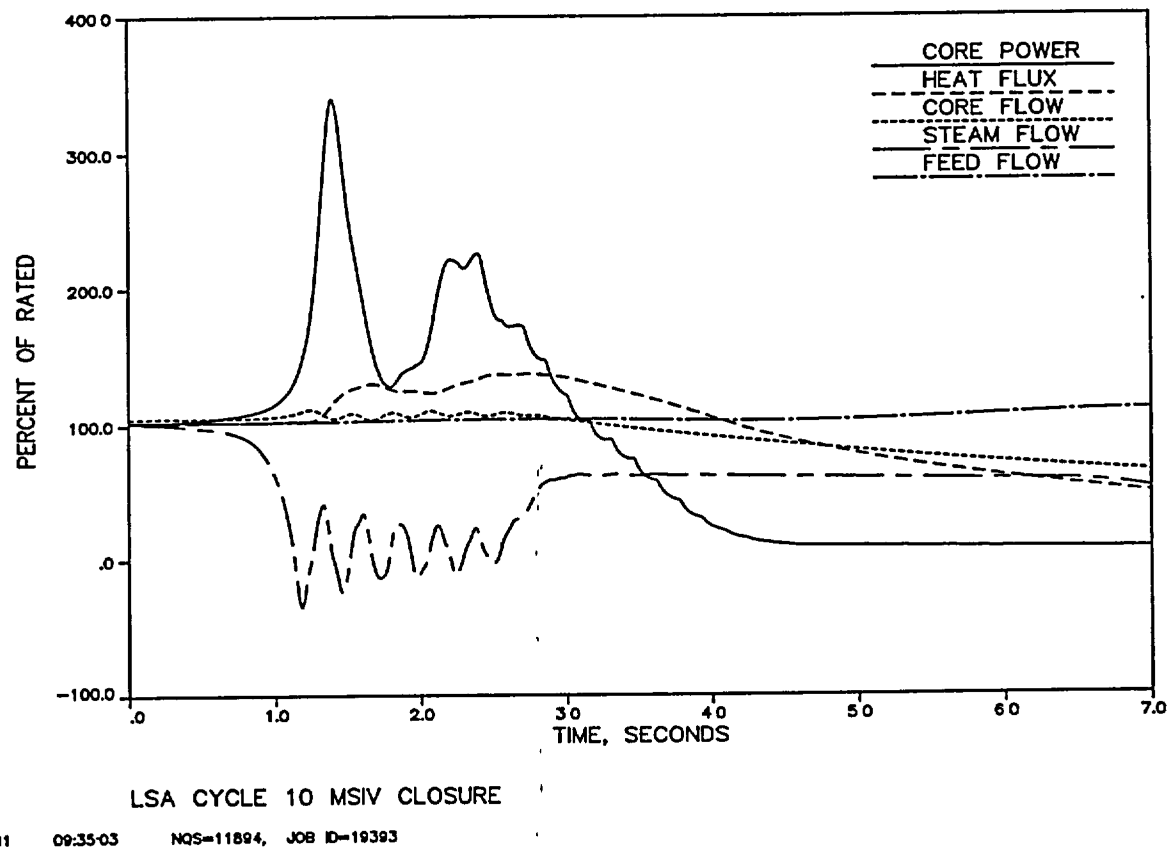


Figure 7.1 Overpressurization Event at 102/105 - MSIV Closure Key Parameters

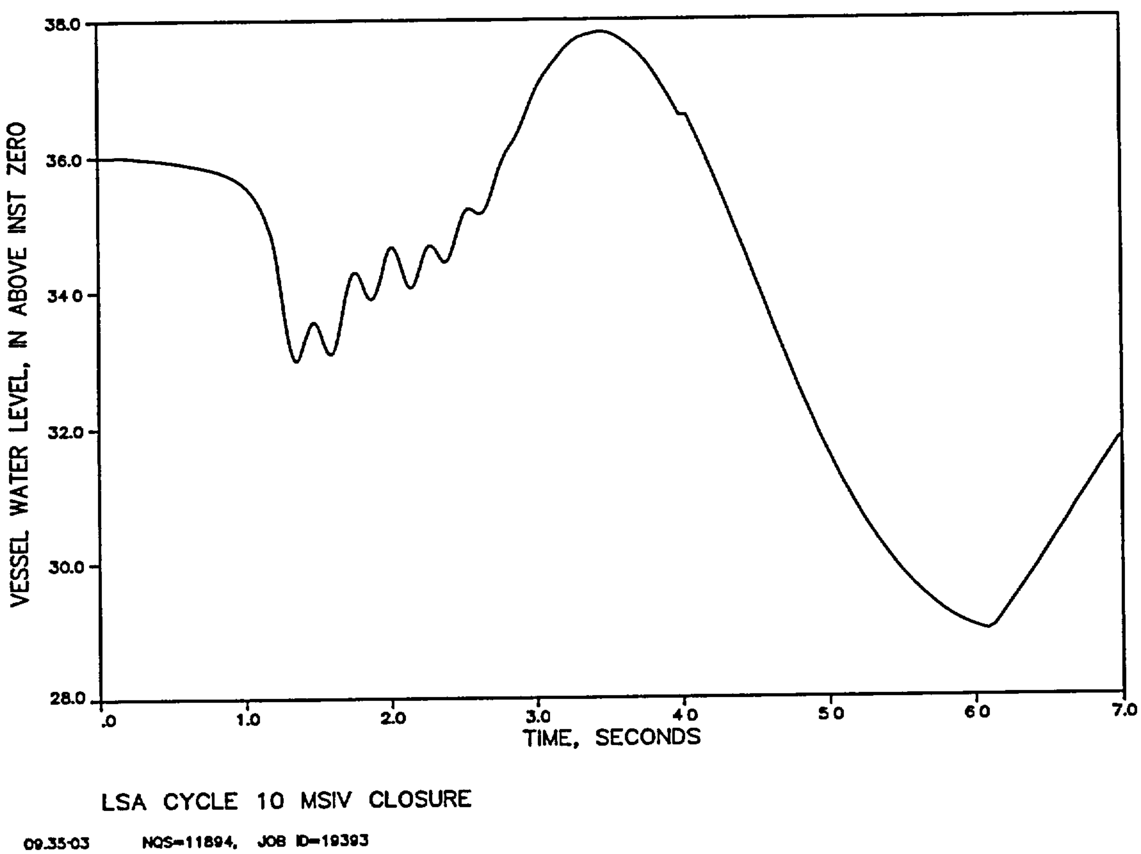


Figure 7.2 Overpressurization Event at 102/105 - MSIV Closure Vessel Water Level

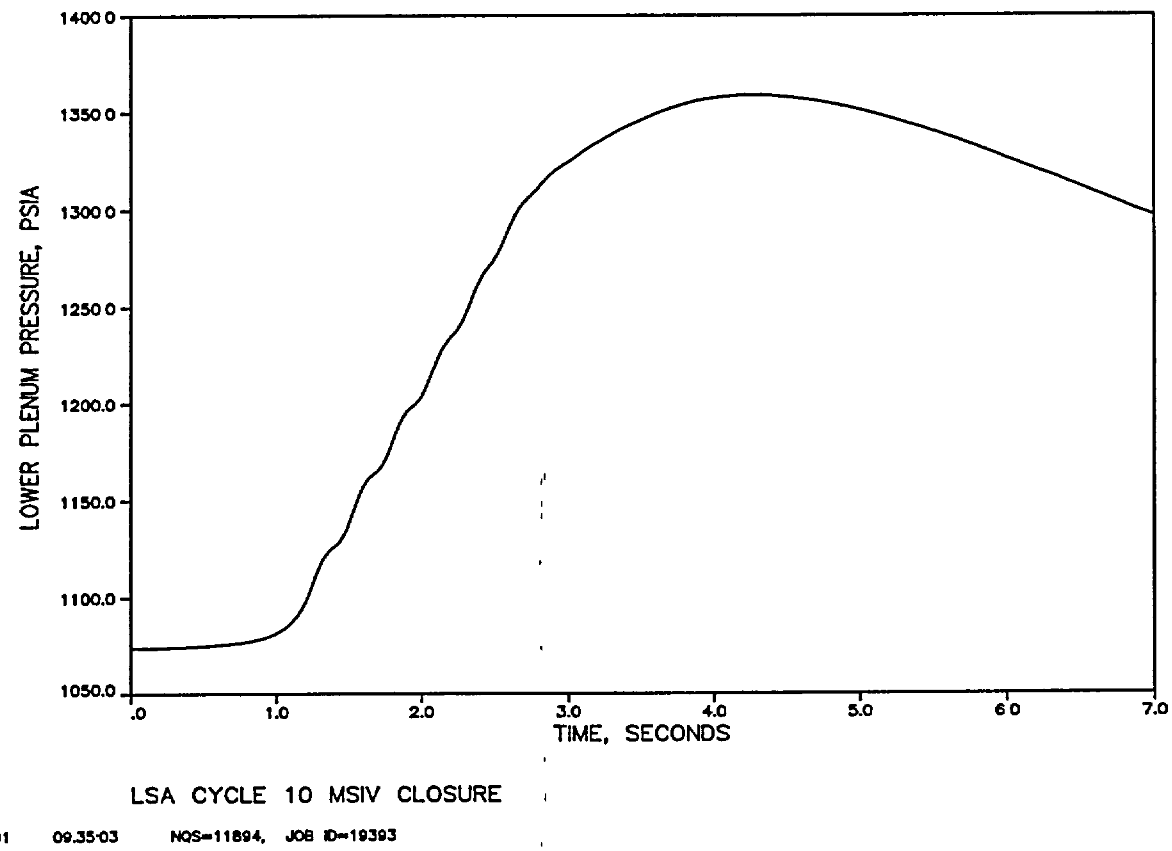


Figure 7.3 Overpressurization Event at 102/105 - MSIV Closure Lower-Plenum Pressure

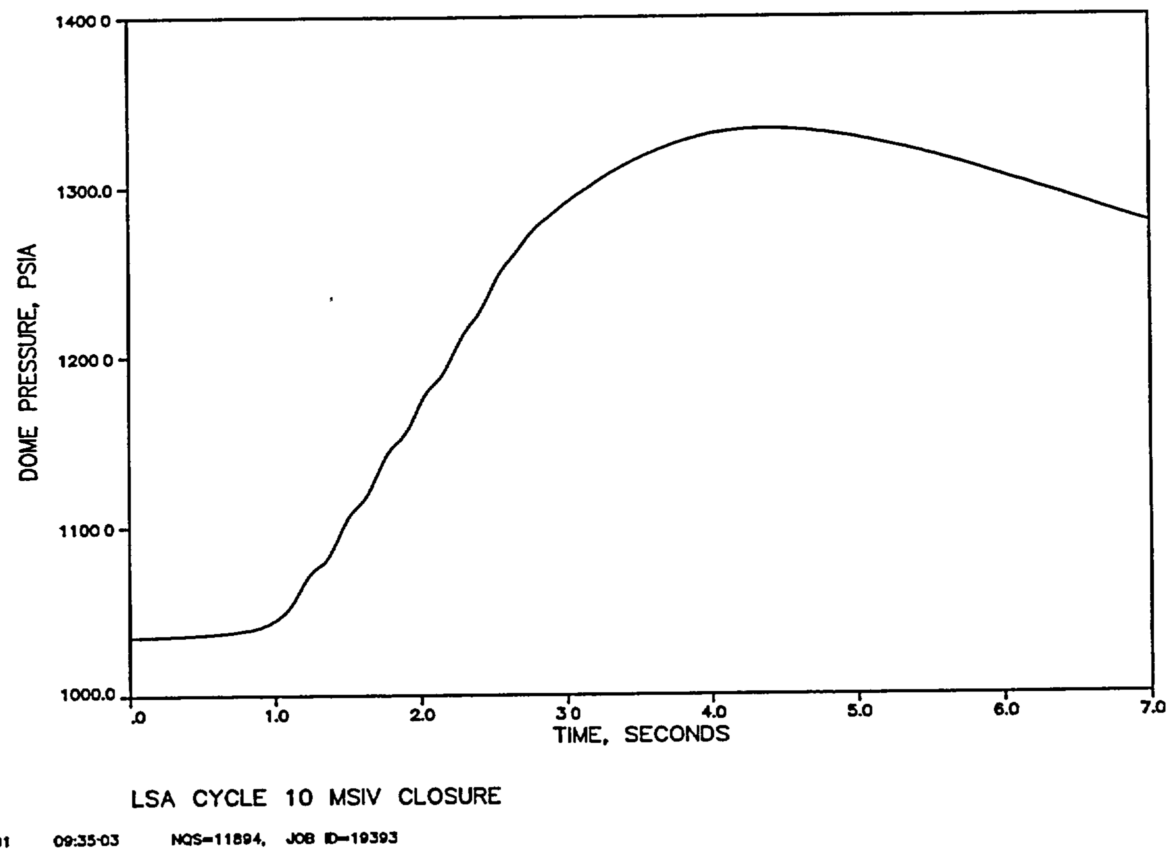
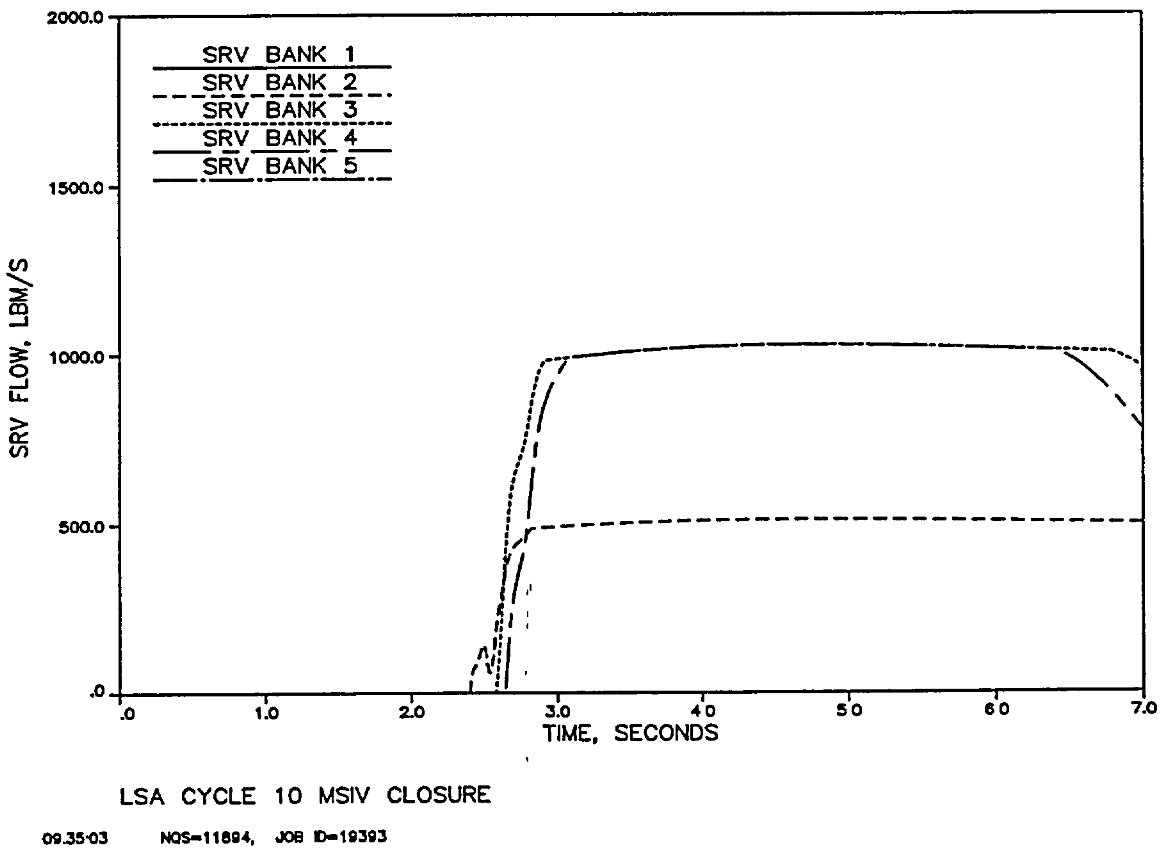


Figure 7.4 Overpressurization Event at 102/105 - MSIV Closure Dome Pressure



Bank	Number of SRVs	Opening Pressure (psia)
1	0	NA
2	2	1235.3
3	4	1245.6
4	4	1255.9
5	0	NA

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

8.0 References

1. Letter, D. E. Garber (FRA-ANP) to R. J. Chin (Exelon), "LaSalle Unit 1 Cycle 10 Calculation Plan," DEG:01:084, June 6, 2001.

2. XN-NF-80-19(P)(A) Volume 4 Revision 1, *Exxon Nuclear Methodology for Boiling Water Reactors: Application of the ENC Methodology to BWR Reloads*, Exxon Nuclear Company, June 1986.

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4. 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.

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

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8. EMF-2533 Revision 0, *LaSalle Unit 1 Cycle 10 Principal Transient Analysis Parameters*, Framatome ANP Richland, Inc., April 2001.

9. Letter, D. E. Garber (FRA-ANP) to F. W. Trikur (Exelon), "Disposition of Events Summary for the Introduction of ATRIUM™-10 Fuel at LaSalle County Station," DEG:01:179, October 30, 2001.

10. Letter, D. E. Garber (SPC) to R. J. Chin (ComEd), "Description of Measured Power Uncertainty for POWERPLEX® Operation Without Calibrated LPRMs," DEG:00:061, March 7, 2000.

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14. *LaSalle County Nuclear Station Units 1 and 2 Improved Technical Specifications*, as amended.

15. EMF-2690 Revision 0, *LaSalle Unit 1 Cycle 10 Reload Analysis*, Framatome ANP, Inc., January 2002.

16. EMF-1903(P) Revision 3, *Impact of Failed/Bypassed LPRMs and TIPs and Extended LPRM Calibration Interval on Radial Bundle Power Uncertainty*, Siemens Power Corporation, March 2000.

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

18. ANF-1373(P), *Procedure Guide for SAFLIM2*, Siemens Power Corporation, February 1991.

19. Letter, D. E. Garber (SPC) to R. J. Chin (ComEd), "Extension of LPRM Calibration Interval to 2500 EFPH," DEG:00:088, April 17, 2000.

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

21. EMF-2589(P) Revision 0, *Mechanical and Thermal-Hydraulic Design Report for LaSalle Units 1 and 2 ATRIUM™-10 Fuel Assemblies*, Framatome ANP Richland, Inc., July 2001.

22. EMF-2563(P) Revision 1, *Fuel Mechanical Design Report Exposure Extension for ATRIUM™-9B Fuel Assemblies at Dresden, Quad Cities, and LaSalle Units*, Framatome ANP Richland, Inc., August 2001.

23. 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.

Appendix A Power-Dependent LHGR Limit Generation

The linear heat generation rate (LHGR) operating limit is established to ensure that the steady-state LHGR (SSLHGR) limit is protected during normal operation and that the protection against power transient (PAPT) LHGR limit is protected during an anticipated operational occurrence (AOO). To ensure that the LHGR operating limit provides the necessary protection during operation at off-rated conditions, adjustments to the SSLHGR limits may be necessary. These adjustments are made by applying power and flow-dependent LHGR multipliers ($LHGRFAC_p$ and $LHGRFAC_f$, respectively) to the SSLHGR limit. The LHGR operating limit (LHGROL) for a given operating condition is determined as follows:

$$LHGROL = \min [LHGRFAC_p \times SSLHGR, LHGRFAC_f \times SSLHGR]$$

The power-dependent LHGR multipliers ($LHGRFAC_p$) are determined using the heat flux excursion experienced by the fuel during AOOs. The heat flux ratio (HFR) is defined as the ratio of the maximum nodal transient heat flux over the maximum nodal heat flux at the initiation of the transient. The HFR provides a measure of the LHGR excursion during the transient. The PAPT limit divided by the SSLHGR limit provides an upper limit for the HFR to ensure that the PAPT LHGR limit is not violated during an AOO. $LHGRFAC_p$ is set equal to the minimum of the PAPT/SSLHGR ratio over HFR, or 1.0. Based on the ATRIUM-10 LHGR limits presented in Reference A.1 and the ATRIUM-9B LHGR limits presented in Reference A.2, $LHGRFAC_p$ is established as follows:

$$\frac{PAPT}{SSLHGR} = 1.35$$

$$HFR = \frac{Q_{maxt}}{Q_{max0}}$$

$$LHGRFAC_p = \min \left[\frac{1.35}{HFR}, 1.0\right]$$

In some cases, the established MCPR limit precludes operation at the SSLHGR limit. This allows for a larger LHGR excursion during the transient without violating the PAPT LHGR limit.

References

A.1 EMF-2589(P) Revision 0, *Mechanical and Thermal-Hydraulic Design Report for LaSalle Units 1 and 2 ATRIUM™-10 Fuel Assemblies,* Framatome ANP Richland, Inc., July 2001.

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Attachment 4

LaSalle Unit 1 Cycle 10A

Transmittal of CBH Effects on Fresh Fuel for LaSalle Unit 1 Cycle 10