Attachment C

Core Operating Limits Report

for

Dresden Unit 2 Cycle 19

Revision 0

Non-Proprietary Version

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Core Operating Limits Report

for

Dresden Unit 2 Cycle 19

Revision 0

[[ ]]

Issuance of Changes Summary

Affected Section	Affected Pages	Summary of Changes	Revision	Date
All	All	Original Issue (Cycle 19)	0	10/03

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References

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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. "Supplemental Reload Licensing Report for Dresden Unit 2 Reload 18 Cycle 19", 0000-0016-1235-SRLR, Revision 0, September 2003.

4. "MICROBURN Steady State LHGR Limit Curve Generation for GE-14 Fuel (D2C18)", BNDD:01-008, May 30, 2001.

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6. "Instrument Setpoint Calculation Nuclear Instrumentation Rod Block Monitor Dresden 2 & 3", GE DRF C51-00217-01, December 15, 1999.

7. "OPL-3 Parameters for Dresden Unit 2 Cycle 19 Transient Analysis", TODI NF0300049 Sequence 00, June 20, 2003.

8. "Fuel Mechanical Design Report Exposure Extension for ATRIUM-9B Fuel Assemblies at Dresden, Quad Cities, and LaSalle Units", EMF-2563(P) Revision 1, TODI NFM0100107 Sequence 0, August 2001.

9. "Dresden Unit 2 Cycle 17 Reload Analysis", NDIT NFM9900187, Sequence 01, EMF-2275 Revision 1, November 1999.

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11. General Electric Standard Application for Reactor Fuel (GESTAR II) and US supplement, NEDE-24011-P-A-14, June 2000.

12. Letter from Carlos de la Hoz to Doug Wise and Alex Misak, "Approval of GE Evaluation of MSIV out of Service for Dresden and Quad Cities", NFM-MW:02-0274, dated August 2, 2002.

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16. "SAFER/GESTR – LOCA Loss-of-Coolant Accident Analysis for Dresden Nuclear Station 2 and 3 and Quad Cities Nuclear Station Units 1 and 2", NEDC-32990P, Revision 2, September 2003., TODI 0100086, Sequence 02, October 2003.

17. Letter from Carlos de la Hoz to Doug Wise and Alex Misak, "Approval of GE Evaluation of Dresden and Quad Cities Pressure Regulator Out of Service Analysis," NF-MW:02-0413, October 22, 2002.

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18. Letter from F. R. Lindquist to A. Giancatarino, "Dresden Unit 2 Cycle 18 Safety Limit MCPR Change," FRL03DR2-003, February 21, 2003.

19. Letter from R. Lindquist to J. Nevling, "TSD NFM-MW-B115 D2C18 CBH Impact from Withdrawing 10B Rods", FRL03DR2-0011, dated January 9, 2003.

20. "D2C19 Core Operating Limits Report Creation", BNDD:03-021, October 14, 2003.

21. "D2C19 Fuel Type based LHGR Limits for Fresh Fuel" (D2C19), BNDD:03-022 Rev. 0, October 9, 2003.

22. Letter from R. Lindquist to J. Nevling, "Dresden and Quad Cities Equipment Out of Service (EOOS) Interpretation Letter", FRL02EX-011, dated September 6, 2002.

23. Letter from Candice Chou to Alex Misak and Doug Wise, "Dresden and Quad Cities Operation with one TSV OOS", NF-MW:03-069, July 28, 2003.

24. Letter from Carlos de la Hoz to Doug Wise and Alex Misak, "Approval of GE evaluation of Dresden and Quad Cities Extended Final Feedwater Temperature Reduction," NF-MW:02-0081, August 27, 2002.

1. Average Planar Linear Heat Generation Rate

1.1 Technical Specification Reference:

Sections 3.2.1 and 3.4.1.

1.2 Description:

Tables 1-1 and 1-2 are used to determine the maximum average planar linear heat generation rate (MAPLHGR) limit for each fuel type. Limits listed in Tables 1-1 and 1-2 are for Dual Reactor Recirculation Loop Operation.

For Single Reactor Recirculation Loop Operation (SLO), the MAPLHGR limits given in Tables 1-1 and 1-2 must be multiplied by a SLO MAPLHGR multiplier. The SLO MAPLHGR multiplier for SPC fuel is 0.84 (Reference 3 Section 16). The SLO MAPLHGR multiplier for GE14 fuel is 0.77 (Reference 3 Section 16).

Table 1-1
Maximum Average Planar Linear Heat
Generation Rate (MAPLHGR) for all ATRIUM-9B Fuel
ATRM9-P9HATB371-13GZ-SPC100T-9WR-144-T6-3912
ATRM9-P9HATB371-13GZ-SPC100T-9WR-144-T6-3914
(Bundles 3912 and 3914 - bundle types 6 and 7)
(Reference 3 Section 16)

Planar Average Exposure (GWd/MTU)	MAPLHGR (kW/ft)
0.00	13.52
17.25	13.52
44.09	10.73
70.00	7.84

Table 1-2
Maximum Average Planar Linear Heat
Generation Rate (MAPLHGR) for all GE14 Fuel
GE14-P10HNAB408-16GZ-100T-145-T6-2483
GE14-P10HNAB411-4G7.0/9G6.0-100T-145-T6-2484
GE14-P10DNAB418-16GZ-100T-145-T6-2646
GE14-P10DNAB389-18GZ-100T-145-T6-2650
(Bundles 2483, 2484, 2646 and 2650,
bundle types 16, 17,19, 20, 28, 29, 31, 32, 38, 39, 41, 42 and 47)
(Reference 3 Section 16)

Planar Average Exposure (GWd/MTU)	MAPLHGR (kW/ft)
0.00	11.68
16.00	11.68
55.12	8.02
63.50	6.97
70.00	4.36

2. Minimum Critical Power Ratio

2.1 Technical Specification Reference:

Sections 3.2.2, 3.4.1 and 3.7.7.

2.2 Description:

The various MCPR limits are described below.

2.2.1 Manual Flow Control MCPR Limits

The Operating Limit MCPR (OLMCPR) is determined from either section 2.2.1.1 or 2.2.1.2, whichever is greater at any given power and flow condition.

2.2.1.1 Power-Dependent MCPR

For operation at less than 38.5% core thermal power, the OLMCPR as a function of core thermal power is shown in Table 2-3. For operation at greater than 38.5% core thermal power, the OLMCPR as a function of core thermal power is determined by multiplying the applicable EOOS condition limit shown in Table 2-1 or 2-2 by the applicable MCPR multiplier K_P given in Table 2-3. For operation at exactly 38.5% core thermal power, the OLMCPR as a function of core thermal power is the higher of either of the two aforementioned methods evaluated at exactly 38.5% core thermal power.

2.2.1.2 Flow-Dependent MCPR

Tables 2-4 and 2-5 provide the $MCPR_F$ limit as a function of flow. The $MCPR_F$ limit determined from these tables is the flow dependent OLMCPR.

2.2.2 Automatic Flow Control MCPR Limits

Automatic Flow Control MCPR Limits are not provided.

2.2.3 Option A and Option B

Option A and Option B refer to scram speeds.

Option A scram speed is the Improved Technical Specification scram speed. The core average scram speed insertion time for 20% insertion must be less than or equal to the Technical Specification Scram Speed to utilize Option A MCPR limits. Reload analyses performed by Global Nuclear Fuel (GNF) for cycle 19 Option A MCPR limits utilized a 20% core average insertion time of 0.900 seconds (Reference 7).

To utilize the MCPR limits for the Option B scram speed, the core average scram insertion time for 20% insertion must be less than or equal to 0.694 seconds (Reference 7). If the core average scram insertion time does not meet the Option B criteria, but is within the Option A criteria, the appropriate MCPR value may be determined from a linear interpolation

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between the Option A and B limits with standard mathematical rounding to two decimal places. When performing a linear interpolation to determine MCPR limits, ensure that the time used for Option A is 0.900 seconds, which is the 20% insertion time utilized by GNF in the reload analysis.

2.2.4 Recirculation Pump Motor Generator Settings

Cycle 19 was analyzed with a maximum core flow runout of 110%; therefore the Recirculation Pump Motor Generator scoop tube mechanical and electrical stops must be set to maintain core flow less than 110% (107.8 Mlb/hr) for all runout events (Reference 13 Section 15). This value is consistent with the analyses of Reference 5.

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Table 2-1
MCPR Option A Based Operating Limits
(Reference 3)

EOOS Combination	Fuel Type	Cycle Exposure	
		<EOR[1] - 1385 MWd/MT	≥ EOR[1] - 1385 MWd/MT
Base Case	GE14	1.58	1.68
	ATRIUM-9B	1.54	1.64
Base Case SLO	GE14	1.59	1.69
	ATRIUM-9B	1.55	1.65
TBPOOS	GE14	1.75	1.77
	ATRIUM-9B	1.69	1.71
TBPOOS SLO	GE14	1.76	1.78
	ATRIUM-9B	1.70	1.72
TCV Slow Closure	GE14	1.60	1.68
	ATRIUM-9B	1.54	1.64
TCV Slow Closure SLO	GE14	1.61	1.69
	ATRIUM-9B	1.55	1.65
PLUOOS	GE14	1.64	1.68
	ATRIUM-9B	1.59	1.64
PLUOOS SLO	GE14	1.65	1.69
	ATRIUM-9B	1.60	1.65
TCV Stuck Closed	GE14	1.58	1.68
	ATRIUM-9B	1.54	1.64
TCV Stuck Closed SLO	GE14	1.59	1.69
	ATRIUM-9B	1.55	1.65

1. EOR refers to the end of rated power (i.e., 100% power/100% flow operation with all rods out)
GE14 fuel is fuel types 16, 17, 19, 20, 28, 29, 31, 32, 38, 39, 41, 42, and 47
ATRIUM-9B fuel is fuel types 6 and 7

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Table 2-2
MCPR Option B Based Operating Limits

(Reference 3)

EOOS Combination	Fuel Type	Cycle Exposure	
		<EOR[1] - 1385 MWd/MT	≥ EOR[1] - 1385 MWd/MT
Base Case	GE14	1.47	1.51
	ATRIUM-9B	1.45	1.47
Base Case SLO	GE14	1.48	1.52
	ATRIUM-9B	1.46	1.48
TBPOOS	GE14	1.58	1.60
	ATRIUM-9B	1.52	1.54
TBPOOS SLO	GE14	1.59	1.61
	ATRIUM-9B	1.53	1.55
TCV Slow Closure	GE14	1.47	1.51
	ATRIUM-9B	1.45	1.47
TCV Slow Closure SLO	GE14	1.48	1.52
	ATRIUM-9B	1.46	1.48
PLUOOS	GE14	1.47	1.51
	ATRIUM-9B	1.45	1.47
PLUOOS SLO	GE14	1.48	1.52
	ATRIUM-9B	1.46	1.48
TCV Stuck Closed	GE14	1.47	1.51
	ATRIUM-9B	1.45	1.47
TCV Stuck Closed SLO	GE14	1.48	1.52
	ATRIUM-9B	1.46	1.48

1. EOR refers to the end of rated power (i.e., 100% power/100% flow operation with all rods out)
GE14 fuel is fuel types 16, 17, 19, 20, 28, 29, 31, 32, 38, 39, 41, 42, and 47
ATRIUM-9B fuel is fuel types 6 and 7

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Table 2-3
MCPR$_P$ for GE and SPC Fuel
(Reference 5 and 18)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)								
		0	25	38.5	38.5	45	60	70	70	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier, K_P					
Base Case	≤ 60	3.19	2.61	2.29	1.32	1.28	1.15	[redacted]	[redacted]	1.00
	> 60	3.81	3.01	2.59						
Base Case SLO	≤ 60	3.20	2.62	2.30	1.32	1.28	1.15	[redacted]	[redacted]	1.00
	> 60	3.82	3.02	2.60						
TBPOOS	≤ 60	5.60	3.81	2.84	1.37	1.28	1.15	[redacted]	[redacted]	1.00
	> 60	6.85	4.66	3.48						
TBPOOS SLO	≤ 60	5.61	3.82	2.85	1.37	1.28	1.15	[redacted]	[redacted]	1.00
	> 60	6.86	4.67	3.49						
TCV Slow Closure	≤ 60	5.60	3.81	2.84	1.64	[redacted]	1.45	1.26	1.11	1.00
	> 60	6.85	4.66	3.48						
TCV Slow Closure SLO	≤ 60	5.61	3.82	2.85	1.64	[redacted]	1.45	1.26	1.11	1.00
	> 60	6.86	4.67	3.49						
PLUOOS	≤ 60	5.60	3.81	2.84	1.64	[redacted]	1.45	1.26	1.11	1.00
	> 60	6.85	4.66	3.48						
PLUOOS SLO	≤ 60	5.61	3.82	2.85	1.64	[redacted]	1.45	1.26	1.11	1.00
	> 60	6.86	4.67	3.49						
TCV Stuck Closed	≤ 60	3.19	2.61	2.29	1.32	1.28	1.15	[redacted]	[redacted]	1.00
	> 60	3.81	3.01	2.59						
TCV Stuck Closed SLO	≤ 60	3.20	2.62	2.30	1.32	1.28	1.15	[redacted]	[redacted]	1.00
	> 60	3.82	3.02	2.60						

Notes for Table 2-3:
- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power multiplier, K_P, should be applied.
- Allowable EOOS conditions are listed in Section 5.
- MCRP$_P$ limits are independent of scram speed.

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Table 2-4

MCPR$_F$ limits for all fuel types and all operating conditions except TCV Stuck Closed

(Reference 10)

Flow (% rated)	MCPR$_F$
110.0	1.22
100.0	1.22
0.0	1.86

Notes for Tables 2-4:

- Values are interpolated between relevant flow values.
- Rated flow is 98 Mlb/hr.
- MCRP$_F$ limit is independent of scram speed.
- This table is not applicable to TCV Stuck Closed operating conditions.

Table 2-5

MCPR$_F$ limits for all fuel types with a TCV Stuck Closed

(Reference 10)

Flow (% rated)	MCPR$_F$
110.0	1.27
108.9	1.27
0.0	1.97

Notes for Tables 2-5:

- Values are interpolated between relevant flow values.
- Rated flow is 98 Mlb/hr.
- MCRP$_F$ limit is independent of scram speed.
- This table is only applicable to TCV Stuck Closed operating conditions.

3. Linear Heat Generation Rate

3.1 Technical Specification Reference:

Section 3.2.3.

3.2 Description:

The linear heat generation rate (LHGR) limit is the product of the LHGR Limit from Tables 3-1, 3-2, 3-3, 3-4, 3-5, or 3-6 and the minimum of either the power dependent LHGR Factor, $LHGRFAC_P$, the flow dependent LHGR Factor, $LHGRFAC_F$ or the single loop operation (SLO) multiplication factor. The applicable power dependent LHGR Factor ($LHGRFAC_P$) is determined from Table 3-7. The applicable flow dependent LHGR Factor ($LHGRFAC_F$) is determined from Tables 3-8 and 3-9. The SLO multiplication factor can be found in Table 3-10.

Table 3-1
LHGR Limits for all ATRIUM-9B Fuel
ATRM9-P9HATB371-13GZ-SPC100T-9WR-144-T6-3912
ATRM9-P9HATB371-13GZ-SPC100T-9WR-144-T6-3914
(Bundles 3912 and 3914 - bundle types 6, and 7)
(Reference 8)

Nodal Exposure (GWd/MT)	LHGR Limit (kW/ft)
0.00	14.40
15.00	14.40
64.30	7.90

Table 3-2
LHGR Limits for Bundle Types 16, 28, and 29
GE14-P10HNAB411-4G7.0/9G6.0-100T-145-T6-2484
(Bundle 2484, bundle types 16, 28, and 29)
(Reference 4)

Nodal Exposure (GWd/MT)	LHGR Limit (kW/ft)
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Table 3-3
LHGR Limits for Bundle Types 17, 31, and 32

GE14-P10HNAB408-16GZ-100T-145-T6-2483
(Bundle 2483, bundle types 17, 31, and 32)
(Reference 4)

Nodal Exposure (GWd/MT)	LHGR Limit (kW/ft)
[[	
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Table 3-4
LHGR Limits for Bundle Types 19, 38 and 39

GE14-P10DNAB418-16GZ-100T-145-T6-2646
(Bundles 2646, bundle types 19, 38, and 39)
(Reference 21)

Nodal Exposure (GWd/MT)	LHGR Limit (kW/ft)
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Table 3-5
LHGR Limits for Bundle Types 20, 41, and 42

GE14-P10DNAB389-18GZ-100T-145-T6-2650
(Bundles 2650, bundle types 20, 41, and 42)
(Reference 21)

Nodal Exposure (GWd/MT)	LHGR Limit (kW/ft)
[[	
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Table 3-6
LHGR Limits for Bundle Type 47

GE14-P10HNAB408-16GZ-100T-145-T6-2483
(Bundle 2483, bundle types 47)
(Reference 4 and 19)

Nodal Exposure (GWd/MT)	LHGR Limit (kW/ft)
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Table 3-7
LHGRFAC$_P$ for all fuel types
(Reference 5)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated) 0	25	38.5	38.5	70	70	80	100
		LHGRFAC$_P$ multiplier							
Base Case	≤ 60	0.50	0.56	0.59	0.68	[redacted]	[redacted]	0.86	1.00
	> 60								
Base Case SLO	≤ 60	0.50	0.56	0.59	0.68	[redacted]	[redacted]	0.86	1.00
	> 60								
TBPOOS	≤ 60	0.22	0.39	0.48	0.54	[redacted]	[redacted]	[redacted]	1.00
	> 60	0.33		0.42					
TBPOOS SLO	≤ 60	0.22	0.39	0.48	0.54	[redacted]	[redacted]	[redacted]	1.00
	> 60	0.33		0.42					
TCV Slow Closure	≤ 60	0.22	0.39	0.48	0.54	0.73	0.78	[redacted]	1.00
	> 60	0.33		0.42					
TCV Slow Closure SLO	≤ 60	0.22	0.39	0.48	0.54	0.73	0.78	[redacted]	1.00
	> 60	0.33		0.42					
PLUOOS	≤ 60	0.22	0.39	0.48	0.54	0.73	0.78	[redacted]	1.00
	> 60	0.33		0.42					
PLUOOS SLO	≤ 60	0.22	0.39	0.48	0.54	0.73	0.78	[redacted]	1.00
	> 60	0.33		0.42					
TCV Stuck Closed	≤ 60	0.50	0.56	0.59	0.68	[redacted]	[redacted]	0.86	1.00
	> 60								
TCV Stuck Closed SLO	≤ 60	0.50	0.56	0.59	0.68	[redacted]	[redacted]	0.86	1.00
	> 60								

Notes for Table 3-7:

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power LHGRFAC$_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 5.
- LHGRFAC$_P$ multiplier is independent of scram speed.
- The LHGR multiplier for any core power/flow condition is the limiting of the LHGRFAC$_P$, LHGRFAC$_F$, and SLO Multiplier (if applicable)

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Table 3-8
$LHGRFAC_F$ multipliers

(Reference 5)

Flow (% rated)	$LHGRFAC_F$
110	1.00
100	1.00
80	1.00
50	0.77
40	0.64
30	0.55
0	0.28

Table 3-9
$LHGRFAC_F$ multipliers for Turbine Control Valve Stuck Closed

(Reference 5)

Flow (% rated)	$LHGRFAC_F$
110	1.00
100	1.00
98.3	1.00
80	0.86
50	0.63
40	0.50
30	0.41
0	0.14

Notes for Tables 3-8 and 3-9:

- Values are interpolated between relevant flow values.
- 98 Mlb/hr is rated flow.
- For thermal limit monitoring above 100% rated core flow, utilize the 100% rated core flow $LHGRFAC_F$ multiplier.
- $LHGRFAC_F$ multipliers are applicable to all fuel types.
- Table 3-8 is valid for all operating conditions for all EOOS scenarios except TCV stuck closed.
- Table 3-9 is valid for all operating conditions with a TCV stuck closed.
- $LHGRFAC_F$ multipliers are independent of scram speed.
- The LHGR multiplier for any core power/flow condition is the limiting of the $LHGRFAC_P$, $LHGRFAC_F$, and SLO Multiplier (if applicable).

Table 3-10
LHGR SLO Multipliers for All Fuel Types

(Reference 3, 15 and 16)

Fuel Product Line	SLO LHGR Multiplier
ATRIUM-9B	0.84
GE-14	0.77

Note for Table 3-10:

- The LHGR multiplier for any core power/flow condition is the limiting of the $LHGRFAC_P$, $LHGRFAC_F$, and SLO Multiplier (if applicable).

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4. Control Rod Withdrawal Block Instrumentation

4.1 Technical Specification Reference:

Table 3.3.2.1-1

4.2 Description:

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	$0.65\ W_d + 55\%$
Single Recirculation Loop Operation	$0.65\ W_d + 51\%$

The setpoint may be lower/higher and will still comply with the Rod Withdrawal Event (RWE) Analysis because RWE is analyzed unblocked.

W_d – percent of drive flow required to produce a rated core flow of 98 Mlb/hr.

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5. Allowed Modes of Operation (B 3.2.2, B 3.2.3)

The Allowed Modes of Operation with combinations of Equipment Out-of-Service are as described below:

Equipment Out of Service Options[1,2,3,7]	----------OPERATING REGION----------		
	Standard	MELLLA	Coastdown[4]
Base Case, Option A or B	Yes	Yes	Yes
Base Case SLO, Option A or B	Yes	Yes	Yes
TBPOOS, Option A or B	Yes	Yes	Yes
TBPOOS SLO, Option A or B	Yes	Yes	Yes
TCV Slow Closure[5], Option A or B	Yes	Yes	Yes
TCV Slow Closure SLO[5], Option A or B	Yes	Yes	Yes
PLUOOS, Option A or B	Yes	Yes	Yes
PLUOOS SLO, Option A or B	Yes	Yes	Yes
TCV Stuck Closed[6], Option A or B	Yes	Yes	Yes
TCV Stuck Closed SLO[6], Option A or B	Yes	Yes	Yes

[1] Each OOS Option may be combined with up to 18 TIP channels OOS (provided the requirements for utilizing SUBTIP methodology are met) with all TIPS available at startup from a refuel outage, a 120°F reduction in feedwater temperature throughout the cycle (Final Feedwater Temperature Reduction was analyzed for the entire cycle, which is subject to restriction in Reference 24), and up to 50% of the LPRMs OOS with an LPRM calibration frequency of 2500 Effective Full Power Hours (EFPH) (2000 EFPH +25%).

[2] Additionally, a single MSIV may be taken OOS (shut) under any and all OOS Options, so long as core thermal power is maintained ≤75% of 2957 MWt (Reference 12).

[3] All OOS Options support 1 Turbine Bypass Valve OOS, if the OPL-3 (Reference 7) assumed opening profile for the Turbine Bypass system is met. If the OPL-3 opening profile is not met, or if more than one Turbine Bypass Valve is OOS, utilize the TBPOOS condition.

[4] Coastdown operation 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 (Reference 11 Section 4.3.1.2.8). Up to a 15% overpower is analyzed per Reference 5.

[5] For operation with a pressure regulator out-of-service (PROOS), the TCV Slow Closure limits should be applied (Reference 17) and the operational notes from Reference 17 reviewed. PROOS and TCV Slow Closure is not an analyzed out-of-service combination.

[6] Operation with one TSV OOS is allowed as evaluated in Reference 23. Combination of one TCV OOS and one TSV OOS is not allowed.

[7] The cycle specific stability analysis may impose restrictions on the Power-to-flow map and/or restrict the applicable temperature for feedwater temperature reduction (FWTR).

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6. Methodology (5.6.5)

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. ANF-1125 (P)(A) and Supplements 1 and 2, "Critical Power Correlation – ANFB," April 1990.
2. ANF-524 (P)(A) Revision 2 and Supplements 1 and 2, "ANF Critical Power Methodology for Boiling Water Reactors," November 1990.
3. XN-NF-79-71 (P)(A) Revision 2 and Supplements 1, 2 & 3, "Exxon Nuclear Plant Transient Methodology for Boiling Water Reactors," March 1986.
4. XN-NF-80-19 (P)(A) Volume 1 Supplements 1 and 2, "Exxon Nuclear Methodology for Boiling Water Reactors – Neutronic Methods for Design and Analysis," March 1993.
5. XN-NF-80-19 (P)(A) Volume 1 Supplement 3, Supplement 3 Appendix F, and Supplement 4, "Exxon Nuclear Methodology for Boiling Water Reactors," November 1990.
6. XN-NF-80-19 (P)(A) Volumes 2, 2A, 2B and 2C, "Exxon Nuclear Methodology for Boiling Water Reactors: EXEM BWR ECCS Evaluation Model," September 1982.
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Attachment D

Core Operating Limits Report

for

Dresden Unit 3 Cycle 18

Revision 1

Core Operating Limits Report

for

Dresden Unit 3 Cycle 18

Revision 1

Issuance of Changes Summary

Affected Section	Affected Pages	Summary of Changes	Revision	Date
All	All	Original Issue (Cycle 18)	0	10/02
References, 1, 3, and 5	ii, iv, v, 1-1, 3-1, 3-2, 3-3, 3-4 and 5-1	Incorporate CBH reference, clarify fuel types being impacted, incorporate revised LHGR limits for fuel type 33, include the LHGR SLO multiplier, and include applicable PROOS reference and note in Section 5.	1	9/03

Table of Contents

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1. Average Planar Linear Heat Generation Rate

1.1 Technical Specification Reference:

Sections 3.2.1 and 3.4.1.

1.2 Description:

Tables 1-1 and 1-2 are used to determine the maximum average planar linear heat generation rate (MAPLHGR) limit for each fuel type. Limits listed in Tables 1-1 and 1-2 are for Dual Reactor Recirculation Loop Operation.

For Single Reactor Recirculation Loop Operation (SLO), the MAPLHGR limits given in Tables 1-1 and 1-2 must be multiplied by a SLO MAPLHGR multiplier. The SLO MAPLHGR multiplier for SPC fuel is 0.84 (Reference 3 Section 16). The SLO MAPLHGR multiplier for GE14 fuel is 0.77 (Reference 3 Section 16).

Table 1-1
Maximum Average Planar Linear Heat
Generation Rate (MAPLHGR) for SPC ATRIUM-9B Fuel
ATRM9-P9DATB326-11GZ-SPC80M-9WR-144-T6-2447
ATRM9-P9DATB326-11GZ-SPC80M-9WR-144-T6-2448
ATRM9-P9DATB339-6GZ-SPC80M-9WR-144-T6-2449
ATRM9-P9DATB362-12GZ-SPC100T-9WR-144-T6-2450
ATRM9-P9DATB360-12GZ-SPC100T-9WR-144-T6-2451
ATRM9-P9DATB378-13GZ-SPC100T-9WR-144-T6-2464
ATRM9-P9DATB378-11GZ-SPC100T-9WR-144-T6-2465
(Bundles 2447, 2448, 2449, 2450, 2451, 2464, 2465, bundle types 16, 17, 18, 19, 49, 20, 1, 31, 2 and 32)
(Reference 3 Section 16 and Reference 13)

Planar Average Exposure (GWd/MTU)	MAPLHGR (kW/ft)
0.00	13.52
17.25	13.52
70.00	7.84

Table 1-2
Maximum Average Planar Linear Heat
Generation Rate (MAPLHGR) for GE14 Fuel
GE14-P10DNAB408-16GZ-100T-145-T6-2554
GE14-P10DNAB411-4G7.0/9G6.0-100T-145-T6-2553
(Bundles 2553 and 2554, bundle types 3, 33, 4 and 34)
(Reference 3 Section 16)

Planar Average Exposure (GWd/MTU)	MAPLHGR (kW/ft)
0.00	11.68
16.00	11.68
55.12	8.01
63.50	6.97
70.00	4.36

2. Minimum Critical Power Ratio

2.1 Technical Specification Reference:

Sections 3.2.2, 3.4.1 and 3.7.7.

2.2 Description:

The various MCPR limits are described below.

2.2.1 Manual Flow Control MCPR Limits

The Operating Limit MCPR (OLMCPR) is determined from either section 2.2.1.1 or 2.2.1.2, whichever is greater at any given power and flow condition.

2.2.1.1 Power-Dependent MCPR

For operation at less than 38.5% core thermal power, the OLMCPR as a function of core thermal power is shown in Table 2-3. For operation at greater than 38.5% core thermal power, the OLMCPR as a function of core thermal power is determined by multiplying the applicable EOOS condition limit shown in Table 2-1 or 2-2 by the applicable MCPR multiplier K_P given in Table 2-3. For operation at exactly 38.5% core thermal power, the OLMCPR as a function of core thermal power is the higher of either of the two aforementioned methods evaluated at exactly 38.5% core thermal power.

2.2.1.2 Flow-Dependent MCPR

Tables 2-4 and 2-5 provide the $MCPR_F$ limit as a function of flow. The $MCPR_F$ limit determined from these tables is the flow dependent OLMCPR.

2.2.2 Automatic Flow Control MCPR Limits

Automatic Flow Control MCPR Limits are not provided.

2.2.3 Option A and Option B

Option A and Option B refer to scram speeds.

Option A scram speed is the Improved Technical Specification scram speed. The core average scram speed insertion time for 20% insertion must be less than or equal to the Technical Specification Scram Speed to utilize Option A MCPR limits. Reload analyses performed by Global Nuclear Fuel (GNF) for cycle 18 Option A MCPR limits utilized a 20% core average insertion time of 0.900 seconds (Reference 7).

To utilize the MCPR limits for the Option B scram speed, the core average scram insertion time for 20% insertion must be less than or equal to 0.694 seconds (Reference 7). If the core average scram insertion time does not meet the Option B criteria, but is within the Option A criteria, the appropriate MCPR value may be determined from a linear interpolation between the Option A and B limits with standard mathematical rounding to two decimal places. When performing a linear interpolation to determine MCPR limits, ensure that the time used for Option A is 0.900 seconds, which is the 20% insertion time utilized by GNF in the reload analysis.

2.2.4 Recirculation Pump Motor Generator Settings

Cycle 18 was analyzed with a maximum core flow runout of 110%; therefore the Recirculation Pump Motor Generator scoop tube mechanical and electrical stops must be set to maintain core flow less than 110% (107.8 Mlb/hr) for all runout events (Reference 12 Section 15). This value is consistent with the analyses of Reference 5.

Table 2-1
MCPR Option A Based Operating Limits
(Reference 3 Appendix G and Reference 14)

EOOS Combination	Fuel Type	Cycle Exposure	
		<13,800 MWd/MT	≥13,800 MWd/MT
Base Case	GE14	1.53	1.65
	ATRIUM-9B	1.52	1.61
Base Case SLO	GE14	1.54	1.66
	ATRIUM-9B	1.53	1.62
TBPOOS	GE14	1.73	1.75
	ATRIUM-9B	1.67	1.69
TBPOOS SLO	GE14	1.74	1.76
	ATRIUM-9B	1.68	1.70
TCV Slow Closure	GE14	1.63	1.65
	ATRIUM-9B	1.58	1.61
TCV Slow Closure SLO	GE14	1.64	1.66
	ATRIUM-9B	1.59	1.62
PLUOOS	GE14	1.68	1.68
	ATRIUM-9B	1.63	1.63
PLUOOS SLO	GE14	1.69	1.69
	ATRIUM-9B	1.64	1.64
TCV Stuck Closed	GE14	1.53	1.65
	ATRIUM-9B	1.52	1.61
TCV Stuck Closed SLO	GE14	1.54	1.66
	ATRIUM-9B	1.53	1.62

Table 2-2

MCPR Option B Based Operating Limits

(Reference 3 Appendix G, Reference 14 and Reference 9)

EOOS Combination	Fuel Type	Cycle Exposure	
		<13,800 MWd/MT	≥13,800 MWd/MT
Base Case	GE14	1.42	1.48
	ATRIUM-9B	1.41	1.44
Base Case SLO	GE14	1.43	1.49
	ATRIUM-9B	1.42	1.45
TBPOOS	GE14	1.56	1.58
	ATRIUM-9B	1.50	1.52
TBPOOS SLO	GE14	1.57	1.59
	ATRIUM-9B	1.51	1.53
TCV Slow Closure	GE14	1.46	1.48
	ATRIUM-9B	1.41	1.44
TCV Slow Closure SLO	GE14	1.47	1.49
	ATRIUM-9B	1.42	1.45
PLUOOS	GE14	1.51	1.51
	ATRIUM-9B	1.46	1.46
PLUOOS SLO	GE14	1.52	1.52
	ATRIUM-9B	1.47	1.47
TCV Stuck Closed	GE14	1.43	1.48
	ATRIUM-9B	1.43	1.44
TCV Stuck Closed SLO	GE14	1.44	1.49
	ATRIUM-9B	1.44	1.45

Table 2-3
MCPR$_P$ for GE and SPC Fuel
(Reference 3 Appendix G)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)								
		0	25	38.5	38.5	45	60	70	70	100
		Operating Limit MCPR			Operating Limit MCPR Multiplier, K_P					
Base Case	≤ 60	3.16	2.58	2.27	1.32	1.28	1.15			1.00
	> 60	3.77	2.99	2.56						
Base Case SLO	≤ 60	3.17	2.59	2.28	1.32	1.28	1.15			1.00
	> 60	3.78	3.00	2.57						
TBPOOS	≤ 60	5.55	3.77	2.82	1.37	1.28	1.15			1.00
	> 60	6.79	4.62	3.45						
TBPOOS SLO	≤ 60	5.56	3.78	2.83	1.37	1.28	1.15			1.00
	> 60	6.80	4.63	3.46						
TCV Slow Closure	≤ 60	5.55	3.77	2.82	1.64		1.45	1.26	1.11	1.00
	> 60	6.79	4.62	3.45						
TCV Slow Closure SLO	≤ 60	5.56	3.78	2.83	1.64		1.45	1.26	1.11	1.00
	> 60	6.80	4.63	3.46						
PLUOOS	≤ 60	5.55	3.77	2.82	1.64		1.45	1.26	1.11	1.00
	> 60	6.79	4.62	3.45						
PLUOOS SLO	≤ 60	5.56	3.78	2.83	1.64		1.45	1.26	1.11	1.00
	> 60	6.80	4.63	3.46						
TCV Stuck Closed	≤ 60	3.16	2.58	2.27	1.32	1.28	1.15			1.00
	> 60	3.77	2.99	2.56						
TCV Stuck Closed SLO	≤ 60	3.17	2.59	2.28	1.32	1.28	1.15			1.00
	> 60	3.78	3.00	2.57						

Notes for Table 2-3:

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power multiplier, K_P, should be applied.
- Allowable EOOS conditions are listed in Section 5.
- MCRP$_P$ limits are independent of scram speed.

Table 2-4
$MCPR_F$ limits for all fuel types and all operating conditions except TCV Stuck Closed

(Reference 9)

Flow (% rated)	$MCPR_F$
110.0	1.22
100.0	1.22
0.0	1.86

Notes for Tables 2-4:

- Values are interpolated between relevant flow values.
- Rated flow is 98 Mlb/hr.
- $MCRP_F$ limit is independent of scram speed.
- This table is not applicable to TCV Stuck Closed operating conditions.

Table 2-5
$MCPR_F$ limits for all fuel types with a TCV Stuck Closed

(Reference 9)

Flow (% rated)	$MCPR_F$
110.0	1.27
108.9	1.27
0.0	1.97

Notes for Tables 2-5:

- Values are interpolated between relevant flow values.
- Rated flow is 98 Mlb/hr.
- $MCRP_F$ limit is independent of scram speed.
- This table is only applicable to TCV Stuck Closed operating conditions.

3. **Linear Heat Generation Rate**

3.1 Technical Specification Reference:

Section 3.2.3.

3.2 Description:

The linear heat generation rate (LHGR) limit is the product of the LHGR Limit from Tables 3-1, 3-2, 3-2a, or 3-3 and the minimum of either the power dependent LHGR Factor, $LHGRFAC_P$, the flow dependent LHGR Factor, $LHGRFAC_F$ or the single loop operation (SLO) multiplication factor. The applicable power dependent LHGR Factor ($LHGRFAC_P$) is determined from Table 3-4. The applicable flow dependent LHGR Factor ($LHGRFAC_F$) is determined from Tables 3-5 and 3-6. The SLO multiplication factor can be found in Table 3-7.

Table 3-1
LHGR Limits for Bundle Types
GE14-P10DNAB408-16GZ-100T-145-T6-2554
(Bundle 2554, bundle types 4 and 34)
(Reference 4)

Nodal Exposure (GWd/MT)	LHGR Limit (kW/ft)
0.00	13.20
10.00	13.20
13.22	12.90
14.33	12.45
18.73	11.74
27.50	10.40
55.11	7.70
63.61	4.48

Table 3-2
LHGR Limits for Bundle Types
GE14-P10DNAB411-4G7.0/9G6.0-100T-145-T6-2553
(Bundle 2553, bundle type 3)
(Reference 4)

Nodal Exposure (GWd/MT)	LHGR Limit (kW/ft)
0.00	13.40
12.50	13.40
14.33	12.90
22.04	11.90
44.09	9.00
55.00	7.95
58.10	7.20
63.02	5.00

Table 3-2a
LHGR Limits for Bundle Types

GE14-P10DNAB411-4G7.0/9G6.0-100T-145-T6-2553
Applicable from 4060 MWD/MTU to End of Cycle (EOC)
(Bundle 2553, bundle type 33)
(Reference 4 and Reference 15)

Nodal Exposure (GWd/MT)	LHGR Limit (kW/ft)
0.00	13.06
12.50	13.06
14.33	12.57
22.04	11.60
44.09	8.77
55.00	7.75
58.10	7.02
63.02	4.87

Table 3-3
LHGR Limits for SPC ATRIUM-9B Fuel

ATRM9-P9DATB326-11GZ-SPC80M-9WR-144-T6-2447
ATRM9-P9DATB326-11GZ-SPC80M-9WR-144-T6-2448
ATRM9-P9DATB339-6GZ-SPC80M-9WR-144-T6-2449
ATRM9-P9DATB362-12GZ-SPC100T-9WR-144-T6-2450
ATRM9-P9DATB360-12GZ-SPC100T-9WR-144-T6-2451
ATRM9-P9DATB378-13GZ-SPC100T-9WR-144-T6-2464
ATRM9-P9DATB378-11GZ-SPC100T-9WR-144-T6-2465
(Bundles 2447, 2448, 2449, 2450, 2451, 2464, 2465,
bundle types 16, 17, 18, 19, 49, 20, 1, 31, 2 and 32)
(Reference 8 Figure 2.1)

Nodal Exposure (GWd/MT)	LHGR Limit (kW/ft)
0.00	14.40
15.00	14.40
64.30	7.90

Table 3-4
LHGRFAC$_P$ for all fuel types
(Reference 3 Appendix G)

EOOS Combination	Core Flow (% of rated)	Core Thermal Power (% of rated)							
		0	25	38.5	38.5	70	70	80	100
		LHGRFAC$_P$ multiplier							
Base Case	≤ 60	0.50	0.56	0.59	0.68	[redacted]	[redacted]	0.86	1.00
	> 60								
Base Case SLO	≤ 60	0.50	0.56	0.59	0.68	[redacted]	[redacted]	0.86	1.00
	> 60								
TBPOOS	≤ 60	0.22	0.39	0.48	0.54	[redacted]	[redacted]	[redacted]	1.00
	> 60	0.33		0.42					
TBPOOS SLO	≤ 60	0.22	0.39	0.48	0.54	[redacted]	[redacted]	[redacted]	1.00
	> 60	0.33		0.42					
TCV Slow Closure	≤ 60	0.22	0.39	0.48	0.54	0.73	0.78	[redacted]	1.00
	> 60	0.33		0.42					
TCV Slow Closure SLO	≤ 60	0.22	0.39	0.48	0.54	0.73	0.78	[redacted]	1.00
	> 60	0.33		0.42					
PLUOOS	≤ 60	0.22	0.39	0.48	0.54	0.73	0.78	[redacted]	1.00
	> 60	0.33		0.42					
PLUOOS SLO	≤ 60	0.22	0.39	0.48	0.54	0.73	0.78	[redacted]	1.00
	> 60	0.33		0.42					
TCV Stuck Closed	≤ 60	0.50	0.56	0.59	0.68	[redacted]	[redacted]	0.86	1.00
	> 60								
TCV Stuck Closed SLO	≤ 60	0.50	0.56	0.59	0.68	[redacted]	[redacted]	0.86	1.00
	> 60								

Notes for Table 3-4:

- Values are interpolated between relevant power levels.
- For thermal limit monitoring at greater than 100% core thermal power, the 100% core thermal power LHGRFAC$_P$ multiplier should be applied.
- Allowable EOOS conditions are listed in Section 5.
- LHGRFAC$_P$ multiplier is independent of scram speed.
- The LHGR multiplier for any core power/flow condition is the limiting of the LHGRFAC$_P$, LHGRFAC$_F$, and SLO Multiplier (if applicable)

Table 3-5
$LHGRFAC_F$ multipliers

(Reference 5 Figure 3-3)

Flow (% rated)	$LHGRFAC_F$
0	0.28
30	0.55
40	0.64
50	0.77
80	1.00
100	1.00
110	1.00

Table 3-6
$LHGRFAC_F$ multipliers for Turbine Control Valve Stuck Closed

(Reference 5 Table 2-17)

Flow (% rated)	$LHGRFAC_F$
0	0.14
30	0.41
40	0.50
50	0.63
80	0.86
98.3	1.00
100	1.00
110	1.00

Notes for Tables 3-5 and 3-6:

- Values are interpolated between relevant flow values.
- 98 Mlb/hr is rated flow.
- $LHGRFAC_F$ multipliers are applicable to all fuel types used in cycle 18.
- Table 3-5 is valid for all operating conditions for all EOOS scenarios except TCV stuck closed.
- Table 3-6 is valid for all operating conditions with a TCV stuck closed.
- $LHGRFAC_F$ multipliers are independent of scram speed.
- The LHGR multiplier for any core power/flow condition is the limiting of the $LHGRFAC_P$, $LHGRFAC_F$, and SLO Multiplier (if applicable).

Table 3-7
LHGR SLO Multipliers for All Fuel Types

(Reference 16 and 17)

Fuel Product Line	SLO LHGR Multiplier
ATRIUM-9B	0.84
GE-14	0.77

Note for Table 3-7:

- The LHGR multiplier for any core power/flow condition is the limiting of the $LHGRFAC_P$, $LHGRFAC_F$, and SLO Multiplier (if applicable).

4. Control Rod Withdrawal Block Instrumentation

4.1 Technical Specification Reference:

Table 3.3.2.1-1

4.2 Description:

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	$0.65\ W_d + 55\%$
Single Recirculation Loop Operation	$0.65\ W_d + 51\%$

The setpoint may be lower/higher and will still comply with the Rod Withdrawal Event (RWE) Analysis because RWE is analyzed unblocked.

W_d – percent of drive flow required to produce a rated core flow of 98 Mlb/hr.

5. Allowed Modes of Operation (B 3.2.2, B 3.2.3)

The Allowed Modes of Operation with combinations of Equipment Out-of-Service are as described below:

	---------OPERATING REGION---------		
Equipment Out of Service Options[1,2,3]	**Standard**	**MELLLA**	**Coastdown[4]**
Base Case, Option A or B	Yes	Yes	Yes
Base Case SLO, Option A or B	Yes	Yes	Yes
TBPOOS, Option A or B	Yes	Yes	Yes
TBPOOS SLO, Option A or B	Yes	Yes	Yes
TCV Slow Closure[5], Option A or B	Yes	Yes	Yes
TCV Slow Closure SLO[5], Option A or B	Yes	Yes	Yes
PLUOOS, Option A or B	Yes	Yes	Yes
PLUOOS SLO, Option A or B	Yes	Yes	Yes
TCV Stuck Closed, Option A or B	Yes	Yes	Yes
TCV Stuck Closed SLO, Option A or B	Yes	Yes	Yes

[1] Each OOS Option may be combined with up to 18 TIP channels OOS (provided the requirements for utilizing SUBTIP methodology are met) with all TIPS available at startup from a refuel outage, a 120°F reduction in feedwater temperature throughout the cycle (Final Feedwater Temperature Reduction was analyzed for the entire cycle), and up to 50% of the LPRMs OOS with an LPRM calibration frequency of 2500 Effective Full Power Hours (EFPH) (2000 EFPH +25%).

[2] Additionally, a single MSIV may be taken OOS (shut) under any and all OOS Options, so long as core thermal power is maintained ≤75% of 2957 MWt (Reference 11).

[3] All OOS Options support 1 Turbine Bypass Valve OOS, if the OPL-3 assumed opening profile for the Turbine Bypass system is met. If the OPL-3 opening profile is not met, or if more than one Turbine Bypass Valve is OOS, utilize the TBPOOS condition.

[4] Coastdown operation 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 (Reference 10 Section 4.3.1.2.8). Up to a 15% overpower is analyzed per Reference 5.

[5] For operation with a pressure regulator out-of-service (PROOS), the TCV Slow Closure limits should be applied (Reference 18) and the operational notes from Reference 18 reviewed. PROOS <u>and</u> TCV Slow Closure is <u>not</u> an analyzed out-of-service combination

6. **Methodology (5.6.5)**

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. ANF-1125 (P)(A) and Supplements 1 and 2, "Critical Power Correlation – ANFB," April 1990.

2. ANF-524 (P)(A) Revision 2 and Supplements 1 and 2, "ANF Critical Power Methodology for Boiling Water Reactors," November 1990.

3. XN-NF-79-71 (P)(A) Revision 2 and Supplements 1, 2 & 3, "Exxon Nuclear Plant Transient Methodology for Boiling Water Reactors," March 1986.

4. XN-NF-80-19 (P)(A) Volume 1 Supplements 1 and 2, "Exxon Nuclear Methodology for Boiling Water Reactors – Neutronic Methods for Design and Analysis," March 1993.

5. XN-NF-80-19 (P)(A) Volume 1 Supplement 3, Supplement 3 Appendix F, and Supplement 4, "Exxon Nuclear Methodology for Boiling Water Reactors," November 1990.

6. XN-NF-80-19 (P)(A) Volumes 2, 2A, 2B and 2C, "Exxon Nuclear Methodology for Boiling Water Reactors: EXEM BWR ECCS Evaluation Model," September 1982.

7. XN-NF-80-19 (P)(A) Volume 3 Revision 2, "Exxon Nuclear Methodology for Boiling Water Reactors, THERMEX: Thermal Limits Methodology Summary Description," January 1987.

8. XN-NF-80-19 (P)(A) Volume 4 Revision 1, "Exxon Nuclear Methodology for Boiling Water Reactors: Application of the ENC Methodology to BWR Reloads," June 1986.

9. XN-NF-85-67 (P)(A) Revision 1, "Generic Mechanical Design for Exxon Nuclear Jet Pump BWR Reload Fuel," September 1986.

10. ANF-913 (P)(A) Volume 1 Revision 1, and Volume 1 Supplements 2, 3, 4, "COTRANSA2: A Computer Program for Boiling Water Reactor Transients Analysis," August 1990.

11. XN-NF-82-06- (P)(A) Revision 1 and Supplements 2, 4 and 5, "Qualification of Exxon Nuclear Fuel for Extended Burnup," October 1986.

12. XN-NF-82-06- (P)(A) Supplement 1 Revision 2, "Qualification of Exxon Nuclear Fuel for Extended Burnup Supplement 1 Extended Burnup Qualification of ENC 9x9 BWR Fuel," May 1988.

13. ANF-89-14(P)(A) Revision 1 and Supplements 1 & 2, "Advanced Nuclear Fuels Corporation Generic Mechanical Design for Advanced Nuclear Fuels Corporation 9X9 – IX and 9x9 – 9X BWR Reload Fuel," October 1991.

14. ANF-89-14(P), "Advanced Nuclear Fuels Corporation Generic Mechanical Design for Advanced Nuclear Fuels Corporation 9X9 – IX and 9x9 – 9X BWR Reload Fuel," May 1989.

15. ANF-89-98 (P)(A), "Generic Mechanical Design Criteria for BWR Fuel Designs," Revision 1 and Revision 1 Supplement 1, May 1995.

16. ANF-91-048 (P)(A), "Advanced Nuclear Fuels Corporation Methodology for Boiling Water Reactors EXEM BWR ECCS Evaluation Model," January 1993.

17. Commonwealth Edison Company Topical Report NFSR-0091, "Benchmark of CASMO/MICROBURN BWR Nuclear Design Methods," Revision 0 and Supplements on Neutronics Licensing Analysis (Supplement 1) and La Salle County Unit 2 benchmarking (Supplement 2), December 1991, March 1992, and May 1992, respectively.

18. EMF-85-74 (P) Revision 0 and Supplement 1(P)(A) and Supplement 2(P)(A), "RODEX2A (BWR) Fuel Rod Thermal-Mechanical Evaluation Model," February 1998.

19. NEDE-24011-P-A-14 Revision 14, "General Electric Standard Application for Reactor Fuel (GESTAR)," June 2000.

20. NEDC-32981P Revision 0, "GEXL96 Correlation for ATRIUM-9B Fuel", September 2000.

21. ANF-1125(P)(A), Supplement 1 Appendix E, "ANFB Critical Power Correlation Determination of ATRIUM-9B Additive Constant uncertainties," September 1998.

22. ANF-91-048(P)(A), Supplements 1 and 2, "BWR Jet Pump Model Revision for RELAX," October 1997.