PSEG Nuclear LLC
P.O. Box 236,, Hancocks Bridge, NJ 08038-0236

PSEG
Nuclear L.L.C.

TS 6.9.1.9

LR-N08-0211
September 09, 2008

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

Hope Creek Generating Station
Facility Operating License No. NPF-57
NRC Docket No. 50-354

Subject: Core Operating Limits Report, Reload 14, Cycle 15, Revisions 1 and 2

In accordance with section 6.9.1.9 of the Hope Creek Technical Specifications, PSEG Nuclear LLC (PSEG) submits Revisions 1 and 2 of the Core Operating Limits Report (COLR) for Hope Creek Reload 14, Cycle 15 in Attachments 1 and 2 of this letter. Revision 1 of the report incorporates changes associated with the implementation of Extended Power Uprate. Revsion 2 updates the SVEA-96+ APLHGR and LHGR limits to provide limits up to 72,000 MWD/MTU Average Planar and Peak Pellet exposure.

Should you have any questions, please contact Paul Duke at (856) 339-1466.

Sincerely,

Jeffrie J. Keenan
Manager - Licensing

Attachments (2)

cc: S. Collins, Regional Administrator – NRC Region I
R. Ennis, Project Manager - USNRC
NRC Senior Resident Inspector - Hope Creek
P. Mulligan, Manager IV, NJBNE

A001
NRR

ATTACHMENT 1

Hope Creek Generating Station
Facility Operating License No. NPF-57
NRC Docket No. 50-354

Core Operating Limits Report
Reload 14, Cycle 15
Revision 1

CORE OPERATING LIMITS REPORT

FOR

Hope Creek Generating Station Unit 1

RELOAD 14, CYCLE 15 EPU

Effective Date: 5/16/08

Prepared By: _____ Date: 5/15/08
J. P. Collins
Preparer

Reviewed By: _____ Date: 5/15/08
F. J. Safin
Independent Reviewer

Approved By: _____ Date: 5/15/08
D. V. Notigan
Manager - BWR Design & Analysis

Table of Contents

	Page
1.0 Terms and Definitions	4
2.0 References	5
3.0 General Information	6
4.0 Technical Specifications that Reference the COLR	7
4.1 Average Planar Linear Heat Generation Rate	8
4.2 Minimum Critical Power Ratio	9
4.3 Linear Heat Generation Rate	12
4.4 Oscillation Power Range Monitor	15
Appendix A: Method of Core Average Scram Speed Calculation	16
Appendix B: Backup Stability Protection	18

List of Tables

TABLE 4.1-1 APLHGR Data for GE14 Fuel 8
TABLE 4.1-2 APLHGR Data for SVEA-96+ Fuel 8
TABLE 4.2-1 Cycle 15 MCPR Operating Limits: Cycle Exposure ≤ 10692 MWD/MTU (≤ 9700 MWD/STU) 10
TABLE 4.2-2 Cycle 15 MCPR Operating Limits: Cycle Exposure > 10692 MWD/MTU (> 9700 MWD/STU) 10
TABLE 4.2-3 Power Dependent MCPR Adjustments and Multiplier (K_p) Data 11
TABLE 4.2-4 Flow Dependent MCPR Limit ($MCPR_f$) 11
TABLE 4.3-1 LHGR Data for GE14 Fuel 13
TABLE 4.3-2 LHGR Data for SVEA-96+ Fuel 13
TABLE 4.3-3 Power Dependent Linear Heat Generation Rate Multiplier ($LHGRFAC_p$) 14
TABLE 4.3-4 Flow Dependent Linear Heat Generation Rate Multiplier ($LHGRFAC_f$) 14
Table B-1 BSP Region Intercepts: Cycle Exposure ≤ 11600 MWD/ST 19
Table B-2 BSP Region Intercepts: Cycle Exposure > 11600 MWD/ST 19

1.0 Terms And Definitions

APLHGR	Average Planar Linear Heat Generation Rate
ARTS	APRM and RBM Technical Specification Analysis
BSP	Backup Stability Protection
COLR	Core Operating Limits Report
ECCS	Emergency Core Cooling Systems
EOC-RPT	End-Of-Cycle Recirculation Pump Trip
LCO	Limiting Condition for Operation
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
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
OPRM	Oscillation Power Range Monitor
SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single Loop Operation
TLO	Two Loop Operation

2.0 References

1. "General Electric Standard Application for Reactor Fuel", NEDE-24011-P-A-15, and the Supplement NEDE-24011-P-A-15-US.

2. "Supplemental Reload Licensing Report for Hope Creek Unit 1 Reload 14 Cycle 15 EPU", Global Nuclear Fuel Document No. 0000-0078-1947-SRLR, Revision 2, April 2008.

3. "Fuel Bundle Information Report for Hope Creek Unit 1 Reload 14, Cycle 15 EPU", Global Nuclear Fuel Document No. 0000-0078-1947-FBIR, Rev. 0, December 2007.

4. "Technical Specifications and Bases for Hope Creek Generating Station Unit", Docket No. 50-354, License No. NPF-57.

5. "Supplemental Reload Licensing Report for Hope Creek Unit 1 Reload 13 Cycle 14", Global Nuclear Fuel Document No. 0000-0041-6021-SRLR, Revision 1, March 2006.

6. "Supplemental Reload Licensing Report for Hope Creek Unit 1 Reload 12 Cycle 13", Global Nuclear Fuel Document No. 0000-0031-0596-SRLR, Revision 1, December 2004.

7. "Fuel Bundle Information Report for Hope Creek Unit 1 Reload 12, Cycle 13", Global Nuclear Fuel Document No. 0000-0031-0596-FBIR, Rev. 0, December 2004.

8. Deleted

9. "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications", Global Nuclear Fuel Document NEDO-32465-A.

3.0 General Information

The purpose of this report is to provide the Core Operating Limits for Hope Creek Generation Station Unit 1 Cycle 15/Reload 14 Extended Power Uprate operation. In addition, this report will provide cycle information on OPRM set points and Backup Stability Regions, single recirculation loop operation, and core average scram speed. Finally, this report also provides a reference to the most recent revision of the implemented approved methodology. The Power Distribution Limits presented here correspond to the core thermal limits for APLHGR, MCPR, and LHGR.

These operating limit values have been determined using NRC approved methods contained in the GESTAR-II, NEDE-24011-P-A (Revision 15, Reference 1) and are established such that all applicable fuel thermal-mechanical, core thermal-hydraulic, ECCS, and nuclear limits such as shutdown margin, and transient and accident analysis limits are met. In addition, the operating limits have been determined consistent with the requirements of NEDO-32465-A (Reference 9), where appropriate.

Various sections of the Hope Creek Technical Specifications reference this COLR. Those sections are listed in section 4 of this document. Hope Creek Technical Specification 6.9.1.9 also requires that this report, including any mid cycle revisions, shall be provided, upon issuance, to the NRC.

This document is specific to Hope Creek Generating Station Unit 1 Cycle 15/Reload 14 EPU and shall not be applicable to any other core or cycle design. This report is applicable for Cycle 15 operation from the date of issuance through the end of cycle including consideration of a power coastdown to a core thermal power that shall not go below 40% rated core thermal power. End of full power capability is reached when 100% rated power can no longer be maintained by increasing core flow (up to 105% of rated core flow), at allowable rated feedwater temperatures, in the all-rods-out configuration. Operation beyond the end of full power capability is defined as power coastdown operation which includes an operating assumption that vessel dome pressure will decrease during the power coastdown period as steam flow decreases (maintaining constant vessel dome pressure during the power coastdown period was not generically considered by GESTAR-II for determining the operating limit LCO values described above).

4.0 Technical Specifications that reference the COLR

The following Hope Creek Technical Specifications reference this COLR:

Tech. Spec.	Title
2.1	Safety Limit Bases
3/4.2b	Power Distribution Bases
3/4.2.1	Average Planar Linear Generation Rate
3/4.2.1b	Average Planar Linear Heat Generation Rate
3/4.2.3	Minimum Critical Power Ratio
3/4.2.4	Linear Heat Generation Rate
3/4.3.11	Oscillation Power Range Monitor
3/4.4.1	Recirculation System Recirculation Loops
6.9.1.9	Administrative Controls, Core Operating Limits Report

4.1 Average Planar Linear Heat Generation Rate

LIMITING CONDITION FOR OPERATION:

All AVERAGE PLANAR LINEAR HEAT GENERATION RATES (APLHGRs) shall be less than or equal to the limits specified in Table 4.1-1 and Table 4.1-2 for Two recirculation Loop Operation (TLO).

When the Technical Specification Section 3/4 .4.1 Action statement a.1.d is entered from that section's Limiting Condition for Operation, reduce the APLHGR limits to the values specified in Table 4.1-1 and Table 4.1-2.

Linear interpolation shall be used to determine APLHGR limits as a function of exposure for intermediate values in Table 4.1-1 and Table 4.1-2

TABLE 4.1-1 APLHGR Data for GE14 Fuel

Average Planar Exposure		APLHGR Limit (kW/ft)	
MWd/MTU	MWd/STU	Two Loop Operation	Single Loop Operation
0.00	0.00	12.82	10.26
21090	19130	12.82	10.26
63500	57610	8.00	6.40
70000	63500	5.00	4.00

TABLE 4.1-2 APLHGR Data for SVEA-96+ Fuel

Average Planar Exposure		APLHGR Limit (kW/ft)	
MWd/MTU	MWd/STU	Two Loop Operation	Single Loop Operation
0.00	0.00	12.85	10.28
3680	3340	12.85	10.28
16000	14510	10.97	8.78
65000	58970	7.24	5.79

4.2 MINIMUM CRITICAL POWER RATIO

LIMITING CONDITION FOR OPERATION:

The MINIMUM CRITICAL POWER RATION (MCPR) shall be equal to or greater than the MCPR limit computed from the following steps:

1. Determine τ as defined in Appendix A.

NOTE
The SLO operating condition MCPR values in Tables 4.2-1, 4.2-2, and 4.2-4 implement the increase in the MCPR Safety Limit to meet the requirements of Technical Specification Section 3/4.4.1.1 ACTION statement a.1.c.

2. Linearly interpolate a MCPR value as a function of τ from the MCPR value at τ=0 and MCPR value at τ=1 as specified in Table 4.2-1 and Table 4.2-2 for the appropriate condition.

3. For the power dependent MCPR adjustment, when thermal power is ≥ 24% rated core thermal power, determine a K_p value by linearly interpolating a K_p value as a function of core rated thermal power from Table 4.2-3. Multiply the MCPR value obtained from Step 2 by the K_p value to determine the power dependent MCPR limit.

   When core thermal power is < 24% rated thermal power, no thermal limits are required.

4. For the flow dependent MCPR adjustment, determine the appropriate flow dependent MCPR limit by linearly interpolating between the MCPR limits as a function of rated core flow using the information in Table 4.2-4.

5. Choose the most limiting (highest value) of the power and flow dependent MCPR limits determined in steps 3 and 4 as the value for the MCPR limit for the limiting Condition For Operation.

Note that the MCPR limit is a function of core average scram speed (τ), cycle exposure, core thermal power, total core flow, EOC-RPT operability, the number of reactor coolant recirculation loops in operation, and main turbine bypass operability.

EOC-RPT system operability is defined by Hope Creek Technical Specification 3.3.4.2.

Reactor coolant recirculation loop operation is defined by Hope Creek Technical Specification 3.4.1.1.

Main Turbine Bypass operability is defined by Hope Creek Technical Specification 3.7.7.

TABLE 4.2-1 Cycle 15 MCPR Operating Limits: Cycle Exposure ≤ 10692 MWD/MTU (≤ 9700 MWD/STU)

Main Turbine Bypass Operable			
Operating Condition	Scram Speed Option	GE14	SVEA-96+
TLO-EOC-RPT Operable	A	1.49	1.49
	B	1.38	1.38
TLO-EOC-RPT Inoperable	A	1.51	1.51
	B	1.40	1.40
SLO-EOC-RPT Operable	A	1.51	1.51
	B	1.40	1.40
SLO-EOC-RPT Inoperable	A	1.53	1.53
	B	1.42	1.42

Scram Speed Option A $\tau = 1$, Scram Speed Option B $\tau = 0$, TLO = Two recirculation Loop Operation, SLO = Single recirculation Loop Operation.

TABLE 4.2-2 Cycle 15 MCPR Operating Limits: Cycle Exposure > 10692 MWD/MTU (> 9700 MWD/STU)

Main Turbine Bypass Operable			
Operating Condition	Scram Speed Option	GE14	SVEA-96+
TLO-EOC-RPT Operable	A	1.59	1.61
	B	1.42	1.44
TLO-EOC-RPT Inoperable	A	1.61	1.62
	B	1.44	1.45
SLO-EOC-RPT Operable	A	1.61	1.63
	B	1.44	1.46
SLO-EOC-RPT Inoperable	A	1.63	1.64
	B	1.46	1.47

Scram Speed Option A $\tau = 1$, Scram Speed Option B $\tau = 0$, TLO = Two recirculation Loop Operation, SLO = Single recirculation Loop Operation.

TABLE 4.2-3 Power Dependent MCPR Adjustments and Multiplier (K_p) Data

Operating Condition	Core Thermal Power (% of Rated)			
	≥ 24	45	60	≥ 100
	MCPR Multiplier Kp			
TLO	1.561	1.280	1.150	1.000
SLO	1.561	1.280	1.150	1.000

TABLE 4.2-4 Flow Dependent MCPR Limit ($MCPR_f$)

Operating Condition	Core Flow (% of Rated)			
	30	60	80.8	105
	MCPR Limit			
TLO	1.55	[redacted]	1.25	1.25
SLO	1.57	1.39	[redacted]	

4.3 Linear Heat Generation Rate

LIMITING CONDITION FOR OPERATION:

The LINEAR HEAT GENERATION RATE (LHGR) shall not exceed the limit computed from the following steps:

1. Determine the exposure dependent LHGR limit for the appropriate fuel design using linear interpolation between the values in Table 4.3-1 and Table 4.3-2.

NOTE
For Two recirculation Loop Operation utilize steps 1, 2, 3 and 6 to determine the LCO LHGR limits. When the Technical Specification Section 3/4 .4.1.1 ACTION statement a.1.e is entered from that section's Limiting Condition for Operation (LCO), utilize steps 1, 4, 5 and 6 to determine the LCO LHGR limits for Single recirculation Loop Operation (SLO).

2. For the power dependent LHGR adjustment for TLO, determine a $LHGRFAC_p$ value by linearly interpolating a $LHGRFAC_p$ value as a function of rated core thermal power from the TLO entries in Table 4.3-3. Multiply the LHGR values obtained from Step 1 by the $LHGRFAC_p$ value to determine the power dependent LHGR limits for each fuel design.

3. For the flow dependent LHGR adjustment for TLO, determine a $LHGRFAC_f$ value by linearly interpolating a $LHGRFAC_f$ value as a function of rated core flow from the TLO entries in Table 4.3-4. Multiply the LHGR values obtained from Step 1 by the $LHGRFAC_f$ value to determine the flow dependent LHGR limits for each fuel design.

4. For the power dependent LHGR adjustment for SLO, determine a $LHGRFAC_p$ value by linearly interpolating a $LHGRFAC_p$ value as a function of rated core thermal power from the SLO entries in Table 4.3-3. Multiply the LHGR values obtained from Step 1 by the $LHGRFAC_p$ value to determine the power dependent LHGR limits for each fuel design.

5. For the flow dependent LHGR adjustment for SLO, determine a $LHGRFAC_f$ value by linearly interpolating a $LHGRFAC_f$ value as a function of rated core flow from the SLO entries in Table 4.3-4. Multiply the LHGR values obtained from Step 1 by the $LHGRFAC_f$ value to determine the flow dependent LHGR limits for each fuel design.

6. Choose the most limiting (lowest value) of the power and flow dependent LHGR limits determined in steps 2 and 3 (TLO) or 4 and 5 (SLO) as the value for the LHGR limit for the Limiting Condition For Operation.

TABLE 4.3-1 LHGR Data for GE14 Fuel

Peak Pellet Exposure		LHGR Limit
MWd/MTU	MWd/STU	KW/ft
0.00	0.00	13.40
16000	14515	13.40
63500	57610	8.00
70000	63500	5.00

TABLE 4.3-2 LHGR Data for SVEA-96+ Fuel

Peak Pellet Exposure		LHGR Limit
MWd/MTU	MWd/STU	KW/ft
0.00	0.00	13.41
16000	14515	10.97
65000	58967	7.24

TABLE 4.3-3 Power Dependent Linear Heat Generation Rate Multiplier ($LHGRFAC_p$)

Operating Condition	Core Thermal Power (% of Rated)		
	≥ 24	60.86	≥ 100
	$LHGRFAC_p$ Multiplier		
TLO	0.603		1.000
SLO	0.603	0.796	

TABLE 4.3-4 Flow Dependent Linear Heat Generation Rate Multiplier ($LHGRFAC_f$)

Operating Condition	Core Flow (% of Rated)					
	30	50	52.7	60	82.2	105
	$LHGRFAC_f$ Multiplier					
TLO	0.500	0.782			1.000	1.000
SLO	0.500	0.782	0.800	0.800		

4.4 Oscillation Power Range Monitor

4.4.1 1.0 Hz Corner Frequency Setpoints for Rated Thermal Power OLMCPR < 1.40

LIMITING CONDITION FOR OPERATION:

Four channels of the OPRM instrumentation shall be OPERABLE. Each OPRM channel period based algorithm amplitude trip setpoint (Sp) shall be less than or equal to the Allowable Value of 1.10.

Additional Information.

The NRC Safety Evaluation Report, dated 12/22/04, which was issued for Technical Specification Amendment Number 159 required that the period based algorithm amplitude trip setpoint (Sp) and confirmation counts be documented in the COLR. The confirmation counts are documented below.

Number of successive confirmation counts for OPRM setpoint (N_2) = 13

4.4.2 1.0 Hz Corner Frequency Setpoints for Rated Thermal Power OLMCPR ≥ 1.40

LIMITING CONDITION FOR OPERATION:

Four channels of the OPRM instrumentation shall be OPERABLE. Each OPRM channel period based algorithm amplitude trip setpoint (Sp) shall be less than or equal to the Allowable Value of 1.11.

Additional Information.

The NRC Safety Evaluation Report, dated 12/22/04, which was issued for Technical Specification Amendment Number 159 required that the period based algorithm amplitude trip setpoint (Sp) and confirmation counts be documented in the COLR. The confirmation counts are documented below.

Number of successive confirmation counts for OPRM setpoint (N_2) = 14

Appendix A: Method of Core Average Scram Speed Calculation

Method of Core Average Scram Speed, τ, Calculation

τ is defined as

$$\tau = \frac{(\tau_{ave} - \tau_B)}{\tau_A - \tau_B}$$

where:

τ_A = 0.86 seconds, control rod average scram insertion time limit to notch 39 per Specification 3.1.3.3

$$\tau_B = 0.672 + 1.65\left[\frac{N_1}{\sum_{i=1}^{n} N_i}\right]^{1/2} (0.016)$$

$$\tau_{ave} = \frac{\sum_{i=1}^{n} N_i \tau_i}{\sum_{i=1}^{n} N_i}$$

n = number of surveillance tests performed to date in cycle,

N_i = number of active control rods measured in the ith surveillance test,

τ_i = average scram time to notch 39 of all rods measured in the ith surveillance test, and

N_1 = total number of active rods measured in Specification 4.1.3.2.a.

If $\tau_{ave} \leq \tau_B$, set τ = 0 to apply Option B OLMCPR.

τ shall be 1.0 (τ = 1.0) prior to performance of the initial scram time measurements for the cycle in accordance with Specification 4.1.3.2.

Appendix B: Backup Stability Protection

Backup Stability Protection Region Intercepts

The BSP region endpoints, given in Table B-1, are bounding for Cycle 15 up to an exposure of 11600 MWD/ST. For exposures greater than 11600 MWD/ST, the Cycle 15 BSP region endpoints given in Table B-2 are applicable. The region boundaries are defined using the Generic Shape Function and the applicable endpoints given in the tables below (Reference 2).

Table B-1 BSP Region Intercepts: Cycle Exposure ≤ 11600 MWD/ST

Region 1 = BSP Scram Region
Region 2 = BSP Controlled Entry Region

Region Boundary Intercept	% Power	% Flow
Region 1 High Flow Control Line	62.8	45.5
Region 1 Natural Circulation Line	44.7	35.0
Region 2 High Flow Control Line	66.3	50.0
Region 2 Natural Circulation Line	32.2	36.3

Table B-2 BSP Region Intercepts: Cycle Exposure > 11600 MWD/ST

Region 1 = BSP Scram Region
Region 2 = BSP Controlled Entry Region

Region Boundary Intercept	% Power	% Flow
Region 1 High Flow Control Line	62.4	45.1
Region 1 Natural Circulation Line	44.7	35.0
Region 2 High Flow Control Line	67.2	51.1
Region 2 Natural Circulation Line	32.2	36.3

ATTACHMENT 2

Hope Creek Generating Station
Facility Operating License No. NPF-57
NRC Docket No. 50-354

Core Operating Limits Report
Reload 14, Cycle 15
Revision 2

CORE OPERATING LIMITS REPORT

FOR

Hope Creek Generating Station Unit 1

RELOAD 14, CYCLE 15 EPU

Effective Date: 9/5/08

Prepared By: _____ Date: 9/4/08
J. P. Collins
Preparer

Reviewed By: _____ Date: 4/Sept/08
K. W. Buckwheat
Independent Reviewer

Approved By: _____ Date: 9/4/08
D. V. Notigan
Manager - BWR Design & Analysis

Table of Contents

	Page
1.0 Terms and Definitions	4
2.0 References	5
3.0 General Information	6
4.0 Technical Specifications that Reference the COLR	7
4.1 Average Planar Linear Heat Generation Rate	8
4.2 Minimum Critical Power Ratio	9
4.3 Linear Heat Generation Rate	12
4.4 Oscillation Power Range Monitor	15
Appendix A: Method of Core Average Scram Speed Calculation	16
Appendix B: Backup Stability Protection	18

List of Tables

TABLE 4.1-1 APLHGR Data for GE14 Fuel 8
TABLE 4.1-2 APLHGR Data for SVEA-96+ Fuel 8
TABLE 4.2-1 Cycle 15 MCPR Operating Limits: Cycle Exposure ≤ 10692 MWD/MTU (≤ 9700 MWD/STU) 10
TABLE 4.2-2 Cycle 15 MCPR Operating Limits: Cycle Exposure > 10692 MWD/MTU (> 9700 MWD/STU) 10
TABLE 4.2-3 Power Dependent MCPR Adjustments and Multiplier (K_p) Data 11
TABLE 4.2-4 Flow Dependent MCPR Limit ($MCPR_f$) 11
TABLE 4.3-1 LHGR Data for GE14 Fuel 13
TABLE 4.3-2 LHGR Data for SVEA-96+ Fuel 13
TABLE 4.3-3 Power Dependent Linear Heat Generation Rate Multiplier ($LHGRFAC_p$) 14
TABLE 4.3-4 Flow Dependent Linear Heat Generation Rate Multiplier ($LHGRFAC_f$) 14
Table B-1 BSP Region Intercepts: Cycle Exposure ≤ 11600 MWD/ST 19
Table B-2 BSP Region Intercepts: Cycle Exposure > 11600 MWD/ST 19

1.0 Terms And Definitions

APLHGR	Average Planar Linear Heat Generation Rate
ARTS	APRM and RBM Technical Specification Analysis
BSP	Backup Stability Protection
COLR	Core Operating Limits Report
ECCS	Emergency Core Cooling Systems
EOC-RPT	End-Of-Cycle Recirculation Pump Trip
LCO	Limiting Condition for Operation
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
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
OPRM	Oscillation Power Range Monitor
SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single Loop Operation
TLO	Two Loop Operation

2.0 References

1. "General Electric Standard Application for Reactor Fuel", NEDE-24011-P-A-15, and the Supplement NEDE-24011-P-A-15-US.

2. "Supplemental Reload Licensing Report for Hope Creek Unit 1 Reload 14 Cycle 15 EPU", Global Nuclear Fuel Document No. 0000-0078-1947-SRLR, Revision 3, August 2008.

3. "Fuel Bundle Information Report for Hope Creek Unit 1 Reload 14, Cycle 15 EPU", Global Nuclear Fuel Document No. 0000-0078-1947-FBIR, Rev. 1, August 2008.

4. "Technical Specifications and Bases for Hope Creek Generating Station Unit", Docket No. 50-354, License No. NPF-57.

5. Deleted

6. Deleted

7. Deleted

8. Deleted

9. "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications", Global Nuclear Fuel Document NEDO-32465-A.

3.0 General Information

The purpose of this report is to provide the Core Operating Limits for Hope Creek Generation Station Unit 1 Cycle 15/Reload 14 Extended Power Uprate operation. In addition, this report will provide cycle information on OPRM set points and Backup Stability Regions, single recirculation loop operation, and core average scram speed. Finally, this report also provides a reference to the most recent revision of the implemented approved methodology. The Power Distribution Limits presented here correspond to the core thermal limits for APLHGR, MCPR, and LHGR.

These operating limit values have been determined using NRC approved methods contained in the GESTAR-II, NEDE-24011-P-A (Revision 15, Reference 1) and are established such that all applicable fuel thermal-mechanical, core thermal-hydraulic, ECCS, and nuclear limits such as shutdown margin, and transient and accident analysis limits are met. In addition, the operating limits have been determined consistent with the requirements of NEDO-32465-A (Reference 9), where appropriate.

Various sections of the Hope Creek Technical Specifications reference this COLR. Those sections are listed in section 4 of this document. Hope Creek Technical Specification 6.9.1.9 also requires that this report, including any mid cycle revisions, shall be provided, upon issuance, to the NRC.

This document is specific to Hope Creek Generating Station Unit 1 Cycle 15/Reload 14 EPU and shall not be applicable to any other core or cycle design. This report is applicable for Cycle 15 operation from the date of issuance through the end of cycle including consideration of a power coastdown to a core thermal power that shall not go below 40% rated core thermal power. End of full power capability is reached when 100% rated power can no longer be maintained by increasing core flow (up to 105% of rated core flow), at allowable rated feedwater temperatures, in the all-rods-out configuration. Operation beyond the end of full power capability is defined as power coastdown operation which includes an operating assumption that vessel dome pressure will decrease during the power coastdown period as steam flow decreases (maintaining constant vessel dome pressure during the power coastdown period was not generically considered by GESTAR-II for determining the operating limit LCO values described above).

Revision 2 of this report updates the SVEA-96+ APLHGR and LHGR limits to provide limits up to 72,000 MWD/MTU Average Planar and Peak Pellet Exposure.

4.0 Technical Specifications that reference the COLR

The following Hope Creek Technical Specifications reference this COLR:

Tech. Spec.	Title
2.1	Safety Limit Bases
3/4.2b	Power Distribution Bases
3/4.2.1	Average Planar Linear Generation Rate
3/4.2.1b	Average Planar Linear Heat Generation Rate
3/4.2.3	Minimum Critical Power Ratio
3/4.2.4	Linear Heat Generation Rate
3/4.3.11	Oscillation Power Range Monitor
3/4.4.1	Recirculation System Recirculation Loops
6.9.1.9	Administrative Controls, Core Operating Limits Report

4.1 Average Planar Linear Heat Generation Rate

LIMITING CONDITION FOR OPERATION:

All AVERAGE PLANAR LINEAR HEAT GENERATION RATES (APLHGRs) shall be less than or equal to the limits specified in Table 4.1-1 and Table 4.1-2 for Two recirculation Loop Operation (TLO).

When the Technical Specification Section 3/4 .4.1 Action statement a.1.d is entered from that section's Limiting Condition for Operation, reduce the APLHGR limits to the values specified in Table 4.1-1 and Table 4.1-2.

Linear interpolation shall be used to determine APLHGR limits as a function of exposure for intermediate values in Table 4.1-1 and Table 4.1-2

TABLE 4.1-1 APLHGR Data for GE14 Fuel

Average Planar Exposure		APLHGR Limit (kW/ft)	
MWd/MTU	MWd/STU	Two Loop Operation	Single Loop Operation
0.00	0.00	12.82	10.26
21090	19130	12.82	10.26
63500	57610	8.00	6.40
70000	63500	5.00	4.00

TABLE 4.1-2 APLHGR Data for SVEA-96+ Fuel

Average Planar Exposure		APLHGR Limit (kW/ft)	
MWd/MTU	MWd/STU	Two Loop Operation	Single Loop Operation
0.00	0.00	12.85	10.28
3680	3340	12.85	10.28
16000	14510	10.97	8.78
65000	58970	7.24	5.79
66500	60330	7.12	5.70
72000	65320	6.50	5.20

4.2 MINIMUM CRITICAL POWER RATIO

LIMITING CONDITION FOR OPERATION:

The MINIMUM CRITICAL POWER RATIO (MCPR) shall be equal to or greater than the MCPR limit computed from the following steps:

1. Determine τ as defined in Appendix A.

NOTE
The SLO operating condition MCPR values in Tables 4.2-1, 4.2-2, and 4.2-4 implement the increase in the MCPR Safety Limit to meet the requirements of Technical Specification Section 3/4.4.1.1 ACTION statement a.1.c.

2. Linearly interpolate a MCPR value as a function of τ from the MCPR value at τ=0 and MCPR value at τ=1 as specified in Table 4.2-1 and Table 4.2-2 for the appropriate condition.

3. For the power dependent MCPR adjustment, when thermal power is ≥ 24% rated core thermal power, determine a K_p value by linearly interpolating a K_p value as a function of core rated thermal power from Table 4.2-3. Multiply the MCPR value obtained from Step 2 by the K_p value to determine the power dependent MCPR limit.

   When core thermal power is < 24% rated thermal power, no thermal limits are required.

4. For the flow dependent MCPR adjustment, determine the appropriate flow dependent MCPR limit by linearly interpolating between the MCPR limits as a function of rated core flow using the information in Table 4.2-4.

5. Choose the most limiting (highest value) of the power and flow dependent MCPR limits determined in steps 3 and 4 as the value for the MCPR limit for the limiting Condition For Operation.

Note that the MCPR limit is a function of core average scram speed (τ), cycle exposure, core thermal power, total core flow, EOC-RPT operability, the number of reactor coolant recirculation loops in operation, and main turbine bypass operability.

EOC-RPT system operability is defined by Hope Creek Technical Specification 3.3.4.2.

Reactor coolant recirculation loop operation is defined by Hope Creek Technical Specification 3.4.1.1.

Main Turbine Bypass operability is defined by Hope Creek Technical Specification 3.7.7.

TABLE 4.2-1 Cycle 15 MCPR Operating Limits: Cycle Exposure ≤ 10692 MWD/MTU (≤ 9700 MWD/STU)

Main Turbine Bypass Operable			
Operating Condition	Scram Speed Option	GE14	SVEA-96+
TLO-EOC-RPT Operable	A	1.49	1.49
	B	1.38	1.38
TLO-EOC-RPT Inoperable	A	1.51	1.51
	B	1.40	1.40
SLO-EOC-RPT Operable	A	1.51	1.51
	B	1.40	1.40
SLO-EOC-RPT Inoperable	A	1.53	1.53
	B	1.42	1.42

Scram Speed Option A $\tau = 1$, Scram Speed Option B $\tau = 0$, TLO = Two recirculation Loop Operation, SLO = Single recirculation Loop Operation.

TABLE 4.2-2 Cycle 15 MCPR Operating Limits: Cycle Exposure > 10692 MWD/MTU (> 9700 MWD/STU)

Main Turbine Bypass Operable			
Operating Condition	Scram Speed Option	GE14	SVEA-96+
TLO-EOC-RPT Operable	A	1.59	1.61
	B	1.42	1.44
TLO-EOC-RPT Inoperable	A	1.61	1.62
	B	1.44	1.45
SLO-EOC-RPT Operable	A	1.61	1.63
	B	1.44	1.46
SLO-EOC-RPT Inoperable	A	1.63	1.64
	B	1.46	1.47

Scram Speed Option A $\tau = 1$, Scram Speed Option B $\tau = 0$, TLO = Two recirculation Loop Operation, SLO = Single recirculation Loop Operation.

TABLE 4.2-3 Power Dependent MCPR Adjustments and Multiplier (K_p) Data

Operating Condition	Core Thermal Power (% of Rated)			
	≥ 24	45	60	≥ 100
	MCPR Multiplier Kp			
TLO	1.561	1.280	1.150	1.000
SLO	1.561	1.280	1.150	1.000

TABLE 4.2-4 Flow Dependent MCPR Limit ($MCPR_f$)

Operating Condition	Core Flow (% of Rated)			
	30	60	80.8	105
	MCPR Limit			
TLO	1.55	[redacted]	1.25	1.25
SLO	1.57	1.39	[redacted]	

4.3 Linear Heat Generation Rate

LIMITING CONDITION FOR OPERATION:

The LINEAR HEAT GENERATION RATE (LHGR) shall not exceed the limit computed from the following steps:

1. Determine the exposure dependent LHGR limit for the appropriate fuel design using linear interpolation between the values in Table 4.3-1 and Table 4.3-2.

> **NOTE**
>
> For Two recirculation Loop Operation utilize steps 1, 2, 3 and 6 to determine the LCO LHGR limits.
>
> When the Technical Specification Section 3/4 .4.1.1 ACTION statement a.1.e is entered from that section's Limiting Condition for Operation (LCO), utilize steps 1, 4, 5 and 6 to determine the LCO LHGR limits for Single recirculation Loop Operation (SLO).

2. For the power dependent LHGR adjustment for TLO, determine a $LHGRFAC_p$ value by linearly interpolating a $LHGRFAC_p$ value as a function of rated core thermal power from the TLO entries in Table 4.3-3. Multiply the LHGR values obtained from Step 1 by the $LHGRFAC_p$ value to determine the power dependent LHGR limits for each fuel design.

3. For the flow dependent LHGR adjustment for TLO, determine a $LHGRFAC_f$ value by linearly interpolating a $LHGRFAC_f$ value as a function of rated core flow from the TLO entries in Table 4.3-4. Multiply the LHGR values obtained from Step 1 by the $LHGRFAC_f$ value to determine the flow dependent LHGR limits for each fuel design.

4. For the power dependent LHGR adjustment for SLO, determine a $LHGRFAC_p$ value by linearly interpolating a $LHGRFAC_p$ value as a function of rated core thermal power from the SLO entries in Table 4.3-3. Multiply the LHGR values obtained from Step 1 by the $LHGRFAC_p$ value to determine the power dependent LHGR limits for each fuel design.

5. For the flow dependent LHGR adjustment for SLO, determine a $LHGRFAC_f$ value by linearly interpolating a $LHGRFAC_f$ value as a function of rated core flow from the SLO entries in Table 4.3-4. Multiply the LHGR values obtained from Step 1 by the $LHGRFAC_f$ value to determine the flow dependent LHGR limits for each fuel design.

6. Choose the most limiting (lowest value) of the power and flow dependent LHGR limits determined in steps 2 and 3 (TLO) or 4 and 5 (SLO) as the value for the LHGR limit for the Limiting Condition For Operation.

TABLE 4.3-1 LHGR Data for GE14 Fuel

Peak Pellet Exposure		LHGR Limit
MWd/MTU	MWd/STU	KW/ft
0.00	0.00	13.40
16000	14515	13.40
63500	57610	8.00
70000	63500	5.00

TABLE 4.3-2 LHGR Data for SVEA-96+ Fuel

Peak Pellet Exposure		LHGR Limit
MWd/MTU	MWd/STU	KW/ft
0.00	0.00	13.10
2000	1814	13.10
16000	14515	10.97
65000	58967	7.24
66500	60328	7.12
72000	65317	6.50

TABLE 4.3-3 Power Dependent Linear Heat Generation Rate Multiplier ($LHGRFAC_p$)

Operating Condition	Core Thermal Power (% of Rated)		
	≥ 24	60.86	≥ 100
	$LHGRFAC_p$ Multiplier		
TLO	0.603		1.000
SLO	0.603	0.796	

TABLE 4.3-4 Flow Dependent Linear Heat Generation Rate Multiplier ($LHGRFAC_f$)

Operating Condition	Core Flow (% of Rated)					
	30	50	52.7	60	82.2	105
	$LHGRFAC_f$ Multiplier					
TLO	0.500	0.782			1.000	1.000
SLO	0.500	0.782	0.800	0.800		

4.4 Oscillation Power Range Monitor

4.4.1 1.0 Hz Corner Frequency Setpoints for Rated Thermal Power OLMCPR < 1.40

LIMITING CONDITION FOR OPERATION:

Four channels of the OPRM instrumentation shall be OPERABLE. Each OPRM channel period based algorithm amplitude trip setpoint (Sp) shall be less than or equal to the Allowable Value of 1.10.

Additional Information.

The NRC Safety Evaluation Report, dated 12/22/04, which was issued for Technical Specification Amendment Number 159 required that the period based algorithm amplitude trip setpoint (Sp) and confirmation counts be documented in the COLR. The confirmation counts are documented below.

Number of successive confirmation counts for OPRM setpoint (N_2) = 13

4.4.2 1.0 Hz Corner Frequency Setpoints for Rated Thermal Power OLMCPR ≥ 1.40

LIMITING CONDITION FOR OPERATION:

Four channels of the OPRM instrumentation shall be OPERABLE. Each OPRM channel period based algorithm amplitude trip setpoint (Sp) shall be less than or equal to the Allowable Value of 1.11.

Additional Information.

The NRC Safety Evaluation Report, dated 12/22/04, which was issued for Technical Specification Amendment Number 159 required that the period based algorithm amplitude trip setpoint (Sp) and confirmation counts be documented in the COLR. The confirmation counts are documented below.

Number of successive confirmation counts for OPRM setpoint (N_2) = 14

Appendix A: Method of Core Average Scram Speed Calculation

Method of Core Average Scram Speed, τ, Calculation

τ is defined as

$$\tau = \frac{(\tau_{ave} - \tau_B)}{\tau_A - \tau_B}$$

where:

τ_A = 0.86 seconds, control rod average scram insertion time limit to notch 39 per Specification 3.1.3.3

$$\tau_B = 0.672 + 1.65\left[\frac{N_1}{\sum_{i=1}^{n} N_i}\right]^{1/2} (0.016)$$

$$\tau_{ave} = \frac{\sum_{i=1}^{n} N_i \tau_i}{\sum_{i=1}^{n} N_i}$$

n = number of surveillance tests performed to date in cycle,

N_i = number of active control rods measured in the ith surveillance test,

τ_i = average scram time to notch 39 of all rods measured in the ith surveillance test, and

N_1 = total number of active rods measured in Specification 4.1.3.2.a.

If $\tau_{ave} \leq \tau_B$, set τ = 0 to apply Option B OLMCPR.

τ shall be 1.0 (τ = 1.0) prior to performance of the initial scram time measurements for the cycle in accordance with Specification 4.1.3.2.

Appendix B: Backup Stability Protection

Backup Stability Protection Region Intercepts

The BSP region endpoints, given in Table B-1, are bounding for Cycle 15 up to an exposure of 11600 MWD/ST. For exposures greater than 11600 MWD/ST, the Cycle 15 BSP region endpoints given in Table B-2 are applicable. The region boundaries are defined using the Generic Shape Function and the applicable endpoints given in the tables below (Reference 2).

Table B-1 BSP Region Intercepts: Cycle Exposure ≤ 11600 MWD/ST

Region 1 = BSP Scram Region
Region 2 = BSP Controlled Entry Region

Region Boundary Intercept	% Power	% Flow
Region 1 High Flow Control Line	62.8	45.5
Region 1 Natural Circulation Line	44.7	35.0
Region 2 High Flow Control Line	66.3	50.0
Region 2 Natural Circulation Line	32.2	36.3

Table B-2 BSP Region Intercepts: Cycle Exposure > 11600 MWD/ST

Region 1 = BSP Scram Region
Region 2 = BSP Controlled Entry Region

Region Boundary Intercept	% Power	% Flow
Region 1 High Flow Control Line	62.4	45.1
Region 1 Natural Circulation Line	44.7	35.0
Region 2 High Flow Control Line	67.2	51.1
Region 2 Natural Circulation Line	32.2	36.3