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GO2-19-087

U.S. Nuclear Regulatory Commission  
ATTN: Document Control Desk  
Washington, D.C. 20555-0001

Subject: **COLUMBIA GENERATING STATION, DOCKET NO. 50-397;  
CYCLE 25 CORE OPERATING LIMITS REPORT**

Dear Sir or Madam:

In accordance with Columbia Generating Station Technical Specification (TS) 5.6.3.d, Energy Northwest herewith submits the Cycle 25 Core Operating Limits Report (COLR). The operating limits in the COLR revision were developed in accordance with the requirements of TS 5.6.3.a, b, and c. The changes to the COLR have been reviewed by the Columbia Generating Station Plant Operations Committee.

No new regulatory commitments are made in this letter. If you have any questions or require additional information, please contact Ms. D.M. Wolfgramm at (509) 377-4792.

Executed on this 10<sup>th</sup> day of June, 2019.

Respectfully,

D.W. Gregoire  
Manager, Regulatory Affairs

Enclosure – as stated

cc: NRC Region IV Regional Admin  
NRC Region IV PM  
NRC Senior Resident Inspector  
C.D. Sonoda – BPA (w/o enc)  
W.A. Horin – Winston & Strawn (w/o enc)

GO2-19-087  
Enclosure

Core Operating Limits Report  
Columbia Generating Station Cycle 25

April 2019

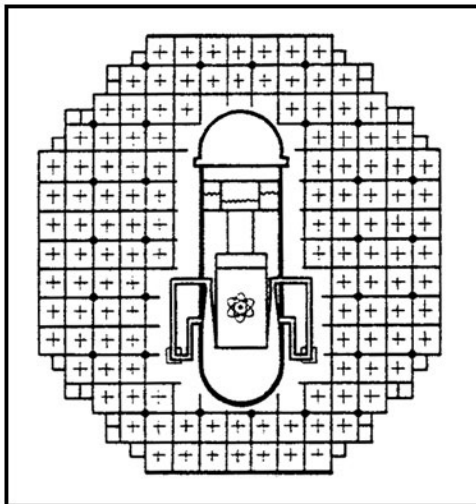
# CORE OPERATING LIMITS REPORT

## COLUMBIA GENERATING STATION CYCLE 25

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**Revision 25.0**

**April 2019**



## DESCRIPTION OF CHANGES

<b>Justification</b>	
The operating limits are established per Technical Specification (TS) 5.6.3a using NRC approved methodology listed in TS 5.6.3b. As required by TS 5.6.3c, the core operating limits are determined such that all applicable limits of the safety analysis are met.	

<b>Page(s)</b>	<b>Description (including summary, reason, initiating document, if applicable)</b>
All	Document revision and cycle number changed for Cycle 25 initial issue.
4, 11 – 19, 21	Remove pre-power uprate limits. Not applicable post-power uprate. Reference updated source references. Delete redundant source references.
4, 6, 15, 21	Remove GE14 limits and references. Cycle 25 contains only GNF2 fuel.
5	GESTAR II revision updated as specified in SRLR.
7	Clarify which MCPR value reported. No change in TS 2.1.1.2 values or requirements.
8,9,11	Tables 3.1 and 3.1-1 updated for the Cycle 25 MCPR operating limits specified in the SRLR. Non-Pressurization Events split for TLO & SLO when Rod Withdrawal Error is limiting in TLO and Recirculation Pump Seizure is limiting in SLO.
7,9,11	The SLO MCPR adder reduced to 0.03. Applying the SLO uncertainties to the TLO transient results from TRACG does not result in a SLO MCPR operating limit increase by more than the difference between the TLO and SLO MCPR safety limits (0.03).
8,11,15 – 18	Note 6 and Tables 3.2 – 3.6 and 4.1 – 4.5 power and flow inequalities changed per SRLR to match 3D MONICORE implementation. No change in 3D MONICORE, which already selects the more conservative limit, when two are specified at a given power or flow. TS Table 3.3.1.1-1 Functions 8 and 9, Pby pass $\geq 29.5$ %RTP not impacted because direct scrams enable prior to crediting in the thermal limits at $> 29.5$ %RTP.
8, 11, 18	Add Note 8 to Table 3.1 and Note 10 to Table 4.5. PROOS limits do not support full arc operation. No impact on turbine governor valve, admission curves because full arc curves not supported by the turbine control system.
21	The SRLR, FBIR and NDR (replaces RLP) updated for Cycle 25 reload analyses. GNF2 GESTAR II, Amendment 22 compliance report updated.
21	GNF2 Fuel Design Cycle-Independent Analyses updated to support Aging Management Program – Boron Carbide Monitoring Program. No change in conclusions.

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## 1.0 Introduction and Summary

This report provides the core operating limits for **Average Planar Linear Heat Generation Rate (APLHGR), Minimum Critical Power Ratio (MCPR), Linear Heat Generation Rate (LHGR), Oscillation Power Range Monitor (OPRM) Instrumentation and Rod Block Monitor Instrumentation** for Columbia Generating Station Cycle 25 as required by Technical Specification 5.6.3. As required by Technical Specification 5.6.3, these limits were determined using NRC-approved methodology and are established so that all applicable limits of the plant safety analysis are met. The specific topical report revisions and supplements which describe the methodology utilized in this cycle specific analysis are shown in Table 1.1.

The reload licensing analyses for this cycle provide operating limits for Average Power Range Monitor / Rod Block Monitor and Technical Specifications Improvement Program (ARTS) and Maximum Extended Load Line Limit Analysis (MELLLA) operation which extends the power and flow operating regime for Columbia Generating Station up to the MELLLA boundary for Two Loop Operation (TLO).

The core operating limits are applicable up to 100% of rated thermal power along and below the MELLLA boundary. The minimum flow for operation at rated power is 82.7%. The maximum flow is 106%.

Single Loop Operation (SLO) is restricted to the Extended Load Line Limit Analysis (ELLLA) boundary. The core operating limits for both TLO and SLO are applicable for normal feedwater temperature, feedwater heaters out of service, final feedwater temperature reduction and coastdown. The Pressure Regulator Out of Service (PROOS) MCPR and LHGR limits are applicable if two (2) of the three (3) Digital Electro-hydraulic (DEH) pressure controllers are not functional.

The FSAR and Technical Specification Bases reference the COLR for the most recent approved version of the General Electric Standard Application for Reactor Fuel (GESTAR II), which is listed in Table 1.1. The FSAR references the COLR for the most recent versions of the Supplemental Reload Licensing Report, the Fuel Bundle Information Report, and the GNF2 Fuel Design Cycle-Independent Analyses, which are References 7.2, 7.3 and 7.6. The FSAR references the COLR for the most recent version of the Reference Loading Pattern, which is documented in References 7.2 and 7.5. The FSAR and Technical Specification Bases reference the COLR for the most recent version of the GNF2 Generic Compliance with GESTAR II, which is Reference 7.7.

**Table 1.1**  
**Columbia Generating Station**  
**Reference Analytical Methods**

NEDE-24011-P-A and NEDE-24011-P-A-US, *General Electric Standard Application for Reactor Fuel (GESTAR II) and Supplement for the United States*, Revision 26, January 2018.

## 2.0 **Average Planar Linear Heat Generation Rate (APLHGR) Limits for Technical Specification 3.2.1**

The APLHGR limits for use in Technical Specification 3.2.1, as a function of Average Planar Exposure, shall not exceed the limits shown in the following tables. APLHGR limits for single loop operation for GNF2 fuel are obtained by applying a 1.00 multiplier to the two loop operation APLHGR limits. See Technical Specification 3.2.1 and the applicable Bases for further application details.

- a. Table 2.1 – GNF2 Reload Fuel

**Table 2.1**  
**Maximum Average Planar Linear Heat Generation Rate (MAPLHGR)**  
**Versus Average Planar Exposure**  
**GNF2 Reload Fuel**

<b>Average Planar Exposure</b>		<b>MAPLHGR Limit</b>
<b>GWd/MTU</b>	<b>GWd/ST</b>	<b>kW/ft</b>
0.00	0.00	13.78
18.92	17.16	13.78
67.00	60.78	6.87
70.00	63.50	5.50

(Reference 7.2 Table 6)



### 3.0 **Minimum Critical Power Ratio (MCPR) Operating Limits for Technical Specification 3.2.2**

The MCPR operating limits for use in Technical Specification 3.2.2 are determined by the larger of the flow dependent (MCPR<sub>f</sub>) and power dependent (MCPR<sub>p</sub>) limits from Table 3.1 through Table 3.7. See Technical Specification 3.2.2 and the applicable Bases for further application details.

The MCPR<sub>99.9%</sub> values used to calculate the MCPR operating limits are 1.10 for two loop operation (TLO) and 1.13 for single loop operation (SLO).

**Table 3.1**  
**MCPR Operating Limits**  
**Two Loop Operation<sup>1</sup>**  
**All Fuel Types**

Appl. Group	Exposure Range <sup>2</sup>	Option A	Option B <sup>3</sup>	Non-Pressurization Events <sup>1,4</sup>	
<b>1</b>	<b>Equipment In Service</b>			<b>TLO</b>	<b>SLO</b>
	Full Power Limits (BOC to MOC1)	1.37	1.32	1.36	1.40
	Full Power Limits (MOC1 to MOC2)	1.37	1.32	1.34	1.40
	Full Power Limits (MOC2 to EOC)	1.37	1.32	1.34	1.40
	Flow Dependent Limits <sup>5</sup>	Table 3.7			
	Power Dependent Limits <sup>6</sup>	Table 3.2			
<b>2</b>	<b>EOC RPT Out of Service (RPTOOS)</b>				
	Full Power Limits (BOC to MOC1)	1.44	1.35	1.36	1.40
	Full Power Limits (MOC1 to MOC2)	1.44	1.35		1.40
	Full Power Limits (MOC2 to EOC)	1.44	1.35		1.40
	Flow Dependent Limits <sup>5</sup>	Table 3.7			
	Power Dependent Limits <sup>6</sup>	Table 3.3			
<b>3</b>	<b>Turbine Bypass Valves Out of Service (TBVOOS)</b>				
	Full Power Limits (BOC to MOC1)	1.42	1.36		1.40
	Full Power Limits (MOC1 to MOC2)	1.42	1.36		1.40
	Full Power Limits (MOC2 to EOC)	1.42	1.36		1.40
	Flow Dependent Limits <sup>5</sup>	Table 3.7			
	Power Dependent Limits <sup>6</sup>	Table 3.4			
<b>4</b>	<b>TBVOOS and RPTOOS</b>				
	Full Power Limits (BOC to MOC1)	1.49	1.38		1.40
	Full Power Limits (MOC1 to MOC2)	1.49	1.38		1.40
	Full Power Limits (MOC2 to EOC)	1.49	1.38		1.40
	Flow Dependent Limits <sup>5</sup>	Table 3.7			
	Power Dependent Limits <sup>6</sup>	Table 3.5			
<b>5</b>	<b>Pressure Regulator Out of Service (PROOS)</b>				
	Full Power Limits (BOC to MOC1)	1.37	1.32	1.36	1.40
	Full Power Limits (MOC1 to MOC2)	1.37	1.32	1.34	1.40
	Full Power Limits (MOC2 to EOC)	1.39	1.32	1.34	1.40
	Flow Dependent Limits <sup>5</sup>	Table 3.7			
	Power Dependent Limits <sup>6,7,8</sup>	Table 3.6			

(Reference 7.2 Section 11)

### Notes for Table 3.1

Note 1: For Single Loop Operation (SLO), the MCPR Operating Limit is 0.03 greater than the Table 3.1. See Notes 5 and 6 for application details. (Reference 7.2 Section 11)

Note 2: The cycle exposure range designation is defined in Table 3.1-1 for use in Table 3.1. End of Rated (EOR) is defined as the cycle exposure corresponding to all rods out, 100% power, 100% flow and normal feedwater temperature.

**Table 3.1-1**  
**Cycle Exposure Range Designation**

Name	Exposure Range
BOC to MOC1	≤ 2342 MWd/ST
MOC1 to MOC2	≤ EOR-3294 MWd/MTU (2988 MWd/ST)
MOC2 to EOC	> EOR-3294 MWd/MTU (2988 MWd/ST)

(Reference 7.2 Sections 7 & 10)

Note 3: The NRC has concluded that a statistical approach (Option B) may be used for pressurization events analyzed with TRACG (Reference 7.4, Section 7.5.2.6). In order to take credit for conservatism in the scram speed performance, it must be demonstrated that there is insufficient reason to reject the plant-specific scram speed as being within the distribution assumed in the statistical analysis.

The procedure described below determines the full power MCPR limit based on the scram times of SR 3.2.2.2. If the scram speed distribution is not within the assumed distribution, the MCPR limit for pressurization events must be re-established based on an interpolation between the applicable limits for Option A (scram times of LCO 3.1.4, "Control Rod Scram Times") and Option B (realistic scram times) analyses.

The surveillance information for the fuel cycle is the number of active control rods measured for each surveillance test (the first test is at the BOC and is denoted  $N_1$ ; the  $i^{\text{th}}$  test denoted  $N_i$ ) and the average scram time to Notch 39 for the active rods measured in test  $i$  denoted  $\tau_i$ .

The equation used to calculate the overall average of all the scram data generated to date in the cycle is:

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

where:

$n$  = number of surveillance tests performed to date in the cycle;

$\sum_{i=1}^n N_i$  = total number of active rods measured to date in the cycle; and

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

sum of the scram time to Notch 39 of all active rods measured to date in the cycle to comply with the Technical Specification surveillance requirements.

The average scram time,  $\tau_{ave}$ , is tested against the analysis mean using the following equation:

$$\tau_{ave} \leq \tau_B \quad (2)$$

where:

$$\tau_B = \mu + 1.65 \sqrt{\frac{N_1}{\sum_{i=1}^n N_i}} \sigma \quad (3)$$

$\mu$  = 0.672 seconds (mean scram time to Notch 39 used in the Option B analysis)

$\sigma$  = 0.016 seconds (standard deviation of  $\mu$ )

$N_1$  = total number of active rods measured at BOC to comply with the Technical Specification surveillance requirements.

If the cycle average scram time satisfies the Equation 2 criterion, continued plant operation under the Option B MCPR limits for pressurization events is permitted. If not, the MCPR limits for pressurization events must be re-established, based on a linear interpolation between the Option B and Option A MCPR limits.

The equation to establish the new operating limit is given below:

$$OLMCPR_{New} = \left( OLMCPR_{Option\ B} + \frac{\tau_{ave} - \tau_B}{\tau_A - \tau_B} (SSAF) \right) \quad (4)$$

where:

$\tau_{ave}$  and  $\tau_B$  = defined in Equations 1 and 3, respectively

$\tau_A$  = 0.866 seconds (the Technical Specification limit on core average scram time to Notch 39)

$SSAF$  =  $OLMCPR_{Option\ A} - OLMCPR_{Option\ B}$  (the difference between the MCPR calculated using Option A and that using Option B for pressurization events from Table 3.1)

$OLMCPR_{Option\ A}$  = the limiting pressurization event Option A MCPR limit

$OLMCPR_{Option\ B}$  = the limiting pressurization event Option B MCPR limit

If continued plant operation under the Option B MCPR limits for pressurization events is permitted, the Full Power Limit is the maximum of  $OLMCPR_{Option\ B}$  and, if applicable, the Full Power Limit for Non-Pressurization Events. Otherwise, the Full Power Limit is the maximum of  $OLMCPR_{New}$  and, if applicable, the Full Power Limit for Non-Pressurization Events. (Reference 7.2 Section 11)

Note 4: The Full Power Limit for Non-Pressurization Events is specified when greater than the Option B Full Power Limit for Pressurization Events. See Note 3 for application guidance. The Full Power Limit for Non-Pressurization Events only applicable to TLO is labeled TLO. The Full Power Limit for Non-Pressurization Events only applicable to SLO is labeled SLO. (Reference 7.2 Section 11)

Note 5: Flow dependent MCPR limits ( $MCPR_f$ ) are applicable to TLO and require the SLO 0.03 adder when operating in SLO.

Note 6: Pbypass is 29.5% of rated power.

Power dependent MCPR limits are provided for core thermal powers greater than or equal to 25% of rated power at all core flows. The power dependent MCPR limits for core thermal powers below Pbypass are subdivided by core flow. A step change in the power dependent MCPR limits occurs at Pbypass because direct scrams on turbine throttle valve closure and turbine governor valve fast closure are automatically bypassed below Pbypass and not applicable per Technical Specification 3.3.1.1.

The power dependent MCPR limits in Tables 3.2 through 3.6 are provided as  $K_p$  multipliers above Pbypass and as absolute  $MCPR_p$  limits below Pbypass.  $MCPR_p$  limits above Pbypass are determined through the following equation:  $MCPR_p = K_p \times (\text{Full Power Limit})$ . Power dependent MCPR limits are applicable to TLO and require the SLO 0.03 adder when operating in SLO.

(Reference 7.2 Appendices D)

Note 7: A step change in the power dependent MCPR limits occurs at 85% of rated power because the APRM Neutron Flux - High scram is limiting at and above 85% and the Reactor Vessel Steam Dome Pressure – High scram is limiting below 85%.

Note 8: PROOS does not support Turbine Governor Valve full arc configuration.

**Table 3.2**  
**Columbia Generating Station**  
**Application Group 1: Equipment In Service**  
**TLO Power Dependent MCPR Limits**  
**All Fuel Types**

<b>Limits for Power ≤ 29.5%</b>		
<b>Power (%)</b>	<b>Limit for Flow ≥ 50.0% MCPR<sub>p</sub></b>	<b>Limit for Flow &lt; 50.0% MCPR<sub>p</sub></b>
25.0	2.32	2.29
29.5	2.27	2.23
<b>Limits for Power &gt; 29.5%</b>		
<b>Power (%)</b>	<b>Limit K<sub>p</sub></b>	
29.5	1.483	
45.0	1.280	
60.0	1.150	
85.0	1.072	
100.0	1.000	

**Table 3.3**  
**Columbia Generating Station**  
**Application Group 2: EOC RPT Out of Service (RPTOOS)**  
**TLO Power Dependent MCPR Limits**  
**All Fuel Types**

<b>Limits for Power ≤ 29.5%</b>		
<b>Power (%)</b>	<b>Limit for Flow ≥ 50.0% MCPR<sub>p</sub></b>	<b>Limit for Flow &lt; 50.0% MCPR<sub>p</sub></b>
25.0	2.32	2.29
29.5	2.27	2.23
<b>Limits for Power &gt; 29.5%</b>		
<b>Power (%)</b>	<b>Limit K<sub>p</sub></b>	
29.5	1.483	
45.0	1.280	
60.0	1.150	
85.0	1.072	
100.0	1.000	

**Table 3.4**  
**Columbia Generating Station**  
**Application Group 3: Turbine Bypass Valve Out of Service (TBVOOS)**  
**TLO Power Dependent MCPR Limits**  
**All Fuel Types**

<b>Limits for Power <math>\leq</math> 29.5%</b>		
<b>Power (%)</b>	<b>Limit for Flow <math>\geq</math> 50.0% <i>MCPR<sub>p</sub></i></b>	<b>Limit for Flow <math>&lt;</math> 50.0% <i>MCPR<sub>p</sub></i></b>
25.0	3.53	3.28
29.5	3.10	2.87
<b>Limits for Power <math>&gt;</math> 29.5%</b>		
<b>Power (%)</b>	<b>Limit <i>K<sub>p</sub></i></b>	
29.5	1.483	
45.0	1.280	
60.0	1.150	
85.0	1.072	
100.0	1.000	

**Table 3.5**  
**Columbia Generating Station**  
**Application Group 4: TBVOOS and RPTOOS**  
**TLO Power Dependent MCPR Limits**  
**All Fuel Types**

<b>Limits for Power <math>\leq</math> 29.5%</b>		
<b>Power (%)</b>	<b>Limit for Flow <math>\geq</math> 50.0% <i>MCPR<sub>p</sub></i></b>	<b>Limit for Flow <math>&lt;</math> 50.0% <i>MCPR<sub>p</sub></i></b>
25.0	3.53	3.28
29.5	3.10	2.87
<b>Limits for Power <math>&gt;</math> 29.5%</b>		
<b>Power (%)</b>	<b>Limit <i>K<sub>p</sub></i></b>	
29.5	1.483	
45.0	1.280	
60.0	1.150	
85.0	1.072	
100.0	1.000	

**Table 3.6**  
**Columbia Generating Station**  
**Application Group 5: Pressure Regulator Out of Service (PROOS)**  
**TLO Power Dependent MCPR Limits**  
**All Fuel Types**

<b>Limits for Power ≤ 29.5%</b>		
<b>Power (%)</b>	<b>Limit for Flow ≥ 50.0% MCPR<sub>p</sub></b>	<b>Limit for Flow &lt; 50.0% MCPR<sub>p</sub></b>
25.0	2.32	2.29
29.5	2.27	2.23
<b>Limits for Power &gt; 29.5%</b>		
<b>Power (%)</b>	<b>Limit K<sub>p</sub></b>	
29.5	1.483	
45.0	1.367	
60.0	1.316	
85.0	1.197	
85.0	1.094	
100.0	1.000	

**Table 3.7**  
**Columbia Generating Station**  
**All Application Groups**  
**TLO Flow Dependent MCPR Limits**  
**All Fuel Types**

<b>Flow (%)</b>	<b>Limit MCPR<sub>f</sub></b>
30.0	1.68
90.0	1.27
108.5	1.27



#### 4.0 Linear Heat Generation Rate (LHGR) Limits for Technical Specification 3.2.3

The LHGR limits for use in Technical Specification 3.2.3 are provided as a function of pellet exposure, power and flow for GNF2 fuel. The LHGR limits shall not exceed the product of the exposure dependent LHGR limit and the minimum of the power dependent LHGR Factor (LHGRFACp) or the flow dependent LHGR Factor (LHGRFACf).

- a. The exposure dependent LHGR limits are provided in the Fuel Bundle Information Report (Reference 7.3) for GNF2.
- b. The power dependent LHGR Factor (LHGRFACp) is provided in Table 4.1 through Table 4.5 for all fuel types. (Reference 7.2, Appendices D)
- c. The flow dependent LHGR Factor (LHGRFACf) is provided in Table 4.6 for all fuel types. (Reference 7.2, Appendices D)

See Technical Specification 3.2.3 and the applicable Bases for further application details.

**Table 4.1**  
**Columbia Generating Station**  
**Application Group 1: Equipment In Service**  
**Power Dependent LHGR Factor (LHGRFACp)**  
**All Fuel Types**

<b>Limits for Power ≤ 29.5%</b>		
<b>Power (%)</b>	<b>Limit for Flow ≥ 50.0% LHGRFACp</b>	<b>Limit for Flow &lt; 50.0% LHGRFACp</b>
25.0	0.527	0.527
29.5	0.527	0.527
<b>Limits for Power &gt; 29.5%</b>		
<b>Power (%)</b>	<b>Limit LHGRFACp</b>	
29.5	0.634	
45.0	0.713	
60.0	0.791	
85.0	0.922	
100.0	1.000	

**Table 4.2**  
**Columbia Generating Station**  
**Application Group 2: EOC RPT Out of Service (RPTOOS)**  
**Power Dependent LHGR Factor (LHGRFAC<sub>p</sub>)**  
**All Fuel Types**

<b>Limits for Power ≤ 29.5%</b>		
<b>Power (%)</b>	<b>Limit for Flow ≥ 50.0% LHGRFAC<sub>p</sub></b>	<b>Limit for Flow &lt; 50.0% LHGRFAC<sub>p</sub></b>
25.0	0.527	0.527
29.5	0.527	0.527
<b>Limits for Power &gt; 29.5%</b>		
<b>Power (%)</b>	<b>Limit LHGRFAC<sub>p</sub></b>	
29.5	0.634	
45.0	0.713	
60.0	0.791	
85.0	0.922	
100.0	1.000	

**Table 4.3**  
**Columbia Generating Station**  
**Application Group 3: Turbine Bypass Valve Out of Service (TBVOOS)**  
**Power Dependent LHGR Factor (LHGRFAC<sub>p</sub>)**  
**All Fuel Types**

<b>Limits for Power ≤ 29.5%</b>		
<b>Power (%)</b>	<b>Limit for Flow ≥ 50.0% LHGRFAC<sub>p</sub></b>	<b>Limit for Flow &lt; 50.0% LHGRFAC<sub>p</sub></b>
25.0	0.380	0.420
29.5	0.414	0.420
<b>Limits for Power &gt; 29.5%</b>		
<b>Power (%)</b>	<b>Limit LHGRFAC<sub>p</sub></b>	
29.5	0.634	
45.0	0.713	
60.0	0.735	
85.0	0.902	
100.0	1.000	

**Table 4.4**  
**Columbia Generating Station**  
**Application Group 4: TBVOOS and RPTOOS**  
**Power Dependent LHGR Factor (LHGRFAC<sub>p</sub>)**  
**All Fuel Types**

<b>Limits for Power ≤ 29.5%</b>		
<b>Power (%)</b>	<b>Limit for Flow ≥ 50.0% LHGRFAC<sub>p</sub></b>	<b>Limit for Flow &lt; 50.0% LHGRFAC<sub>p</sub></b>
25.0	0.380	0.420
29.5	0.414	0.420
<b>Limits for Power &gt; 29.5%</b>		
<b>Power (%)</b>	<b>Limit LHGRFAC<sub>p</sub></b>	
29.5	0.634	
45.0	0.713	
60.0	0.735	
85.0	0.902	
100.0	1.000	

**Table 4.5**  
**Columbia Generating Station**  
**Application Group 5: Pressure Regulator Out of Service (PROOS)<sup>9,10</sup>**  
**Power Dependent LHGR Factor (LHGRFACp)**  
**All Fuel Types**

<b>Limits for Power ≤ 29.5%</b>		
<b>Power (%)</b>	<b>Limit for Flow ≥ 50.0% LHGRFACp</b>	<b>Limit for Flow &lt; 50.0% LHGRFACp</b>
25.0	0.527	0.527
29.5	0.527	0.527
<b>Limits for Power &gt; 29.5%</b>		
<b>Power (%)</b>	<b>Limit LHGRFACp</b>	
29.5	0.634	
45.0	0.672	
60.0	0.728	
85.0	0.728	
85.0	0.909	
100.0	1.000	

**Table 4.6**  
**Columbia Generating Station**  
**All Application Groups**  
**Flow Dependent LHGR Factor (LHGRFACf)**  
**All Fuel Types**

<b>Flow (%)</b>	<b>Limit LHGRFACf</b>
30.0	0.592
50.0	0.761
80.0	0.966
85.0	1.000
108.5	1.000

<sup>9</sup> A step change in LHGRFACp occurs at 85% of rated power because the APRM Neutron Flux - High scram is limiting at and above 85% and the Reactor Vessel Steam Dome Pressure – High scram is limiting below 85%.

<sup>10</sup> PROOS does not support Turbine Governor Valve full arc configuration.

## 5.0 Oscillation Power Range Monitor (OPRM) Instrumentation for Technical Specification 3.3.1.1

- 5.1 Period Based Detection Algorithm (PBDA) trip setpoints for Technical Specification Table 3.3.1.1-1, Footnote (g) and THERMAL POWER value for use in Table 3.3.1.1-1, Footnote (f). See Technical Specification 3.3.1.1 and the applicable Bases for further application details.

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	TRIP SETPOINT
2 Average Power Range Monitors		
f. OPRM Upscale	(f)	1.15 Peak/Average
Amplitude Trip (Sp)		16
Confirmation Count (Np)		

- (f) THERMAL POWER  $\geq$  19.6% RTP.  
(Reference 7.2, Section 15.1)  
(Reference 7.1, Table 3-2, Item 8.9)

- 5.2 THERMAL POWER value for Technical Specification 3.3.1.1, Required Action J.1:

THERMAL POWER < 19.6% RTP  
(Reference 7.1, Table 3-2, Item 8.9)

- 5.3 OPRM Not Bypassed setpoints for SR 3.3.1.1.17

APRM Simulated Thermal Power (Pb)  $\geq$  24.6 %  
Recirculation Drive Flow (Wb) < 60 %  
(Reference 7.2, Section 15.2)  
(Reference 7.1, Table 3-2, Item 8.9)

## 6.0 Rod Block Monitor Instrumentation for Technical Specification 3.3.2.1

- 6.1 Rod Block Monitor Instrumentation for Technical Specification Table 3.3.2.1-1, Footnote (f) and Licensee Controlled Specifications Table 1.3.2.1-2 and Appendix A. See Technical Specification 3.3.2.1 and the applicable Bases for further application details.

FUNCTION	LIMITING TRIP SETPOINT	ALLOWABLE VALUE
1 Rod Block Monitor		
a. Low Power Range – Upscale	121.2	121.6
b. Intermediate Power Range – Upscale	116.2	116.6
c. High Power Range – Upscale	111.2	111.6

(Reference 7.1, Table 3-2, Item 10.7)

- 6.2 Rod Block Monitor (RBM) Instrumentation MCPR limits for Technical Specification Table 3.3.2.1-1, Footnotes (a), (b) and (c). See Technical Specification 3.3.2.1 and the applicable Bases for further application details.

THERMAL POWER	RBM MCPR Limit
< 90 % RTP	1.75
≥ 90 % RTP	1.44

(Reference 7.2, Section 10)

## 7.0 References

- 7.1 Design Specification for Division 60, "Reactor Core and System Analysis Parameters for Columbia Generating Station."
- 7.2 004N4251, Revision 0, "Supplemental Reload Licensing Report for Columbia Reload 24 Cycle 25," March 2019.
- 7.3 004N4252, Revision 0, "Fuel Bundle Information Report for Columbia Reload 24 Cycle 25," March 2019.
- 7.4 NEDE-32906P-A, Revision 3, "TRACG Application for Anticipated Operational Occurrences (AOO) Transient Analyses," GE Nuclear Energy, September 2006.
- 7.5 004N4253, Revision 1, "Nuclear Design Report for Columbia Cycle 25," February 2019.
- 7.6 002N3439, Revision 3, GNF2 Fuel Design Cycle-Independent Analyses for Energy Northwest Columbia Generating Station, May 2017.
- 7.7 NEDC-33270P, Revision 9, "GNF2 Advantage Generic Compliance with NEDE-24011-P-A (GESTAR II)," December 2017.