Core Operating Limits Report

For

Quad Cities Unit 1 Cycle 16

December 1998

ISSUANCE OF CHANGES SUMMARY

Affected Section	Affected Pages	Summary of Changes	Date
All	All	Original Issue (Cycle 11).	06/89
All	All	Original Issue (Cycle 12).	10/90
All	Al	Original Issue (Cycle 13).	11/92
2	iv, 2 2-1-2-8	Converted Figures 2-1 through 2-8 to actual tables from References 4 and 5	01/93
All 2,4,5	All 2,4,5	Original Issue (Cycle 14). Added Section 2.3 on SLO, revised Section 4.2 requiring OLMCPR penalty during coastdown operation, added Section 5.0 on Analytical Methods.	03/94
All	All	Original Issue (Cycle 15), Latest Date Revised added to each COLR page, added special instructions and boxed in TSUP references for TSUP implementation, added control rod withdrawal block equation for single loop operation.	05/96
All	All	Original Issue (Cycle 16).	12/98

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SPECIAL INSTRUCTIONS

This Core Operating Limits Report (COLR) contains the applicable reactor core limits and operational information mandated by Technical Specification 6.9.A.6. When the COLR is referenced by applicable Technical Specifications or procedures for Technical Specification compliance, a controlled copy of this report shall be used as the official source of the applicable limit or requirement.

REFERENCES

1. Commonwealth Edison Company and MidAmerican Energy Company Docket No. 50-254, Quad Cities Station, Unit 1 Facility Operating License, License No. DPR-29.

2. Letter from D.M. Crutchfield to All Power Reactor Licenses and Applicants, Generic Letter 88-16; Removal of Cycle-Specific Parameter Limits from Technical Specifications.

3. "Quad Cities Unit 1 Cycle 16 Neutronics Licensing Report", NDIT NFM 9800150.

4. Quad Cities Nuclear Power Station, Units 1 and 2, SAFER/GESTR - LOCA Loss-of-Coolant Accident Analysis, NEDC-31345P, Revision 2, Class III, July 1989 (as amended).

5. EMF-96-037(P), Rev. 1, "Quad Cities Extended Operating Domain (EOD) and Equipment Out Of Service (EOOS) Safety Analysis for ATRIUM-9B Fuel", September 1996, NFS NDIT # 9600134 Seq 02.

6. EMF-98-051, Revision 0, "Quad Cities Unit 1 Cycle 16 Plant Transient Analysis", August 1998, NDIT # NFM9800186 Seq 00.

7. EMF-98-052, Revision 0, "Quad Cities Unit 1 Cycle 16 Reload Analysis", August 1998, NDIT # NFM 9800191 Seq 00.

8. EMF-96-185(P), Revision 4, "Quad Cities LOCA-ECCS Analysis MAPLHGR Limits for ATRIUM-9B Fuel", August 1998, NDIT # NFM970015 Seq 3.

9. DEG:98:177, "Permission to Send the NRC Nonproprietary Transient Analysis and Reload Analysis Reports", D.E. Garber to R.J. Chin, June 1, 1998.

LIST OF TABLES

1.0 CONTROL ROD WITHDRAWAL BLOCK INSTRUMENTATION (3.2/4.2)

1.1 TECHNICAL SPECIFICATION REFERENCE:

TLO: 3.2.E-1
SLO: 3.6.A.1.c

1.2 DESCRIPTION (TLO):

The Rod Withdrawal Block Monitor Upscale Instrumentation Trip Setpoint for two recirculation loop operation is determined from the following relationship:

$$\leq (0.65)Wd + 43\% \text{ **}$$

1.3 DESCRIPTION (SLO):

The Rod Withdrawal Block Monitor Upscale Instrumentation Trip Setpoint for Single Loop Operation (SLO) is determined from he following relationship:

$$\leq (0.65)Wd + 39\% \text{ **}$$

** Clamped with an allowable value not to exceed the allowable value for recirculation loop drive flow (Wd) of 100%

Wd is the percent of drive flow required to produce a rated core flow of 98 million lb/hr. Trip level setting is in percent of rated power (2511 MWth).

2.0 AVERAGE PLANAR LINEAR HEAT GENERATION RATE (APLHGR) (3.5/4.5)

2.1 TECHNICAL SPECIFICATION REFERENCE:

Technical Specification 3.11.A

2.2 DESCRIPTION:

The Maximum Average Planar Linear Heat Generation Rates (MAPLHGR) vs. Average Planar Exposure for GE9B-P8DWB305-7GZ-80M-145-CECO is determined from Table 2-1.

The Maximum Average Planar Linear Heat Generation Rates (MAPLHGR) vs. Average Planar Exposure for GE10-P8HXB311-8GZ-100M-145-CECO is determined from Table 2-2.

The Maximum Average Planar Linear Heat Generation Rates (MAPLHGR) vs. Average Planar Exposure for GE10-P8HXB312-7GZ-100M-145-CECO is determined from Table 2-3.

The Maximum Average Planar Linear Heat Generation Rates (MAPLHGR) vs. Average Planar Exposure for GE10-P8HXB332-8G5.0-100M-145-CECO is determined from Table 2-4.

The Maximum Average Planar Linear Heat Generation Rates (MAPLHGR) vs. Average Planar Exposure for GE10-P8HXB333-4G5.0/6G4.0-100M-145-CECO is determined from Table 2-5.

The Maximum Average Planar Linear Heat Generation Rates (MAPLHGR) vs. Average Planar Exposure for SPCA9-3.48B-11G6.5-ADV and SPCA9-3.60B-11G6.5-ADV is determined from Table 2-6.

2.3 SINGLE LOOP OPERATION MULTIPLIER:

The tabulated values are multiplied by 0.85 for GE fuel and 0.90 for SPC fuel whenever Quad Cities enters Single Loop Operation.

TABLE 2-1
MAPLHGR vs. Average Planar Exposure for
GE9B-P8DWB305-7GZ-80M-145-CECO

LATTICE 731: P8DWL071-NOG-80M-T
LATTICE 1516: P8DWL339-3G4.0/4G3.0-80M-T
LATTICE 1517: P8DWL339-7G3.0-80M-T
LATTICE 1518: P8DWL324-7G3.0-80M-T
LATTICE 1061: P8DWL071-7GE1-80M-T

AVERAGE PLANAR EXPOSURE (GWD/ST)	MAPLHGR LIMITS (KW/FT)				
	731	1516	1517	1518	1061
0.0	11.64	12.00	12.00	11.97	11.64
0.2	11.57	12.10	12.11	12.04	11.57
1.0	11.38	12.26	12.27	12.11	11.38
2.0	11.36	12.42	12.44	12.31	11.36
3.0	11.41	12.59	12.60	12.59	11.41
4.0	11.49	12.74	12.75	12.91	11.49
5.0	11.56	12.88	12.89	13.09	11.56
6.0	11.63	13.01	13.01	13.23	11.63
7.0	11.69	13.10	13.06	13.36	11.69
8.0	11.74	13.13	13.09	13.48	11.74
9.0	11.78	13.15	13.12	13.54	11.78
10.0	11.81	13.16	13.15	13.56	11.81
12.5	11.54	13.07	13.08	13.52	11.54
15.0	11.16	12.72	12.73	13.12	11.16
20.0	10.37	12.04	12.05	12.35	10.37
25.0	9.58	11.39	11.40	11.60	9.58
35.0	8.01	10.15	10.15	10.19	8.01
43.7	4.71	-	-	-	4.71
45.0	-	8.69	8.69	8.68	-
50.7	-	5.89	5.90	-	-
51.2	-	-	-	5.78	-

TABLE 2-2

MAPLHGR vs. Average Planar Exposure for GE10-P8HXB311-8GZ-100M-145-CECO

LATTICE 1807: P8HXL071-8GE-100M-T
LATTICE 1806: P8HXL335-8G3.0-100M-T
LATTICE 1805: P8HXL353-2G4.0/6G3.0-100M-T
LATTICE 1804: P8HXL335-4G4.0/4G3.0-100M-T
LATTICE 1054: P8HXL071-NOG-100M-T

AVERAGE PLANAR EXPOSURE (GWD/ST)	MAPLHGR LIMITS (KW/FT)				
	1054	1806	1805	1804	1807
0.0	11.85	12.06	11.10	12.02	11.85
.02	11.78	12.12	11.14	12.08	11.78
1.0	11.59	12.28	11.27	12.22	11.59
2.0	11.57	12.48	11.51	12.40	11.57
3.0	11.61	12.68	11.81	12.57	11.61
4.0	11.68	12.89	12.14	12.76	11.68
5.0	11.75	13.11	12.50	12.94	11.75
6.0	11.81	13.29	12.88	13.12	11.81
7.0	11.86	13.41	13.19	13.28	11.86
8.0	11.91	13.47	13.28	13.40	11.91
9.0	11.94	13.48	13.34	13.46	11.94
10.0	11.97	13.46	13.39	13.49	11.97
12.5	11.75	13.34	13.44	13.33	11.75
15.0	11.38	12.96	13.09	12.95	11.38
20.0	10.59	12.22	12.40	12.22	10.59
25.0	9.81	11.51	11.73	11.50	9.81
35.0	8.26	10.13	10.39	10.13	8.26
44.9	4.93	-	-	-	4.93
45.0	-	8.55	9.00	8.55	-
50.4	-	5.85	-	-	-
50.5	-	-	-	5.85	-
51.5	-	-	5.86	-	-

TABLE 2-3

MAPLHGR vs. Average Planar Exposure for GE10-P8HXB312-7GZ-100M-145-CECO

LATTICE 1811: P8HXL071-7GE-100M-T
LATTICE 1810: P8HXL336-7G3.0-100M-T
LATTICE 1809: P8HXL354-1G4.0/6G3.0-100M-T
LATTICE 1808: P8HXL336-3G4.0/4G3.0-100M-T
LATTICE 1054: P8HXL071-NOG-100M-T

AVERAGE PLANAR EXPOSURE (GWD/ST)	MAPLHGR LIMITS (KW/FT)				
	1054	1810	1809	1808	1811
0.0	11.85	12.04	11.27	12.01	11.85
0.2	11.78	12.11	11.31	12.08	11.78
1.0	11.59	12.27	11.42	12.23	11.59
2.0	11.57	12.49	11.65	12.43	11.57
3.0	11.61	12.72	11.93	12.65	11.61
4.0	11.68	12.96	12.24	12.88	11.68
5.0	11.75	13.15	12.58	13.09	11.75
6.0	11.81	13.30	12.94	13.22	11.81
7.0	11.86	13.41	13.15	13.32	11.86
8.0	11.91	13.46	13.32	13.40	11.91
9.0	11.94	13.47	13.43	13.45	11.94
10.0	11.97	13.45	13.50	13.47	11.97
12.5	11.75	13.35	13.45	13.35	11.75
15.0	11.38	12.97	13.10	12.97	11.38
20.0	10.59	12.24	12.41	12.23	10.59
25.0	9.81	11.52	11.74	11.51	9.81
35.0	8.26	10.15	10.41	10.14	8.26
44.9	4.93	-	-	-	4.93
45.0	-	8.60	9.01	8.61	-
50.5	-	5.85	-	-	-
50.6	-	-	-	5.85	-
51.6	-	-	5.86	-	-

TABLE 2-4

MAPLHGR vs. Average Planar Exposure for GE10-P8HXB332-8G5.0-100M-145-CECO

LATTICE 1054: P8HXL071-NOG-100T-T
LATTICE 2080: P8HXL358-8G5.0-100T-T
LATTICE 2081: P8HXL377-8G5.0-100T-T
LATTICE 2082: P8HXL071-8GE-100T-T

AVERAGE PLANAR EXPOSURE (GWD/ST)	MAPLHGR LIMITS (KW/FT)			
	1054	2080	2081	2082
0.0	11.85	11.98	11.55	11.85
.02	11.78	12.05	11.58	11.78
1.0	11.59	12.18	11.65	11.59
2.0	11.57	12.33	11.80	11.57
3.0	11.61	12.48	11.97	11.61
4.0	11.68	12.57	12.11	11.68
5.0	11.75	12.67	12.25	11.75
6.0	11.81	12.77	12.38	11.81
7.0	11.86	12.88	12.47	11.86
8.0	11.91	12.85	12.57	11.91
9.0	11.94	12.83	12.67	11.94
10.0	11.97	12.84	12.77	11.97
12.5	11.75	13.05	12.92	11.75
15.0	11.38	12.89	12.77	11.38
20.0	10.59	12.17	12.24	10.59
25.0	9.81	11.46	11.50	9.81
35.0	8.26	10.09	10.08	8.26
44.89	4.93	-	-	4.93
45.0	-	8.82	8.51	-
50.5	-	-	5.80	-
51.38	-	5.78	-	-

TABLE 2-5

MAPLHGR vs. Average Planar Exposure for GE10-P8HXB333-4G5.0/6G4.0-100M-145-CECO

LATTICE 1054: P8HXL071-NOG-100T-T
LATTICE 2077: P8HXL358-4G5.0/6G4.0-100T-T
LATTICE 2078: P8HXL377-4G5.0/6G4.0-100T-T
LATTICE 2079: P8HXL071-10GE-100T-T

AVERAGE PLANAR EXPOSURE (GWD/ST)	MAPLHGR LIMITS (KW/FT)			
	1054	2077	2078	2079
0.0	11.85	11.81	11.22	11.85
0.2	11.78	11.86	11.26	11.78
1.0	11.59	11.95	11.36	11.59
2.0	11.57	12.11	11.52	11.57
3.0	11.61	12.25	11.69	11.61
4.0	11.68	12.40	11.88	11.68
5.0	11.75	12.56	12.08	11.75
6.0	11.81	12.72	12.29	11.81
7.0	11.86	12.85	12.46	11.86
8.0	11.91	12.89	12.61	11.91
9.0	11.94	12.94	12.76	11.94
10.0	11.97	13.00	12.90	11.97
12.5	11.75	13.14	13.02	11.75
15.0	11.38	12.90	12.79	11.38
20.0	10.59	12.17	12.24	10.59
25.0	9.81	11.46	11.50	9.81
35.0	8.26	10.08	10.08	8.26
44.89	4.93	-	-	4.93
45.0	-	8.81	8.47	-
50.41	-	-	5.81	-
51.42	-	5.77	-	-

TABLE 2-6

MAPLHGR vs. Average Planar Exposure for
SPCA9-3.48B-11G6.5-ADV
and
SPCA9-3.60B-11G6.5-ADV

AVERAGE PLANAR EXPOSURE (GWD/MTU)	ATRIUM-9B MAPLHGR (KW/FT)
0.0	13.5
20.0	13.5
60.0	8.7

3.0 LINEAR HEAT GENERATION RATE (LHGR) (3.5/4.5)

3.1 TECHNICAL SPECIFICATION REFERENCE:

Technical Specification 3.11.D

3.2 DESCRIPTION

A. The LHGR limit is 14.4 kW/ft for all of the GE fuel types in the Q1C16 core:

GE9B-P8DWB305-7GZ-80M-145-CECO
GE10-P8HXB311-8GZ-100M-145-CECO
GE10-P8HXB312-7GZ-100M-145-CECO
GE10-P8HXB332-8G5.0-100M-145-CECO
GE10-P8HXB333-4G5.0/6G4.0-100M-145-CECO

B. The LHGR limits are provided in Table 3-1 for all of the SPC fuel types (ATRIUM-9B Offset) in the Q1C16 core.

The Protection Against Power Transient LHGR Limits for ATRIUM-9B Offset fuel are provided in Table 3-2.

SPCA9-3.48B-11G6.5-ADV
SPCA9-3.60B-11G6.5-ADV

TABLE 3-1

LHGR vs AVERAGE PLANAR EXPOSURE for ATRIUM-9B
Steady State

AVERAGE PLANAR EXPOSURE (GWD/MTU)	ATRIUM-9B LHGR (KW/FT)
0.0	14.4
15.0	14.4
61.1	8.32

TABLE 3-2

LHGR vs AVERAGE PLANAR EXPOSURE for ATRIUM-9B
Transient

AVERAGE PLANAR EXPOSURE (GWD/MTU)	ATRIUM-9B LHGR (KW/FT)
0.0	19.4
15.0	19.4
61.1	11.2

4.0 MINIMUM CRITICAL POWER RATIO (MCPR)

4.1 TECHNICAL SPECIFICATION REFERENCE:

Technical Specification 3.11.C

4.2 DESCRIPTION

A. The Operating Limit MCPRs for Q1C16 are listed in Tables 4-1 through 4-4 for the GE9, GE10 and ATRIUM-9B fuel. There are two sets of Operating Limit MCPRs (OLMCPRs) calculated for Q1C16, one based on Technical Specification SCRAM Insertion Speeds (TSSS) and the other based on Nominal SCRAM Insertion Speeds (NSS). The TSSS OLMCPRs should be used until full core SCRAM time testing has occurred and data has been shown to meet NSS criteria.

All Operating Limit MCPRs in Tables 4-1 through 4-4 are based on a 1.11 MCPR Safety Limit. If the unit is in Single Loop Operation, the MCPR Safety Limit increases to 1.12; therefore, the Operating Limit should be increased by 0.01 accordingly. Consequently, if the unit is in Single Loop Operation all the MCPR Operating Limits in Tables 4-1 through 4-4 must be increased by 0.01.

B. During Manual Flow Control, the Operating Limit MCPR for each fuel type at reduced core flow conditions can be determined from the greater of the following (adding the 0.01 Single Loop Operation penalty if appropriate):

1. Table 4-2 using the appropriate flow rate, or

2. The OLMCPR determined from Table 4-1 as appropriate.

C. During Automatic Flow Control, the Operating Limit MCPR (OLMCPR) for each fuel type at reduced core flow conditions can be determined from the greater of the following Table 4-3 or 4-4 using the appropriate flow rate and appropriate EOD/EOOS condition and adding the 0.01 Single Loop Operation penalty if appropriate.

The OLMCPRs for Automatic Flow Control are based off of the TSSS OLMCPRs which is conservative compared to NSS OLMCPRs.

TABLE 4-1

Q1C16 Operating Limit MCPRs based on 1.11 SLMCPR

	GE9 OLMCPR		GE10 OLMCPR		ATRIUM-9B OLMCPR	
	TSSS	NSS	TSSS	NSS	TSSS	NSS
Normal Operation	1.57	1.56	1.47	1.46	1.44	1.43
EOD/EOOS Operation (FFTR, FHOOS, Coastdown, or any combination thereof)	1.62	1.61	1.52	1.51	1.49	1.48

TABLE 4-2

Q1C16 Operating Limit MCPRs for Manual Flow Control
(For Normal Operation or EOD/EOOS Operation)

Total Core Flow (% of Rated)	GE9 OLMCPR	GE10 OLMCPR	ATRIUM-9B Offset OLMCPR
110	1.11	1.11	1.11
30	1.96	1.98	2.02
0	2.49	2.51	2.53

TABLE 4-3

Q1C16 Operating Limit MCPRs for Automatic Flow Control (Base Case OLMCPR)
based on TSSS OLMCPRs

Total Core Flow (% of Rated)	GE9 OLMCPR	GE10 OLMCPR	ATRIUM-9B Offset OLMCPR
108	1.57	1.47	1.44
30	2.92	2.76	2.76
0	3.83	3.63	3.59

TABLE 4-4

Q1C16 Operating Limit MCPRs for Automatic Flow Control EOD/EOOS
based on TSSS OLMCPRs

Total Core Flow (% of Rated)	GE9 OLMCPR	GE10 OLMCPR	ATRIUM-9B Offset OLMCPR
108	1.62	1.52	1.49
30	3.07	2.85	2.86
0	3.94	3.75	3.71

5.0 ANALYTICAL METHODS

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC in the latest approved revision or supplement of the topical reports describing the methodology. For Quad Cities Unit 1, the topical reports are:

SEE SECTION 6.9.A.6.b OF THE QUAD CITIES TECHNICAL SPECIFICATIONS