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

Quad Cities Nuclear Power Station, Unit 1
Renewed Facility Operating License No. DPR-29
NRC Docket No. 50-254

Subject: Core Operating Limits Report for Quad Cities Unit 1 Cycle 21

Quad Cities Nuclear Power Station Unit 1 was shutdown for Refuel Outage 20 (Q1R20) on April 27, 2009. In accordance with Technical Specifications Section 5.6.5.d, enclosed is the Core Operating Limits Report (COLR) for Quad Cities Unit 1 Cycle 21.

Should you have any questions concerning this letter, please contact Mr. Wally J. Beck at (309) 227-2800.

Respectfully,

Timothy J. Tulon
Site Vice President
Quad Cities Nuclear Power Station

Enclosure: Core Operating Limits Report for Quad Cities Unit 1 Cycle 21

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station

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Enclosure

Core Operating Limits Report

for

Quad Cities Unit 1 Cycle 21

Quad Cities Unit 1 Cycle 21

Core Operating Limits Report

Revision 0

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1. Terms and Definitions

APLHGR	Average planar linear heat generation rate
APRM	Average power range monitor
AOO	Anticipated Operational Occurrence
ASD	Adjustable Speed Drive
BOC	Beginning of cycle
DEHC	Digital Electro-Hydraulic Control
DLO	Dual loop operation
EFPH	Effective full power hour
ELLLA	Extended load line limit analysis
EOC	End of cycle
EOOS	Equipment out of service
EOFPL	End of full power life
FFWTR	Final Feedwater Temperature Reduction
FWTR	Feedwater temperature reduction
FWHOOS	Feedwater heater out of service
FWT	Feedwater temperature
GE14	GE14C fuel
GNF	Global Nuclear Fuel
ICF	Increased core flow
ISS	Intermediate scram speed
LHGR	Linear heat generation rate
LHGRFAC(F)	Flow dependent LHGR multiplier
LHGRFAC(P)	Power dependent LHGR multiplier
LPRM	Local power range monitor
MAPLHGR	Maximum average planar linear heat generation rate
MAPRAT	Maximum average planar ratio
MCPR	Minimum critical power ratio
MCPR(F)	Flow dependent MCPR
MCPR(P)	Power dependent MCPR
MELLLA	Maximum extended load line limit analysis
MSIV	Main steam isolation valve
NSS	Nominal Scram Speed
OLMCPR	Operating limit minimum critical power ratio
OPRM	Oscillation power range monitor
PBDA	Period based detection algorithm
PLUOOS	Power load unbalance out of service
PCOOS	Pressure controller out of service
RBM	Rod block monitor
RPTOOS	Recirculation pump trip out of service
RWE	Rod withdrawal error
SLMCPR	Safety limit minimum critical power ratio
SLO	Single loop operation
SRVOOS	Safety-relief valve out of service
TBVOOS	Turbine bypass valve out of service
TCV	Turbine control valve
TCVOOS	Turbine control valve out of service
TIP	Traversing incore probe
TSSS	Technical Specification scram speed
TSV	Turbine stop valve
TSVOOS	Turbine stop valve out of service

2. General Information

Power and flow dependent limits are listed for various power and flow levels. Linear interpolation is to be used to find intermediate values.

Rated core flow is 98 Mlb/hr. Operation up to 108% rated flow is licensed for this cycle. Licensed rated thermal power is 2957 MWth. For allowed operating regions, see plant power/flow map.

Coastdown is defined as any cycle exposure beyond the full power, all rods out condition with plant power slowly lowering to a lesser value while core flow is held constant.

MCPR(P) and MCPR(F) values are independent of scram time.

LHGRFAC(P) and LHGRFAC(F) values are independent of scram speed.

All thermal limits are analyzed to either NSS, ISS, or TSSS. Only MCPR limits vary with scram speed.

For thermal limit monitoring above 100% rated power or 100% rated core flow, the 100% rated power and the 100% core flow values, respectively, can be used unless otherwise indicated in the applicable table.

The OPRM PBDA trip settings are based, in part, on the cycle specific OLMCPR and the power dependent MCPR limits. Any change to the OLMCPR values and/or the power dependent MCPR limits should be evaluated for potential impact on the OPRM PBDA trip settings.

3. Average Planar Linear Heat Generation Rate

The MAPLHGR values for the most limiting lattice (excluding natural uranium) of the GE14 bundle types as a function of average planar exposure is given in Table 3-1. During single loop operation, these limits are multiplied by the SLO multiplier listed in Table 3-2.

For Optima2 fuel, lattice-specific MAPLHGR values for DLO and SLO are provided in Tables 3-3 through 3-20. Table 3-5 is based on the combination of limits from Reference 3 for Lattice 105, which is part of two types of Optima2 fuel bundles. For Optima2 fuel, the MAPLHGR for natural U lattices 101: Opt2-B0.71 and 108: Opt2-T0.71 must be set equal to the most restrictive MAPLHGR limits from among the enriched lattice types in the bundle (References 3 and 13).

Table 3-1 MAPLHGR for bundle(s):
GE14-P10DNAB409-17GZ-100T-145-T6-2825
GE14-P10DNAB408-15GZ-100T-145-T6-2826

(References 19, 27, and 28)

Avg. Planar Exposure (GWd/MT)	MAPLHGR (kW/ft)
0.00	10.86
25.14	10.86
44.09	9.16
55.12	8.09
63.50	6.97
70.00	4.36

Table 3-2 MAPLHGR SLO multiplier for GE Fuel
(Reference 19)

Fuel Type	SLO Multiplier
GE14	0.77

Table 3-3 MAPLHGR for bundle/lattice:
OPT2-3.99-15GZ8.00-3G6.00/Lattices 101, 102, 103, and 108
(References 3 and 20)

Lattices 101: Opt2-B0.71 102: Opt2-B4.38-15G8.00-3G6.00 103: Opt2-BE4.47-15G8.00-3G6.00 108: Opt2-T0.71		
Avg. Planar Exposure (GWd/MT)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0.0	9.26	7.96
7.5	9.11	7.83
17.5	9.11	7.83
24.0	9.45	8.13
58.0	9.45	8.13
70.0	8.08	6.95

Table 3-4 MAPLHGR for bundle/lattice:
OPT2-3.99-15GZ8.00-3G6.00/Lattice 104
(References 3 and 20)

Lattice 104: Opt2-M4.47-15G8.00-3G6.00		
Avg. Planar Exposure (GWd/MT)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0.0	9.37	8.06
7.5	9.17	7.89
17.5	9.17	7.89
24.0	9.57	8.23
58.0	9.57	8.23
70.0	8.20	7.05

Table 3-5 MAPLHGR for bundle/lattice:
OPT2-3.99-15GZ8.00-3G6.00/Lattice 105
OPT2-4.00-13GZ8.00-3G6.00/Lattice 105
(References 3 and 20)

Lattice 105: Opt2-ME4.46-11G8.00-3G6.00		
Avg. Planar Exposure (GWd/MT)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0.0	9.37	8.06
7.5	9.17	7.89
17.5	9.17	7.89
24.0	9.57	8.23
58.0	9.57	8.23
70.0	8.20	7.05

Table 3-6 MAPLHGR for bundle/lattice:
OPT2-3.99-15GZ8.00-3G6.00
OPT2-4.00-13GZ8.00-3G6.00
Lattices 106 and 107
(References 3 and 20)

Lattices 106: Opt2-T4.46-11G8.00-3G6.00 107: Opt2-T4.46-14G6.00		
Avg. Planar Exposure (GWd/MT)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0.0	10.15	8.73
10.0	9.68	8.32
20.0	9.68	8.32
24.0	9.85	8.47
58.0	9.85	8.47
70.0	8.48	7.29

Table 3-7 MAPLHGR for bundle/lattice:
OPT2-4.00-13GZ8.00-3G6.00
Lattices 101, 108, 109, and 110
(References 3 and 20)

Lattices 101: Opt2-B0.71 108: Opt2-T0.71 109: Opt2-B4.40-13G8.00-3G6.00 110: Opt2-BE4.48-13G8.00-3G6.00		
Avg. Planar Exposure (GWd/MT)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0.0	9.50	8.17
10.0	9.25	7.96
20.0	9.25	7.96
24.0	9.45	8.13
58.0	9.45	8.13
70.0	8.08	6.95

Table 3-8 MAPLHGR for bundle/lattice:
OPT2-4.00-13GZ8.00-3G6.00/Lattice 111
(References 3 and 20)

Lattice 111: Opt2-M4.48-13G8.00-3G6.00		
Avg. Planar Exposure (GWd/MT)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0.0	9.59	8.25
10.0	9.32	8.02
20.0	9.32	8.02
24.0	9.57	8.23
58.0	9.57	8.23
70.0	8.20	7.05

Table 3-9 MAPLHGR for bundle/lattice:
OPT2-4.05-12GZ7.00-2G6.00
Lattices 101, 108, 112, and 113
(References 3 and 20)

Lattices 101: Opt2-B0.71 108: Opt2-T0.71 112: Opt2-B4.44-12G7.00-2G6.00 113: Opt2-BE4.55-10G7.00-2G6.00		
Avg. Planar Exposure (GWd/MT)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0.0	9.90	8.51
10.0	9.52	8.19
58.0	9.52	8.19
70.0	8.15	7.01

Table 3-10 MAPLHGR for bundle/lattice:
OPT2-4.05-12GZ7.00-2G6.00
Lattices 114 and 115
(References 3 and 20)

Lattices 114: Opt2-M4.55-10G7.00-2G6.00 115: Opt2-ME4.51-10G7.00-2G6.00		
Avg. Planar Exposure (GWd/MT)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0.0	10.33	8.88
12.5	9.69	8.33
58.0	9.69	8.33
70.0	8.32	7.16

Table 3-11 MAPLHGR for bundle/lattice: OPT2-4.05-12GZ7.00-2G6.00/Lattice 116
(References 3 and 20)

Lattice 116: Opt2-T4.51-10G7.00-2G6.00		
Avg. Planar Exposure (GWd/MT)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0.0	10.66	9.17
10.0	9.91	8.52
58.0	9.91	8.52
70.0	8.54	7.34

Table 3-12 MAPLHGR for bundle/lattice: OPT2-3.98-18GZ8.00/Lattices 101, 108, and 117
(References 13 and 22)

Lattice 101: Opt2-B0.71 108: Opt2-T0.71 117: Opt2-B4.37-18G8.00		
Avg. Planar Exposure (GWd/MTU)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0	8.32	7.16
5.0	8.65	7.44
15.0	9.04	7.77
20.0	9.40	8.09
24.0	9.66	8.31
30.0	9.51	8.18
58.0	9.51	8.18
70.0	8.14	7.00

Table 3-13 MAPLHGR for bundle/lattice:
OPT2-3.98-18GZ8.00
Lattices 118 and 119
(References 13 and 22)

Lattices 118: Opt2-BE4.47-18G8.00 119: Opt2-M4.47-18G8.00		
Avg. Planar Exposure (GWd/MTU)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0	8.35	7.18
5.0	8.68	7.46
15.0	9.14	7.86
20.0	9.52	8.19
24.0	9.79	8.42
30.0	9.63	8.28
58.0	9.63	8.28
70.0	8.26	7.10

Table 3-14 MAPLHGR for bundle/lattice:
OPT2-3.98-18GZ8.00
Lattices 120, 121 and 122
(References 13 and 22)

Lattices 120: Opt2-ME4.42-18G8.00 121: Opt2-T4.42-18G8.00 122: Opt2-T4.44-16G5.00		
Avg. Planar Exposure (GWd/MTU)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0	8.46	7.27
5.0	8.80	7.57
10.0	9.03	7.77
15.0	9.29	7.99
20.0	9.90	8.51
24.0	10.02	8.62
30.0	9.85	8.47
58.0	9.75	8.38
70.0	8.38	7.20

Table 3-15 MAPLHGR for bundle/lattice:
OPT2-3.99-16GZ8.00/Lattices 101, 108, and 123
(References 13 and 22)

Lattices 101: Opt2-B0.71 108: Opt2-T0.71 123: Opt2-B4.39-16G8.00		
Avg. Planar Exposure (GWd/MTU)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0	8.60	7.40
5.0	8.90	7.65
15.0	9.18	7.90
20.0	9.44	8.12
24.0	9.65	8.30
30.0	9.49	8.16
58.0	9.49	8.16
70.0	8.12	6.98

Table 3-16 MAPLHGR for bundle/lattice:
OPT2-3.99-16GZ8.00
Lattices 124 and 125
(References 13 and 22)

Lattices 124: Opt2-BE4.49-16G8.00 125: Opt2-M4.49-16G8.00		
Avg. Planar Exposure (GWd/MTU)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0	8.63	7.42
5.0	8.93	7.68
15.0	9.29	7.99
20.0	9.56	8.22
24.0	9.78	8.41
30.0	9.63	8.28
58.0	9.63	8.28
70.0	8.25	7.10

Table 3-17 MAPLHGR for bundle/lattice:
OPT2-3.99-16GZ8.00
Lattices 126, 127 and 128
(References 13 and 22)

Lattices 126: Opt2-ME4.44-16G8.00 127: Opt2-T4.44-16G8.00 128: Opt2-T4.46-14G5.00		
Avg. Planar Exposure (GWd/MTU)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0	8.78	7.55
5.0	9.08	7.81
15.0	9.44	8.12
20.0	9.92	8.53
24.0	10.00	8.60
30.0	9.92	8.53
58.0	9.77	8.40
70.0	8.40	7.22

Table 3-18 MAPLHGR for bundle/lattice:
OPT2-4.01-14GZ6.00/Lattices 101, 108, and 129
(References 13 and 22)

Lattices 101: Opt2-B0.71 108: Opt2-T0.71 129: Opt2-B4.40-14G6.00		
Avg. Planar Exposure (GWd/MTU)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0	9.01	7.75
5.0	9.26	7.97
10.0	9.32	8.02
15.0	9.44	8.12
20.0	9.62	8.28
24.0	9.67	8.32
30.0	9.46	8.14
58.0	9.46	8.14
70.0	8.09	6.96

Table 3-19 MAPLHGR for bundle/lattice:
OPT2-4.01-14GZ6.00
Lattices 130 and 131
(References 13 and 22)

Lattices 130: Opt2-BE4.50-14G6.00 131: Opt2-M4.50-14G6.00		
Avg. Planar Exposure (GWd/MTU)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0	9.06	7.79
5.0	9.32	8.02
10.0	9.42	8.11
15.0	9.57	8.23
20.0	9.75	8.39
24.0	9.80	8.43
30.0	9.59	8.25
58.0	9.59	8.25
70.0	8.22	7.07

Table 3-20 MAPLHGR for bundle/lattice:
OPT2-4.01-14GZ6.00
Lattices 132 and 133
(References 13 and 22)

Lattices 132: Opt2-ME4.46-14G6.00 133: Opt2-T4.48-12G6.00		
Avg. Planar Exposure (GWd/MTU)	**DLO MAPLHGR (kW/ft)**	**SLO MAPLHGR (kW/ft)**
0	9.24	7.94
5.0	9.51	8.18
10.0	9.58	8.24
15.0	9.85	8.47
20.0	10.05	8.64
24.0	10.08	8.67
30.0	9.88	8.50
58.0	9.88	8.50
70.0	8.51	7.32

4. Operating Limit Minimum Critical Power Ratio

The Operating Limit Minimum Critical Power Ratios (OLMCPRs) for Q1C21 were established to protect the Safety Limit Minimum Critical Power Ratio (SLMCPR) for the anticipated operational occurrences. The SLMCPR values for DLO and SLO for Q1C21 were determined to be 1.11 and 1.13 (Reference 23), respectively, which are unchanged from the NRC-approved values for the previous operating cycle (i.e., Q1C20). Likewise, the conservative OLMCPR adder applied to the GE14 fuel for Q1C21 remains unchanged at the NRC-approved value of 0.934 (Reference 13).

In determining the SLMCPR values for Q1C21, Westinghouse applied the methodologies from CENPD-300-P-A, consistent with the manner specified in Limitations 1 through 6 and 8 of the NRC Safety Evaluation Report (SER) approving CENPD-300-P-A (References 15 and 23). The application of these methodologies was previously approved by the NRC for Q1C20 in license amendment 237 to Renewed Facility Operating License DPR-29 (Reference 5).

Similarly, in both the determination and justification of the conservative adder applied to the GE14 fuel for Q1C21, Westinghouse complied with Limitation 7 of the SER approving CENPD-300-P-A (References 23 and 24). The NRC previously approved Westinghouse and Exelon compliance with Limitation 7 (i.e., for determination and justification of the conservative adder) in Reference 5.

In that the conservative adder for Q1C21, and its justification, have not changed from previously-approved operating cycles, the NRC has already approved this determination and justification, as stated in Reference 25.

4.1. Manual Flow Control MCPR Limits

The OLMCPR is determined for a given power and flow condition by evaluating the power-dependent MCPR and the flow-dependent MCPR and selecting the greater of the two.

4.1.1. Power-Dependent MCPR

For operation at less than 38.5% of rated core thermal power, the OLMCPR as a function of core thermal power (MCPR(P)) is shown in Tables 4-8 and 4-9. For operation at greater than 38.5% of rated core thermal power, the OLMCPR as a function of core thermal power is determined by multiplying the applicable rated condition OLMCPR limit shown in Table 4-2 through 4-7 by the applicable MCPR multiplier K(P) given in Table 4-8 and 4-9. For operation at exactly 38.5% of rated core thermal power, the OLMCPR as a function of core thermal power is the maximum of either of the two aforementioned methods evaluated at 38.5% of rated core thermal power.

4.1.2. Flow-Dependent MCPR

Tables 4-10 through 4-13 give the MCPR(F) limit as a function of the flow based on the applicable plant condition. The MCPR(F) limit determined from these tables is the flow dependent OLMCPR.

4.2. Automatic Flow Control MCPR Limits

Automatic Flow Control MCPR Limits are not provided.

4.3. Scram Time

TSSS, ISS, and NSS refer to scram speeds. TSSS is the Technical Specification Scram Speed, ISS is the Intermediate Scram Speed, and NSS is the Nominal Scram Speed. The scram time values are shown in Table 4-1. Reference 13 indicates that TSSS control rod insertion time values used in the analysis are conservative in comparison to the values shown in Table 4-1.

The NSS scram times are based on a conservative interpretation of scram time surveillance measurements. In the event that plant surveillance shows these scram insertion times to be exceeded, the MCPR limits are to default to the values which correspond to the ISS scram time. The ISS times have been chosen to provide an intermediate value between the NSS and the TSSS, but the interpolation between these values is not supported by Westinghouse methodology. In the event that the ISS times are exceeded, MCPR limits for the TSSS apply.

Table 4-1 Scram Times
(References 13 and 18)

Control Rod Insertion Fraction (%)	TSSS (seconds)	ISS (seconds)	NSS (seconds)
5	0.48	0.360	0.324
20	0.89	0.720	0.694
50	1.98	1.580	1.510
90	3.44	2.800	2.670

4.4. Recirculation Pump Motor Generator Settings

Cycle 21 was analyzed with a maximum core flow runout of 110%; therefore the ASD must be set to maintain core flow less than 110% (107.8 Mlb/hr) for all runout events (Reference 26). This value is consistent with the analyses of Reference 13.

Table 4-2 MCPR TSSS Based Operating Limits – Nominal FWT
(Reference 13)

EOOS Combination	Fuel Type	Cycle Exposure	
		≤ 13275 MWd/MT	> 13275 MWd/MT
BASE	Optima2	1.62	1.81
	GE14	1.67	1.74
BASE SLO	Optima2	1.65	1.85
	GE14	1.71	1.78
PLUOOS	Optima2	1.63	1.82
	GE14	1.70	1.80
PLUOOS SLO	Optima2	1.66	1.86
	GE14	1.74	1.84
TBVOOS	Optima2	1.77	1.90
	GE14	1.81	1.88
TBVOOS SLO	Optima2	1.81	1.94
	GE14	1.85	1.92
TCV SLOW CLOSURE	Optima2	1.68	1.88
	GE14	1.73	1.82
TCV SLOW CLOSURE SLO	Optima2	1.72	1.92
	GE14	1.77	1.86
TCV STUCK CLOSED	Optima2	1.62	1.81
	GE14	1.67	1.74
TCV STUCK CLOSED SLO	Optima2	1.65	1.85
	GE14	1.71	1.78

Table 4-3 MCPR TSSS Based Operating Limits – FWTR
(Reference 13)

EOOS Combination	Fuel Type	Cycle Exposure	
		≤ 13275 MWd/MT	> 13275 MWd/MT
BASE	Optima2	1.62	1.81
	GE14	1.67	1.74
BASE SLO	Optima2	1.65	1.85
	GE14	1.71	1.78
PLUOOS	Optima2	1.63	1.82
	GE14	1.70	1.80
PLUOOS SLO	Optima2	1.66	1.86
	GE14	1.74	1.84
TBVOOS	Optima2	1.77	1.90
	GE14	1.81	1.88
TBVOOS SLO	Optima2	1.81	1.94
	GE14	1.85	1.92
TCV SLOW CLOSURE	Optima2	1.68	1.88
	GE14	1.73	1.82
TCV SLOW CLOSURE SLO	Optima2	1.72	1.92
	GE14	1.77	1.86
TCV STUCK CLOSED	Optima2	1.62	1.81
	GE14	1.67	1.74
TCV STUCK CLOSED SLO	Optima2	1.65	1.85
	GE14	1.71	1.78

Table 4-4 MCPR ISS Based Operating Limits – Nominal FWT
(Reference 13)

EOOS Combination	Fuel Type	Cycle Exposure	
		≤ 13275 MWd/MT	> 13275 MWd/MT
BASE	Optima2	1.43	1.53
	GE14	1.64	1.64
BASE SLO	Optima2	1.46	1.56
	GE14	1.67	1.67
PLUOOS	Optima2	1.43	1.59
	GE14	1.64	1.64
PLUOOS SLO	Optima2	1.46	1.62
	GE14	1.67	1.67
TBVOOS	Optima2	1.52	1.69
	GE14	1.64	1.67
TBVOOS SLO	Optima2	1.55	1.73
	GE14	1.67	1.71
TCV SLOW CLOSURE	Optima2	1.45	1.60
	GE14	1.64	1.64
TCV SLOW CLOSURE SLO	Optima2	1.48	1.63
	GE14	1.67	1.67
TCV STUCK CLOSED	Optima2	1.43	1.53
	GE14	1.64	1.64
TCV STUCK CLOSED SLO	Optima2	1.46	1.56
	GE14	1.67	1.67

Table 4-5 MCPR ISS Based Operating Limits - FWTR
(Reference 13)

EOOS Combination	Fuel Type	Cycle Exposure	
		≤ 13275 MWd/MT	> 13275 MWd/MT
BASE	Optima2	1.44	1.53
	GE14	1.64	1.64
BASE SLO	Optima2	1.47	1.56
	GE14	1.67	1.67
PLUOOS	Optima2	1.44	1.59
	GE14	1.64	1.64
PLUOOS SLO	Optima2	1.47	1.62
	GE14	1.67	1.67
TBVOOS	Optima2	1.53	1.69
	GE14	1.64	1.67
TBVOOS SLO	Optima2	1.56	1.73
	GE14	1.67	1.71
TCV SLOW CLOSURE	Optima2	1.45	1.60
	GE14	1.64	1.64
TCV SLOW CLOSURE SLO	Optima2	1.48	1.63
	GE14	1.67	1.67
TCV STUCK CLOSED	Optima2	1.44	1.53
	GE14	1.64	1.64
TCV STUCK CLOSED SLO	Optima2	1.47	1.56
	GE14	1.67	1.67

Table 4-6 MCPR NSS Based Operating Limits – Nominal FWT
(Reference 13)

EOOS Combination	Fuel Type	Cycle Exposure	
		≤ 13275 MWd/MT	> 13275 MWd/MT
BASE	Optima2	1.43	1.49
	GE14	1.64	1.64
BASE SLO	Optima2	1.46	1.52
	GE14	1.67	1.67
PLUOOS	Optima2	1.43	1.54
	GE14	1.64	1.64
PLUOOS SLO	Optima2	1.46	1.57
	GE14	1.67	1.67
TBVOOS	Optima2	1.51	1.64
	GE14	1.64	1.64
TBVOOS SLO	Optima2	1.54	1.67
	GE14	1.67	1.67
TCV SLOW CLOSURE	Optima2	1.43	1.57
	GE14	1.64	1.64
TCV SLOW CLOSURE SLO	Optima2	1.46	1.60
	GE14	1.67	1.67
TCV STUCK CLOSED	Optima2	1.43	1.49
	GE14	1.64	1.64
TCV STUCK CLOSED SLO	Optima2	1.46	1.52
	GE14	1.67	1.67

Table 4-7 MCPR NSS Based Operating Limits – FWTR
(Reference 13)

EOOS Combination	Fuel Type	Cycle Exposure	
		≤ 13275 MWd/MT	> 13275 MWd/MT
BASE	Optima2	1.43	1.52
	GE14	1.64	1.64
BASE SLO	Optima2	1.46	1.55
	GE14	1.67	1.67
PLUOOS	Optima2	1.43	1.54
	GE14	1.64	1.64
PLUOOS SLO	Optima2	1.46	1.57
	GE14	1.67	1.67
TBVOOS	Optima2	1.52	1.64
	GE14	1.64	1.65
TBVOOS SLO	Optima2	1.55	1.67
	GE14	1.67	1.68
TCV SLOW CLOSURE	Optima2	1.43	1.57
	GE14	1.64	1.64
TCV SLOW CLOSURE SLO	Optima2	1.46	1.60
	GE14	1.67	1.67
TCV STUCK CLOSED	Optima2	1.43	1.52
	GE14	1.64	1.64
TCV STUCK CLOSED SLO	Optima2	1.46	1.55
	GE14	1.67	1.67

Table 4-8 MCPR(P) for GE and Westinghouse Fuel – Nominal FWT
(Reference 13)

EOOS Combination	Core Flow (% of Rated)	Core Thermal Power (% of rated)								
		0	25	≤ 38.5	≥ 38.5	41	60	80	100	102
		Operating Limit MCPR			Operating Limit MCPR Multiplier, Kp					
Base	≤60	2.95	2.41	2.12	1.40	1.35	1.17	1.07	1.00	1.00
	>60	3.39	2.74	2.39						
Base SLO	≤60	3.01	2.46	2.16	1.40	1.35	1.17	1.07	1.00	1.00
	>60	3.46	2.79	2.44						
PLUOOS	≤60	2.95	2.41	2.12	1.69	1.65	1.37	1.07	1.00	1.00
	>60	3.39	2.74	2.39						
PLUOOS SLO	≤60	3.01	2.46	2.16	1.69	1.65	1.37	1.07	1.00	1.00
	>60	3.46	2.79	2.44						
TBVOOS	≤60	4.45	3.19	2.51	1.40	1.35	1.17	1.07	1.00	1.00
	>60	4.82	3.54	2.85						
TBVOOS SLO	≤60	4.54	3.25	2.56	1.40	1.35	1.17	1.07	1.00	1.00
	>60	4.91	3.61	2.91						
TCV SLOW CLOSURE	≤60	2.95	2.41	2.12	1.69	1.65	1.37	1.08	1.00	1.00
	>60	3.39	2.74	2.39						
TCV SLOW CLOSURE SLO	≤60	3.01	2.46	2.16	1.69	1.65	1.37	1.08	1.00	1.00
	>60	3.46	2.79	2.44						
TCV STUCK CLOSED	≤60	2.95	2.41	2.12	1.40	1.35	1.17	1.09	1.00	1.00
	>60	3.39	2.74	2.39						
TCV STUCK CLOSED SLO	≤60	3.01	2.46	2.16	1.40	1.35	1.17	1.09	1.00	1.00
	>60	3.46	2.79	2.44						

Table 4-9 MCPR(P) for GE and Westinghouse Fuel - FWTR
(Reference 13)

EOOS Combination	Core Flow (% of Rated)	Core Thermal Power (% of rated)								
		0	25	≤ 38.5	≥ 38.5	41	60	80	100	102
		Operating Limit MCPR			Operating Limit MCPR Multiplier, Kp					
Base	≤60	2.95	2.41	2.12	1.49	1.43	1.20	1.07	1.00	1.00
	>60	3.39	2.74	2.39						
Base SLO	≤60	3.01	2.46	2.16	1.49	1.43	1.20	1.07	1.00	1.00
	>60	3.46	2.79	2.44						
PLUOOS	≤60	2.95	2.41	2.12	1.69	1.65	1.37	1.07	1.00	1.00
	>60	3.39	2.74	2.39						
PLUOOS SLO	≤60	3.01	2.46	2.16	1.69	1.65	1.37	1.07	1.00	1.00
	>60	3.46	2.79	2.44						
TBVOOS	≤60	4.77	3.36	2.60	1.49	1.43	1.20	1.07	1.00	1.00
	>60	4.88	3.63	2.96						
TBVOOS SLO	≤60	4.86	3.43	2.65	1.49	1.43	1.20	1.07	1.00	1.00
	>60	4.97	3.70	3.02						
TCV SLOW CLOSURE	≤60	2.95	2.41	2.12	1.69	1.65	1.37	1.08	1.00	1.00
	>60	3.39	2.74	2.39						
TCV SLOW CLOSURE SLO	≤60	3.01	2.46	2.16	1.69	1.65	1.37	1.08	1.00	1.00
	>60	3.46	2.79	2.44						
TCV STUCK CLOSED	≤60	2.95	2.41	2.12	1.49	1.43	1.20	1.09	1.00	1.00
	>60	3.39	2.74	2.39						
TCV STUCK CLOSED SLO	≤60	3.01	2.46	2.16	1.49	1.43	1.20	1.09	1.00	1.00
	>60	3.46	2.79	2.44						

Table 4-10 MCPR(F) Limits for GE Fuel, DLO Operation
(Reference 13)

Flow (% rated)	MCPR(F) Limit
110.0	1.26
100.0	1.26
80.0	1.44
60.0	1.63
40.0	1.80
20.0	2.00
0.0	2.21

Table 4-11 MCPR(F) Limits for GE Fuel, SLO Operation
(Reference 13)

Flow (% rated)	MCPR(F) Limit
110.0	1.29
100.0	1.29
80.0	1.46
60.0	1.66
40.0	1.84
20.0	2.03
0.0	2.24

Table 4-12 MCPR(F) Limits for Westinghouse Fuel, DLO Operation
(Reference 13)

Flow (% rated)	MCPR(F) Limit
110.0	1.17
100.0	1.17
80.0	1.34
60.0	1.49
40.0	1.55
20.0	1.59
0.0	1.63

Table 4-13 MCPR(F) Limits for Westinghouse Fuel, SLO Operation
(Reference 13)

Flow (% rated)	MCPR(F) Limit
110.0	1.20
100.0	1.20
80.0	1.36
60.0	1.52
40.0	1.57
20.0	1.62
0.0	1.67

5. Linear Heat Generation Rate

The maximum LHGR shall not exceed the zero exposure limit of 12.46 kW/ft for the following fuel bundles. This limit is based on a 13.40 kW/ft peak LHGR from Reference 7 thermal mechanical limit reduced to 12.46 kW/ft based on References 27 and 28 which require a 7% reduction in peak LHGR. The maximum LHGR in Tables 5-1 and 5-2 is limited to 12.46 kW/ft, while the LHGR in Tables 5-3 and 5-4 was conservatively reduced by 7% for all burnup values.

GE14-P10DNAB409-17GZ-100T-145-T6-2825
GE14-P10DNAB408-15GZ-100T-145-T6-2826

The thermal mechanical operating limit at rated conditions for the Optima2 fuel is established in terms of the maximum LHGR given in Table 5-5 as a function of rod nodal exposure. The limit applies to all Optima2 bundle designs.

The linear heat generation rate (LHGR) limit is the product of the exposure dependent LHGR limit from Tables 5-1 through 5-5 and the minimum of: the power dependent LHGR Factor, LHGRFAC(P), the flow dependent LHGR Factor, LHGRFAC(F), or the single loop operation (SLO) multiplication factor where applicable. The LHGRFAC(P) is determined from Tables 5-6, 5-7, and 5-8. The LHGRFAC(F) is determined from Table 5-9 through 5-13.

Table 5-1: LHGR Limit for GE14-P10DNAB409-17GZ-100T-145-T6-2825
(References 14, 27, and 28)

Lattice 6824, 6825, 6826, 6827, 6829, and 6830 LHGR Limit kW/ft **6824: P10DNAL071-NOG-100T-T6-6824** **6825: P10DNAL456-4G7.0/11G6.0/2G3.0-100T-T6-6825** **6826: P10DNAL456-4G7.0/10G6.0/2G3.0-100T-T6-6826** **6827: P10DNAL448-14G6.0/2G3.0-100T-E-T6-6827** **6829: P10DNAL071-NOG-100T-V-T6-6829** **6830: P10DNAL071-17GE-100T-V-T6-6830**	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0000	12.46
24.2600	12.46
63.5000	8.0000
70.0000	5.0000

Table 5-2: LHGR Limit for GE14-P10DNAB408-15GZ-100T-145-T6-2826
(References 14, 27, and 28)

Lattice 6824, 6832, 6833, 6835, and 6836 LHGR Limit kW/ft 6824: P10DNAL071-NOG-100T-T6-6824 6832: P10DNAL455-14G6.0/1G3.0-100T-T6-6832 6833: P10DNAL448-13G6.0/1G3.0-100T-E-T6-6833 6835: P10DNAL071-NOG-100T-V-T6-6835 6836: P10DNAL071-15GE-100T-V-T6-6836	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0000	12.46
24.2600	12.46
63.5000	8.0000
70.0000	5.0000

Table 5-3: LHGR Limit for GE14-P10DNAB409-17GZ-100T-145-T6-2825, Lattice 6828
(References 14, 27, and 28)

Lattice 6828 LHGR Limit kW/ft 6828: P10DNAL448-14G6.0/2G3.0-100T-V-T6-6828	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0	12.4600
15.0498	12.4600
16.3328	12.4268
17.6026	12.2925
18.8592	12.1597
20.1044	12.0280
22.5708	11.7672
26.2373	11.3796
32.2831	10.7404
38.2384	10.1107
44.0904	9.4921
49.8351	8.8735
55.4794	8.2595
61.0422	7.6971
66.5524	6.1298
70.0	4.6500

Table 5-4: LHGR Limit for GE14-P10DNAB408-15GZ-100T-145-T6-2826, Lattice 6834
(References 14, 27, and 28)

Lattice 6834 LHGR Limit kW/ft 6834: P10DNAL448-13G6.0/1G3.0-100T-V-T6-6834	
UO2 Pellet Burnup (GWd/MTU)	**LHGR Limit (kW/ft)**
0.0	12.4600
14.7557	12.4600
16.0380	12.4580
17.3111	12.3234
18.5741	12.1898
19.8276	12.0573
22.3110	11.7947
25.9974	11.4050
32.0720	10.7627
38.0552	10.1302
43.9337	9.5086
49.7028	8.8987
55.3685	8.2950
60.9492	7.7083
66.4736	6.1636
70.0	4.6500

Table 5-5: LHGR Limit for Westinghouse Optima2 Fuel
OPT2-3.99-15GZ8.00-3G6.00
OPT2-4.00-13GZ8.00-3G6.00
OPT2-4.05-12GZ7.00-2G6.00
OPT2-3.98-18GZ8.00
OPT2-3.99-16GZ8.00
OPT2-4.01-14GZ6.00
(Reference 13)

Rod Nodal Exposure (GWd/MTU)	LHGR Limit (kW/ft)
0.00	13.11
14.00	13.11
72.00	6.48

Table 5-6 LHGRFAC(P) for GE14 Fuel, DLO
(Reference 13)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)								
		0	25	≤ 38.5	> 38.5	70	70.01	80	100	102
		LHGRFAC(P) Multiplier								
Base	≤ 60	0.50	0.56	0.59	0.68			0.86	1.00	1.00
	> 60									
PLUOOS	≤ 60	0.54	0.54	0.54	0.54	0.73	0.78		1.00	1.00
	> 60									
TBVOOS	≤ 60	0.22	0.39	0.48	0.54				1.00	1.00
	> 60	0.33		0.42						
TCV Slow Closure	≤ 60	0.54	0.54	0.54	0.54	0.73	0.78		1.00	1.00
	> 60									
TCV Stuck Closed	≤ 60	0.50	0.56	0.59	0.68			0.86	1.00	1.00
	> 60									

Table 5-7 LHGRFAC(P) for GE14 Fuel, SLO
(Reference 13)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)							
		0	25	≤ 38.5	> 38.5	70	CP*	100	102
		LHGRFAC(P) Multiplier							
Base SLO	≤ 60	0.50	0.56	0.59	0.68		0.77	0.77	0.77
	> 60								
PLUOOS SLO	≤ 60	0.54	0.54	0.54	0.54	0.73	0.77	0.77	0.77
	> 60								
TBVOOS SLO	≤ 60	0.22	0.39	0.48	0.54		0.77	0.77	0.77
	> 60	0.33		0.42					
TCV Slow Closure SLO	≤ 60	0.54	0.54	0.54	0.54	0.73	0.77	0.77	0.77
	> 60								
TCV Stuck Closed SLO	≤ 60	0.50	0.56	0.59	0.68		0.77	0.77	0.77
	> 60								

* CP is the cutoff power level and is equal to 59.25% for Base Case SLO and TCV Stuck Closed SLO, 70.01% for PLUOOS SLO, 69.25% for TBVOOS SLO, and 70.01% for TCV Slow Closure SLO.

Table 5-8 LHGRFAC(P) for Westinghouse Fuel
(Reference 13)

EOOS Combination	Core Thermal Power (% of rated)								
	0	25	≤ 38.5	>38.5	41	60	80	100	102
	LHGRFAC(P) Multiplier								
Base	0.54	0.63	0.68	0.72	0.73	0.81	0.86	1.00	1.00
Base SLO	0.54	0.63	0.68	0.72	0.73	0.81	0.86	1.00	1.00
PLUOOS	0.54	0.63	0.68	0.68	0.68	0.79	0.86	1.00	1.00
PLUOOS SLO	0.54	0.63	0.68	0.68	0.68	0.79	0.86	1.00	1.00
TBVOOS	0.26	0.44	0.54	0.67	0.68	0.75	0.81	1.00	1.00
TBVOOS SLO	0.26	0.44	0.54	0.67	0.68	0.75	0.81	1.00	1.00
TCV Slow Closure	0.54	0.63	0.68	0.68	0.68	0.79	0.86	1.00	1.00
TCV Slow Closure SLO	0.54	0.63	0.68	0.68	0.68	0.79	0.86	1.00	1.00
TCV Stuck Closed	0.54	0.63	0.68	0.72	0.73	0.81	0.86	1.00	1.00
TCV Stuck Closed SLO	0.54	0.63	0.68	0.72	0.73	0.81	0.86	1.00	1.00

Table 5-9 LHGRFAC(F) Multipliers, GE Fuel, DLO, All Cases except TCV Stuck Closed
(Reference 13)

Flow (% rated)	LHGRFAC(F) Multiplier
100.0	1.00
80.0	1.00
50.0	0.77
40.0	0.64
30.0	0.55
0.0	0.28

Table 5-10 LHGRFAC(F) Multipliers, GE Fuel, DLO, TCV Stuck Closed
(Reference 13)

Flow (% rated)	LHGRFAC(F) Multiplier
100.0	1.00
98.3	1.00
80.0	0.86
50.0	0.63
40.0	0.50
30.0	0.41
0.0	0.14

Table 5-11 LHGRFAC(F) Multipliers, GE Fuel, SLO, All Cases except TCV Stuck Closed
(Reference 13)

Flow (% rated)	LHGRFAC(F) Multiplier
100.0	0.77
50.0	0.77
40.0	0.64
30.0	0.55
0.0	0.28

Table 5-12 LHGRFAC(F) Multipliers, GE Fuel, SLO, TCV Stuck Closed
(Reference 13)

Flow (% rated)	LHGRFAC(F) Multiplier
100.0	0.77
68.3	0.77
50.0	0.63
40.0	0.50
30.0	0.41
0.0	0.14

Table 5-13 LHGRFAC(F) Multipliers, Westinghouse Fuel
(Reference 13)

Flow (% rated)	LHGRFAC(F) Multiplier
110.00	1.00
100.00	1.00
80.00	1.00
60.00	0.79
40.00	0.59
20.00	0.43
0.00	0.27

6. Rod Block Monitor

The Rod Block Monitor Upscale Instrumentation Setpoints are determined from the relationships shown below (Reference 6):

ROD BLOCK MONITOR UPSCALE TRIP FUNCTION	ALLOWABLE VALUE
Two Recirculation Loop Operation	0.65 W_d + 56.1%
Single Recirculation Loop Operation	0.65 W_d + 51.4%

The setpoint may be lower/higher and will still comply with the rod withdrawal error (RWE) analysis because RWE is analyzed unblocked. (Reference 26)

The allowable value is clamped with a maximum value not to exceed the allowable value for a recirculation loop drive flow (W_d) of 100%

W_d – percent of recirculation loop drive flow required to produce a rated core flow of 98.0 Mlb/hr.

7. Stability Protection Setpoints

The OPRM PBDA Trip Settings (Reference 13):

PBDA Trip Amplitude Setpoint (Sp)	Corresponding Maximum Confirmation Count Setpoint (Np)
1.16	17

The PBDA is the only OPRM setting credited in the safety analysis as documented in the licensing basis for the OPRM system.

The OPRM PBDA trip settings are based, in part, on the cycle specific OLMCPR and the power dependent MCPR limits. Any change to the OLMCPR values and/or the power dependent MCPR limits should be evaluated for potential impact on the OPRM PBDA trip settings.

The OPRM PBDA trip settings are applicable when the OPRM system is declared operable, and the associated Technical Specifications are implemented.

8. Modes of Operation

The allowed Modes of Operation with the combinations of equipment out-of-service are as described below:

EOOS Options	Thermal Limit Sets
Base	Base (DLO or SLO)
PLUOOS	PLUOOS (DLO or SLO)
TBVOOS	TBVOOS (DLO or SLO) ➢ See Table 8-1 for power restrictions
TCV Slow Closure	TCV Slow Closure (DLO or SLO)
TCV Stuck Closed	TCV Stuck Closed (DLO or SLO) ➢ Not applicable to combination of one TCV and one TSV stuck closed ➢ Operation is only allowed at or below 80% rated thermal power
TSV Stuck Closed	TCV Stuck Closed (DLO or SLO) ➢ Not applicable to combination of one TCV and one TSV stuck closed ➢ Operation is only allowed at or below 80% rated thermal power
PCOOS	TCV Slow Closure (DLO or SLO)
PCOOS and PLUOOS	PLUOOS (DLO or SLO)
PCOOS and TCV Slow Closure	TCV Slow Closure (DLO or SLO)
PCOOS and one TCV Stuck Closed	➢ Operation is only allowed at or below 80% rated thermal power and ➢ the more restrictive of the flow-dependent limits (established by one TCV stuck closed) and power dependent limits (established by TCV/TSV Stuck Closed, TCV slow closure, and PLUOOS limits) apply.
PLUOOS and one TCV Stuck Closed	➢ Operation is only allowed at or below 80% rated thermal power and ➢ The more restrictive of the flow-dependent limits (established by one TCV Stuck Closed) and power-dependent limits (established by TCV/TSV Stuck Closed, TCV Slow Closure and PLUOOS limits) apply

Common Notes – Applicable to all EOOS Combination

1. All modes are allowed for operation at MELLLA, ICF (up to 108%), full power operation to End of Full Power Life (EOFPL = 16556 MWd/MTU) + 25 Effective Full Power Days (EFPD) and a coastdown period to End of Cycle (EOC = 17211 MWd/MTU) (Reference 13), subject to the restrictions in Table 8-1). Each OOS Option may be combined with up to 18 TIP channels OOS provided the requirements (as clarified in Reference 16) for utilizing SUBTIP methodology are met and up to 50% of the LPRMs OOS with an LPRM calibration frequency of 2500 EFPH (2000 EFPH +25%).

2. All analyses support the fastest Turbine Bypass Valve (assumed to be #1) OOS, with the remaining 8 Turbine Bypass Valves meeting the assumed opening profile in Reference 21. The analyses also support Turbine Bypass flow of 29.6% of vessel rated steam flow, equivalent to one Turbine Bypass Valve OOS (or partially closed Turbine Bypass Valves equivalent to one closed Turbine Bypass Valve), if the assumed opening profile (Reference 21) for the remaining Turbine Bypass Valves is met. If the opening profile is **NOT** met, or if the Turbine Bypass Valve system cannot pass an equivalent of 29.6% of vessel rated steam flow, utilize the TBVOOS condition.

3. For all cases, including TBVOOS, the equivalent of 2 of the first 3.4 Turbine Bypass Valves must be capable of responding to pressure increases under DEHC control. The TBVOOS condition assumes that all of the Turbine Bypass Valves do not trip open on Turbine Control Valve fast closure or on Turbine Stop Valve closure but does require that the equivalent of 2 of the first 3.4 Turbine Bypass Valves must be capable of responding to pressure increases under DEHC control.

4. For both Base and EOOS DLO/SLO conditions, for operation at nominal FWT, the OLMCPR limit is applicable to a variation of +10°F/-30°F in feedwater temperature, and an operating steam dome pressure region bounded by the maximum value of 1020 psia and the minimum pressure curve in Reference 26.

5. For operation outside of nominal FWT, reduced FWT of up to 120°F is also supported for cycle operation through EOC subject to the restriction in Reference 11 for feedwater temperature reductions of greater than 100 °F. The restriction is to maintain less than 100% rod line. This includes, but is not limited to FWHOOS and FFTR. For a feedwater temperature reduction of between 30°F and 120°F, the reduced FWT limits should be applied.

6. A single MSIV may be taken OOS (closed) under any of the specified OOS Options if the core thermal power is maintained ≤ 75% of 2957 MWth (Reference 13).

Table 8-1 Core Thermal Power Restriction for TBVOOS
(Reference 13)

Core Thermal Power Restriction (% of Rated Power)	Depletion (MWd/MTU)	Number of Safety Valves Available
≤ 100.00	Entire Cycle	9 of 9
≤ 100.00	≤ 16,876	8 of 9
≤ 97.00	> 16,876	8 of 9

9. Methodology

The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

1. Westinghouse Topical Report CENPD-300-P-A, "Reference Safety Report for Boiling Water Reactor Reload Fuel," July 1996.

2. Westinghouse Topical Report CENPD-390-P-A, "The Advanced PHOENIX and POLCA Codes for Nuclear Design of Boiling Water Reactors," December 2000.

3. Westinghouse Report WCAP-16081-P-A, "10x10 SVEA Fuel Critical Power Experiments and CPR Correlation: SVEA-96 Optima2," March 2005.

4. Westinghouse Report WCAP-15682-P-A, "Westinghouse BWR ECCS Evaluation Model: Supplement 2 to Code Description, Qualification and Application," April 2003.

5. Westinghouse Report WCAP-16078-P-A, "Westinghouse BWR ECCS Evaluation Model: Supplement 3 to Code Description, Qualification and Application to SVEA-96 Optima2 Fuel," November 2004.

6. Westinghouse Topical Report WCAP-15836-P-A, "Fuel Rod Design Methods for Boiling Water Reactors – Supplement 1," April 2006.

7. Westinghouse Topical Report WCAP-15942-P-A, "Fuel Assembly Mechanical Design Methodology for Boiling Water Reactors, Supplement 1 to CENPD-287-P-A," March 2006.

8. NEDE-24011-P-A-15, "General Electric Standard Application for Reactor Fuel (GESTAR-II)," September 2005.

9. NEDO-32465-A, "BWR Owners' Group Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications," August 1996.

10. References

1. Exelon Generation Company, LLC, Docket No. 50-254, Quad Cities Nuclear Power Station, Unit 1 Facility Operating License, License No. DPR-29.
2. Letter from D. M. Crutchfield to All Power Reactor Licensees and Applicants, Generic Letter 88-16; Concerning the Removal of Cycle-Specific Parameter Limits from Tech Specs, October 3, 1988.
3. Westinghouse Document, WCAP-16728-P, Rev. 2, "Quad Cities Nuclear Power Station Unit 1 Cycle 20 Reload Licensing Report," June 2008 (TODI NF0700086, Revision 2).
4. GE Document, GE-NE-J11-03912-00-01-R3, "Dresden 2 and 3 Quad Cities 1 and 2 Equipment Out-Of-Service and Legacy Fuel Transient Analysis," September 2005 (TODI NFM0100091 Sequence 03).
5. NRC Letter, "Quad Cities Nuclear Power Station, Units 1 and 2 – Issuance of Amendments RE: Safety Limit Minimum Critical Power Ratio (TAC NOS. MD7374 AND MD7375)
6. GE DRF C51-00217-01, "Instrument Setpoint Calculation Nuclear Instrumentation, Rod Block Monitor, Commonwealth Edison Company, Quad Cities 1 & 2," December 14, 1999.
7. GE Design Basis Document, DB-0012.03, Revision 1, "Fuel-Rod Thermal-Mechanical Performance Limits for GE14C," May 2005.
8. GE Document, NEDE-24011-P-A-15, "General Electric Standard Application for Reactor Fuel (GESTAR-II)," September 2005.
9. Westinghouse Document, NF-BEX-08-106, Revision 0, "Final Task Report for Quad Cities Unit 1 Cycle 21 Reload Licensing Analysis Plan", September 2, 2008.
10. Letter from NRC (Joseph Williams) to Exelon Generation Company, LLC, dated May 3, 2007, Quad Cities Nuclear Power Station, Unit 1 – Issuance of Amendment RE: Request for Technical Specification Change for Minimum Critical Power Ratio Safety Limit (TAC No. MD4008).
11. Nuclear Fuels Letter, NF-MW:02-0081, "Approval of GE Evaluation of Dresden and Quad Cities Extended Final Feedwater Temperature Reduction," August 27, 2002.
12. Not Used.
13. Westinghouse Document, NF-BEX-09-42, Revision 1, "Quad Cities Nuclear Power Station Unit 1 Cycle 21 Reload Licensing Report," April 2009.
14. GNF Letter, MJM-EXN-EE1-04-047, "TSD B207: Quad Cities 1 C19 LHGR Limits", December 17, 2004. (Attachment 2 to FCP 352744 Rev. 1)
15. Exelon Letter RS-05-078, "Request for Licensing Amendment Regarding Transition to Westinghouse Fuel," Patrick R. Simpson to U.S. Nuclear Regulatory Commission, June 15, 2005. (Available in EDMS)
16. FANP Letter, NJC:04:031/FAB04-496, "Startup with TIP Equipment Out of Service," April 20, 2004 (EC 348897-00)
17. Not Used
18. Technical Specifications for Quad Cities 1 and 2, Table 3.1.4-1, "Control Rod Scram Times".
19. GNF Document, 0000-0028-1626-SRLR, Rev. 1, "Supplemental Reload Licensing Report for Quad Cities 1 Reload 18 Cycle 19," May 2005 (TODI NF0500036, Revision 1).
20. Westinghouse Document, NF-BEX-06-254, Revision 1, "Exelon Nuclear – Final Report Quad Cities 1 Cycle 20 Bundle Designs Revision 1", December 22, 2006.
21. Exelon TODI QDC-08-033, Revision 0, "OPL-W Parameters for Quad Cities Unit 1 Cycle 21 Transient Analysis," August 27, 2008.
22. Westinghouse Document, NF-BEX-08-129, Revision 1, "Final Report for Quad Cities 1 Cycle 21 Bundle Designs Revision 1", November 6, 2008.

23. Westinghouse Letter NF-BEX-09-01, "Quad Cities Unit 1 Cycle 21 SLMCPR," E. J. Mercier (Westinghouse) to Ed McVey, January 5, 2009. (Attachment 20 to FCP 370379)

24. Exelon Letter RS-06-009, "Additional Information Supporting Request for Licensing Amendment Regarding Transition to Westinghouse Fuel," Patrick R. Simpson to U.S. Nuclear Regulatory Commission, January 26, 2006.

25. NRC Memo, "Staff Position Regarding the Use of Methods Described In ABB/Westinghouse Topical Report CENPD-300-P-A, "Reference Safety Report for Boiling Water Reactor Reload Fuel," for Safety Limit Minimum Critical Power Ratio Determinations," Benjamin T. Parks (NRC) to Gregory Cranston (NRC), August 13, 2008. (Attachment 23 to FCP 368721)

26. Westinghouse Report NF-BEX-09-36, "Quad Cities Nuclear Power Station Unit 1 Cycle 21 Reload Engineering Report," March 2009.

27. GE Report 0000-0085-9120-R0, "Evaluation of LOCA Analysis Effects from Installation of Adjustable Speed Drive for Dresden and Quad Cities", August 2008.

28. GEH Report GEH 0000-0084-1975 R0, "Summary of Engineering Review of GEH Evaluation Reports with Respect to ASD Modification in Dresden and Quad Cities," October 2008.