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April 27, 2009

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Gentlemen:

In the Matter of   )   Docket No. 50-328
Tennessee Valley Authority (TVA)   )

SEQUOYAH NUCLEAR PLANT (SQN) - UNIT 2 CYCLE 16 CORE OPERATING LIMITS REPORT (COLR)

In accordance with SQN Unit 2 Technical Specification 6.9.1.14.c, enclosed is Revision 1 to the Unit 2 Cycle 16 COLR. An error was identified with the departure from nucleate boiling maximum allowable peaking limits used in Unit 2 Cycle 16 COLR.

An operability assessment demonstrates there is no adverse impact for the continued operation of Unit 2, however the values in the COLR were incorrect. An evaluation shows that sufficient margin existed to account for the error.

Please direct questions concerning this report to Beth A. Wetzel at (423) 843-7170.

Sincerely,

Timothy P. Cleary

Enclosure
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SEQUOYAH UNIT 2 CYCLE 16

CORE OPERATING LIMITS REPORT

REVISION 1

April 2009

Prepared by: _____ / __3/26/09__
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Verified by: _____ / __3/27/2009__
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Reviewed by: _____ / __3/27/09__
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Reactor Engineering Supervisor   Date

Approved by: _____ / __4-2-09__
PORC Chairman   Date

__C. R. Church___ _____ / __2 April 2009__
Plant Manager   Date

Revision __1__

Pages affected __9__

Reason for Revision: _Revised Table 2_

1.0 CORE OPERATING LIMITS REPORT

This Core Operating Limits Report (COLR) for Sequoyah Unit 2 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 OTΔT 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 OPΔT 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
> HZP 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/HZP MTC shall be less positive than 0 Δk/k/°F (BOL limit). With the measured BOL/ARO/HZP MTC more positive than -0.04×10^{-5} Δk/k/°F (as-measured MTC limit), establish control rod withdrawal limits to ensure the MTC remains less positive than 0 Δk/k/°F for all times in core life.

The EOL/ARO/RTP MTC shall be less negative than or equal to -4.5×10^{-4} Δk/k/°F.

2.1.2   The 300 ppm surveillance limit is:

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

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:

Cycle Burnup (MWD/MTU)	Steps Withdrawn
≥ 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 (AFD^{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:

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

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

where P = Thermal Power / Rated Thermal Power

2.5.1 $F_Q^{RTP} = 2.48$

2.5.2   K(Z) is provided in Figure 3.

The following parameters are required for core monitoring per the Surveillance Requirements of Specification 3/4.2.2:

2.5.3 $NSLOPE^{AFD} = 1.10$

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

2.5.4 $PSLOPE^{AFD} = 2.20$

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

2.5.5 $NSLOPE^{f_2(\Delta I)} = 1.27$

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

2.5.6 $PSLOPE^{f_2(\Delta I)} = 2.41$

        where $PSLOPE^{f_2(\Delta I)} =$ Adjustment to positive OPΔT $f_2(\Delta I)$ 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 cycle burnups 0 to 6686 MWd/mtU, use   2.0%
For cycle burnups 6686 to 7591 MWd/mtU, use   2.3%
For cycle burnups > 7591 MWd/mtU, use   2.0%

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:

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

2.6.1   MAP(X,Y,Z) is provided in Table 2.

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:

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

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

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

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

2.6.2   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   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   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.

BHNOM(X,Y), BHDES(X,Y) and 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   RRH = 3.34 when $0.8 < P \leq 1.0$

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

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 OTΔT 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 [f₁(ΔI)] 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).

3.2 <u>**Trip Reset Term [$f_2(\Delta I)$] for Overpower Delta-T Trip**</u> **(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).

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)

7. EMF-2103P-A, "Realistic Large Break LOCA Methodology for Pressurized Water Reactors," April 2003.

   (Methodology for Specification 3/4.2.2-Heat Flux Hot Channel Factor)

Table 2

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

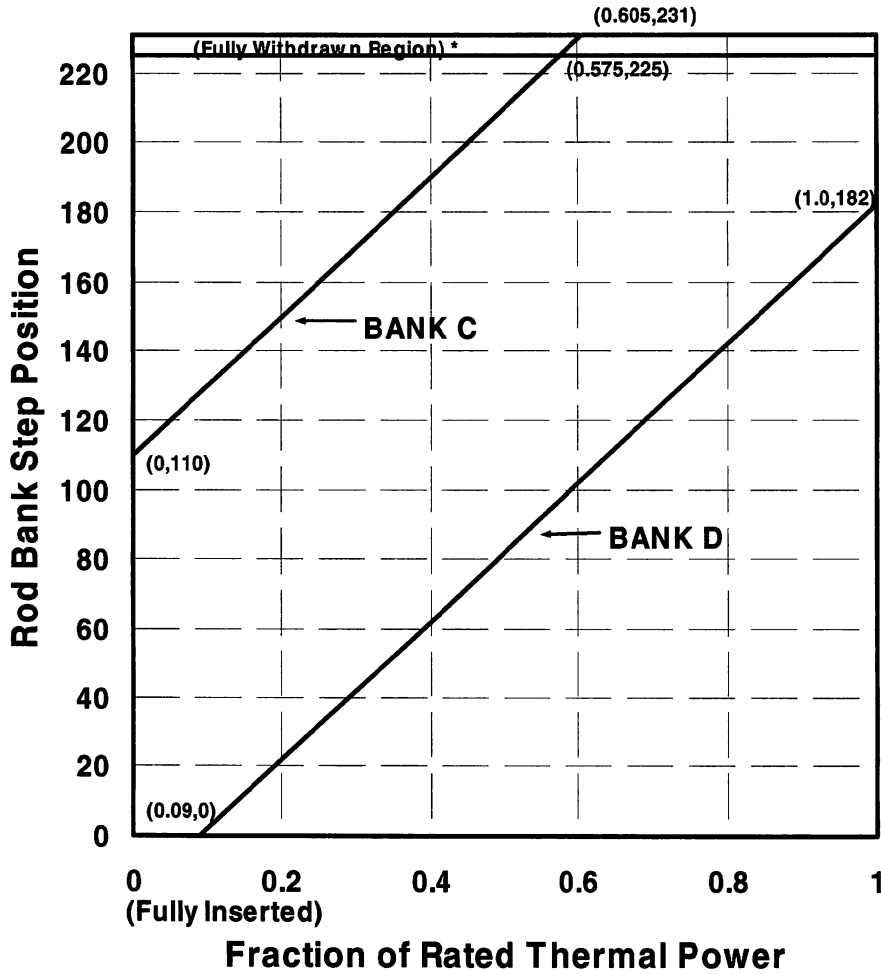| AXIAL(X,Y)	ELEVATION (ft)	MAP(X,Y,Z)	AXIAL(X,Y)	ELEVATION (ft)	MAP(X,Y,Z)
1.1	2 4 6 8 10	1.9796 1.9750 1.9675 1.9561 1.9346	1.9	2 4 6 8 10	2.8084 2.9772 2.9986 2.8424 2.6948
1.2	2 4 6 8 10	2.1787 2.1683 2.1890 2.1626 2.0894	>1.9	2 4 6 8 10	2.5301 2.6821 2.7014 2.5607 2.4278
1.3	2 4 6 8 10	2.4200 2.4024 2.4119 2.3100 2.1923	2.2	2 4 6 8 10	2.6742 3.3050 3.1569 3.0147 2.7071
1.4	2 4 6 8 10	2.6650 2.6238 2.5696 2.4224 2.2895	2.6	2 4 6 8 10	2.6810 3.5687 3.5402 3.3006 2.9649
1.5	2 4 6 8 10	2.7164 2.7476 2.6782 2.5262 2.3832	3.0	2 4 6 8 10	2.9366 3.7887 4.1090 3.6762 3.3366
1.7	2 4 6 8 10	2.7673 2.9138 2.8590 2.7018 2.5502	3.5	2 4 6 8 10	2.9665 4.0948 4.1053 3.7168 3.4708

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)	Steps Withdrawn
≥ 0	≥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.
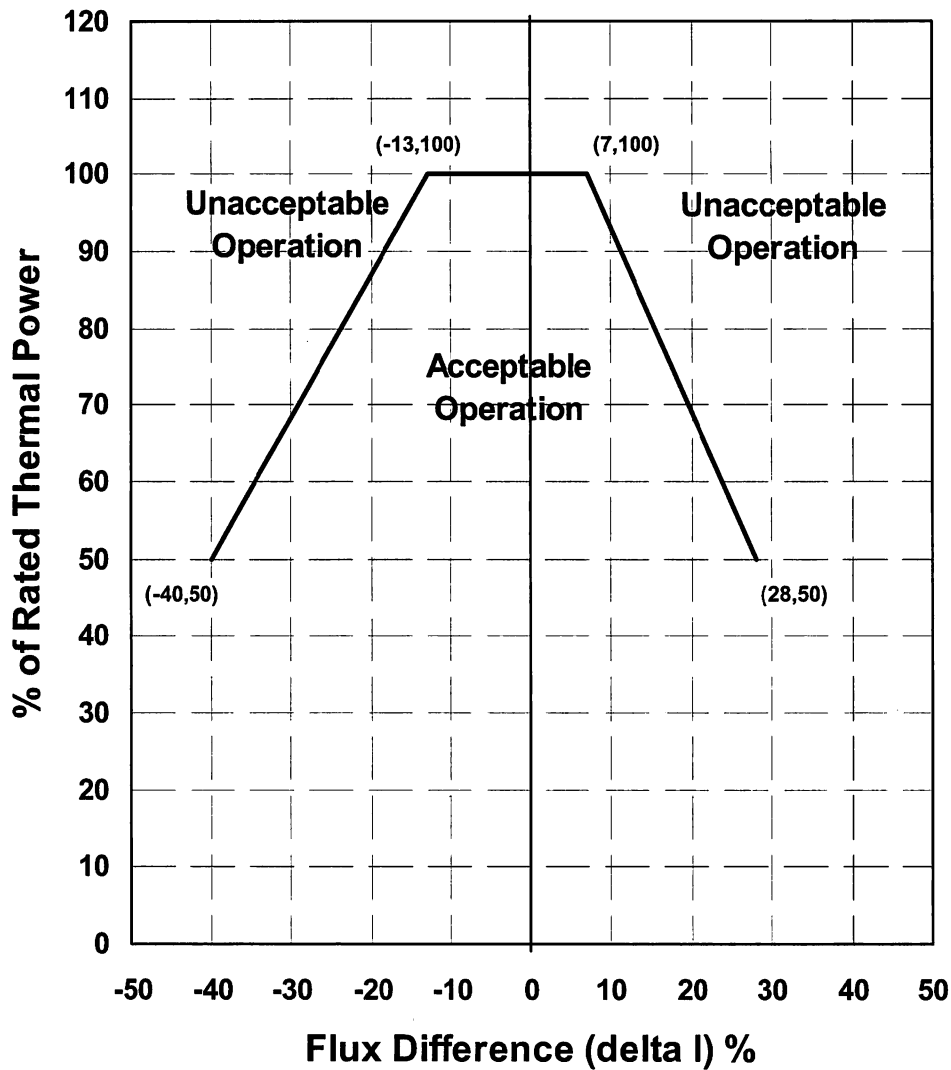
FIGURE 2A

Axial Flux Difference Limits
As A Function of Thermal Power
For Burnup Range of 0 EFPD to 356±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.
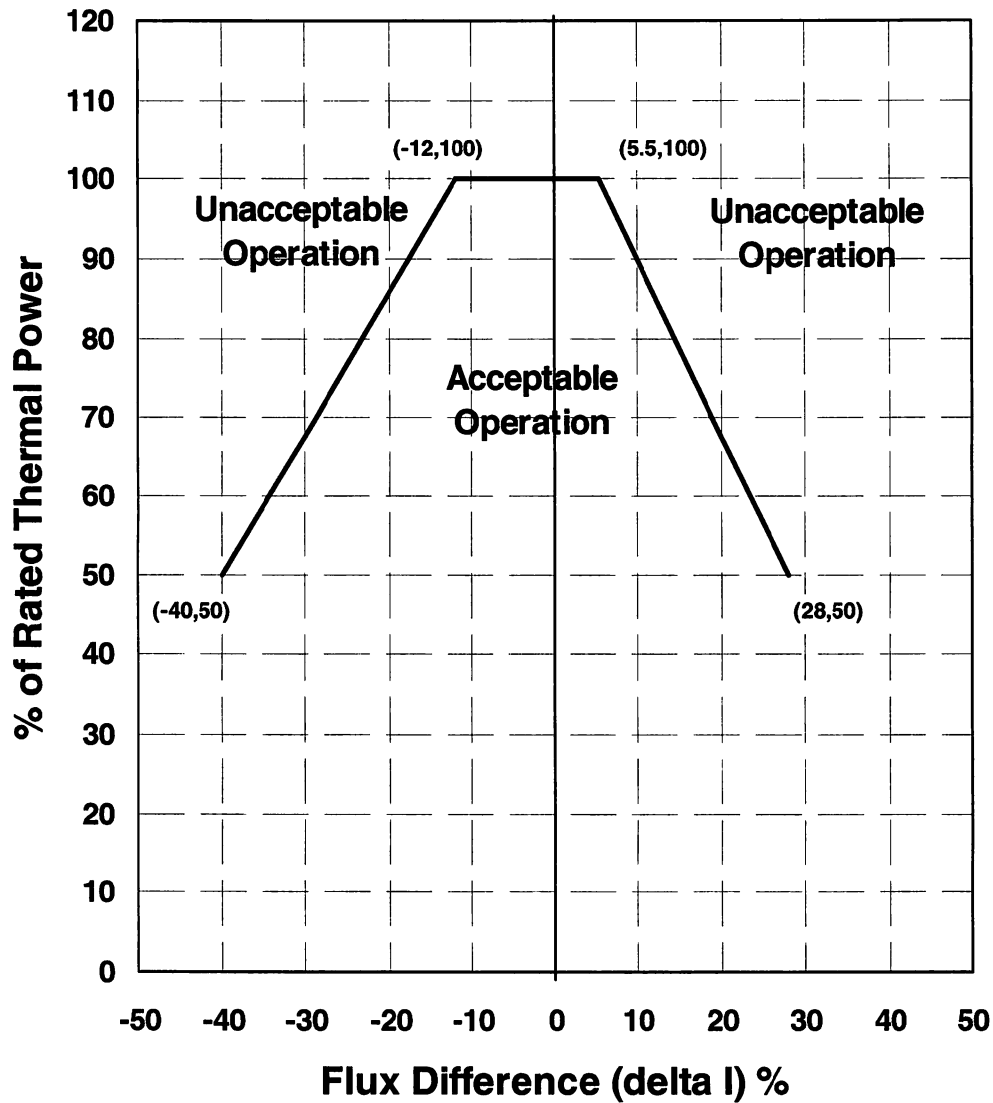
FIGURE 2B

**Axial Flux Difference Limits
As A Function of Thermal Power
For Burnup Range of 356±10 EFPD to 483±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.
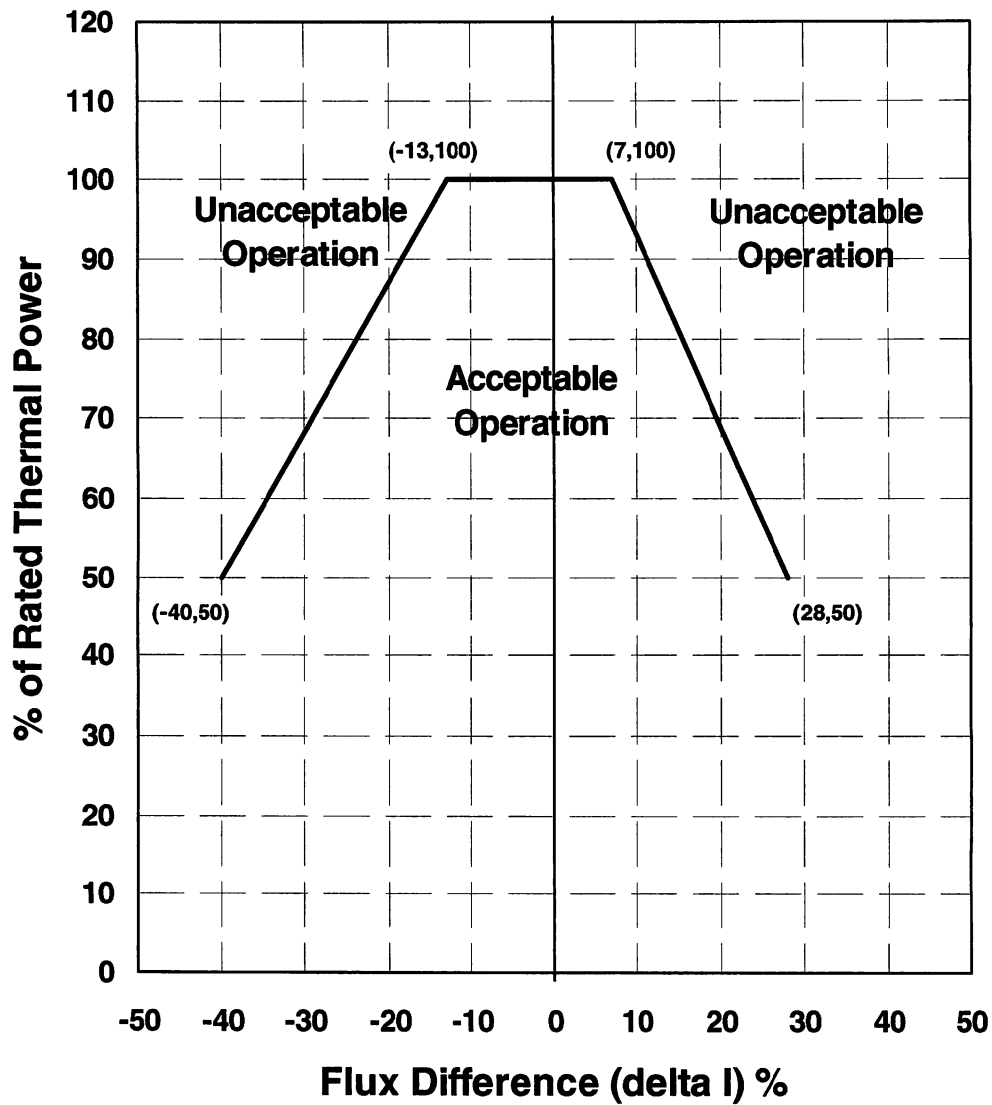
FIGURE 2C

Axial Flux Difference Limits
As A Function of Thermal Power
For Burnup Range of 483±10 EFPD to EOL

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.

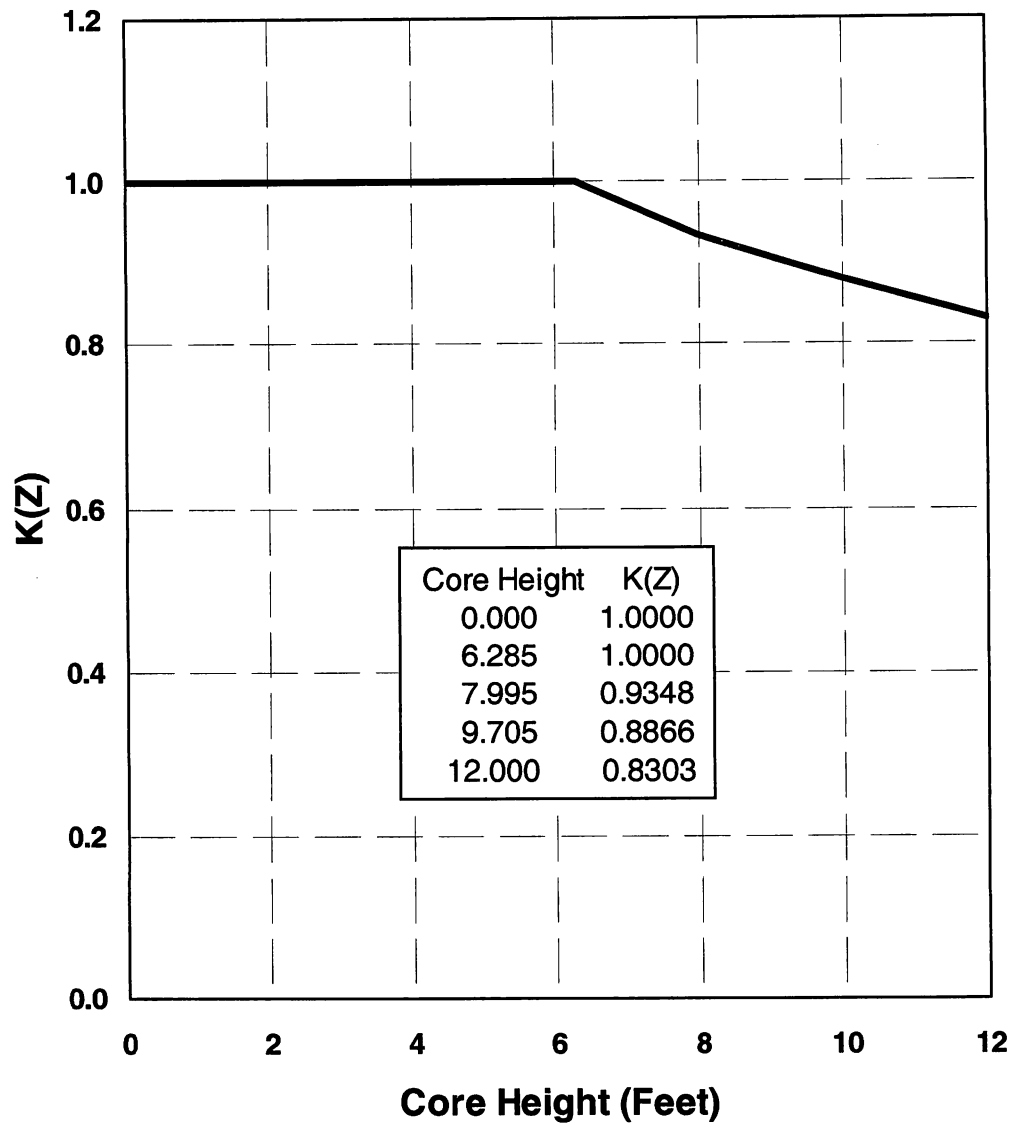| Core Height	K(Z)
0.000	1.0000
6.285	1.0000
7.995	0.9348
9.705	0.8866
12.000	0.8303

FIGURE 3

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