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TS 6.9.1.12

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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 8, Cycle 9, Revision 2

Dear Sir/Madam:

Enclosed is a copy of the Core Operating Limits Report (COLR) for Limerick Generating Station, Unit 2, Reload 8, Cycle 9, Revision 2. Revision 2 of this report incorporates the adjusted off-rated thermal limit multipliers for the revised Power Load Unbalance Analysis.

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.

Very truly yours,

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

Enclosure

cc: S. J. Collins, Regional Administrator, Region I, USNRC
S. Hansell, USNRC Senior Resident Inspector, LGS
T. Valentine, Project Manager [LGS], USNRC

CORE OPERATING LIMITS REPORT

FOR

LIMERICK GENERATING STATION UNIT 2

RELOAD 8, CYCLE 9

(This is a complete rewrite)

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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at which reactor power is equal to 3458 MWth with recirculation system flow equal to 100%, all control rods fully withdrawn, all feedwater heating in service and equilibrium Xenon.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 9:

- 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 Fuel Management 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 9 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 (Reference 2). The limiting MAPLHGR value is the same for all fuel types in the Limerick Unit 2 Cycle 9 core. For single loop operation, a reduction factor is used which is shown in Table 3-2 (Reference 2).

TABLE 3-1
MAPLHGR Versus Average Planar Exposure
All Fuel Types
(Reference 2)

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**

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 9 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 (References 2 and 5). 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 8 and 11). 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 8).

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

EOOS Combination	SCRAM Time Option[2]	Cycle Exposure	
		< EOR – 2600 MWd/ST	≥ EOR – 2600 MWd/ST
BASE	B	1.32	1.37
	A	1.35	1.40
BASE SLO	B	1.44[3]	1.44[3]
	A	1.44[3]	1.44[3]
TBVOOS	B	1.37	1.42
	A	1.40	1.45
TBVOOS SLO	B	1.44[3]	1.44
	A	1.44[3]	1.47
RPTOOS	B	1.40	1.46
	A	1.51	1.63
RPTOOS SLO	B	1.44[3]	1.48
	A	1.53	1.65

[1] This table is valid for all Cycle 9 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 Analysis (Reference 2.)

TABLE 4-2
Power Dependent MCPR Limit Adjustments And Multipliers
(References 2, 8 and 11)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of Rated)									
		0	25	< 30	≥ 30	40	50	< 55	≥55	60	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier, Kp						
Base	≤ 60	2.66	2.66	2.44	1.481	1.347	1.300	1.300	1.193	1.150	1.000
	> 60	3.39	3.39	2.93							
Base SLO	≤ 60	2.68	2.68	2.46	1.481	1.347	1.300	1.300	1.193	1.150	1.000
	> 60	3.41	3.41	2.95							
RPTOOS	≤ 60	2.66	2.66	2.44	1.481	1.347	1.300	1.300	1.193	1.150	1.000
	> 60	3.39	3.39	2.93							
RPTOOS SLO	≤ 60	2.68	2.68	2.46	1.481	1.347	1.300	1.300	1.193	1.150	1.000
	> 60	3.41	3.41	2.95							
TBVOOS	≤ 60	3.07	3.07	2.63	1.563		1.370	1.370	1.193	1.150	1.000
	> 60	4.54	4.54	3.77							
TBVOOS SLO	≤ 60	3.09	3.09	2.65	1.563		1.370	1.370	1.193	1.150	1.000
	> 60	4.56	4.56	3.79							

TABLE 4-3
Flow Dependent MCPR Limits MCPR(F)
(References 2, 3 and 5)

Flow (% rated)	MCPR(F) Limit
0.0	1.7073
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 UO_2 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 LGHR multipliers for dual-loop and single-loop operation (References 2, 3, 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 (References 8 and 11). 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 8).

TABLE 5-1
Linear Heat Generation Rate Limits
(Reference 9)

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

[1] Applied through Table 5-4

TABLE 5-3
Power Dependent LHGR Multiplier LHGRFAC(P)
(References 2, 5 and 8)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)							
		0	25	< 30	≥ 30	50	< 55	≥ 55	100
		LHGRFAC(P) Multiplier							
Base	≤ 60	0.485	0.485	0.490	0.6340				1.0000
	> 60	0.434	0.434	0.473					
Base SLO	≤ 60	0.485	0.485	0.490	0.6340				1.0000
	> 60	0.434	0.434	0.473					
RPTOOS	≤ 60	0.485	0.485	0.490	0.6340				1.0000
	> 60	0.434	0.434	0.473					
RPTOOS SLO	≤ 60	0.485	0.485	0.490	0.6340				1.0000
	> 60	0.434	0.434	0.473					
TBVOOS	≤ 60	0.463	0.463	0.490	0.5730	0.678	0.678	0.765	1.0000
	> 60	0.352	0.352	0.386					
TBVOOS SLO	≤ 60	0.463	0.463	0.490	0.5730	0.678	0.678	0.765	1.0000
	> 60	0.352	0.352	0.386					

TABLE 5-4
Flow Dependent LHGR Multiplier LHGRFAC(F)
(References 2, 3 and 5)

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 Setpoints[1]
(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	92.0%	89.0%

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 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
(References 4 and 8)

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 9 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 10. 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 Setpoints

PBDA Trip Amplitude	Corresponding Maximum Confirmation Count Trip Setting
1.12	14

9.0 Modes Of Operation

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

EOOS Options	Operating Region[1]
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

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", NEDE-24011-P-A-14, June 2000 and U.S. Supplement NEDE-24011-P-A-14-US, June 2000.

[1] Operating Region refers to operation on the Power to Flow map with or without FFWTR.

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 8 Cycle 9", Global Nuclear Fuel Document No. 0000-0031-7705-SRLR, Revision 0, January 2005.

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 8 Cycle 9", TODI 04-00254

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", NEDE-24011-P-A-14, June 2000 and U.S. Supplement NEDE-24011-P-A-14-US, June 2000.

7. "Power Range Neutron Monitoring System Setpoint Calculations Limerick Generating Station, Units 1 &2 Mod. No. P00224", LE-0107, Rev. 0, March 2000.

8. "Limerick 1 and 2 Off-Rated Analyses Below the PLU Power Level", GE Nuclear Document No. GE-NE-0000-0037-3253-R0, March 2005.

9. "Fuel Bundle Information Report for Limerick Generating Station Unit 2 Reload 8 Cycle 9", Global Nuclear Fuel Document No. 0000-0031-7705-FBIR, January 2005.

10. "Limerick 2 Cycle 9 Option III Stability Analysis", GE Nuclear Energy Document No. GENE-0000-0037-1045-R0, March 2005.

11. "Application Of The Limerick Unit 1 and Unit 2 Power Dependent Limits for A 55% PLU Power Level", GE Nuclear Energy Document No. GENE-0000-0049-0134-R0, December 2005.