



Tennessee Valley Authority, Post Office Box 2000, Soddy-Daisy, Tennessee 37384-2000

November 14, 2007

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

Gentlemen:

In the Matter of)
Tennessee Valley Authority (TVA))

Docket No. 50-327

**SEQUOYAH NUCLEAR PLANT (SQN) - UNIT 1 CYCLE 16 CORE OPERATING LIMITS
REPORT (COLR) REVISION**

In accordance with the SQN Unit 1 Technical Specifications 6.9.1.14.c, enclosed is the Unit 1
Cycle 16 COLR.

Please direct questions concerning this issue to me at (423) 843-7170 or J. W. Proffitt at (423)
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Sincerely,

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Enclosure

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ADD
LRR

SEQUOYAH UNIT 1 CYCLE 16
CORE OPERATING LIMITS REPORT

REVISION 0

October 2007

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Revision 0

Pages affected All

Reason for Revision Initial issue

COLR FOR SEQUOYAH UNIT 1 CYCLE 16

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Sequoyah Unit 1 Cycle 16 has been prepared in accordance with the requirements of Technical Specification (TS) 6.9.1.14.

The TSs affected by this report are listed below:

TABLE 2.2-1 $f_1(\Delta I)$ trip reset function for OT Δ T Trip (QTNL, QTPL) and rates of trip setpoint decrease per percent ΔI (QTNS, QTPS)

TABLE 2.2-1 $f_2(\Delta I)$ trip reset function for OP Δ T Trip (QPNL, QPPL) and rates of trip setpoint decrease per percent ΔI (QPNS, QPPS)

3/4.1.1.3	Moderator Temperature Coefficient (MTC)
3/4.1.3.5	Shutdown Rod Insertion Limit
3/4.1.3.6	Control Rod Insertion Limits
3/4.2.1	Axial Flux Difference (AFD)
3/4.2.2	Heat Flux Hot Channel Factor ($F_Q(X,Y,Z)$)
3/4.2.3	Nuclear Enthalpy Rise Hot Channel Factor ($F_{\Delta H}(X,Y)$)

2.0 OPERATING LIMITS

The cycle-specific parameter limits for the specifications listed in section 1.0 are presented in the following subsections. These limits have been developed using the NRC approved methodologies specified in TS 6.9.1.14. The versions of the topical reports which describe the methodologies used for this cycle are listed in Table 1.

The following abbreviations are used in this section:

BOL stands for Beginning of Cycle Life
ARO stands for All Rods Out
HZIP stands for Hot Zero THERMAL POWER
EOL stands for End of Cycle Life
RTP stands for RATED THERMAL POWER

2.1 Moderator Temperature Coefficient - MTC (Specification 3/4.1.1.3)

2.1.1 The MTC limits are:

The BOL/ARO/HZIP MTC shall be less positive than $0 \Delta k/k/^\circ F$ (BOL limit). With the measured BOL/ARO/HZIP MTC more positive than $-0.11 \times 10^{-5} \Delta k/k/^\circ F$ (as-measured MTC limit), establish control rod withdrawal limits to ensure the MTC remains less positive than $0 \Delta k/k/^\circ F$ for all times in core life.

The EOL/ARO/RTP MTC shall be less negative than or equal to $-4.5 \times 10^{-4} \Delta k/k/^\circ F$.

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2.1.2 The 300 ppm surveillance limit is:

The measured 300 ppm/ARO/RTP MTC should be less negative than or equal to $-3.75 \times 10^{-4} \Delta k/k/^{\circ}\text{F}$.

2.2 Shutdown Rod Insertion Limit (Specification 3/4.1.3.5)

2.2.1 The shutdown rods shall be withdrawn to a position as defined below:

<u>Cycle Burnup (MWD/MTU)</u>	<u>Steps Withdrawn</u>
≥ 0	≥ 225 to ≤ 231

2.3 Control Rod Insertion Limits (Specification 3/4.1.3.6)

2.3.1 The control rod banks shall be limited in physical insertion as shown in Figure 1.

2.4 Axial Flux Difference - AFD (Specification 3/4.2.1)

2.4.1 The axial flux difference (AFD) limits ($\text{AFD}^{\text{Limit}}$) are provided in Figures 2A, 2B, and 2C.

2.5 Heat Flux Hot Channel Factor - $F_Q(X,Y,Z)$ (Specification 3/4.2.2)

$F_Q(X,Y,Z)$ shall be limited by the following relationships:

$$F_Q(X,Y,Z) \leq \frac{F_Q^{\text{RTP}}}{P} * K(Z) \quad \text{for } P > 0.5$$

$$F_Q(X,Y,Z) \leq \frac{F_Q^{\text{RTP}}}{0.5} * K(Z) \quad \text{for } P \leq 0.5$$

where P = Thermal Power / Rated Thermal Power

2.5.1 $F_Q^{\text{RTP}} = 2.48$

2.5.2 $K(Z)$ is provided in Figure 3.

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The following parameters are required for core monitoring per the Surveillance Requirements of Specification 3/4.2.2.2:

2.5.3 $NSLOPE^{AFD} = 1.20$

where $NSLOPE^{AFD}$ = Negative AFD limit adjustment required to compensate for each 1% that $F_Q(X,Y,Z)$ exceeds BQDES.

2.5.4 $PSLOPE^{AFD} = 1.77$

where $PSLOPE^{AFD}$ = Positive AFD limit adjustment required to compensate for each 1% that $F_Q(X,Y,Z)$ exceeds BQDES.

2.5.5 $NSLOPE^{f_2(\Delta I)} = 1.31$

where $NSLOPE^{f_2(\Delta I)}$ = Adjustment to negative $OP\Delta T f_2(\Delta I)$ limit required to compensate for each 1% that $F_Q(X,Y,Z)$ exceeds BCDES.

2.5.6 $PSLOPE^{f_2(\Delta I)} = 2.42$

where $PSLOPE^{f_2(\Delta I)}$ = Adjustment to positive $OP\Delta T f_2(\Delta I)$ limit required to compensate for each 1% that $F_Q(X,Y,Z)$ exceeds BCDES.

2.5.7 $BQNOM(X,Y,Z) =$ Nominal design peaking factor, increased by an allowance for the expected deviation between the nominal design power distribution and the measurement.

2.5.8 $BQDES(X,Y,Z) =$ Maximum allowable design peaking factor which ensures that the $F_Q(X,Y,Z)$ limit will be preserved for operation within the LCO limits, including allowances for calculational and measurement uncertainties.

2.5.9 $BCDES(X,Y,Z) =$ Maximum allowable design peaking factor which ensures that the centerline fuel melt limit will be preserved for operation within the LCO limits, including allowances for calculational and measurement uncertainties.

$BQNOM(X,Y,Z)$, $BQDES(X,Y,Z)$, and $BCDES(X,Y,Z)$ data bases are provided for input to the plant power distribution analysis codes on a cycle specific basis and are determined using the methodology for core limit generation described in the references in Specification 6.9.1.14.

2.5.10 The increase in $F_Q^M(X,Y,Z)$ for compliance with the 4.2.2.2.e Surveillance Requirements is defined as follows:

For all cycle burnups 2.0%

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2.6 Nuclear Enthalpy Rise Hot Channel Factor - $F_{\Delta H}(X,Y)$ (Specification 3/4.2.3)

$F_{\Delta H}(X,Y)$ shall be limited by the following relationship:

$$F_{\Delta H}(X,Y) \leq \text{MAP}(X,Y,Z) / \text{AXIAL}(X,Y)$$

2.6.1 $\text{MAP}(X,Y,Z)$ is provided in Table 2.

$\text{AXIAL}(X,Y)$ is the axial peak from the normalized axial power shape.

The following parameters are required for core monitoring per the Surveillance Requirements of Specification 3/4.2.3:

$$F_{\Delta HR}^M(X,Y) \leq \text{BHNOM}(X,Y)$$

$$\text{where } F_{\Delta HR}^M(X,Y) = F_{\Delta H}^M(X,Y) / [\text{MAP}^M / \text{AXIAL}(X,Y)]$$

$F_{\Delta H}^M(X,Y)$ is the measured radial peak at location X,Y.

MAP^M is the value of $\text{MAP}(X,Y,Z)$ obtained from Table 2 for the measured peak.

2.6.2 $\text{BHNOM}(X,Y)$ = Nominal design radial peaking factor, increased by an allowance for the expected deviation between the nominal design power distribution and the measurement.

2.6.3 $\text{BHDES}(X,Y)$ = Maximum allowable design radial peaking factor which ensures that the $F_{\Delta H}(X,Y)$ limit will be preserved for operation within the LCO limits, including allowances for calculational and measurement uncertainties.

2.6.4 $\text{BRDES}(X,Y)$ = Maximum allowable design radial peaking factor which ensures that the steady state DNBR limit will be preserved for operation within the LCO limits, including allowances for calculational and measurement uncertainties.

$\text{BHNOM}(X,Y)$, $\text{BHDES}(X,Y)$ and $\text{BRDES}(X,Y)$ data bases are provided for input to the plant power distribution analysis computer codes on a cycle specific basis and are determined using the methodology for core limit generation described in the references in Specification 6.9.1.14.

2.6.5 $\text{RRH} = 3.34$ when $0.8 < P \leq 1.0$

$\text{RRH} = 1.67$ when $P \leq 0.8$

where RRH = Thermal power reduction required to compensate for each 1% that $F_{\Delta H}(X,Y)$ exceeds its limit.

P = Thermal Power / Rated Thermal Power

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2.6.6 $TRH = 0.0334$ when $0.8 < P \leq 1.0$

$TRH = 0.0167$ when $P \leq 0.8$

where TRH = Reduction in $OT\Delta T K_1$ setpoint required to compensate for each 1% $F_{\Delta H}(X,Y)$ exceeds its limit.

P = Thermal Power / Rated Thermal Power

2.6.7 All cycle burnups shall use a 2% increase in $F_{\Delta H}^M(X,Y)$ margin for compliance with the 4.2.3.2.d.1 Surveillance Requirement.

3.0 REACTOR CORE PROTECTIVE LIMITS

3.1 Trip Reset Term [$f_1(\Delta I)$] for Overtemperature Delta T-Trip (Specification 2.2.1)

The following parameters are required to specify the power level-dependent $f_1(\Delta I)$ trip reset term limits for the Overtemperature Delta-T trip function:

3.1.1 $QTNL = -20\%$

where $QTNL$ = Maximum negative ΔI setpoint at rated thermal power at which the trip setpoint is not reduced by the axial power distribution.

3.1.2 $QTPL = +5\%$

where $QTPL$ = Maximum positive ΔI setpoint at rated thermal power at which the trip setpoint is not reduced by the axial power distribution.

3.1.3 $QTNS = 2.50\%$

where $QTNS$ = Percent reduction in Overtemperature Delta-T trip setpoint for each percent that the magnitude of ΔI exceeds its negative limit at rated thermal power ($QTNL$).

3.1.4 $QTPS = 1.40\%$

where $QTPS$ = Percent reduction in Overtemperature Delta-T trip setpoint for each percent that the magnitude of ΔI exceeds its positive limit at rated thermal power ($QTPL$).

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3.2 Trip Reset Term [$f_2(\Delta I)$] for Overpower Delta-T Trip (Specification 2.2.1)

The following parameters are required to specify the power level-dependent $f_2(\Delta I)$ trip reset term limits for the Overpower Delta-T trip function:

3.2.1 $QPNL = -25\%$

where $QPNL$ = Maximum negative ΔI setpoint at rated thermal power at which the trip setpoint is not reduced by the axial power distribution.

3.2.2 $QPPL = +25\%$

where $QPPL$ = Maximum positive ΔI setpoint at rated thermal power at which the trip setpoint is not reduced by the axial power distribution.

3.2.3 $QPNS = 1.70\%$

where $QPNS$ = Percent reduction in Overpower Delta-T trip setpoint for each percent that the magnitude of ΔI exceeds its negative limit at rated thermal power ($QPNL$).

3.2.4 $QPPS = 1.70\%$

where $QPPS$ = Percent reduction in Overpower Delta-T trip setpoint for each percent that the magnitude of ΔI exceeds its positive limit at rated thermal power ($QPPL$).

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Table 1

COLR Methodology Topical Reports

1. BAW-10180-A, Revision 1, "NEMO – Nodal Expansion Method Optimized," March 1993.
(Methodology for Specification 3/4.1.1.3 - Moderator Temperature Coefficient)
2. BAW-10169P-A, Revision 0, "RSG Plant Safety Analysis – B&W Safety Analysis Methodology for Recirculating Steam Generator Plants," October 1989.
(Methodology for Specification 3/4.1.1.3 - Moderator Temperature Coefficient)
3. BAW-10163P-A, Revision 0, "Core Operating Limit Methodology for Westinghouse-Designed PWRs," June 1989.
(Methodology for Specifications 2.2.1 – Reactor Trip System Instrumentation Setpoints [$f_1(\Delta I)$, $f_2(\Delta I)$ limits], 3/4.1.3.5 - Shutdown Rod Insertion Limit, 3/4.1.3.6 - Control Rod Insertion Limits, 3/4.2.1 - Axial Flux Difference, 3/4.2.2 - Heat Flux Hot Channel Factor, 3/4.2.3 - Nuclear Enthalpy Rise Hot Channel Factor)
4. BAW-10168P-A, Revision 3, "RSG LOCA – BWNT Loss of Coolant Accident Evaluation Model for Recirculating Steam Generator Plants," December 1996.
(Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)
5. BAW-10227P-A, Revision 1, "Evaluation of Advanced Cladding and Structural Material (M5) in PWR Reactor Fuel," June 2003.
(Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)
6. BAW-10186P-A, Revision 2, "Extended Burnup Evaluation," June 2003.
(Methodology for Specification 3/4.2.2 - Heat Flux Hot Channel Factor)

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Table 2

Maximum Allowable Peaking Limits MAP(X,Y,Z)

AXIAL(X,Y)	ELEVATION (ft)	MAP(X,Y,Z)	AXIAL(X,Y)	ELEVATION (ft)	MAP(X,Y,Z)
1.1	2	1.9540	1.9	2	2.8169
	4	1.9494		4	3.1537
	6	1.9431		6	3.0026
	8	1.9337		8	2.8465
	10	1.9147		10	2.6987
1.2	2	2.1780	>1.9	2	2.5377
	4	2.1682		4	2.8412
	6	2.1543		6	2.7051
	8	2.1317		8	2.5644
	10	2.0855		10	2.4313
1.3	2	2.4025	2.2	2	2.6873
	4	2.3875		4	3.3150
	6	2.3672		6	3.1660
	8	2.3029		8	3.0227
	10	2.1902		10	2.7136
1.4	2	2.6264	2.6	2	2.6965
	4	2.6047		4	3.5807
	6	2.5629		6	3.5514
	8	2.4204		8	3.3102
	10	2.2893		10	2.9726
1.5	2	2.8525	3.0	2	2.9517
	4	2.8119		4	3.8016
	6	2.6771		6	4.1225
	8	2.5251		8	3.6877
	10	2.3839		10	3.3466
1.7	2	2.7765	3.5	2	3.1500
	4	3.0191		4	4.1097
	6	2.8610		6	4.1197
	8	2.7036		8	3.7296
	10	2.5528		10	3.4811

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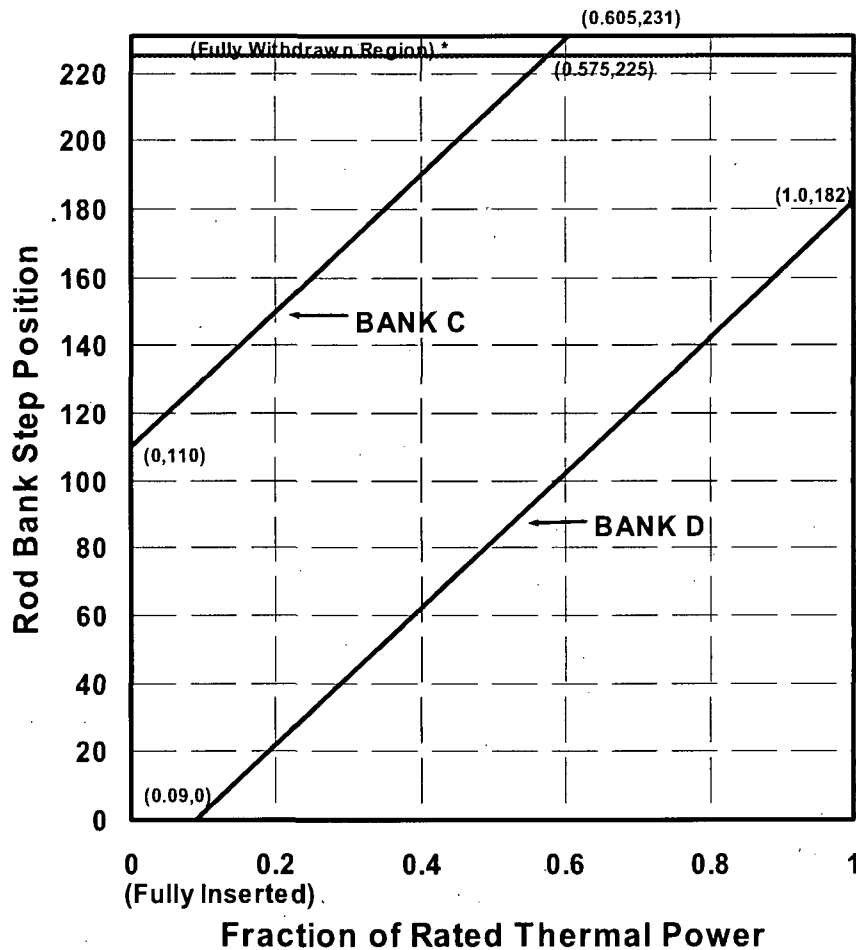


FIGURE 1
Rod Bank Insertion Limits Versus
Thermal Power, Four Loop Operation

*Fully withdrawn region shall be the condition where shutdown and control banks are at a position within the interval of ≥ 225 and ≤ 231 steps withdrawn, inclusive.

Fully withdrawn shall be the position as defined below,

Cycle Burnup (MWd/mtU)
 ≥ 0

Steps Withdrawn
 ≥ 225 to ≤ 231

This figure is valid for operation at a rated thermal power of 3455 MWt when the LEFM is in operation.

If the LEFM becomes inoperable, then prior to the next NIS calibration, the maximum allowable power level must be reduced by 1.3% in power, and the rod insertion limit lines must be increased by 3 steps withdrawn until the LEFM is returned to operation.

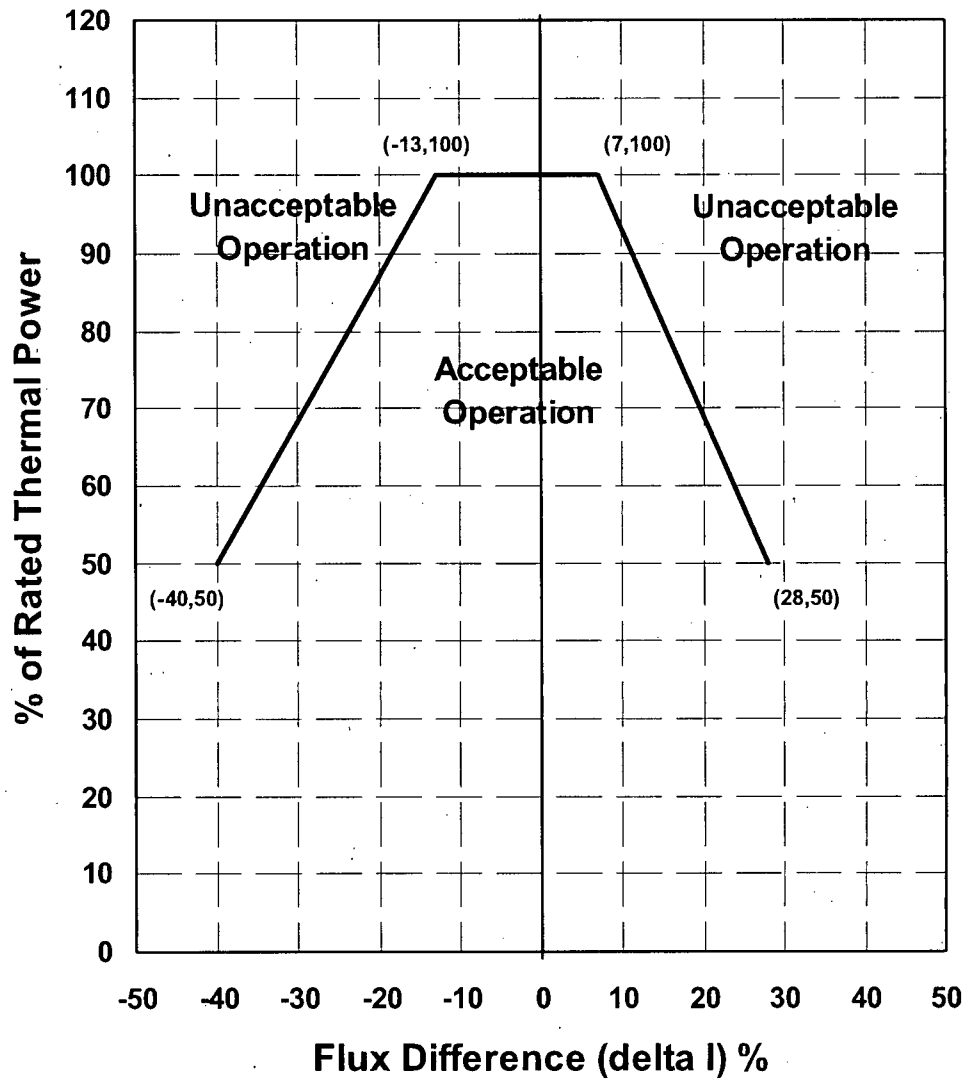


FIGURE 2A

**Axial Flux Difference Limits
As A Function of Thermal Power
For Burnup Range of 0 EFPD to 254±10 EFPD**

This figure is valid for operation at a rated thermal power of 3455 MWt when the LEFM is in operation.

If the LEFM becomes inoperable, then prior to the next NIS calibration, the maximum allowable power level must be reduced by 1.3% in power, and the AFD limit lines must be made more restrictive by 1% in AFD until the LEFM is returned to operation.

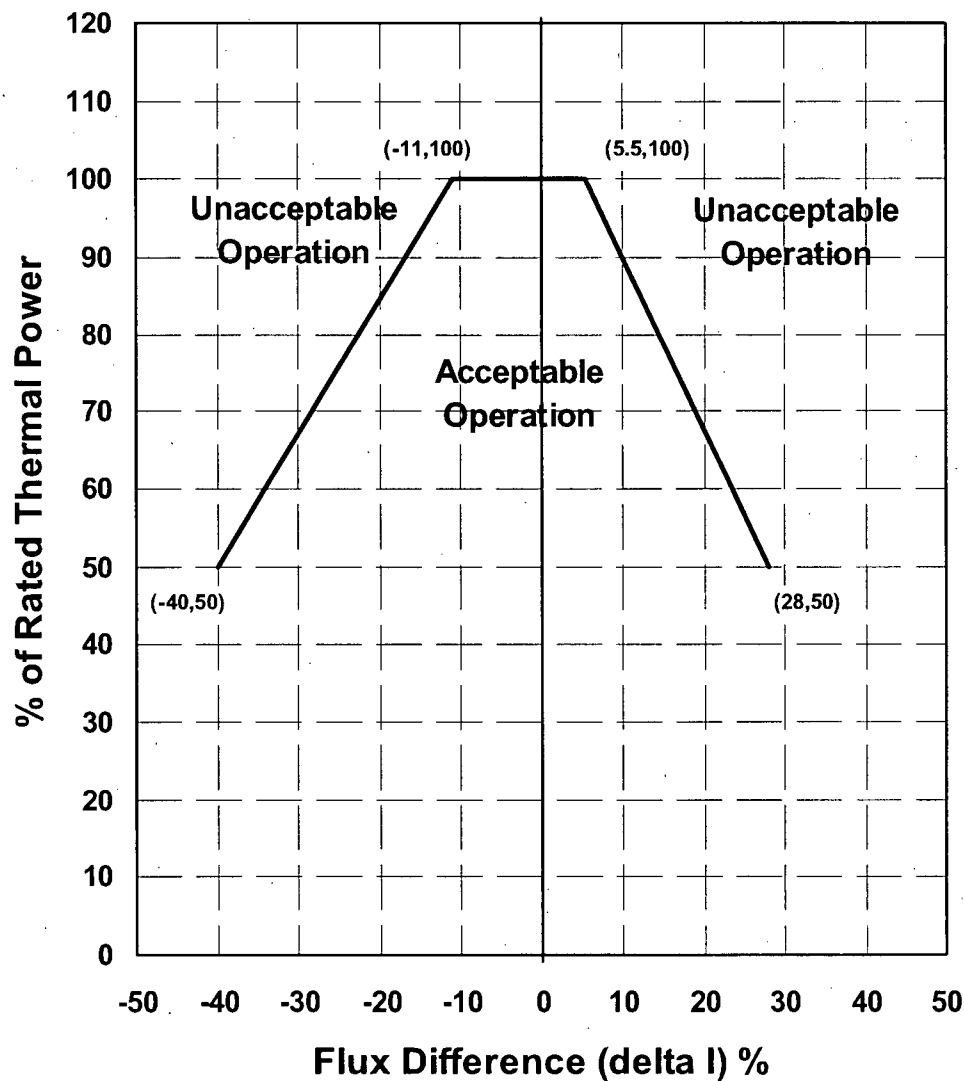


FIGURE 2B

**Axial Flux Difference Limits
As A Function of Thermal Power
For Burnup Range of 254 ± 10 EFPD to 458 ± 10 EFPD**

This figure is valid for operation at a rated thermal power of 3455 MWt when the LEFM is in operation.

If the LEFM becomes inoperable, then prior to the next NIS calibration, the maximum allowable power level must be reduced by 1.3% in power, and the AFD limit lines must be made more restrictive by 1% in AFD until the LEFM is returned to operation.

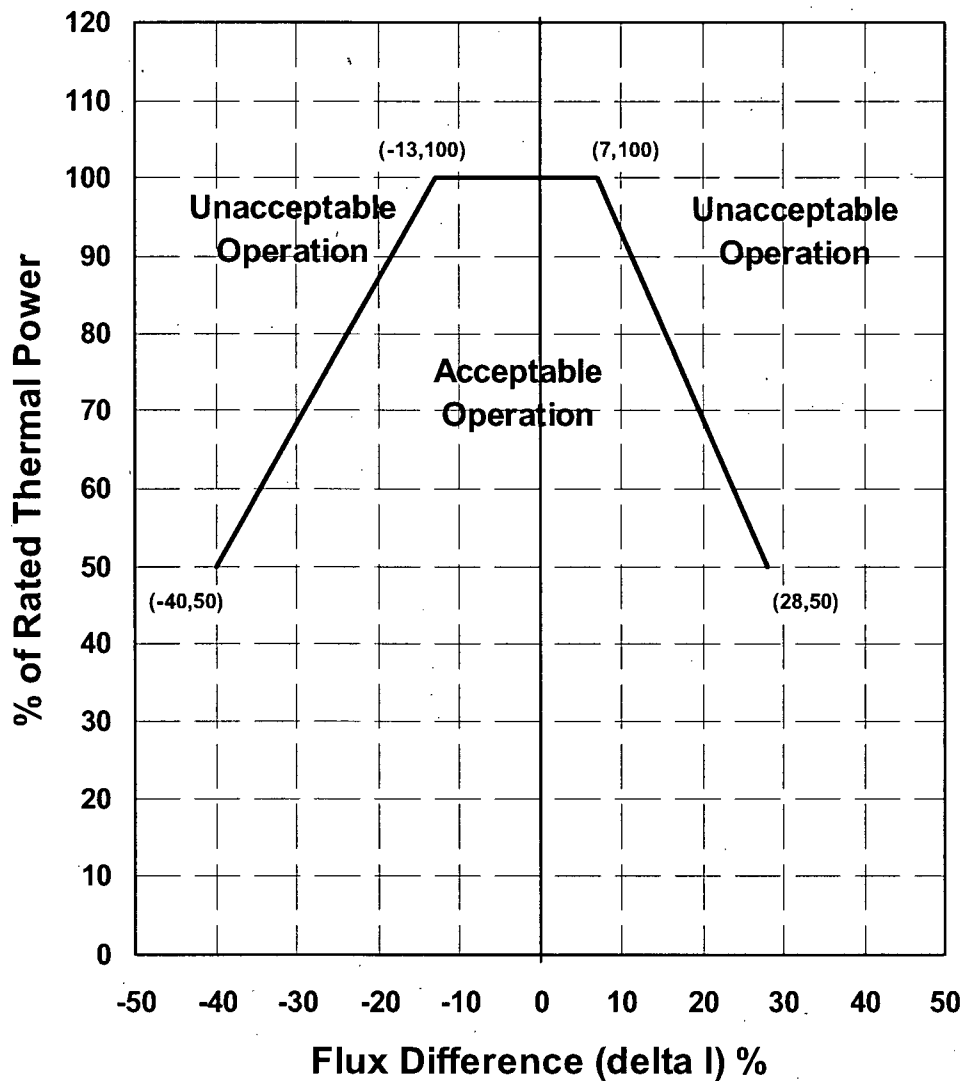


FIGURE 2C

**Axial Flux Difference Limits
As A Function of Thermal Power
For Burnup Range of 458 ± 10 EFPD to EOC**

This figure is valid for operation at a rated thermal power of 3455 MWt when the LEFM is in operation.

If the LEFM becomes inoperable, then prior to the next NIS calibration, the maximum allowable power level must be reduced by 1.3% in power, and the AFD limit lines must be made more restrictive by 1% in AFD until the LEFM is returned to operation.

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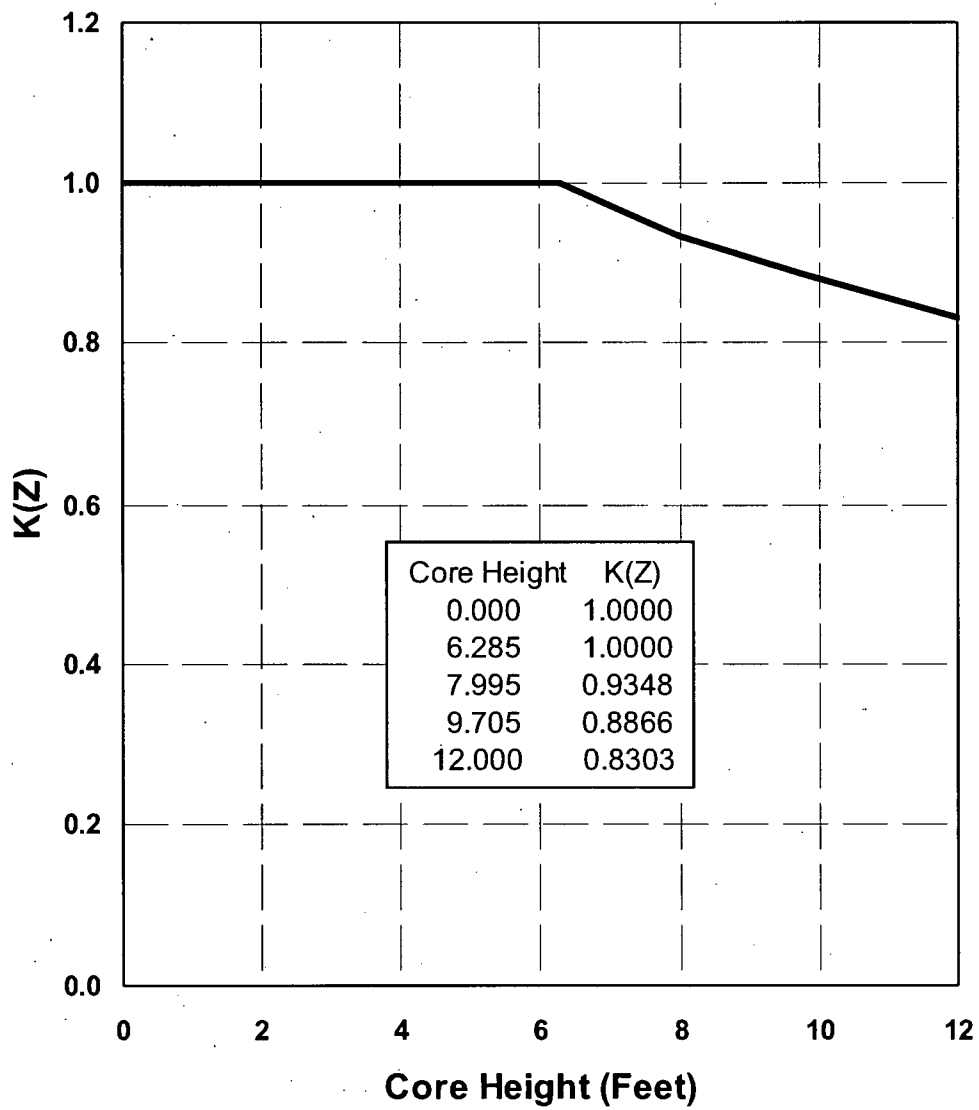


FIGURE 3

K(Z) - Normalized FQ(X,Y,Z) as a Function of Core Height