Exelon Generation.

Dresden Nuclear Power Station
6500 North Dresden Road
Morris, IL 60450

SVPLTR # 20-0054

November 5, 2020

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
Washington, DC 20555-0001

Dresden Nuclear Power Station, Unit 3
Renewed Facility Operating License No. DPR-25
NRC Docket No. 50-249

Subject: Core Operating Limits Report for Dresden Unit 3 Cycle 27

The purpose of this letter is to transmit the Core Operating Limits Report (COLR) for Dresden Nuclear Power Station (DNPS) Unit 3 operating cycle 27 (D3C27) in accordance with Technical Specifications Section 5.6.5, "CORE OPERATING LIMITS REPORT (COLR)."

There are no regulatory commitments contained in this submittal.

Should you have any questions concerning this letter, please contact Mr. Ryan Sprengel, Regulatory Assurance Manager, at (815) 416-2800.

Respectfully,

Peter J. Karaba
Site Vice President
Dresden Nuclear Power Station

Attachment: Core Operating Limits Report for Dresden Unit 3, Revision 17

Cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Dresden Nuclear Power Station

A001
NRR

Core Operating Limits Report

For

Dresden Unit 3 Cycle 27

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Table of Contents

Record of Dresden 3 COLR Revisions

Revision	Description
17	Initial issuance for D3C27

List of Tables

1. Terms and Definitions

AOO	Anticipated operational occurrence
ASD	Adjustable speed drive
BOC	Beginning of cycle
CAVEX	Core average exposure
CRWE	Control rod withdrawal error
CTP	Core thermal power
EFPD	Effective full power day
EFPH	Effective full power hour
EOCLB	End of cycle licensing basis
EOFPL	End of full power life
EOFPLB	End of full power licensing basis
EOOS	Equipment out of service
FHOOS	Feedwater heater out of service
FRV	Feedwater regulating valve
FWT	Feedwater temperature
ICF	Increased core flow
ISS	Intermediate scram speed
LHGR	Linear heat generation rate
$LHGRFAC_f$	Flow dependent linear heat generation rate multiplier
$LHGRFAC_p$	Power dependent linear heat generation rate multiplier
LPRM	Local power range monitor
MAPLHGR	Maximum average planar linear heat generation rate
MCPR	Minimum critical power ratio
$MCPR_f$	Flow dependent minimum critical power ratio
$MCPR_p$	Power dependent minimum critical power ratio
MELLLA	Maximum extended load line limit analysis
MSIVOOS	Main steam isolation valve out of service
MWd/MTU	Megawatt days per metric ton Uranium
NRC	Nuclear Regulatory Commission
NSS	Nominal scram speed
OLMCPR	Operating limit minimum critical power ratio
OOS	Out of service
OPRM	Oscillation power range monitor
PBDA	Period based detection algorithm
PCOOS	Pressure controller out of service
PLU	Power load unbalance
PLUOOS	Power load unbalance out of service
SLMCPR	Safety limit minimum critical power ratio
SLO	Single loop operation
SRV	Safety/relief valve
SRVOOS	Safety/relief valve out of service
TBV	Turbine bypass valve
TBVOOS	Turbine bypass valves out of service
TCV	Turbine control valve
TCV SLOW C	TCV slow closure
TIP	Traversing in-core probe
TLO	Two loop operation
TMOL	Thermal mechanical operating limit
TRM	Technical Requirements Manual
TSSS	Technical Specification scram speed
TSV	Turbine stop valve

2. General Information

This report is prepared in accordance with Technical Specification 5.6 5. The D3C27 reload is licensed by Framatome.

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

The licensing analysis supports full power operation to EOCLB (38,332 MWd/MTU CAVEX). Note that this value includes coastdown, where full power operation is not expected. The transient analysis limits are provided for operation up to specific CAVEX exposures as defined in Section 4.3.

Coastdown is defined as operation beyond EOFPL (37,536 MWd/MTU CAVEX) with the plant power gradually reducing as available core reactivity diminishes. The D3C27 reload analyses do not credit this reduced power during coastdown and the EOCLB limits remain valid for operation up to rated power. The minimum allowed coastdown power level is 40% rated CTP per Reference 1.

Power and flow dependent limits are listed for various power and flow levels. Linear interpolation on power and flow (as applicable) is to be used to find intermediate values. Linear interpolation is also to be used for table items intentionally left blank, as indicated by boxes which are grayed out.

Only $MCPR_P$ varies with scram speed. All other thermal limits are analyzed to remain valid with NSS, ISS, and TSSS.

$LHGRFAC_f$ is independent of feedwater temperature and EOOS conditions.

For thermal limit monitoring above 100% rated power or 108% rated core flow, the 100% rated power or the 108% core flow thermal limit values, respectively, shall be used. Steady state operation is not allowed in this region. Limits are provided for transient conditions only.

3. Average Planar Linear Heat Generation Rate

Technical Specifications Sections 3.2.1 and 3 4.1

Table 3-1 provides the MAPLHGR SLO multiplier for ATRIUM 10XM.

For ATRIUM 10XM fuel, the MAPLHGR values applicable for all lattices can be found in Table 3-2.

During SLO, the limits in Table 3-2 are multiplied by the fuel-specific SLO multiplier listed in Table 3-1.

Table 3-1: MAPLHGR SLO Multiplier
(Reference 6)

Fuel Type	Multiplier
ATRIUM 10XM	0.80

Table 3-2: MAPLHGR for ATRIUM 10XM
(Reference 6)

All ATRIUM 10XM Lattices	
Average Planar Exposure (MWd/MTU)	**TLO MAPLHGR (kW/ft)**
0	12.20
20,000	12.20
67,000	7 73

4. Operating Limit Minimum Critical Power Ratio

Technical Specification Sections 3 2 2, 3,4.1, and 3.7.7

The OLMCPRs for D3C27 were established so that less than 0.1% of the fuel rods in the core are expected to experience boiling transition during an AOO initiated from rated or off-rated conditions and are based on the Technical Specifications SLMCPR values (Reference 6)

Tables 4-3 through 4-12 include MCPR limits for various specified EOOS conditions. The EOOS conditions separated by "/" in these tables represent single EOOS conditions and not any combination of conditions. Refer to Section 8 for a detailed explanation of allowable combined EOOS conditions

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

The OLMCPR as a function of core thermal power ($MCPR_p$) is shown in Tables 4-3 through 4-11. $MCPR_p$ limits are dependent on scram times as described in Section 4 2, exposure as described in Section 4.3, FWT, and whether the plant is in TLO or SLO. TLO limits for ATRIUM 10XM fuel are given in Tables 4-3 through 4-8 and SLO limits for ATRIUM 10XM fuel are given in Tables 4-9 through 4-11.

4.1.2. Flow-Dependent MCPR

Table 4-12 gives the OLMCPR limit as a function of the flow ($MCPR_f$) based on the applicable plant condition. These values are applicable to ATRIUM 10XM.

4.2. Scram Time

TSSS, ISS, and NSS refer to scram speeds The scram time values associated with these speeds are shown in Table 4-1. The TSSS scram times shown in Table 4-1 are the same as those specified in the Technical Specifications (Reference 2).

To utilize the OLMCPR limits for NSS in Tables 4-3, 4-6, and 4-9 the average control rod insertion time at each control rod insertion fraction must be equal to or less than the NSS time shown in Table 4-1 below.

To utilize the OLMCPR limits for ISS in Tables 4-4, 4-7, and 4-10, the average control rod insertion time at each control rod insertion fraction must be equal to or less than the ISS time shown in Table 4-1 below.

The "Average Control Rod Insertion Time" is defined as the sum of the control rod insertion times of all operable control rods divided by the number of operable control rods. Conservative adjustments to the NSS and ISS scram speeds were made to the analysis inputs to appropriately account for the effects of 1 stuck control rod and one additional control rod that is assumed to fail to scram (Reference 6).

To utilize the OLMCPR limits for TSSS in Tables 4-5, 4-8, and 4-11, the control rod insertion time of each operable control rod at each control rod insertion fraction must be equal to or less than the TSSS time shown in Table 4-1 below. The Technical Specifications allow operation with up to 12 "slow" and 1 stuck control rod. One additional control rod is assumed to fail to scram for the system transient analyses performed to establish $MCPR_P$ limits (Reference 6). Conservative adjustments to the TSSS scram speeds were made to the analysis inputs to appropriately account for the effects of the slow and stuck rods on scram reactivity (Reference 6).

For cases below 38.5% power (P_{bypass}), the results are relatively insensitive to scram speed, and only TSSS analyses were performed (Reference 6).

Table 4-1: Scram Times
(References 2 and 6)

Control Rod Insertion Fraction (%)	NSS (seconds)	ISS (seconds)	TSSS (seconds)
5	0 324	0 36	0.48
20	0 700	0.72	0.89
50	1.510	1.58	1.98
90	2.635	2.74	3.44

4.3. Exposure Dependent MCPR Limits

Exposure-dependent $MCPR_P$ limits were established to support operation from BOC to EOFPLB (CAVEX of 37,536 MWd/MTU) and EOFPLB to EOCLB (CAVEX of 38,332 MWd/MTU) as defined by the CAVEX values listed in Table 4-2. The limits at a later exposure range can be used earlier in the cycle as they are the same or more conservative.

Table 4-2: Exposure Basis for Transient Analysis
(Reference 6)

Core Average Exposure (CAVEX) (MWd/MTU)	Description
37,536	Design basis rod patterns to EOFPL + 25 EFPD (EOFPLB)
38,332	EOCLB – Maximum licensing core exposure, including coastdown

4.4. Recirculation Pump ASD Settings

Technical Requirement Manual 2.1.a.1

Dresden 3 Cycle 27 was analyzed with a slow flow excursion event assuming a failure of the recirculation flow control system such that the core flow increases slowly to the maximum flow physically permitted by the equipment, assumed to be 112% of rated core flow (Reference 6), therefore, the recirculation pump ASD must be set to maintain core flow less than 112% (109.76 Mlb/hr) for all runout events

Table 4-3: ATRIUM 10XM TLO MCPR$_p$ Limits for NSS Insertion Times BOC to EOFPLB (37,536 MWd/MTU Core Average Exposure)
(Reference 6)

Nominal FWT							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.44	2.44	2.14	1.89	[redacted]	1.41
	> 60	2.61	2 61	2.26			
TBVOOS	≤ 60	3.36	3.36	2 56	1.97	[redacted]	1.45
	> 60	3.52	3.52	2.73			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2.44	2 44	2.25	2.25	1.71	1.41
	> 60	2.61	2 61	2 26			
1 FRV In Manual Mode*	≤ 60	2.44	2.44	2.14	1.93	[redacted]	1.41
	> 60	2.61	2 61	2 26			
FHOOS							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.61	2.61	2 24	2.03	[redacted]	1 41
	> 60	2 67	2.67	2.26			
TBVOOS	≤ 60	3 48	3.48	2.66	2.03	[redacted]	1 45
	> 60	3 63	3.63	2.81			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2.61	2.61	2.25	2.25	1.71	1.41
	> 60	2 67	2.67	2.26			

*EOOS condition 1 FRV in Manual Mode is not applicable at power levels below P_{bypass} (≤38.5%).

Table 4-4: ATRIUM 10XM TLO $MCPR_p$ Limits for ISS Insertion Times BOC to EOFPLB (37,536 MWd/MTU Core Average Exposure)
(Reference 6)

Nominal FWT							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.44	2.44	2 14	1.90	[illegible]	1.41
	> 60	2 61	2.61	2 26			
TBVOOS	≤ 60	3.36	3.36	2 56	1.97	[illegible]	1.45
	> 60	3 52	3.52	2.73			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2 44	2.44	2.25	2.25	1.72	1.41
	> 60	2.61	2.61	2.26			
1 FRV in Manual Mode*	≤ 60	2 44	2 44	2.14	1.93	[illegible]	1.41
	> 60	2 61	2 61	2.26			
FHOOS							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.61	2 61	2 24	2.04	[illegible]	1 41
	> 60	2.67	2.67	2 26			
TBVOOS	≤ 60	3.48	3 48	2 66	2.04	[illegible]	1.45
	> 60	3.63	3.63	2 81			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2.61	2 61	2 25	2.25	1.72	1.41
	> 60	2.67	2 67	2 26			

*EOOS condition 1 FRV in Manual Mode is not applicable at power levels below P_{bypass} (≤38.5%).

Table 4-5: ATRIUM 10XM TLO MCPR$_p$ Limits for TSSS Insertion Times BOC to EOFPLB (37,536 MWd/MTU Core Average Exposure)
(Reference 6)

Nominal FWT							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.44	2 44	2.14	1 97	[redacted]	1 41
	> 60	2.61	2 61	2 26			
TBVOOS	≤ 60	3.36	3 36	2.56	1.98	[redacted]	1.45
	> 60	3.52	3.52	2.73			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2.44	2 44	2 26	2.26	1.74	1.41
	> 60	2.61	2 61	2.26			
1 FRV In Manual Mode*	≤ 60	2.44	2.44	2.14	1.97	[redacted]	1.43
	> 60	2.61	2.61	2.26			
FHOOS							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.61	2.61	2.24	2.11	[redacted]	1.41
	> 60	2 67	2.67	2.26			
TBVOOS	≤ 60	3 48	3.48	2.66	2.11	[redacted]	1.45
	> 60	3 63	3.63	2.81			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2.61	2.61	2.26	2.26	1 74	1 41
	> 60	2 67	2.67	2.26			

*EOOS condition 1 FRV in Manual Mode is not applicable at power levels below P_{bypass} (≤38.5%).

Table 4-6: ATRIUM 10XM TLO $MCPR_p$ Limits for NSS Insertion Times EOFPLB to EOCLB (38,332 MWd/MTU Core Average Exposure)
(Reference 6)

Nominal FWT							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.44	2.44	2.14	1.89	[redacted]	1 41
	> 60	2.61	2.61	2.26			
TBVOOS	≤ 60	3 36	3 36	2.56	1.97	[redacted]	1 45
	> 60	3 52	3 52	2 73			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2.44	2.44	2.25	2.25	1.71	1.41
	> 60	2.61	2.61	2 26			
1 FRV in Manual Mode*	≤ 60	2.44	2.44	2.14	1 93	[redacted]	1 41
	> 60	2 61	2.61	2.26			
FHOOS							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.61	2.61	2.24	2.03	[redacted]	1.41
	> 60	2 67	2 67	2.26			
TBVOOS	≤ 60	3.48	3 48	2 66	2.03	[redacted]	1 45
	> 60	3.63	3.63	2.81			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2 61	2.61	2.25	2.25	1.71	1.41
	> 60	2 67	2.67	2.26			

*EOOS condition 1 FRV in Manual Mode is not applicable at power levels below P_{bypass} (≤38 5%).

Table 4-7: ATRIUM 10XM TLO MCPR$_p$ Limits for ISS Insertion Times EOFPLB to EOCLB (38,332 MWd/MTU Core Average Exposure)
(Reference 6)

Nominal FWT							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.44	2.44	2.14	1.90		1.41
	> 60	2.61	2.61	2.26			
TBVOOS	≤ 60	3.36	3.36	2.56	1.97		1.45
	> 60	3.52	3.52	2.73			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2.44	2.44	2.25	2 25	1.72	1.41
	> 60	2.61	2 61	2.26			
1 FRV in Manual Mode*	≤ 60	2.44	2.44	2.14	1.93		1.41
	> 60	2.61	2.61	2.26			
FHOOS							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.61	2 61	2.24	2.04		1.41
	> 60	2.67	2.67	2.26			
TBVOOS	≤ 60	3 48	3.48	2.66	2.04		1.45
	> 60	3.63	3.63	2.81			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2 61	2.61	2.25	2 25	1.72	1.41
	> 60	2.67	2.67	2.26			

*EOOS condition 1 FRV in Manual Mode is not applicable at power levels below P_{bypass} (≤38 5%).

Table 4-8: ATRIUM 10XM TLO $MCPR_p$ Limits for TSSS Insertion Times EOFPLB to EOCLB (38,332 MWd/MTU Core Average Exposure)
(Reference 6)

Nominal FWT							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2 44	2.44	2.14	1.97		1.41
	> 60	2.61	2.61	2.26			
TBVOOS	≤ 60	3.36	3.36	2.56	1.98		1.45
	> 60	3.52	3.52	2.73			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2 44	2.44	2.26	2.26	1.74	1.41
	> 60	2.61	2.61	2.26			
1 FRV in Manual Mode*	≤ 60	2.44	2.44	2 14	1.97		1.43
	> 60	2 61	2 61	2.26			
FHOOS							
EOOS Condition	**Core Flow (% rated)**	**Core Power (% rated)**					
		0	**25**	**≤ 38.5**	**> 38.5**	**75**	**100**
Base/TCV Stuck Closed/MSIVOOS	≤ 60	2.61	2.61	2.24	2.11		1.41
	> 60	2.67	2.67	2.26			
TBVOOS	≤ 60	3.48	3.48	2.66	2.11		1.45
	> 60	3.63	3.63	2.81			
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	2.61	2.61	2.26	2.26	1.74	1.41
	> 60	2.67	2.67	2.26			

*EOOS condition 1 FRV in Manual Mode is not applicable at power levels below P_{bypass} (≤38.5%).

Table 4-9: ATRIUM 10XM SLO $MCPR_p$ Limits for NSS Insertion Times, All Exposures
(Reference 6)

Nominal FWT					
EOOS Condition (all Include SLO)	Core Power (% rated)				
	0	25	≤ 38.5	> 38.5	50
Base/TCV Stuck Closed/MSIVOOS	2.46	2.46	2.16	2.06	2.06
TBVOOS	3 38	3.38	2.58	2.06	2.06
TCV Slow Closure/ PLUOOS/PCOOS	2.46	2.46	2.27	2.27	2.10
FHOOS					
EOOS Condition (all include SLO)	Core Power (% rated)				
	0	25	≤ 38.5	> 38.5	50
Base/TCV Stuck Closed/MSIVOOS	2 63	2.63	2 26	2.06	2.06
TBVOOS	3 50	3.50	2 68	2.06	2.06
TCV Slow Closure/ PLUOOS/PCOOS	2 63	2.63	2.27	2.27	2.10

Table 4-10: ATRIUM 10XM SLO $MCPR_p$ Limits for ISS Insertion Times, All Exposures
(Reference 6)

Nominal FWT					
EOOS Condition (all include SLO)	**Core Power (% rated)**				
	0	**25**	**≤ 38.5**	**> 38.5**	**50**
Base/TCV Stuck Closed/MSIVOOS	2.46	2.46	2.16	2.06	2.06
TBVOOS	3.38	3.38	2.58	2.06	2.06
TCV Slow Closure/ PLUOOS/PCOOS	2.46	2 46	2.27	2.27	2.11
FHOOS					
EOOS Condition (all include SLO)	**Core Power (% rated)**				
	0	**25**	**≤ 38.5**	**> 38.5**	**50**
Base/TCV Stuck Closed/MSIVOOS	2 63	2 63	2.26	2.06	2.06
TBVOOS	3.50	3.50	2.68	2 06	2.06
TCV Slow Closure/ PLUOOS/PCOOS	2.63	2.63	2.27	2.27	2 11

Table 4-11: ATRIUM 10XM SLO $MCPR_P$ Limits for TSSS Insertion Times, All Exposures
(Reference 6)

Nominal FWT					
EOOS Condition (all include SLO)	**Core Power (% rated)**				
	0	**25**	**≤ 38.5**	**> 38.5**	**50**
Base/TCV Stuck Closed/MSIVOOS	2.46	2.46	2.16	2.06	2.06
TBVOOS	3.38	3 38	2.58	2.06	2.06
TCV Slow Closure/ PLUOOS/PCOOS	2.46	2.46	2.28	2.28	2.12
FHOOS					
EOOS Condition (all include SLO)	**Core Power (% rated)**				
	0	**25**	**≤ 38.5**	**> 38.5**	**50**
Base/TCV Stuck Closed/MSIVOOS	2.63	2.63	2.26	2.13	2.06
TBVOOS	3 50	3.50	2 68	2 13	2.06
TCV Slow Closure/ PLUOOS/PCOOS	2 63	2.63	2.28	2.28	2.12

Table 4-12: ATRIUM 10XM $MCPR_f$ Limits
(Reference 6)

EOOS Condition*	Core Flow (% rated)	$MCPR_f$ Limit
Base Case / FHOOS / PCOOS / PLUOOS / TCV Slow Closure / PLUOOS + PCOOS In TLO and SLO / 1 FRV in Manual Mode in TLO	0	1.64
	35	1.64
	108	1.20
Any Scenario with One MSIVOOS**	0	1.82
	35	1.82
	108	1 20
Any Scenario with TBVOOS**	0	1.88
	35	1.88
	108	1.35
Any Scenario with 1 Stuck Closed TCV/TSV**	0	1.64
	35	1 64
	108	1.20

* See Section 8 for further operating restrictions.
** "Any Scenario" implies any other combination of allowable EOOS conditions that is not otherwise covered by this table.

Note that the $MCPR_f$ limits for any scenario with 1 stuck closed TCV/TSV are identical to base case $MCPR_f$ limits. This is reflected in the thermal limit sets presented in Table 8-1.

5. Linear Heat Generation Rate

Technical Specification Sections 3.2.3, 3.4.1, and 3.7.7

The TMOL at rated conditions for the ATRIUM 10XM fuel is established in terms of the maximum LHGR as a function of peak pellet (rod nodal) exposure. The LHGR limits for ATRIUM 10XM fuel are presented in Table 5-1.

The power- and flow-dependent LHGR multipliers ($LHGRFAC_p$ and $LHGRFAC_f$) are applied directly to the LHGR limits to protect against fuel melting and overstraining of the cladding during an AOO (Reference 6) In all conditions, the margin to the LHGR limits is determined by applying the lowest multiplier from the applicable $LHGRFAC_p$ and $LHGRFAC_f$ multipliers for the power/flow statepoint of interest to the steady state LHGR limit (Reference 6).

$LHGRFAC_p$ and $LHGRFAC_f$ multipliers were established to support base case and all EOOS conditions for all Cycle 27 exposures and scram speeds. The $LHGRFAC_p$ multipliers for ATRIUM 10XM are presented in Table 5-2. The $LHGRFAC_f$ multipliers for ATRIUM 10XM are presented in Table 5-3.

Table 5-1: LHGR Limits for ATRIUM 10XM
(Reference 6)

Peak Pellet Exposure (MWd/MTU)	LHGR Limit (kW/ft)
0	14.1
18,900	14.1
74,400	7.4

Table 5-2: ATRIUM 10XM LHGRFAC$_P$ Multipliers for All Scram Insertion Times, All Exposures
(Reference 6)

Nominal FWT								
EOOS Condition	Core Flow (% rated)	Core Power (% rated)						
		0	25	≤ 38.5	> 38.5	60	90	100
Base/TCV Stuck Closed/MSIVOOS	≤ 60	0.54	0 54	0.58	0.61	0.68	0.89	1.00
	> 60	0.54	0.54	0.58				
TBVOOS	≤ 60	0 40	0.40	0.54	0.61	0 68	0.89	1 00
	> 60	0 36	0.36	0.48				
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	0.54	0.54	0.58	0.61	0.68	0.89	1.00
	> 60	0.54	0.54	0.58				
1 FRV in Manual Mode*	≤ 60	0 54	0.54	0.58	0.59	0.63	0.87	0.98
	> 60	0.54	0.54	0.58				
FHOOS								
EOOS Condition	Core Flow (% rated)	Core Power (% rated)						
		0	25	≤ 38.5	> 38.5	60	90	100
Base/TCV Stuck Closed/MSIVOOS	≤ 60	0 50	0 50	0.54	0.61	0.68	0.89	1 00
	> 60	0.48	0 48	0.54				
TBVOOS	≤ 60	0 36	0 36	0.48	0.61	0.68	0.89	1.00
	> 60	0.34	0.34	0.46				
TCV Slow Closure/ PLUOOS/PCOOS	≤ 60	0.50	0.50	0.54	0.61	0.68	0.89	1 00
	> 60	0.48	0.48	0.54				

*EOOS condition 1 FRV in Manual Mode is not applicable at power levels below P_{bypass} (≤38.5%)

Table 5-3: ATRIUM 10XM $LHGRFAC_f$ Multipliers for All Cycle 27 Exposures, All EOOS
(Reference 6)

Core Flow (% rated)	$LHGRFAC_f$
0.0	0.57
35.0	0.57
80.0	1.00
108.0	1.00

6. Control Rod Block Setpoints

Technical Specification Sections 3 3.2.1 and 3.4.1

The Rod Block Monitor Upscale Instrumentation Setpoints are determined from the relationships shown in Table 6-1.

Table 6-1: Rod Block Monitor Upscale Instrumentation Setpoints
(Reference 3)

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%

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

The setpoint may be lower/higher and will still comply with the CRWE analysis because CRWE is analyzed unblocked (Reference 6).

7. Stability Protection Setpoints

Technical Specification Section 3.3.1.3

The OPRM PBDA Trip Settings are provided in Table 7-1.

Table 7-1: OPRM PBDA Trip Settings
(Reference 6)

PBDA Trip Amplitude Setpoint (Sp)	Corresponding Maximum Confirmation Count Setpoint (Np)
1.11	14

The PBDA is the only OPRM setting credited in the safety analysis as documented in the licensing basis for the OPRM system (Methodology 2).

The OPRM PBDA trip settings are based, in part, on the cycle specific OLMCPR and the power/flow dependent MCPR limits. Any change to the OLMCPR values and/or the power/flow 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 combinations of EOOS are as described in Table 8-1. The EOOS conditions separated by "/" in these tables represent single EOOS conditions and not combinations of conditions

Note that the following EOOS options have operational restrictions: all SLO, all EOOS options with 1 TCV/TSV stuck closed, 1 MSIVOOS, and 1 FRV In Manual Mode. See Table 8-2 for specific restrictions.

Table 8-1: Modes of Operation
(Reference 6)

EOOS Option	Thermal Limit Set
Base Case	BASE CASE ➢ TLO or SLO ➢ Nominal FWT or FHOOS
TBVOOS	TBVOOS ➢ TLO or SLO ➢ Nominal FWT or FHOOS
1 TCV/TSV Stuck Closed	BASE CASE ➢ TLO or SLO ➢ Nominal FWT or FHOOS
One MSIVOOS	MSIVOOS ➢ TLO or SLO ➢ Nominal FWT or FHOOS
TCV Slow Closure	PLUOOS/TCV SLOW C ➢ TLO or SLO ➢ Nominal FWT or FHOOS
PLUOOS	PLUOOS/TCV SLOW C ➢ TLO or SLO ➢ Nominal FWT or FHOOS
PCOOS	PLUOOS/TCV SLOW C ➢ TLO or SLO ➢ Nominal FWT or FHOOS
PLUOOS and 1 TCV/TSV Stuck Closed	PLUOOS/TCV SLOW C ➢ TLO for Nominal FWT or FHOOS ➢ SLO for Nominal FWT*
PCOOS and PLUOOS	PLUOOS/TCV SLOW C ➢ TLO for Nominal FWT or FHOOS ➢ SLO for Nominal FWT*
PCOOS and 1 TCV/TSV Stuck Closed	PLUOOS/TCV SLOW C ➢ TLO for Nominal FWT or FHOOS ➢ SLO for Nominal FWT*
1 FRV in Manual Mode	1 MANUAL FRV ALL POSITIONS ➢ TLO for Nominal FWT**

* FHOOS cannot be applied to SLO for the cases of PLUOOS and 1 TCV/TSV Stuck Closed, PCOOS and PLUOOS, and PCOOS and 1 TCV/TSV Stuck Closed.
** SLO and FHOOS cannot be applied for the case of 1 FRV in Manual Mode.

Table 8-2: Core Thermal Power Restriction for EOOS Conditions
(Reference 6)

EOOS Condition	Core Flow (% of Rated)	Core Thermal Power (% of Rated Power)	Rod Line (%)
1 TCV/TSV Stuck Closed PCOOS and 1 TCV/TSV Stuck Closed PLUOOS and 1 TCV/TSV Stuck Closed	N/A	< 75	< 80
One MSIVOOS	N/A	< 75	N/A
SLO	< 51	< 50	N/A
1 FRV in Manual Mode	N/A	> 38 5 (P_{bypass})	N/A

All requirements for all applicable conditions listed in Table 8-2 MUST be met.

Common Notes

1. Base case operation assumes:
    a 1 TBV OOS (only 8 of the 9 bypass valves are available) per Reference 6.
    b. Between 25% and 50% rated power, the PLU will not actuate per Reference 8.
    c. The limiting relief, safety, or SRV is out-of-service per Reference 6.
    d Both dome pressure and throttle pressure control are supported per Reference 6.
    e. Operation with a feedwater temperature band of +10/-30°F relative to the nominal feedwater temperature presented in Reference 7, Item 2.4.2.
    f. Operation for dome pressures between the minimum and maximum bands per Reference 7, Item 2.4.5.

2. All modes are allowed for operation at MELLLA, ICF (up to 108% rated core flow), and coastdown subject to the power restrictions in Table 8-2 (Reference 6). The licensing analysis supports full power operation to EOCLB (38,332 MWd/MTU CAVEX) Note that this value includes coastdown, where full power operation is not expected The minimum allowed coastdown power level is 40% rated CTP per Reference 1. Each OOS Option may be combined with each of the following conditions (Reference 6):
    a. Up to 40% of the TIP channels OOS or the equivalent number of TIP channels, using the guidance in Reference 4 for startup with TIP machines OOS
    b. Up to 50% of the LPRMs OOS
    c An LPRM calibration frequency of up to 2500 EFPH

3. Nominal FWT results are valid for application within a +10°F/-30°F temperature band around the nominal FWT curve (Reference 6) For operation outside of nominal FWT, a FWT reduction of between 30°F and 120°F is supported for all FHOOS conditions listed in Table 8-1 for cycle operation through EOCLB (Reference 6). At lower power levels, the feedwater temperature reduction is less (Reference 6) Per Reference 5, there is a restriction which requires that for a FWT reduction greater than 100°F, operation needs to be restricted to less than the 100% rod line. For a feedwater temperature reduction of between 30°F and 120°F, the FHOOS limits should be applied.

4. The base case and EOOS limits and multipliers support operation with 8 of 9 turbine bypass valves operational (i.e., one bypass valve out of service) with the exception of the TBVOOS condition in which all bypass valves are inoperable (Reference 6). Use of the response curve in TRM Appendix H supports operation with any single TBV OOS. TRM Appendix H facilitates analysis with one valve OOS in that the capacity at 0.5 seconds from start of TSV closure is equivalent to the total capacity with eight out of the nine valves in service (Reference 7). The analyses also support Turbine Bypass flow of 29.8% of vessel rated steam flow (Reference 7), equivalent to one TBV OOS (or partially closed TBVs equivalent to one closed TBV), if the assumed opening profile for the remaining TBVs is met. If the opening profile is NOT met, or if the TBV system CANNOT pass an equivalent of 29.8% of vessel rated steam flow, utilize the TBVOOS condition.

5. TBVOOS assumes that ALL the TBVs do <u>not</u> trip open on TCV fast closure or TSV closure and that ALL the TBVs are <u>not</u> capable of opening via the pressure control system (Reference 8). Steam relief capacity is defined in Reference 7.

6 Between 25% and 50% of rated thermal power, the PLUOOS/TCV Slow Closure thermal limit set ensures that the AOO acceptance criteria are met for a load rejection event if the 86 Device is OOS (Reference 6). Therefore, use the PLUOOS/TCV Slow Closure thermal limit set between 25% and 50% of rated thermal power if the 86 Device is OOS.

7. Operating restrictions apply when one Feedwater Regulating Valve is placed in manual mode, per Reference 6 Additional EOOS conditions that are supported with 1 FRV in Manual Mode consist of 40% of TIP channels OOS and 50% of the LPRMs out-of-service. Other conditions associated with base case conditions, such as the feedwater temperature band, the pressure band, single and three-element level control, dome and turbine pressure control, operation with 1 SRVOOS, and operation with 1 TBV OOS, are supported as discussed in Section 5.1 of Reference 6.

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. GE Topical Report NEDE-24011-P-A, Revision 15, "General Electric Standard Application for Reactor Fuel (GESTAR)," September 2005.

2. GE Topical Report NEDO-32465-A, Revision 0, "Reactor Stability Detect and Suppress Solutions Licensing Basis Methodology for Reload Applications," August 1996.

3. Exxon Nuclear Company Report XN-NF-81-58(P)(A), Revision 2 and Supplements 1 and 2, "RODEX2 Fuel Rod Thermal-Mechanical Response Evaluation Model," March 1984.

4. Advanced Nuclear Fuels Corporation Report ANF-89-98(P)(A), Revision 1 and Supplement 1, "Generic Mechanical Design Criteria for BWR Fuel Designs," May 1995.

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

6 AREVA NP Topical Report BAW-10247PA, Revision 0, "Realistic Thermal-Mechanical Fuel Rod Methodology for Boiling Water Reactors," February 2008.

7. Exxon Nuclear Company Topical Report XN-NF-80-19(P)(A), Volume 1 Revision 0 and Supplements 1 and 2, "Exxon Nuclear Methodology for Boiling Water Reactors – Neutronic Methods for Design and Analysis," March 1983.

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

9. Exxon Nuclear Company Topical Report 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.

10. Siemens Power Corporation Topical Report EMF-2158(P)(A), Revision 0, "Siemens Power Corporation Methodology for Boiling Water Reactors: Evaluation and Validation of CASMO-4/MICROBURN-B2," October 1999.

11. AREVA Topical Report ANP-10298P-A, Revision 1, "ACE/ATRIUM 10XM Critical Power Correlation," March 2014.

12. AREVA NP Topical Report ANP-10307PA, Revision 0, "AREVA MCPR Safety Limit Methodology for Boiling Water Reactors," June 2011.

13 Exxon Nuclear Company Report XN-NF-84-105(P)(A), Volume 1 Revision 0 and Volume 1 Supplements 1 and 2, "XCOBRA-T: A Computer Code for BWR Transient Thermal-Hydraulic Core Analysis," February 1987.

14. Advanced Nuclear Fuels Corporation Report ANF-913(P)(A), Volume 1 Revision 1 and Volume 1 Supplements 2, 3, and 4, "COTRANSA2: A Computer Program for Boiling Water Reactor Transient Analyses," August 1990.

15. Framatome ANP Report EMF-2361(P)(A), Revision 0, "EXEM BWR-2000 ECCS Evaluation Model," May 2001.

16 Siemens Power Corporation Report EMF-2292(P)(A), Revision 0, "ATRIUM™-10. Appendix K Spray Heat Transfer Coefficients," September 2000.

17. Framatome ANP Topical Report ANF-1358(P)(A), Revision 3, "The Loss of Feedwater Heating Transient in Boiling Water Reactors," September 2005.

18. Siemens Power Corporation Topical Report EMF-CC-074(P)(A), Volume 4 Revision 0, "BWR Stability Analysis. Assessment of STAIF with Input from MICROBURN-B2," August 2000.

10. References

1. Exelon Generation Company, LLC, Docket No 50-249, Dresden Nuclear Power Station, Unit 3, Renewed Facility Operating License No DPR-25.
2. Exelon Technical Specifications for Dresden 2 and 3, Table 3.1.4-1, "Control Rod Scram Times."
3. Exelon Design Analysis GE DRF C51-00217-01, "Instrument Setpoint Calculation Nuclear Instrumentation Rod Block Monitor," July 30, 2012.
4. FANP Letter, NJC:04-031/FAB04-496, "Startup with TIP Equipment Out of Service," April 20, 2004. (Exelon EC 348897-000)
5. Exelon Letter, NF-MW:02-0081, "Approval of GE Evaluation of Dresden and Quad Cities Extended Final Feedwater Temperature Reduction," Carlos de la Hoz to Doug Wise and Alex Misak, August 27, 2002. (The GE Evaluation can be found in EDMS as GE-NE-A13-00487-00-01P.)
6. Framatome Report ANP-3863P, Revision 0, "Dresden Unit 3 Cycle 27 Reload Safety Analysis," August 2020.
7 Exelon TODI ES2000003, Revision 0, "Dresden Unit 3 Cycle 27 Plant Parameters Document (PPD)," February 12, 2020.
8. Exelon TODI ES1500011, Revision 0, "Equipment Out of Service Description for Transition to AREVA Fuel – Dresden," May 20, 2015.