

TS 6.9.1.12

August 20, 2008

U.S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington DC 20555

Limerick Generating Station, Unit 2
Facility Operating License No. NPF-85
NRC Docket No. 50-353

Subject: Issuance of the Core Operating Limits Report
For Reload 9, Cycle 10, Revision 4

Enclosed is a copy of the Core Operating Limits Report (COLR) for Limerick Generating Station, Unit 2, Reload 9, Cycle 10, Revision 4. Revision 4 incorporates a change to Operating Limit Minimum Critical Power Ratio, and changes associated with the rod block monitor downscale setpoint.

This COLR is being submitted to the NRC in accordance with LGS, Unit 2 Technical Specifications (TS) Section 6.9.1.12.

If you have any questions, please do not hesitate to contact us.

Respectfully,



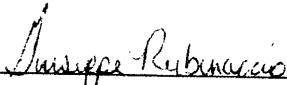
David P. Helker
Manager - Licensing and Regulatory Affairs
Exelon Generation Company, LLC

Attachment

cc: S. J. Collins, Regional Administrator, Region I, USNRC
E. M. DiPaolo, USNRC Senior Resident Inspector, LGS
P. Bamford, Project Manager [LGS], USNRC

CORE OPERATING LIMITS REPORT
FOR
LIMERICK GENERATING STATION UNIT 2
RELOAD 9, CYCLE 10


Prepared By:


G. Rubinaccio
Preparer

Date:

08/13/08

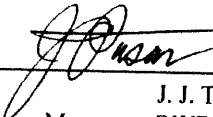
Reviewed By:


Michael Holmes
Independent Reviewer

Date:

3/13/08

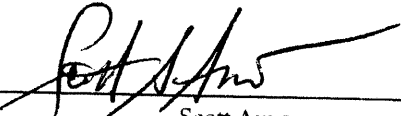
Approved By:


J. J. Tusar
Manager - BWR Design (GNF)

Date:

8/13/08

Station Qualified
Reviewed By:


Scott Auve
Station Qualified Reviewer

Date:

8/14/08

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1.0 Terms And Definitions

ARTS	APRM and RBM Technical Specification Analysis
BASE CASE	A case analyzed with Turbine Bypass System in service and Recirculation Pump Trip in service and Feedwater Temperature Reduction allowed (FFWTR includes feedwater heater OOS or final feedwater temperature reduction) at any point during the cycle in Dual Loop mode.
DTSP	Rod Block Monitor Downscale Trip Setpoint
EOOS	Equipment Out of Service
End of Rated (EOR)	The cycle exposure at which reactor power is equal to 3458 MWth with recirculation system flow equal to 100%, all control rods fully withdrawn, all feedwater heating in service and equilibrium Xenon.
FFWTR	Final Feedwater Temperature Reduction
FWHOOS	Feedwater Heaters Out of Service
HTSP	Rod Block Monitor High Trip Setpoint
ICF	Increased Core Flow
ITSP	Rod Block Monitor Intermediate Trip Setpoint
LHGR	Linear Heat Generation Rate
LHGRFAC(F)	ARTS LHGR thermal limit flow dependent adjustments and multipliers
LHGRFAC(P)	ARTS LHGR thermal limit power dependent adjustments and multipliers
LTSP	Rod Block Monitor Low Trip Setpoint
MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
MCPR	Minimum Critical Power Ratio
MCPR(P)	ARTS MCPR thermal limit power dependent adjustments and multipliers
MCPR(F)	ARTS MCPR thermal limit flow dependent adjustments and multipliers
MELLLA	Maximum Extended Load Line Limit Analysis
OLMCPR	Operating Limit Minimum Critical Power Ratio
OPRM PBDA	Oscillation Power Range Monitor Period Based Detection Algorithm
RPTOOS	Recirculation Pump Trip Out of Service

SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single Loop Operation
TBVOOS	Turbine Bypass Valves Out of Service

2.0 General Information

This report provides the following cycle-specific parameter limits for Limerick Generating Station Unit 2 Cycle 10:

- Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)
- Minimum Critical Power Ratio (MCPR)
- Single Loop Operation (SLO) MCPR adjustment
- ARTS MCPR thermal limit adjustments and multipliers (MCPR(P) or MCPR(F))
- ARTS LHGR thermal limit multipliers (LHGRFAC(P) or LHGRFAC(F))
- Rod Block Monitor (RBM) setpoints
- MAPLHGR single loop operation reduction factor
- LHGR single loop operation reduction factor
- Linear Heat Generation Rate (LHGR)
- Turbine Bypass Valve parameters
- Reactor Coolant System Recirculation Flow Upscale Trips
- Oscillation Power Range Monitor Period Based Detection Algorithm Trip Setpoints

These values have been determined using NRC-approved methodology (Reference 6), and are established such that all applicable limits of the plant safety analysis are met.

This report is prepared in accordance with Technical Specification 6.9.1.9 of Reference 1. Preparation of this report was performed in accordance with Exelon Nuclear, Nuclear Fuels T&RM NF-AB-120-3600.

The data presented in this report is valid for all licensed operating domains on the operating map, including:

- Maximum Extended Load Line Limit down to 81% of rated core flow during full power operation
- Increased Core Flow (ICF) up to 110% of rated core flow
- Final Feedwater Temperature Reduction (FFWTR) up to 105°F during cycle extension operation
- Feedwater Heater Out of Service (FWHOOS) up to 60°F feedwater temperature reduction at any time during the cycle prior to cycle extension.

Further information on the cycle specific analyses for Limerick 2 Cycle 10 and the associated operating domains discussed above is available in Reference 2.

3.0 MAPLHGR Limits

3.1 Technical Specification

Section 3.2.1

3.2 Description

The limiting MAPLHGR value for the most limiting lattice (excluding natural uranium) of each fuel type as a function of average planar exposure is given in Table 3-1 (References 2 and 9). The limiting MAPLHGR value is the same for all fuel types in the Limerick Unit 2 Cycle 10 core. For single loop operation, a reduction factor is used which is shown in Table 3-2 (Reference 2). MAPFAC(P) and MAPFAC(F) are 1.0 for all power and flow conditions. The power and flow dependent multipliers for MAPLHGR have been removed and replaced with LHGRFAC(P) and LHGRFAC(F).

TABLE 3-1
MAPLHGR Versus Average Planar Exposure
All Fuel Types
(References 2 and 9)

Average Planar Exposure (GWD/ST)	MAPLHGR Limit (kW/ft)
0.0	12.82
14.51	12.82
19.13	12.82
57.61	8.00
63.50	5.00

TABLE 3-2
MAPLHGR Single Loop Operation (SLO) Reduction Factor
(Reference 2)

SLO Reduction Factor	0.80
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4.0 MCPR Limits

4.1 Technical Specification

Section 3.2.3

4.2 Description

Table 4-1 is derived from the Reference 2 analyses and is valid for all Cycle 10 fuel types and operating domains. Table 4-1 includes treatment of these MCPR limits for SLO. Bounding MCPR values are also provided for inoperable Recirculation Pump Trip or inoperable Steam Bypass System. These two options represent the Equipment Out of Service conditions. The cycle exposure that represents EOR is given in the latest verified and approved Cycle Management Report or an associated Engineering Change Request.

ARTS provides for power and flow dependent thermal limit adjustments and multipliers, which allow for a more reliable administration of the MCPR thermal limit. The flow-dependent adjustment MCPR(F) is sufficiently generic to apply to all fuel types and operating domains (Reference 2). In addition, there are also two sets of power-dependent MCPR multipliers for use with the Turbine Bypass Valves in service and TBVOOS conditions (References 2 and 3). Section 7.0 contains the conditions for Turbine Bypass Valve Operability. These adjustments are provided in Table 4-2 and 4-3. The OLMCPR is determined for a given power and flow condition by evaluating the power-dependent MCPR and the flow-dependent MCPR and selecting the greater of the two. The MCPR(P) curves are independent of recirculation pump trip operability (Reference 3).

TABLE 4-1
Operating Limit Minimum Critical Power Ratio (OLMCPR)¹
(Reference 2)

EOOS Combination	SCRAM Time Option ²	Cycle Exposure	
		< EOR – 2800 MWd/ST	≥ EOR – 2800 MWd/ST
BASE	B	1.33	1.38
	A	1.36	1.41
BASE SLO	B	1.44 ⁽³⁾	1.44 ⁽³⁾
	A	1.44 ⁽³⁾	1.44 ⁽³⁾
TBVOOS	B	1.37	1.43
	A	1.40	1.46
TBVOOS SLO	B	1.44 ⁽³⁾	1.45
	A	1.44 ⁽³⁾	1.48
RPTOOS	B	1.40	1.48
	A	1.51	1.65
RPTOOS SLO	B	1.44 ⁽³⁾	1.50
	A	1.53	1.67

¹ This table is valid for all Cycle 10 fuel types.

² When Tau does not equal 0 or 1, determine OLMCPR via linear interpolation.

³ OLMCPR limit set by the Single Loop Operation Recirculation Pump Seizure (Reference 2)

TABLE 4-2
Power Dependent MCPR Limit Adjustments And Multipliers
 (References 2 and 3)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of Rated)						
		0	25	< 30	≥ 30	45	60	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier, Kp			
Base	≤ 60	2.66	2.66	2.44	1.481	1.280	1.150	1.000
	> 60	3.39	3.39	2.93				
Base SLO	≤ 60	2.68	2.68	2.46	1.481	1.280	1.150	1.000
	> 60	3.41	3.41	2.95				
RPTOOS	≤ 60	2.66	2.66	2.44	1.481	1.280	1.150	1.000
	> 60	3.39	3.39	2.93				
RPTOOS SLO	≤ 60	2.68	2.68	2.46	1.481	1.280	1.150	1.000
	> 60	3.41	3.41	2.95				
TBVOOS	≤ 60	3.07	3.07	2.63	1.481	1.280	1.150	1.000
	> 60	4.54	4.54	3.77				
TBVOOS SLO	≤ 60	3.09	3.09	2.65	1.481	1.280	1.150	1.000
	> 60	4.56	4.56	3.79				

TABLE 4-3
Flow Dependent MCPR Limits MCPR(F)
 (References 2)

Flow (% rated)	MCPR(F) Limit
30.0	1.534
79.06	1.25
110.0	1.25

5.0 Linear Heat Generation Rate Limits

5.1 Technical Specification

Section 3.2.4

5.2 Description

The LHGR is an exposure dependent value. Due to the proprietary nature of these values only the maximum UO₂ LHGR for each fuel type is listed in Table 5-1. For single loop operation, a reduction factor is used which is shown in Table 5-2 (Reference 2).

ARTS provides for power- and flow-dependent thermal limit multipliers, which allow for a more reliable administration of the LHGR thermal limits. There are two sets of flow-dependent LHGR multipliers for dual-loop and single-loop operation (References 2 and 5). In addition, there are also two sets of power-dependent LHGR multipliers for use with the Turbine Bypass Valves in service and TBVOOS conditions (Reference 3). Section 7.0 contains the conditions for Turbine Bypass Valve Operability. The LHGR multipliers are shown in Tables 5-3 through 5-4.

Thermal limit monitoring must be performed with the more limiting LHGR limit resulting from the power- and flow-biased calculation. The LHGRFAC(P) curves are independent of recirculation pump trip operability (Reference 3).

TABLE 5-1
Linear Heat Generation Rate Limits
(References 8 and 10)

FUEL TYPE	MAXIMUM VALUE
GE14	13.4 kW/ft

TABLE 5-2
LHGR Single Loop Operation (SLO) Reduction Factor
(Reference 2)

SLO Reduction Factor ¹	0.80
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¹ Applied through Table 5-4

TABLE 5-3
Power Dependent LHGR Multiplier LHGRFAC(P)
 (References 2, 3 and 11)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)				
		0	25	< 30	≥ 30	100
		LHGRFAC(P) Multiplier				
Base	≤ 60	0.485	0.485	0.490	0.634	1.000
	> 60	0.434	0.434	0.473		
Base SLO	≤ 60	0.485	0.485	0.490	0.634	1.000
	> 60	0.434	0.434	0.473		
RPTOOS	≤ 60	0.485	0.485	0.490	0.634	1.000
	> 60	0.434	0.434	0.473		
RPTOOS SLO	≤ 60	0.485	0.485	0.490	0.634	1.000
	> 60	0.434	0.434	0.473		
TBVOOS	≤ 60	0.463	0.463	0.490	0.634	1.000
	> 60	0.352	0.352	0.386		
TBVOOS SLO	≤ 60	0.463	0.463	0.490	0.634	1.000
	> 60	0.352	0.352	0.386		

TABLE 5-4
Flow Dependent LHGR Multiplier LHGRFAC(F)
 (References 2, 5 and 9)

EOOS Combination	Core Flow (% of rated)				
	0	44.07	70	80	110
	LHGRFAC(F) Multiplier				
Dual Loop	0.5055		0.9732	1.00	1.00
Single Loop	0.5055	0.80	0.80	0.80	0.80

6.0 Control Rod Block Setpoints

6.1 Technical Specification

Section 3.3.6

6.2 Description

Technical Specification Limiting Condition for Operation number 3.3.6 requires control rod block instrumentation channels shall be OPERABLE with their trip setpoints consistent with the values shown in the Trip Setpoint column of Technical Specification Table 3.3.6-2. The Reactor Coolant System Recirculation Flow Upscale Trip is a cycle-specific value and as such is found in Table 6-2 of this COLR. Table 6-2 lists the Nominal Trip Setpoint and Allowable Value. These setpoints are set high enough to allow full utilization of the enhanced ICF domain up to 110% of rated core flow. Additionally, the ARTS Rod Block Monitor provides for power-dependent RBM trips. The trip setpoints/allowable values and applicable RBM signal filter time constant data are shown in Table 6-1. These values are for use with Technical Specification 3.3.6.

TABLE 6-1
Rod Block Monitor Setpoints¹
(References 2 and 7)

	Nominal Trip Setpoint	Allowable Value
LTSP	121.5%	121.5%
ITSP	116.5%	116.5%
HTSP	111.0%	111.7%
DTSP	5.0%	2.0%

TABLE 6-2
Reactor Coolant System Recirculation Flow Upscale Trip
(Reference 7)

Nominal Trip Setpoint	113.4%
Allowable Value	115.6%

¹ These setpoints (with Rod Block Monitor filter time constant between 0.1 seconds and 0.55 seconds) are based on a cycle-specific rated RWE MCPR limit of 1.30, which is less than or equal to the minimum cycle OLMCPR (see COLR references 2 and 7).

7.0 Turbine Bypass Valve Parameters

7.1 Technical Specification

Section 3.7.8 and 4.7.8.C

7.2 Description

The operability requirements for the steam bypass system for use in Technical Specifications 3.7.8 and 4.7.8.C are found in Tables 7-1 and 7-2. If these requirements cannot be met, the MCPR, MCPR(P) and LHGRFAC(P) limits for inoperable Steam Bypass System, known as Turbine Bypass Valve Out Of Service, must be used.

TABLE 7-1
Turbine Bypass System Response Time
(Reference 4)

Maximum delay time before start of bypass valve opening following generation of the turbine bypass valve flow signal	0.11 sec
Maximum time after generation of a turbine bypass valve flow signal for bypass valve position to reach 80% of full flow (includes the above delay time)	0.31 sec

TABLE 7-2
Minimum Required Bypass Valves To Maintain System Operability
(Reference 4)

Reactor Power	No. of Valves in Service
$P \geq 25\%$	7

8.0 Stability Protection Setpoints

8.1 Technical Specification

Section 2.2.1.2.F

8.2 Description

The Limerick 2 Cycle 10 OPRM Period Based Detection Algorithm (PBDA) Trip Setpoints for the OPRM System for use in Technical Specification 2.2.1 are found in Table 8-1. These values are based on the cycle specific analysis documented in Reference 2. The setpoints provided in Table 8-1 are bounding for all modes of operation shown in Table 9-1.

TABLE 8-1
OPRM PBDA Trip Setpoints¹
(Reference 2)

PBDA Trip Amplitude	Corresponding Maximum Confirmation Count Trip Setting
≤ 1.13	≤ 15

9.0 Modes Of Operation

TABLE 9-1
Modes of Operation
(References 2, 3 and 5)

EOOS Options	Operating Region ²
Base, Option A or B	Yes
Base SLO, Option A or B	Yes
TBVOOS, Option A or B	Yes
TBVOOS SLO, Option A or B	Yes
RPTOOS, Option A or B	Yes
RPTOOS SLO, Option A or B	Yes
TBVOOS and RPTOOS, Option A or B	No
TBVOOS and RPTOOS SLO, Option A or B	No

¹ The station has conservatively decided to maintain the PDBA Trip Amplitude at 1.12 with a Corresponding Maximum Count Trip Setting of 14 until such time where these changes do not introduce a Unit difference at Limerick. This decision was agreed upon by Operations and Site Engineering.

² Operating Region refers to operation on the Power to Flow map with or without FFWTR.

10.0 Methodology

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following document:

1. "General Electric Standard Application for Reactor Fuel", GNF Document, NEDE-24011-P-A-15, September 2005 and U.S. Supplement NEDE-24011-P-A-15-US, Revision 15, September 2005.

11.0 References

1. "Technical Specifications and Bases for Limerick Generating Station Unit 2", Docket No. 50-353, License No. NPF-85.
2. "Supplemental Reload Licensing Report for Limerick Generating Station Unit 2 Reload 9 Cycle 10", Global Nuclear Fuel Document No. 0000-0054-5796-SRLR, Revision 2, July 2008.
3. "GE14 Fuel Design Cycle-Independent Analyses for Limerick Generating Station Units 1 and 2", GE-NE-L12-00884-00-01P, March 2001.
4. "OPL-3 Transient Protection Parameters Verification for Reload Licensing Analyses for Limerick 2 Reload 9 Cycle 10", TODI: NF0600311 Rev. 1
5. "ARTS Flow-Dependent Limits with TBVOOS for Peach Bottom Atomic Power Station and Limerick Generating Station", GENE Document NEDC-32847P, June 1998.
6. "General Electric Standard Application for Reactor Fuel", GNF Document, NEDE-24011-P-A-15, September 2005 and U.S. Supplement NEDE-24011-P-A-15-US, Revision 15, September 2005.
7. "Power Range Neutron Monitoring System Setpoint Calculations Limerick Generating Station, Units 1 & 2 Mod. No. P00224", LE-0107, Rev. 0 (including minor revision 00C), April 2008.
8. "Fuel Bundle Information Report for Limerick Generating Station Unit 2 Reload 9 Cycle 10", Global Nuclear Fuel Document No. 0000-0054-5796-FBIR, Revision 0, January 2007.
9. "Supplemental Reload Licensing Report for Limerick Generating Station Unit 2 Reload 8 Cycle 9", Global Nuclear Fuel Document No. 0000-0031-7705-SRLR, Revision 0, January 2005.
10. "Fuel Bundle Information Report for Limerick Generating Station Unit 2 Reload 8 Cycle 9", Global Nuclear Fuel Document No. 0000-0031-7705-FBIR, Revision 0, January 2005.
11. "Limerick Units 1 and 2 Off-Rated Analysis Below PLU Power Level With Credit for Backup Trip", GE-NE-0000-0053-9467-R1, August 2006.