Exelon Generation.

10 CFR 50.90

January 29, 2015

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

Peach Bottom Atomic Power Station, Units 2 and 3
Renewed Facility Operating License Nos. DPR-44 and DPR-56
NRC Docket Nos. 50-277 and 50-278

Subject: MELLLA+ License Amendment Request – Supplement 1
Supplemental Reload Licensing Report

Reference: 1. Exelon letter to the NRC, "License Amendment Request – Maximum Extended Load Line Limit Analysis Plus," dated September 4, 2014 (ADAMS Accession No. ML14247A503)

In accordance with 10 CFR 50.90, Exelon Generation Company, LLC (EGC) requested amendments to Facility Operating License Nos. DPR-44 and DPR-56 for Peach Bottom Atomic Power Station (PBAPS) Units 2 and 3, respectively (Reference 1). Specifically, the proposed changes would revise the Renewed Operating Licenses to allow operation in the expanded Maximum Extended Load Line Limit Analysis Plus (MELLLA+) operating domain which utilizes use of the Detect and Suppress – Confirmation Density (DSS-CD) stability solution.

This supplement provides a copy of the Supplemental Reload Licensing Report (SRLR) for PBAPS Unit 2 Cycle 21 in accordance with Section 1.1.1 of Reference 1 for NRC staff confirmation. This SRLR was prepared to specifically evaluate implementation of MELLLA+ during Unit 2 Cycle 21.

As the PBAPS MELLLA+ application is the first for multiple units, the following summary is also provided regarding any differences between the PBAPS Units 2 and 3 SRLRs. The Peach Bottom Unit 2 Cycle 21 MELLLA+ SRLR is representative of the Peach Bottom Unit 3 Cycle 21 MELLLA+ SRLR. The Peach Bottom Unit 2 Cycle 21 and Unit 3 Cycle 21 MELLLA+ SRLRs will both reflect:

- Reactor cores comprised of GNF2 fuel at EPU (3951 MWt) conditions
- The MELLLA+ operating domain
- Transient analysis results based on bounding core flow conditions (MELLLA+ and ICF (Increased Core Flow))
- Reload analysis performed using NRC-approved methodologies, consistent with GESTAR II (General Electric Standard Application for Reactor Fuel).

The only differences between the M+ SRLR for each unit will be typical unit-specific differences like the individual bundle designs and the core loading pattern; there are no differences related to the implementation of MELLLA+.

EGC has reviewed the information supporting a finding of no significant hazards consideration and the environmental consideration provided to the U.S. Nuclear Regulatory Commission in the referenced LAR. The supplemental information provided in this submittal does not affect the bases for concluding that the proposed license amendment does not involve a significant hazards consideration. Further, the additional information provided in this submittal does not affect the bases for concluding that neither an environmental impact statement nor an environmental assessment needs to be prepared in connection with the proposed amendment.

In accordance with 10 CFR 50.91, "Notice for public comment; State consultation," paragraph (b), EGC is notifying the Commonwealth of Pennsylvania and the State of Maryland of this application by transmitting a copy of this letter along with the attachments to the designated State Officials.

There are no regulatory commitments contained in this letter.

Should you have any questions concerning this letter, please contact Mr. David Neff at (610) 765-5631.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 29th day of January 2015.

Respectfully,

Kevin F. Borton
Manager, Licensing – Power Uprate
Exelon Generation Company, LLC

Attachment: Supplemental Reload Licensing Report for PBAPS Unit 2 Cycle 21

cc:	USNRC Region I, Regional Administrator	w/attachments
	USNRC Senior Resident Inspector, PBAPS	w/attachments
	USNRC Project Manager, PBAPS	w/attachments
	R. R. Janati, Commonwealth of Pennsylvania	w/attachments
	S. T. Gray, State of Maryland	w/attachments

Peach Bottom Atomic Power Station Unit 2

MELLLA+ License Amendment Request – Supplement 1

Supplemental Reload Licensing Report for PBAPS Unit 2 Cycle 21

Global Nuclear Fuel

A Joint Venture of GE, Toshiba, & Hitachi

001N2150-SRLR
Revision 1
Class I
January 2015

Supplemental Reload Licensing Report

for

Peach Bottom Unit 2

Reload 20 Cycle 21

Extended Power Uprate (EPU)/Maximum Extended Load Line Limit Analysis Plus (MELLLA+)

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Important Notice Regarding Contents of This Report

Please Read Carefully

This report was prepared by Global Nuclear Fuel - Americas, LLC (GNF-A) solely for use by Exelon Corporation ("Recipient") in support of the operating license for Peach Bottom Unit 2 (the "Nuclear Plant"). The information contained in this report (the "Information") is believed by GNF-A to be an accurate and true representation of the facts known by, obtained by or provided to GNF-A at the time this report was prepared.

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This SRLR is intended for the Extended Power Uprate (EPU) / Maximum Extended Load Line Limit Analysis Plus (MELLLA+) license for Peach Bottom Unit 2 Cycle 21. This SRLR is applicable for the MELLLA+ domain with a rated power of 3951 MWt.

Acknowledgement

The engineering and reload licensing analyses, which form the technical basis of this Supplemental Reload Licensing Report, were performed by GNF-A/GEH Nuclear Analysis personnel. The Supplemental Reload Licensing Report was prepared by Rachel Shapiro. This document has been verified by Mike Smith.

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The basis for this report is *General Electric Standard Application for Reactor Fuel*, NEDE-24011-P-A-20, December 2013; and the U.S. Supplement, NEDE-24011-P-A-20-US, December 2013.

A proprietary *Fuel Bundle Information Report* (FBIR) supplements this licensing report. The FBIR references the thermal-mechanical linear heat generation rate limits and also provides a description of the fuel bundles to be loaded. The document number for this report is 001N6160.1-FBIR Revision 1.

1. Plant Unique Items

Appendix A: Analysis Conditions
Appendix B: Thermal-Mechanical Compliance
Appendix C: Decrease in Core Coolant Temperature Event
Appendix D: Off-Rated Limits
Appendix E: TRACG04 AOO Supplementary Information
Appendix F: Interim Methods LTR (NEDC-33173P-A Revision 4) Supplemental Information
Appendix G: MELLLA+ LTR (NEDC-33006P-A Revision 3) Supplemental Information
Appendix H: List of Acronyms

2. Reload Fuel Bundles

Fuel Type	Cycle Loaded	Number
Irradiated:		
GNF2-P10DG2B406-12G6.0-100T2-150-T6-3337 (GNF2)	19	56
GNF2-P10DG2B393-15GZ-100T2-150-T6-3334 (GNF2)	19	20
GNF2-P10DG2B388-6G8.0/6G7.0/2G6.0-100T2-150-T6-3336 (GNF2)	19	36
GNF2-P10DG2B392-15GZ-100T2-150-T6-3335 (GNF2)	19	32
GNF2-P10DG2B392-15GZ-100T2-150-T6-3332 (GNF2)	19	4
GNF2-P10DG2B399-11G7.0/2G6.0-100T2-150-T6-4130 (GNF2)	20	48
GNF2-P10DG2B392-15GZ-100T2-150-T6-3335 (GNF2)	20	112
GNF2-P10DG2B397-14GZ-100T2-150-T6-4128 (GNF2)	20	40
GNF2-P10DG2B403-12GZ-100T2-150-T6-4129 (GNF2)	20	88
New:		
GNF2-P10DG2B417-2G8.0/10G7.0-100T2-150-T6-4288 (GNF2)	21	88
GNF2-P10DG2B409-14GZ-100T2-150-T6-4287 (GNF2)	21	72
GNF2-P10DG2B402-13G8.0-100T2-150-T6-4286 (GNF2)	21	88
GNF2-P10DG2B403-14GZ-100T2-150-T6-4285 (GNF2)	21	80
Total:		**764**

3. Reference Core Loading Pattern

	Core Average Exposure	Cycle Exposure
Nominal previous end-of-cycle exposure:	37403 MWd/MT (33931 MWd/ST)	18005 MWd/MT (16334 MWd/ST)
Minimum previous end-of-cycle exposure (for cold shutdown considerations):	37072 MWd/MT (33631 MWd/ST)	17675 MWd/MT (16034 MWd/ST)
Assumed reload beginning-of-cycle exposure:	16822 MWd/MT (15261 MWd/ST)	0 MWd/MT (0 MWd/ST)
Assumed reload end-of-cycle exposure (rated conditions):	33467 MWd/MT (30361 MWd/ST)	16645 MWd/MT (15100 MWd/ST)
Reference core loading pattern:	Figure 1	

4. Calculated Core Effective Multiplication and Control System Worth

Beginning of Cycle, $k_{effective}$	
Uncontrolled (20°C)	1.110
Fully controlled (20°C)	0.954
Strongest control rod out (most reactive condition, 20°C)	0.985
R, Maximum increase in strongest rod out reactivity during the cycle (Δk)	0.000
Cycle exposure at which R occurs	0 MWd/MT (0 MWd/ST)

5. Standby Liquid Control System Shutdown Capability

Boron (ppm) (at 20°C)	Shutdown Margin (Δk) (at 160°C, Xenon Free)	
	Analytical Requirement	Achieved
660	≥0.010	0.026

6. Reload Unique Anticipated Operational Occurrences (AOO) Analysis Initial Condition Parameters [1]

Operating domain: ICF (HBB) Exposure range : BOC to MOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GNF2	1.0	1.42	1.48	0.98	7.321	122.5	1.64

Operating domain: ICF (HBB) Exposure range : MOC to EOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GNF2	1.0	1.37	1.32	0.97	7.098	127.2	1.61

Operating domain: MELLLA+ (HBB) Exposure range : BOC to MOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GNF2	1.0	1.41	1.47	0.98	7.307	91.5	1.43

Operating domain: MELLLA+ (HBB) Exposure range : MOC to EOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GNF2	1.0	1.37	1.26	0.98	7.108	95.1	1.43

[1] Exposure range designation is defined in Table 7-1. Application condition number is defined in Section 11.

Operating domain: ICF & FWTR (HBB) Exposure range : BOC to MOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GNF2	1.0	1.48	1.55	0.98	7.648	120.2	1.60

Operating domain: ICF & FWTR (HBB) Exposure range : MOC to EOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GNF2	1.0	1.38	1.32	0.97	7.114	127.9	1.64

Operating domain: MELLLA & FWTR (HBB) Exposure range : BOC to MOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GNF2	1.0	1.41	1.55	0.98	7.272	110.0	1.62

Operating domain: MELLLA & FWTR (HBB) Exposure range : MOC to EOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	Local	Radial	Axial	R-Factor	Bundle Power (MWt)	Bundle Flow (1000 lb/hr)	Initial MCPR
GNF2	1.0	1.37	1.30	0.97	7.076	114.4	1.60

Operating domain: ICF (UB) Exposure range : BOC to EOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GNF2	1.0	1.38	1.25	0.97	7.130	126.0	1.70

Operating domain: MELLLA+ (UB) Exposure range : BOC to EOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GNF2	1.0	1.36	1.40	0.97	7.050	93.2	1.53

Operating domain: ICF & FWTR (UB) Exposure range : BOC to EOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GNF2	1.0	1.38	1.27	0.97	7.128	126.7	1.75

Operating domain: MELLLA & FWTR (UB) Exposure range : BOC to EOC (Application Condition: 1, 2, 3)							
	Peaking Factors						
Fuel Design	**Local**	**Radial**	**Axial**	**R-Factor**	**Bundle Power (MWt)**	**Bundle Flow (1000 lb/hr)**	**Initial MCPR**
GNF2	1.0	1.37	1.27	0.97	7.091	113.3	1.69

7. Selected Margin Improvement Options [2]

Recirculation pump trip:	Yes
Rod withdrawal limiter:	No
Thermal power monitor:	Yes
Improved scram time:	Yes (Option B)
Measured scram time:	No
Exposure dependent limits:	Yes
Exposure points analyzed:	2

Table 7-1 Cycle Exposure Range Designation

Name	Exposure Range [3]
BOC to MOC	BOC21 to EOR21-4860 MWd/MT (4409 MWd/ST)
MOC to EOC	EOR21-4860 MWd/MT (4409 MWd/ST) to EOC21
BOC to EOC	BOC21 to EOC21

[2] Refer to the GESTAR basis document identified at the beginning of this report for the margin improvement options currently supported therein.

[3] End of Rated (EOR) is defined as the cycle exposure corresponding to all rods out, 100% power/100% flow, and normal feedwater temperature. For plants without mid-cycle OLMCPR points, EOR is not applicable.

8. Operating Flexibility Options [4] [5]

The following information presents the operational domains and flexibility options which are supported by the reload licensing analysis.

Extended Operating Domain (EOD):	Yes
EOD type: Maximum Extended Load Line Limit Analysis Plus (MELLLA+)	
Minimum core flow at rated power:	83.0 %
Increased Core Flow:	Yes
Flow point analyzed throughout cycle:	110.0 %
Feedwater Temperature Reduction:	Yes
Feedwater temperature reduction during cycle:	55.0°F
Final feedwater temperature reduction:	90.0°F
ARTS Program:	Yes
Single Loop Operation:	Yes
Equipment Out of Service:	
Safety/relief valves Out of Service: (credit taken for 10 valves)	Yes
TBV Out-of-Service	Yes
EOC RPT Out-of-Service	Yes

[4] Refer to the GESTAR basis document identified at the beginning of this report for the operating flexibility options currently supported therein.
[5] Feedwater Temperature Reduction and Single Loop Operation are prohibited in the MELLLA+ domain.

9. Core-wide AOO Analysis Results [6] [7]

Methods used: GEXL-PLUS, TRACG04

Operating domain: ICF (HBB) **Exposure range : BOC to MOC (Application Condition: 1, 2, 3)**				
			Uncorrected ΔCPR/ICPR	
Event	**Flux (% rated)**	**STP (% rated)**	**GNF2**	**Fig.**
Load Rejection w/o Bypass	206.4	104.4	0.133	2
FW Controller Failure	140.6	106.3	0.096	3

Operating domain: ICF (UB) **Exposure range : MOC to EOC (Application Condition: 1, 2, 3)**				
			Uncorrected ΔCPR/ICPR	
Event	**Flux (% rated)**	**STP (% rated)**	**GNF2**	**Fig.**
Load Rejection w/o Bypass	297.3	106.5	0.178	4
FW Controller Failure	186.1	108.1	0.151	5

Operating domain: ICF with TBVOOS (HBB) **Exposure range : BOC to MOC (Application Condition: 2)**				
			Uncorrected ΔCPR/ICPR	
Event	**Flux (% rated)**	**STP (% rated)**	**GNF2**	**Fig.**
Inadvertent HPCI /L8	183.3	112.6	0.141	6
FW Controller Failure	184.3	108.3	0.137	7

[6] Exposure range designation is defined in Table 7-1. Application condition number is defined in Section 11.
[7] The Heat Flux (Q/A) (% rated) output is not available from TRACG04, so the Simulated Thermal Power (STP) (% rated) is shown.

Operating domain: ICF with TBVOOS (UB) **Exposure range : MOC to EOC (Application Condition: 2)**				
			Uncorrected ΔCPR/ICPR	
Event	**Flux (% rated)**	**STP (% rated)**	**GNF2**	**Fig.**
Inadvertent HPCI /L8	227.4	114.1	0.187	8
FW Controller Failure	240.3	110.1	0.184	9

Operating domain: ICF with RPTOOS (HBB) **Exposure range : BOC to MOC (Application Condition: 3)**				
			Uncorrected ΔCPR/ICPR	
Event	**Flux (% rated)**	**STP (% rated)**	**GNF2**	**Fig.**
Load Rejection w/o Bypass	290.0	106.9	0.171	10
FW Controller Failure	231.8	110.2	0.154	11

Operating domain: ICF with RPTOOS (UB) **Exposure range : MOC to EOC (Application Condition: 3)**				
			Uncorrected ΔCPR/ICPR	
Event	**Flux (% rated)**	**STP (% rated)**	**GNF2**	**Fig.**
Load Rejection w/o Bypass	407.9	108.7	0.206	12
FW Controller Failure	319.1	111.9	0.193	13

10. Rod Withdrawal Error AOO Summary

The Rod Withdrawal Error (RWE) event was analyzed in the GE BWR Licensing Report *Maximum Extended Load Line Limit and ARTS Improvement Program Analyses for Peach Bottom Atomic Power Station Unit 2 and 3*, NEDC-32162P, Rev. 2, March 1995.

RWE Results:

EIS and RPTOOS	
RBM Setpoint (%)	**ΔCPR**
108.0	0.20
111.0	0.21
114.0	0.25
117.0	0.30

TBVOOS	
RBM Setpoint (%)	**ΔCPR**
108.0	0.27
111.0	0.28
114.0	0.29
117.0	0.30

The more limiting of the cycle specific and the generic ΔCPR values are reported in the table above. The RWE OLMCPR is determined by adding the ΔCPR for the desired RBM setpoint from the table above to the SLMCPR in Section 11.

The ARTS RWE analysis validated that the following MCPR values provide the required margin for full withdrawal of any control rod during this cycle:

For Power < 90%: MCPR ≥ 1.70

For Power ≥ 90%: MCPR ≥ 1.40

The RBM operability requirements have been evaluated and shown to be sufficient to ensure that the SLMCPR and cladding strain criteria will not be exceeded in the event of a RWE.

11. Cycle SLMCPR and OLMCPR Summary [8] [9] [10]

Two Loop Operation (TLO) safety limit: 1.15

Single Loop Operation (SLO) safety limit: 1.15

Stability MCPR Design Basis: See Section 15

ECCS MCPR Design Basis: See Section 16 (Initial MCPR)

Non-pressurization Events:

Exposure range: BOC to EOC	
	GNF2
Rod Withdrawal Error (114.0 % RBM Setpoint)	1.40 (EIS, RPTOOS) 1.44 (TBVOOS)
Loss of Feedwater Heating	1.27
Fuel Loading Error (Mislocated)	1.38
Fuel Loading Error (Misoriented)	1.35
Rated Equivalent SLO Pump Seizure [11]	1.43

[8] Exposure range designation is defined in Table 7-1.
[9] For SLO, the MCPR operating limit is equal to the two loop value.
[10] The safety limit values presented include a 0.02 adder in accordance with Interim Methods LTR Safety Evaluation Report Limitation and Condition 9.5, as noted in Appendix F.
[11] The cycle-independent OLMCPR for the recirculation pump seizure event for GNF2 is 1.60 based on the cycle-specific SLO SLMCPR. When adjusted for the off-rated power/flow conditions of SLO, this limit corresponds to a rated OLMCPR of 1.43. This limit does not require an adjustment for the SLO SLMCPR.

Limiting Pressurization Events OLMCPR Summary Table: [12]

Appl. Cond.	Exposure Range	Option A	Option B
		GNF2	**GNF2**
1	**Equipment In Service**		
	BOC to MOC	1.41	1.33
	MOC to EOC	1.48	1.40
2	**TBV Out-of-Service**		
	BOC to MOC	1.43	1.34
	MOC to EOC	1.52	1.43
3	**EOC RPT Out-of-Service**		
	BOC to MOC	1.56	1.39
	MOC to EOC	1.64	1.47

Pressurization Events: [13]

Operating domain: ICF (HBB)
Exposure range : BOC to MOC (Application Condition: 1, 2, 3)

	Option A	Option B
	GNF2	**GNF2**
Load Rejection w/o Bypass	1.41	1.33

Operating domain: ICF (UB)
Exposure range : MOC to EOC (Application Condition: 1, 2, 3)

	Option A	Option B
	GNF2	**GNF2**
Load Rejection w/o Bypass	1.48	1.40

Operating domain: ICF with TBVOOS (HBB)
Exposure range : BOC to MOC (Application Condition: 2)

	Option A	Option B
	GNF2	**GNF2**
Inadvertent HPCI /L8	1.43	1.34

[12] Each application condition (Appl. Cond.) covers the entire range of licensed flow and feedwater temperature unless specified otherwise. The OLMCPR values presented apply to rated power operation based on the two loop operation safety limit MCPR.
[13] Application condition numbers shown for each of the following pressurization events represent the application conditions for which this event contributed in the determination of the limiting OLMCPR value.

Operating domain: ICF with TBVOOS (UB) **Exposure range : MOC to EOC (Application Condition: 2)**		
	Option A	**Option B**
	GNF2	**GNF2**
Inadvertent HPCI /L8	1.52	1.43

Operating domain: ICF with RPTOOS (HBB) **Exposure range : BOC to MOC (Application Condition: 3)**		
	Option A	**Option B**
	GNF2	**GNF2**
Load Rejection w/o Bypass	1.56	1.39

Operating domain: ICF with RPTOOS (UB) **Exposure range : MOC to EOC (Application Condition: 3)**		
	Option A	**Option B**
	GNF2	**GNF2**
Load Rejection w/o Bypass	1.64	1.47

12. Overpressurization Analysis Summary[14]

Event	Pdome (psig)	Pv (psig)	Plant Response
MSIV Closure (Flux Scram) – ICF (HBB)	1313	1341	Figure 14
MSIV Closure (Flux Scram) – MELLLA+ (HBB)	1313	1337	Figure 15

[14] Overpressure calculated at an initial dome pressure of 1035 psig.

13. Fuel Loading Error Results

Variable water gap misoriented bundle analysis: Yes [15]

Misoriented Fuel Bundle	ΔCPR
GNF2-P10DG2B403-14GZ-100T2-150-T6-4285 (GNF2)	0.19
GNF2-P10DG2B402-13G8.0-100T2-150-T6-4286 (GNF2)	0.19
GNF2-P10DG2B409-14GZ-100T2-150-T6-4287 (GNF2)	0.19
GNF2-P10DG2B417-2G8.0/10G7.0-100T2-150-T6-4288 (GNF2)	0.14
GNF2-P10DG2B399-11G7.0/2G6.0-100T2-150-T6-4130 (GNF2)	0.19
GNF2-P10DG2B392-15GZ-100T2-150-T6-3335 (GNF2)	0.16
GNF2-P10DG2B397-14GZ-100T2-150-T6-4128 (GNF2)	0.20
GNF2-P10DG2B403-12GZ-100T2-150-T6-4129 (GNF2)	0.18

14. Control Rod Drop Analysis Results

Peach Bottom Unit 2 operates in a banked position withdrawal sequence; therefore, the control rod drop accident analysis is not required. NRC approval is documented in NEDE-24011-P-A-US.

[15] Includes a 0.02 penalty due to variable water gap R-factor uncertainty.

15. Stability Analysis Results

Exelon is seeking approval for operating Peach Bottom Unit 2 in the MELLLA+ operating domain. Operation within the MELLLA+ operating domain requires the use of the Detect and Suppress Solution – Confirmation Density (DSS-CD) stability solution. Stability results for operation at EPU with MELLLA+ and DSS-CD are contained in this section.

15.1 Stability DSS-CD Solution

Peach Bottom Unit 2 will implement the stability DSS-CD solution using the Oscillation Power Range Monitor (OPRM) as described in Reference 1 in Section 15.4. Plant-specific analyses for the DSS-CD Solution are provided in Reference 2 in Section 15.4. The Detect and Suppress function of the DSS-CD solution based on the OPRM system relies on the Confirmation Density Algorithm (CDA), which constitutes the licensing basis. The Backup Stability Protection (BSP) solution may be used by the plant in the event that the OPRM system is declared inoperable.

The CDA enabled through the OPRM system and the BSP solution described in Reference 2 in Section 15.4 provide the stability licensing bases for Peach Bottom Unit 2 Cycle 21. The safety evaluation report for Reference 1 in Section 15.4 concludes that the DSS-CD solution is acceptable subject to certain cycle-specific limitations and conditions. These cycle-specific limitations and conditions are met for Peach Bottom Unit 2 Cycle 21.

15.2 Detect and Suppress Evaluation

A reload DSS-CD evaluation has been performed in accordance with the licensing methodology described in Reference 1 in Section 15.4 to confirm the Amplitude Discriminator Setpoint (S_{AD}) of the CDA established in Reference 2 in Section 15.4. The Cycle 21 DSS-CD evaluation and the results for the DSS-CD Reload Confirmation Applicability Checklist documented in Table 15-1 demonstrate that: 1) the DSS-CD Solution is applicable to Peach Bottom Unit 2 Cycle 21; and, 2) the S_{AD}=1.10 established in Reference 2 in Section 15.4 is confirmed for operation of Peach Bottom Unit 2 Cycle 21.

The S_{AD}=1.10 setpoint is applicable to TLO and to SLO. The S_{AD}=1.10 setpoint is applicable for a rated feedwater temperature equal to or greater than 371.5°F in the MELLLA+ domain per Reference 2 in Section 15.4.

Table 15-1 DSS-CD Reload Confirmation Applicability Checklist

Parameter	DSS-CD Criterion	Peach Bottom Unit 2 Cycle 21 Results	Acceptance
BWR Product Line	BWR/3-6 design	BWR/4	Confirmed
Fuel Product Line	GNF2 and earlier GE designs	GNF2	Confirmed
Operating Domain (TLO)	≤ EPU/MELLLA+ including currently licensed operational flexibility features	EPU/MELLLA+ including currently licensed operational flexibility features	Confirmed
Operating Domain (SLO)	≤ EPU/MELLLA including currently licensed operational flexibility features	EPU/MELLLA including currently licensed operational flexibility features	Confirmed
Rated T_{FW} Reduction	≤ 120 °F (EPU/MELLLA) No T_{FW} Reduction (MELLLA+ Extension)	90 °F (EPU/MELLLA)	Confirmed
Margin for TLO	see Table 2-4 in Reference 2 in Section 15.4	≥ 0.179	Confirmed
Margin for SLO	see Table 2-5 in Reference 2 in Section 15.4	≥ 0.281	Confirmed

15.3 Backup Stability Protection

Reference 1 in Section 15.4 describes two BSP options that are based on selected elements from three distinct constituents: BSP Manual Regions, BSP Boundary, and Automated BSP (ABSP) setpoints.

The Manual BSP region boundaries and the BSP Boundary were calculated for Peach Bottom Unit 2 Cycle 21 for normal feedwater temperature operation and reduced feedwater temperature. The endpoints of the regions are defined in Table 15-2 and Table 15-3. The Scram Region boundary, the Controlled Entry Region boundary, and the BSP Boundary are shown in Figure 16 and in Figure 17 for the normal and reduced feedwater temperature, respectively.

The ABSP APRM Simulated Thermal Power setpoints associated with the ABSP Scram Region are determined for Cycle 21 and are defined in Table 15-4. These ABSP setpoints are applicable for both TLO and SLO.

The BSP Boundary and the Manual BSP region boundaries for normal feedwater temperature operation are adequate to bound a variation in normal feedwater temperature of -10°F.

Table 15-2 BSP Endpoints for Normal Feedwater Temperature

Endpoint	Power (%)	Flow (%)	Definition
A1	77.7	53.6	Scram Region Boundary, HFCL
B1	40.5	31.0	Scram Region Boundary, NCL
A2	64.5	50.0	Controlled Entry Region Boundary, MELLLA
B2	28.1	30.1	Controlled Entry Region Boundary, NCL
A3	100	99.0	BSP Boundary Intercept, MELLLA
B3	60.5	44.9	BSP Boundary Intercept, MELLLA Line

Table 15-3 BSP Endpoints for Reduced Feedwater Temperature

Endpoint	Power (%)	Flow (%)	Definition
A1	67.1	53.4	Scram Region Boundary, MELLLA
B1	35.1	30.7	Scram Region Boundary, NCL
A2	69.3	56.2	Controlled Entry Region Boundary, MELLLA
B2	28.1	30.1	Controlled Entry Region Boundary, NCL

Note: The BSP Boundary for Reduced Feedwater Temperature is defined by the MELLLA line, per Reference 1 in Section 15.4.

Table 15-4 ABSP Setpoints for the Scram Region

Parameter	Symbol	Value
Slope of ABSP APRM flow-biased trip linear segment.	m_{Trip}	1.65
ABSP APRM flow-biased trip setpoint power intercept. Constant Power Line for Trip from zero Drive Flow to Flow Breakpoint value.	$P_{BSP\text{-}Trip}$	40.5 %RTP
ABSP APRM flow-biased trip setpoint drive flow intercept. Constant Flow Line for Trip.	$W_{BSP\text{-}Trip}$	46.7 %RDF
Flow Breakpoint value	$W_{BSP\text{-}Break}$	25.0 %RDF

15.4 References

1. *GE Hitachi Boiling Water Reactor, Detect and Suppress Solution – Confirmation Density*, NEDC-33075P-A, Revision 8, November 2013.

2. *Safety Analysis Report for Peach Bottom Atomic Power Station Units 2 & 3 Maximum Extended Load Line Limit Analysis Plus*, NEDC-33720P, Revision 0, September 2014.

16. Loss-of-Coolant Accident Results

16.1 10CFR50.46 Licensing Results

The ECCS-LOCA GNF2 analysis is based on the SAFER/PRIME ECCS-LOCA methodology. NRC approval of the PRIME methodology is contained in the Final Safety Evaluation in Reference 2 for GNF2 in Section 16.4. The licensing results applicable to the GNF2 fuel type in the new cycle are summarized in the following table.

Table 16.1-1 Licensing Results

Fuel Type	Licensing Basis PCT (°F)	Local Oxidation (%)	Core-Wide Metal-Water Reaction (%)
GNF2	1920	< 4.00	< 0.10

The SAFER/PRIME ECCS-LOCA analysis results for the GNF2 fuel type are documented in Reference 1 for GNF2 in Section 16.4.

For GNF2, the small break Appendix K ECCS-LOCA result at EPU power and MELLLA+ core flow is 1910 °F as documented in Reference 1. The small break Appendix K ECCS-LOCA result at EPU power and rated core flow is 1905 °F as documented in Reference 1.

16.2 10CFR50.46 Error Evaluation

The 10CFR50.46 errors applicable to the GNF2 Licensing Basis PCT are shown in the following table.

Table 16.2-1 Impact on Licensing Basis Peak Cladding Temperature for GNF2

10CFR50.46 Error Notifications		
Number	**Subject**	**PCT Impact (°F)**
2014-01	SAFER04A E4-Maintenance Update Changes	0
2014-02	SAFER04A E4-Mass Non-Conservatism	+10
2014-03	SAFER04A E4-Minimum Core DP Model	-10
2014-04	SAFER04A E4-Bundle/Lower Plenum CCFL Head	+5
	Total PCT Adder (°F)	+5

After accounting for the error impact, the GNF2 Licensing Basis PCT with the total PCT adder remains below the 10CFR50.46 limit of 2200 °F.

16.3 ECCS-LOCA Operating Limits

The ECCS-LOCA MAPLHGR operating limits for all fuel bundles in this cycle are shown in the following table.

Table 16.3-1 MAPLHGR Limits

Bundle Type(s): GNF2-P10DG2B403-14GZ-100T2-150-T6-4285 (GNF2)
GNF2-P10DG2B402-13G8.0-100T2-150-T6-4286 (GNF2)
GNF2-P10DG2B406-12G6.0-100T2-150-T6-3337 (GNF2)
GNF2-P10DG2B393-15GZ-100T2-150-T6-3334 (GNF2)
GNF2-P10DG2B409-14GZ-100T2-150-T6-4287 (GNF2)
GNF2-P10DG2B417-2G8.0/10G7.0-100T2-150-T6-4288 (GNF2)
GNF2-P10DG2B388-6G8.0/6G7.0/2G6.0-100T2-150-T6-3336 (GNF2)
GNF2-P10DG2B392-15GZ-100T2-150-T6-3335 (GNF2)
GNF2-P10DG2B392-15GZ-100T2-150-T6-3332 (GNF2)
GNF2-P10DG2B399-11G7.0/2G6.0-100T2-150-T6-4130 (GNF2)
GNF2-P10DG2B397-14GZ-100T2-150-T6-4128 (GNF2)
GNF2-P10DG2B403-12GZ-100T2-150-T6-4129 (GNF2)

Average Planar Exposure		MAPLHGR Limit
GWd/MT	**GWd/ST**	**kW/ft**
0.00	0.00	13.78
19.31	17.52	13.78
67.00	60.78	7.50
70.00	63.50	6.69

The power and flow dependent LHGR multipliers are sufficient to provide adequate protection for the off-rated conditions from an ECCS-LOCA analysis perspective. The MAPLHGR multipliers can either be set to unity or set equal to the LHGR multipliers, which remain compliant with the basis of the ECCS-LOCA analysis with no loss of ECCS-LOCA margin.

The single loop operation multipliers on LHGR and MAPLHGR and the ECCS-LOCA analytical initial MCPR values, applicable to the GNF2 fuel type in the new cycle core are shown in the following table.

Table 16.3-2 Initial MCPR and Single Loop Operation Multiplier on LHGR and MAPLHGR

Fuel Type	Initial MCPR	Single Loop Operation Multiplier on LHGR and MAPLHGR
GNF2	1.25	0.73

The GNF2 SLO multiplier applies to the EPU operating domain only, and SLO operation in the MELLLA+ domain is not permitted.

16.4 References

The SAFER/PRIME ECCS-LOCA analysis base reports applicable to the new cycle core are:

References for GNF2

1. *Project Task Report, Exelon Generation Company LLC, Peach Bottom Atomic Power Station, Units 2 & 3 MELLLA+ Task T0407: ECCS-LOCA Performance*, 0000-0162-2354-R0, Revision 0, December 2013.
2. *Licensing Topical Report, The PRIME Model for Analysis of Fuel Rod Thermal-Mechanical Performance*, Part 1 - Technical Bases - NEDC-33256P-A, Revision 1, Part 2 - Qualification - NEDC-33257P-A, Revision 1, and Part 3 - Application Methodology - NEDC-33258P-A, Revision 1, September 2010.

60									10	19	11	19	19	8	8	8	8	19	19	20	21	20								
58								9	8	19	8	26	24	22	22	22	22	24	26	20	19	8	9							
56						19	20	8	1	23	26	4	25	4	24	24	4	25	4	26	23	1	20	8	10					
54						11	8	22	4	4	4	4	5	4	5	5	4	5	4	4	4	4	22	8	11					
52					8	1	25	4	13	12	28	6	27	3	27	27	3	27	6	28	12	13	4	25	8	1				
50			11	8	19	25	4	4	12	25	6	6	7	26	5	5	26	7	6	6	25	12	4	4	25	19	19	11		
48			20	8	25	4	25	12	25	6	22	3	25	5	24	24	5	25	3	22	6	25	12	25	4	25	8	8		
46		9	8	22	4	4	12	26	6	25	3	22	5	25	3	3	25	5	22	3	25	6	26	12	4	4	22	8	9	
44	20	8	10	4	13	12	25	6	28	12	22	5	24	3	24	24	3	24	5	22	12	28	6	25	12	13	4	10	8	19
42	21	11	23	4	12	25	6	25	12	22	2	23	3	26	5	5	26	3	23	2	22	12	25	6	25	12	4	23	11	8
40	19	8	26	4	28	6	22	3	22	2	25	3	27	2	24	24	2	27	3	25	2	22	3	22	6	28	4	26	8	9
38	9	26	4	4	6	6	3	22	5	23	3	26	5	22	7	7	22	5	26	3	23	5	22	3	6	6	4	4	26	19
36	8	24	25	5	27	7	25	5	24	3	27	5	28	3	26	26	3	28	5	27	3	24	5	25	7	27	5	25	24	8
34	20	22	4	4	3	26	5	25	3	26	2	22	3	25	5	5	25	3	22	2	26	3	25	5	26	3	4	4	22	11
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30	8	22	24	5	27	5	24	3	24	5	24	7	26	5	22	22	5	26	7	24	5	24	3	24	5	27	5	24	22	8
28	19	22	4	4	3	26	5	25	3	26	2	22	3	25	5	5	25	3	22	2	26	3	25	5	26	3	4	4	22	8
26	8	24	25	5	27	7	25	5	24	3	27	5	28	3	26	26	3	28	5	27	3	24	5	25	7	27	5	25	24	8
24	19	26	4	4	6	6	3	22	5	23	3	26	5	22	7	7	22	5	26	3	23	5	22	3	6	6	4	4	26	9
22	9	19	26	4	28	6	22	3	22	2	25	3	27	2	24	24	2	27	3	25	2	22	3	22	6	28	4	26	8	19
20	21	8	23	4	12	25	6	25	12	22	2	23	3	26	5	5	26	3	23	2	22	12	25	6	25	12	4	23	11	21
18	20	8	10	4	13	12	25	6	28	12	22	5	24	3	24	24	3	24	5	22	12	28	6	25	12	13	4	10	8	20
16		9	8	22	4	4	12	26	6	25	3	22	5	25	3	3	25	5	22	3	25	6	26	12	4	4	22	8	9	
14			8	1	25	4	25	12	25	6	22	3	25	5	24	24	5	25	3	22	6	25	12	25	4	25	20	1		
12			11	19	8	25	4	4	12	25	6	6	7	26	5	5	26	7	6	6	25	12	4	4	25	8	19	11		
10					8	20	25	4	13	12	28	6	27	3	27	27	3	27	6	28	12	13	4	25	19	8				
8						11	20	22	4	4	4	4	5	4	5	5	4	5	4	4	4	4	22	20	11					
6						10	8	8	1	23	26	4	25	4	24	24	4	25	4	26	23	1	8	8	10					
4								9	11	19	8	26	24	22	22	22	22	24	26	8	19	8	9							
2									11	8	20	19	19	8	8	8	8	19	19	20	19	11								
	1	3	5	7	9	11	13	15	17	19	21	23	25	27	29	31	33	35	37	39	41	43	45	47	49	51	53	55	57	59

Fuel Type

1=GNF2-P10DG2B393-15GZ-100T2-150-T6-3334	(Cycle 19)	13=GNF2-P10DG2B417-2G8.0/10G7.0-100T2-150-T6-4288	(Cycle 21)
2=GNF2-P10DG2B403-14GZ-100T2-150-T6-4285	(Cycle 21)	19=GNF2-P10DG2B388-6G8.0/6G7.0/2G6.0-100T2-150-T6-3336	(Cycle 19)
3=GNF2-P10DG2B403-14GZ-100T2-150-T6-4285	(Cycle 21)	20=GNF2-P10DG2B392-15GZ-100T2-150-T6-3335	(Cycle 19)
4=GNF2-P10DG2B417-2G8.0/10G7.0-100T2-150-T6-4288	(Cycle 21)	21=GNF2-P10DG2B392-15GZ-100T2-150-T6-3332	(Cycle 19)
5=GNF2-P10DG2B402-13G8.0-100T2-150-T6-4286	(Cycle 21)	22=GNF2-P10DG2B392-15GZ-100T2-150-T6-3335	(Cycle 20)
6=GNF2-P10DG2B409-14GZ-100T2-150-T6-4287	(Cycle 21)	23=GNF2-P10DG2B397-14GZ-100T2-150-T6-4128	(Cycle 20)
7=GNF2-P10DG2B402-13G8.0-100T2-150-T6-4286	(Cycle 21)	24=GNF2-P10DG2B399-11G7.0/2G6.0-100T2-150-T6-4130	(Cycle 20)
8=GNF2-P10DG2B406-12G6.0-100T2-150-T6-3337	(Cycle 19)	25=GNF2-P10DG2B403-12GZ-100T2-150-T6-4129	(Cycle 20)
9=GNF2-P10DG2B393-15GZ-100T2-150-T6-3334	(Cycle 19)	26=GNF2-P10DG2B392-15GZ-100T2-150-T6-3335	(Cycle 20)
10=GNF2-P10DG2B388-6G8.0/6G7.0/2G6.0-100T2-150-T6-3336	(Cycle 19)	27=GNF2-P10DG2B397-14GZ-100T2-150-T6-4128	(Cycle 20)
11=GNF2-P10DG2B392-15GZ-100T2-150-T6-3335	(Cycle 19)	28=GNF2-P10DG2B403-12GZ-100T2-150-T6-4129	(Cycle 20)
12=GNF2-P10DG2B409-14GZ-100T2-150-T6-4287	(Cycle 21)		

Figure 1 Reference Core Loading Pattern

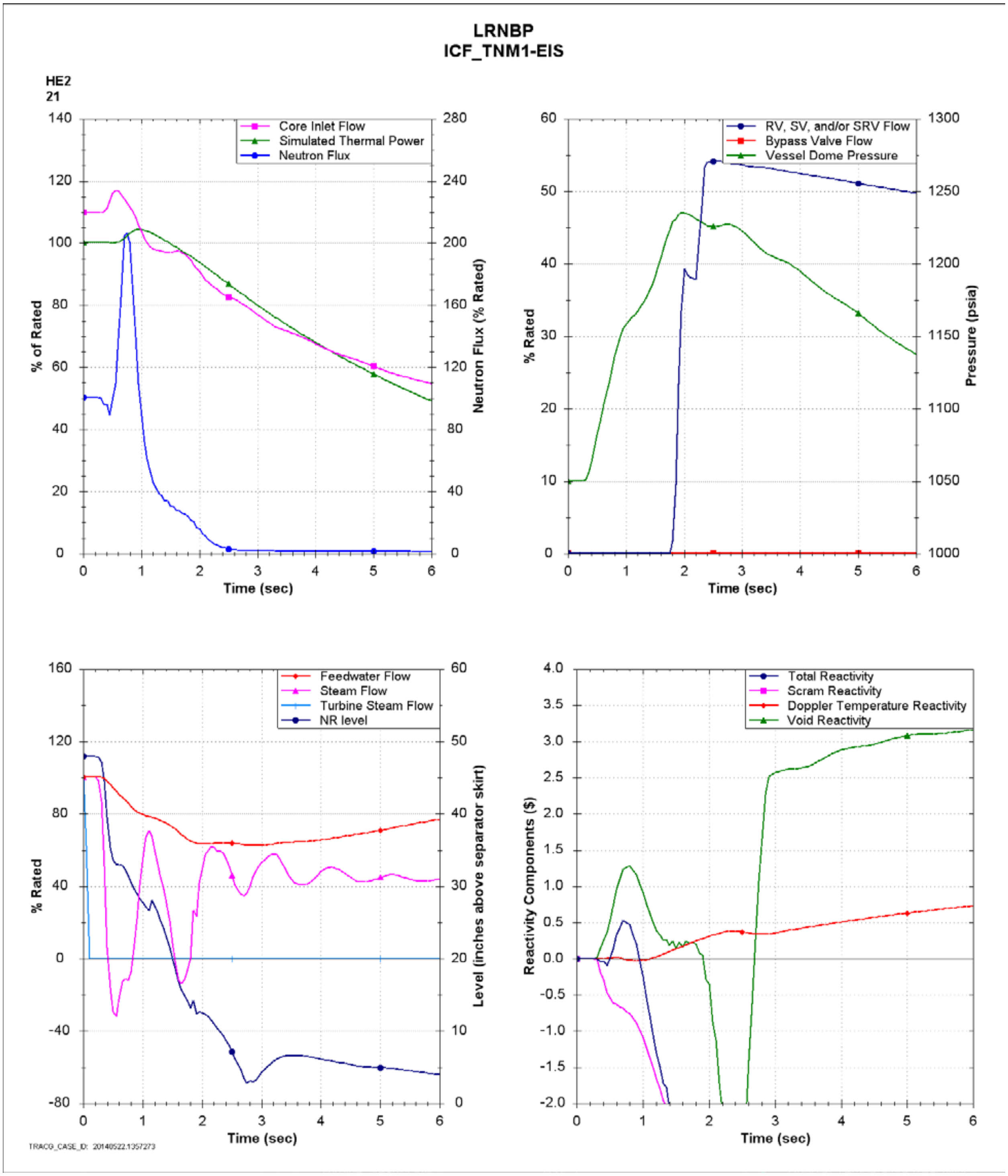

Figure 2 Plant Response to Load Rejection w/o Bypass
(MOC ICF (HBB))

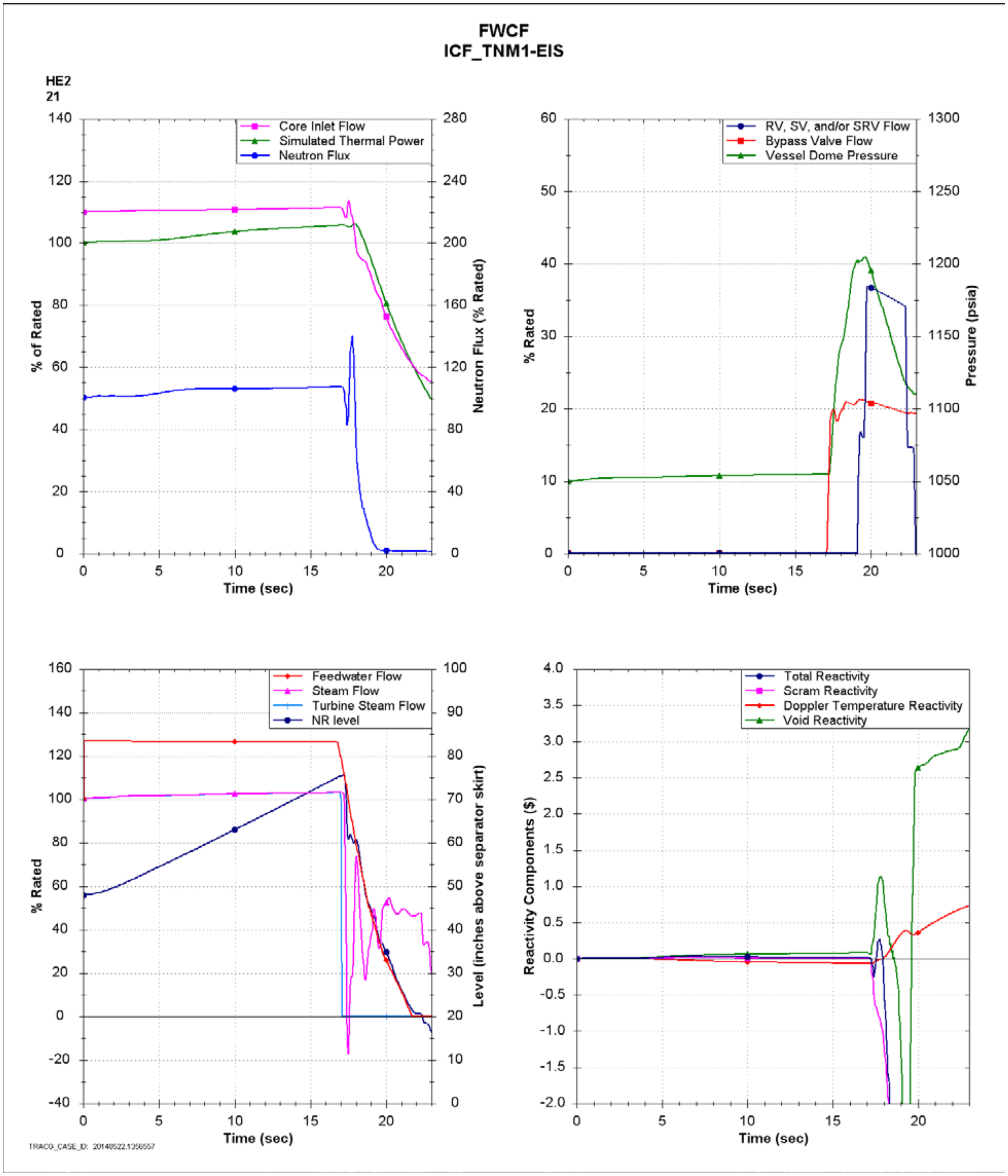

Figure 3 Plant Response to FW Controller Failure
(MOC ICF (HBB))

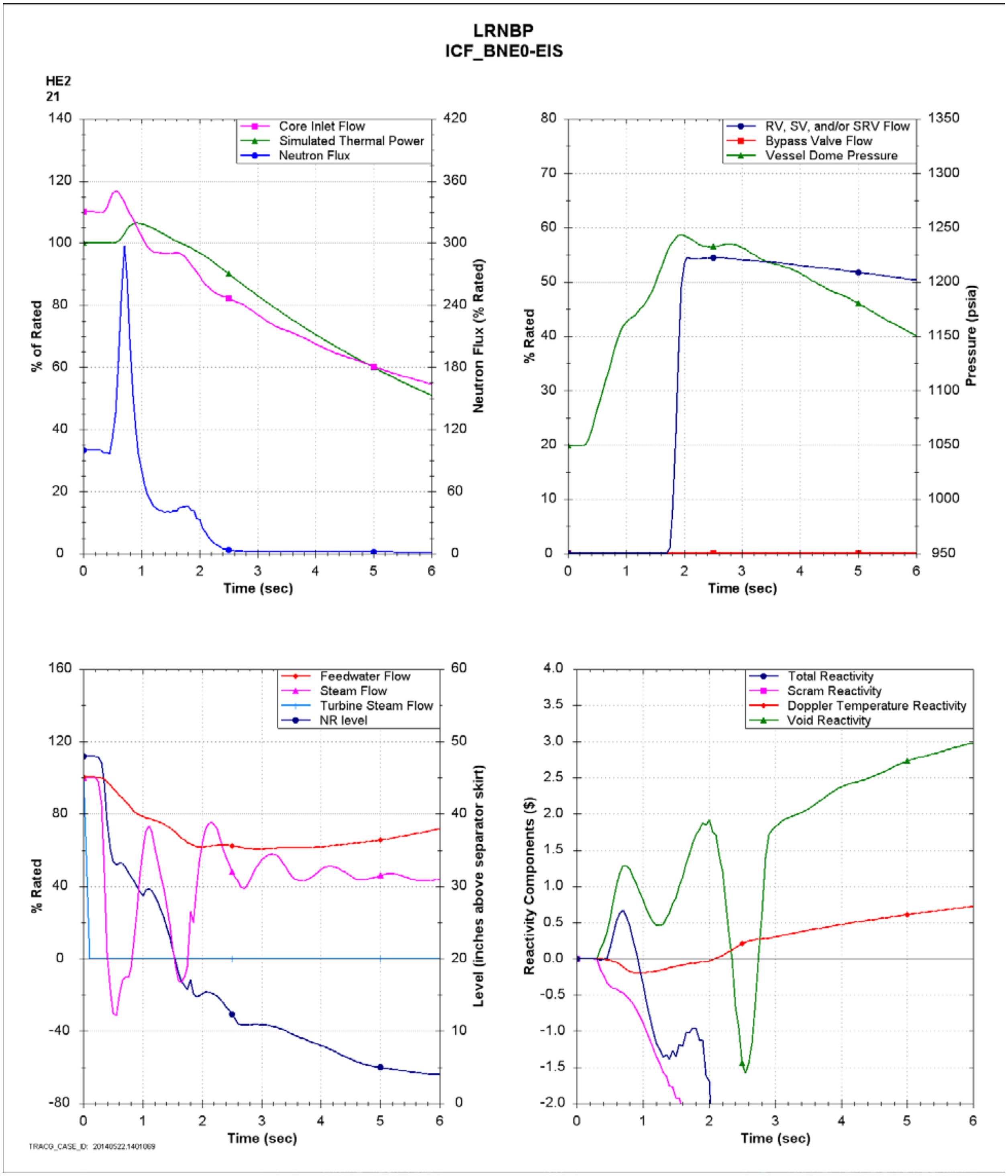

Figure 4 Plant Response to Load Rejection w/o Bypass
(EOC ICF (UB))

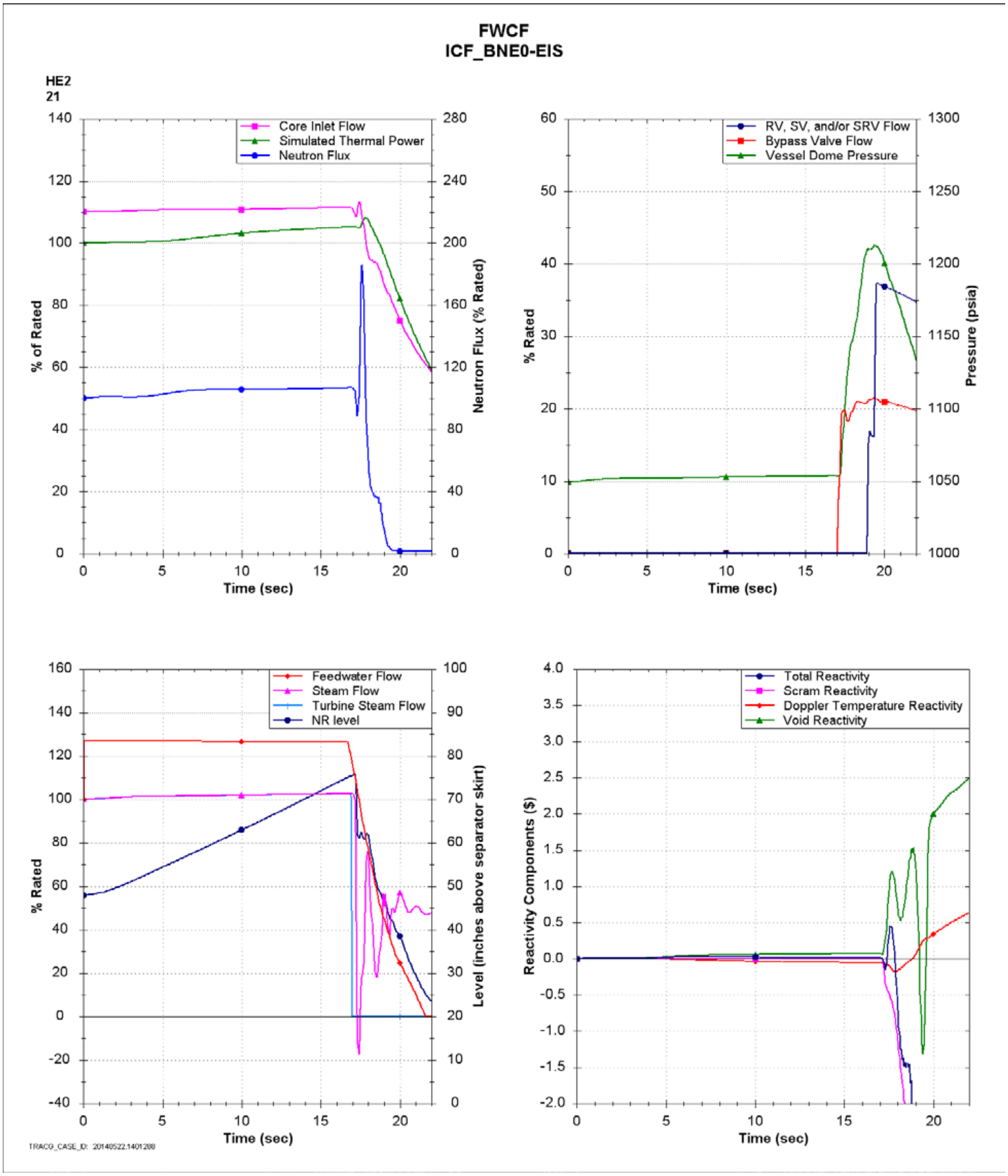

Figure 5 Plant Response to FW Controller Failure
(EOC ICF (UB))

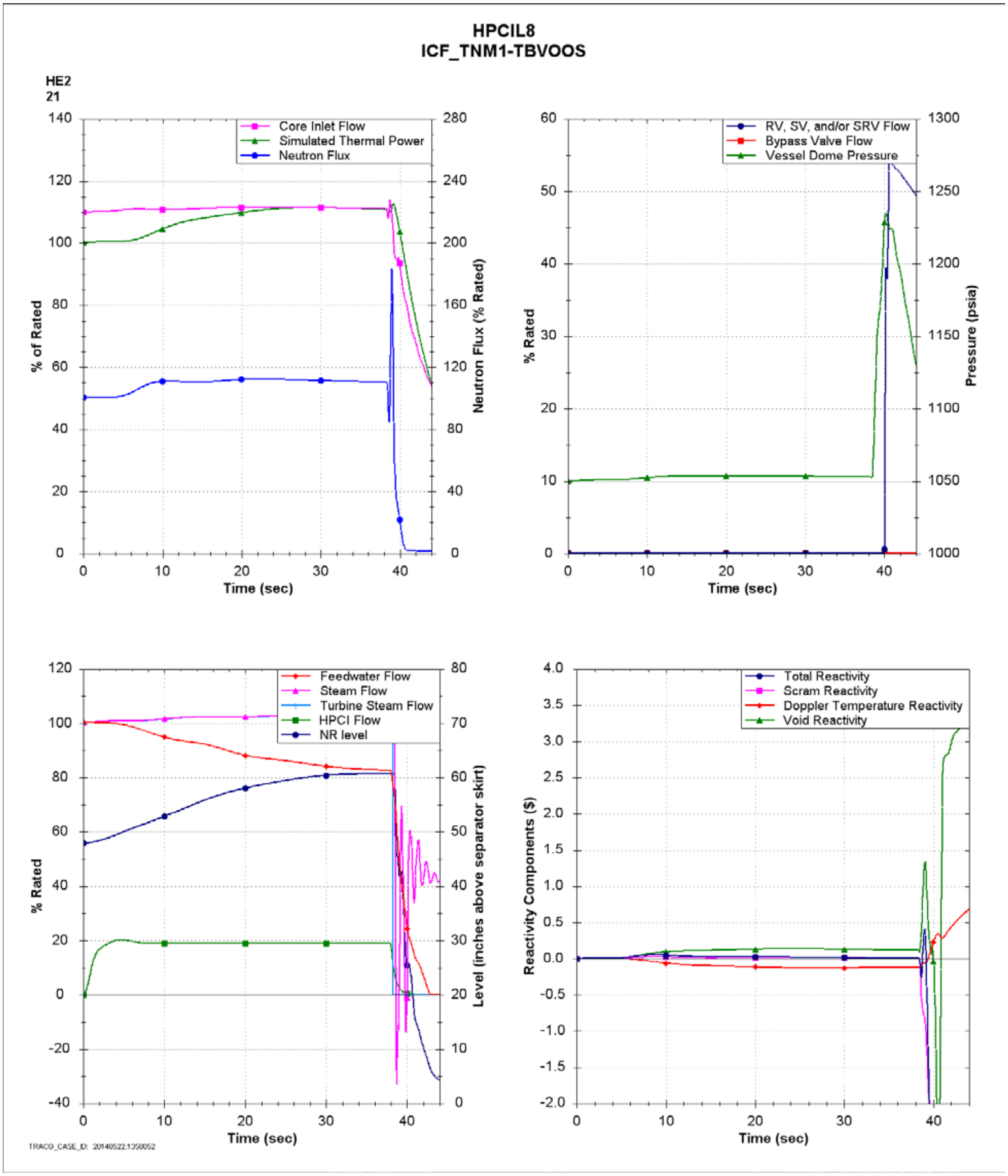

Figure 6 Plant Response to Inadvertent HPCI/L8
(MOC ICF with TBVOOS (HBB))

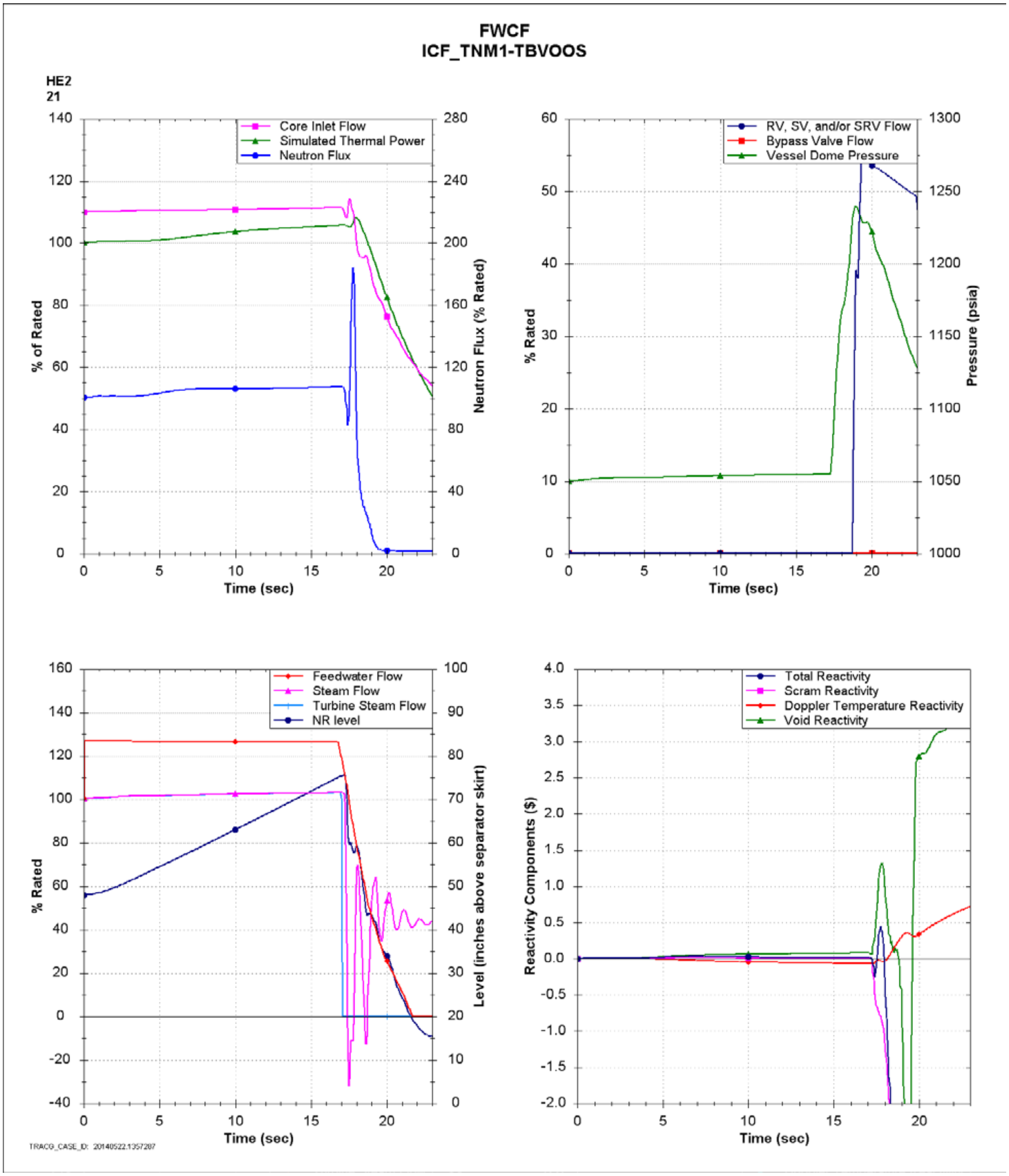

Figure 7 Plant Response to FW Controller Failure
(MOC ICF with TBVOOS (HBB))

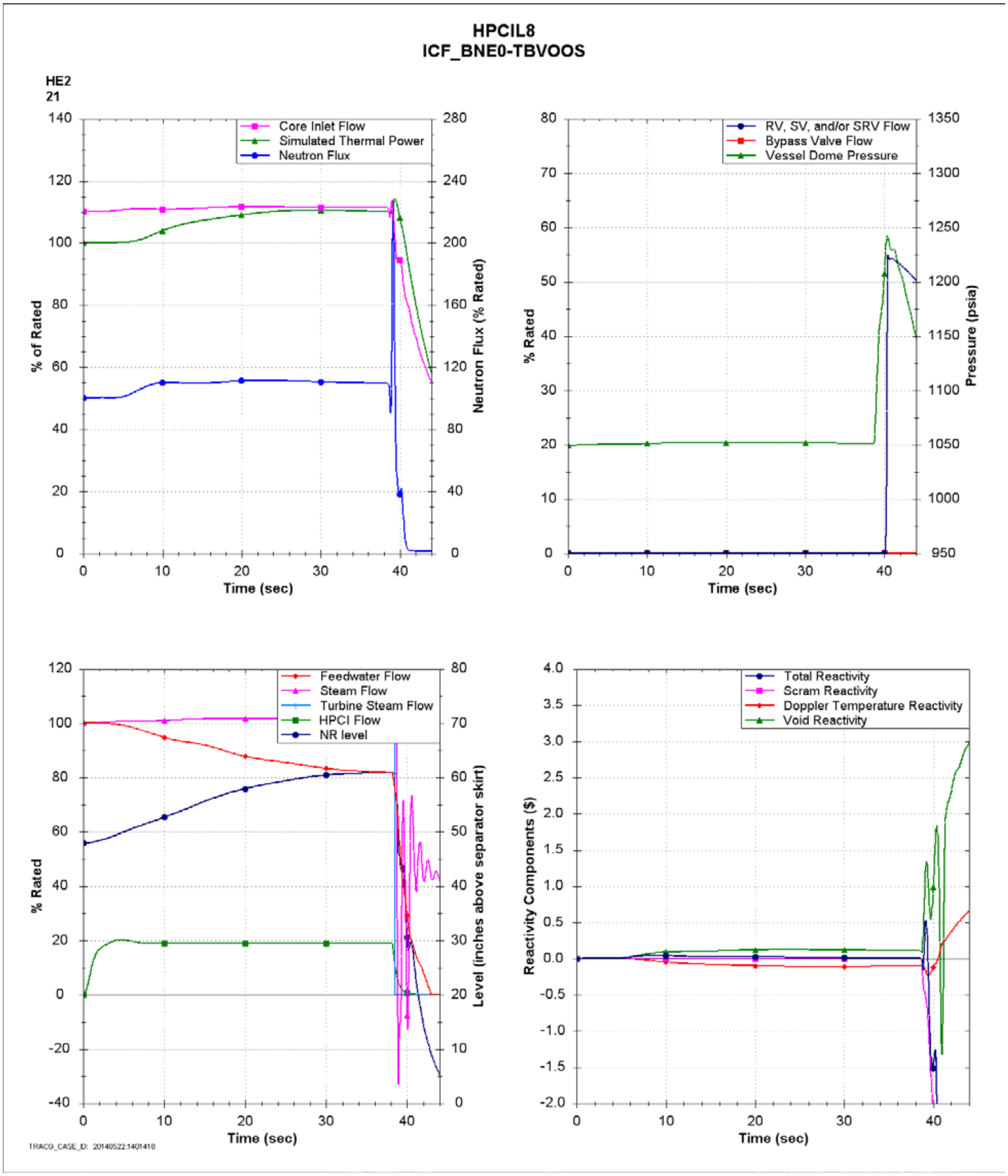

Figure 8 Plant Response to Inadvertent HPCI/L8
(EOC ICF with TBVOOS (UB))

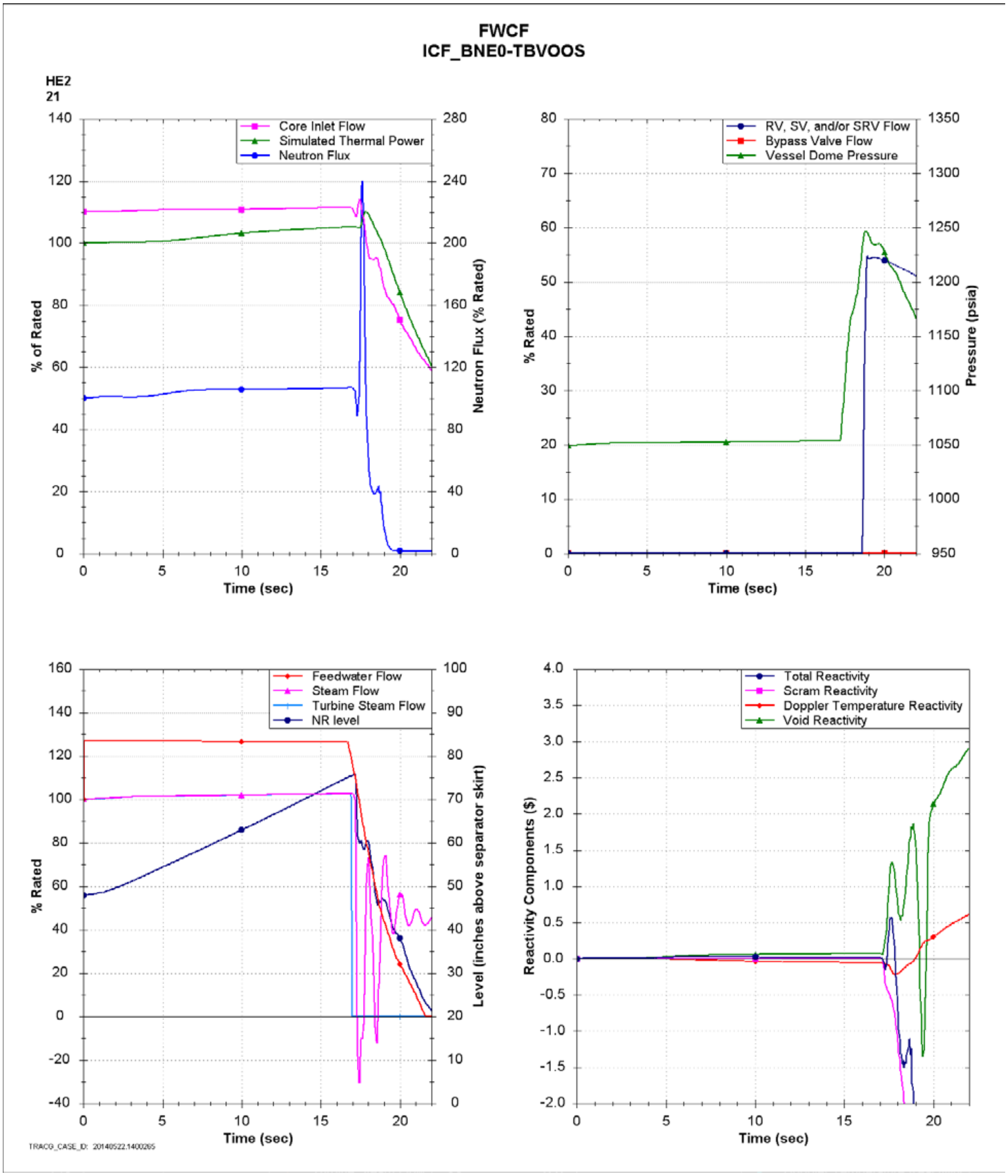

Figure 9 Plant Response to FW Controller Failure
(EOC ICF with TBVOOS (UB))

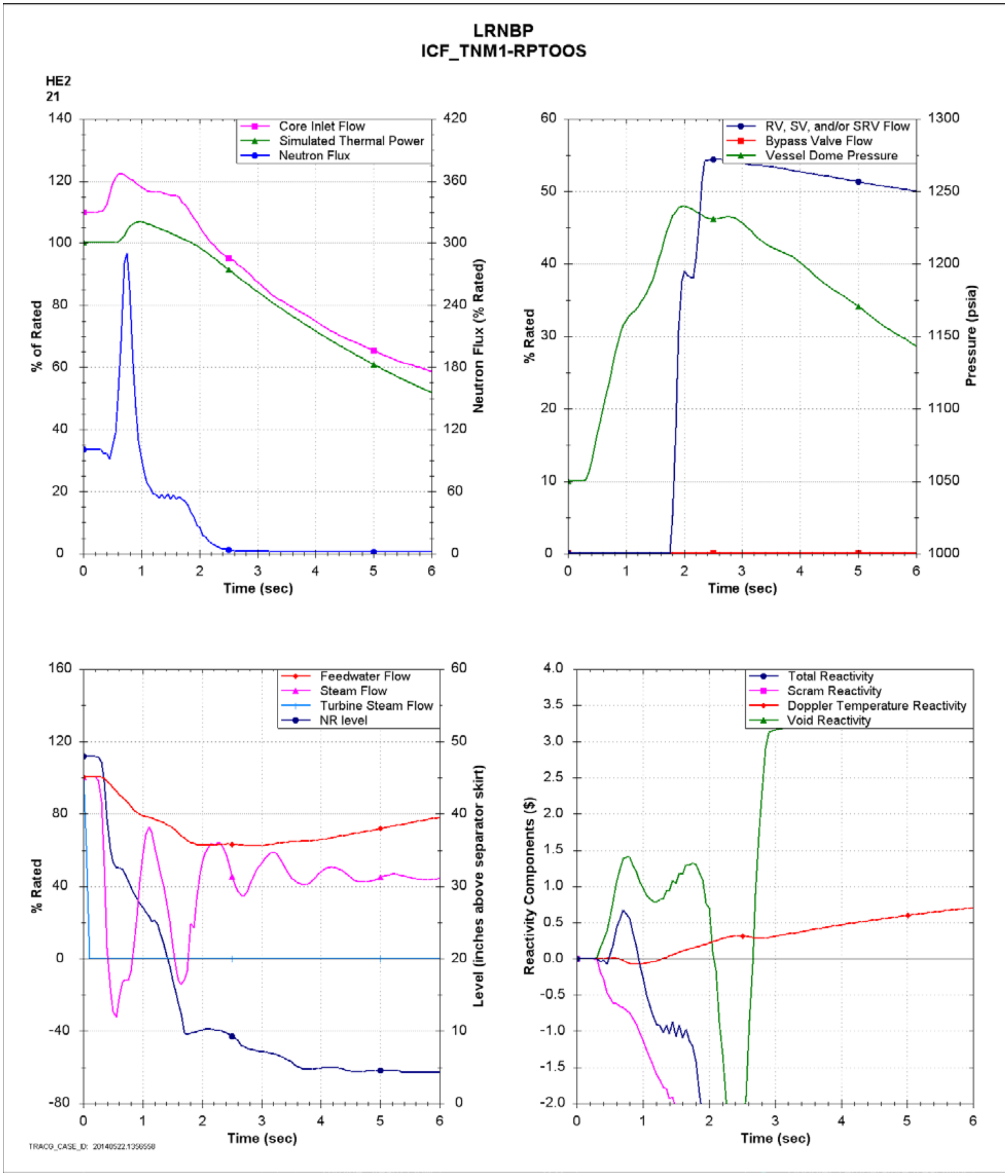

Figure 10 Plant Response to Load Rejection w/o Bypass
(MOC ICF with RPTOOS (HBB))

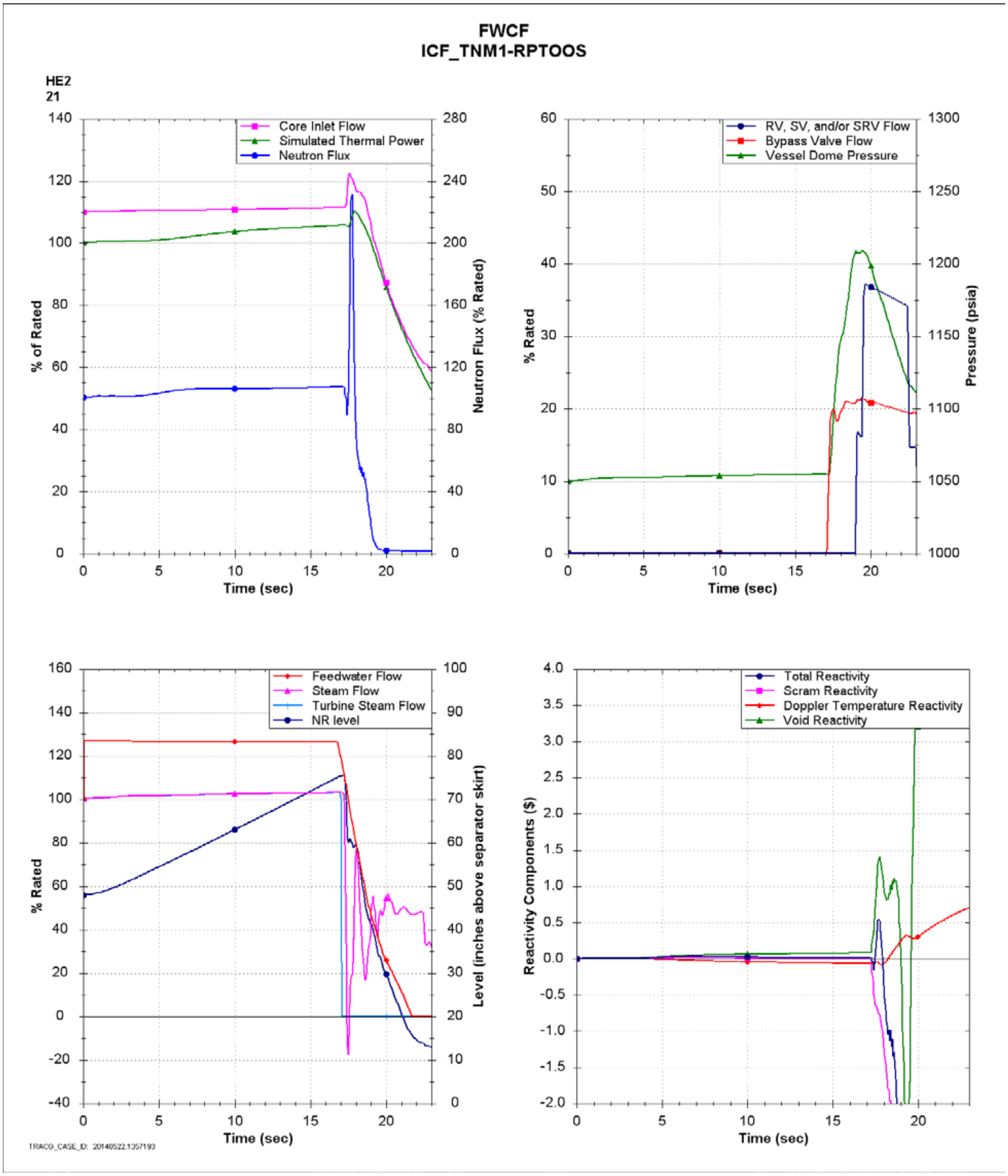

Figure 11 Plant Response to FW Controller Failure
(MOC ICF with RPTOOS (HBB))

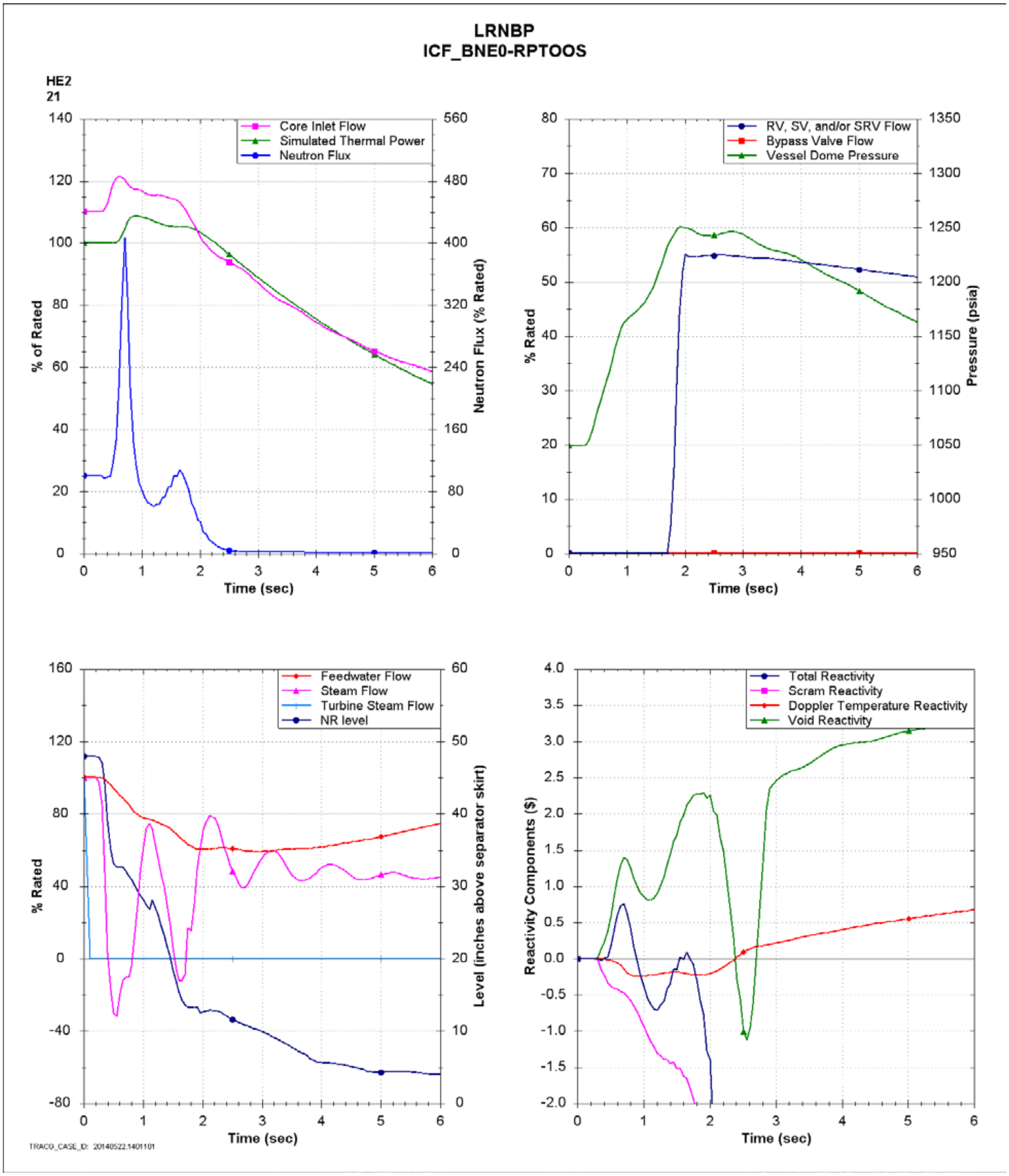

Figure 12 Plant Response to Load Rejection w/o Bypass
(EOC ICF with RPTOOS (UB))

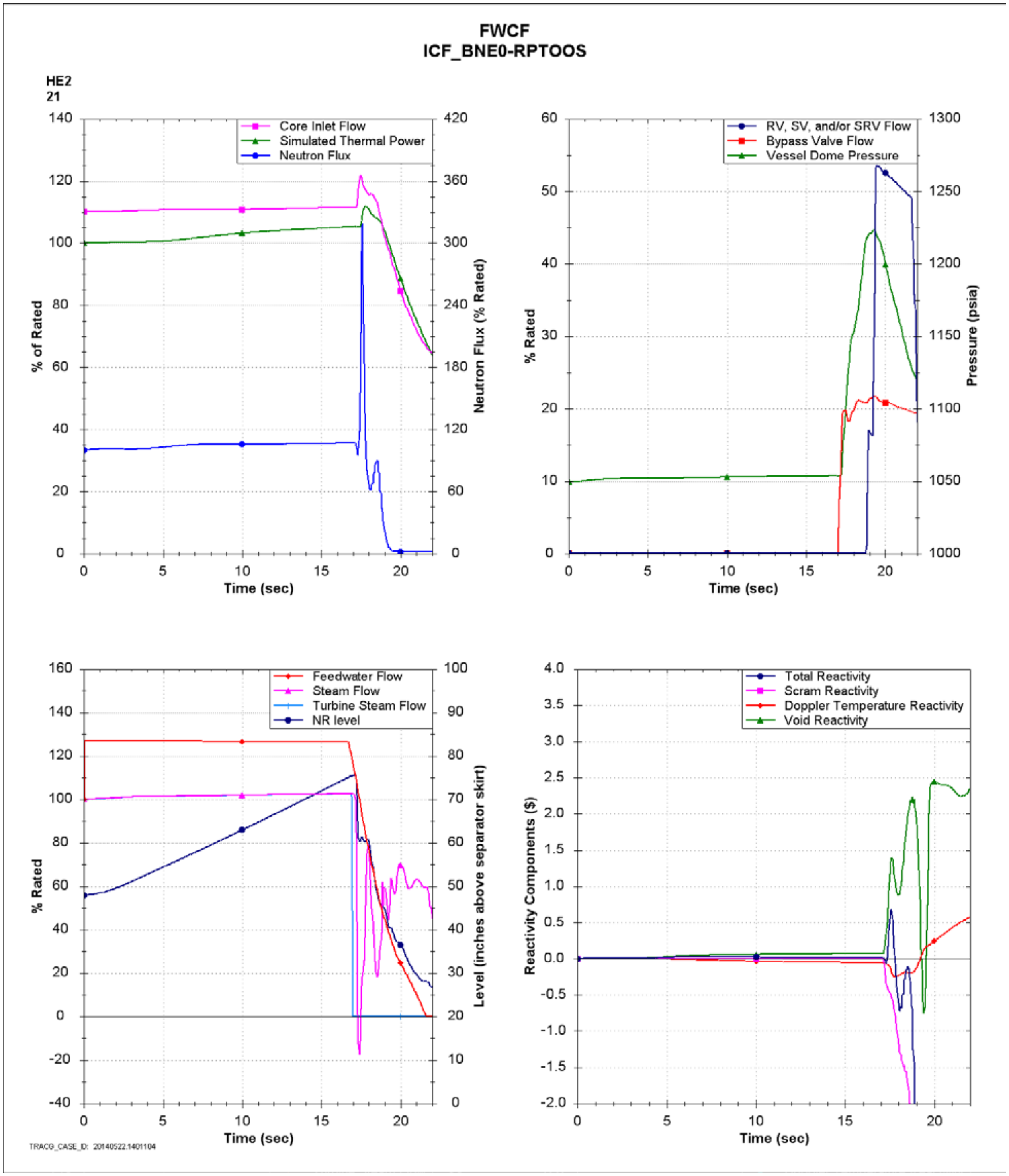

Figure 13 Plant Response to FW Controller Failure
(EOC ICF with RPTOOS (UB))

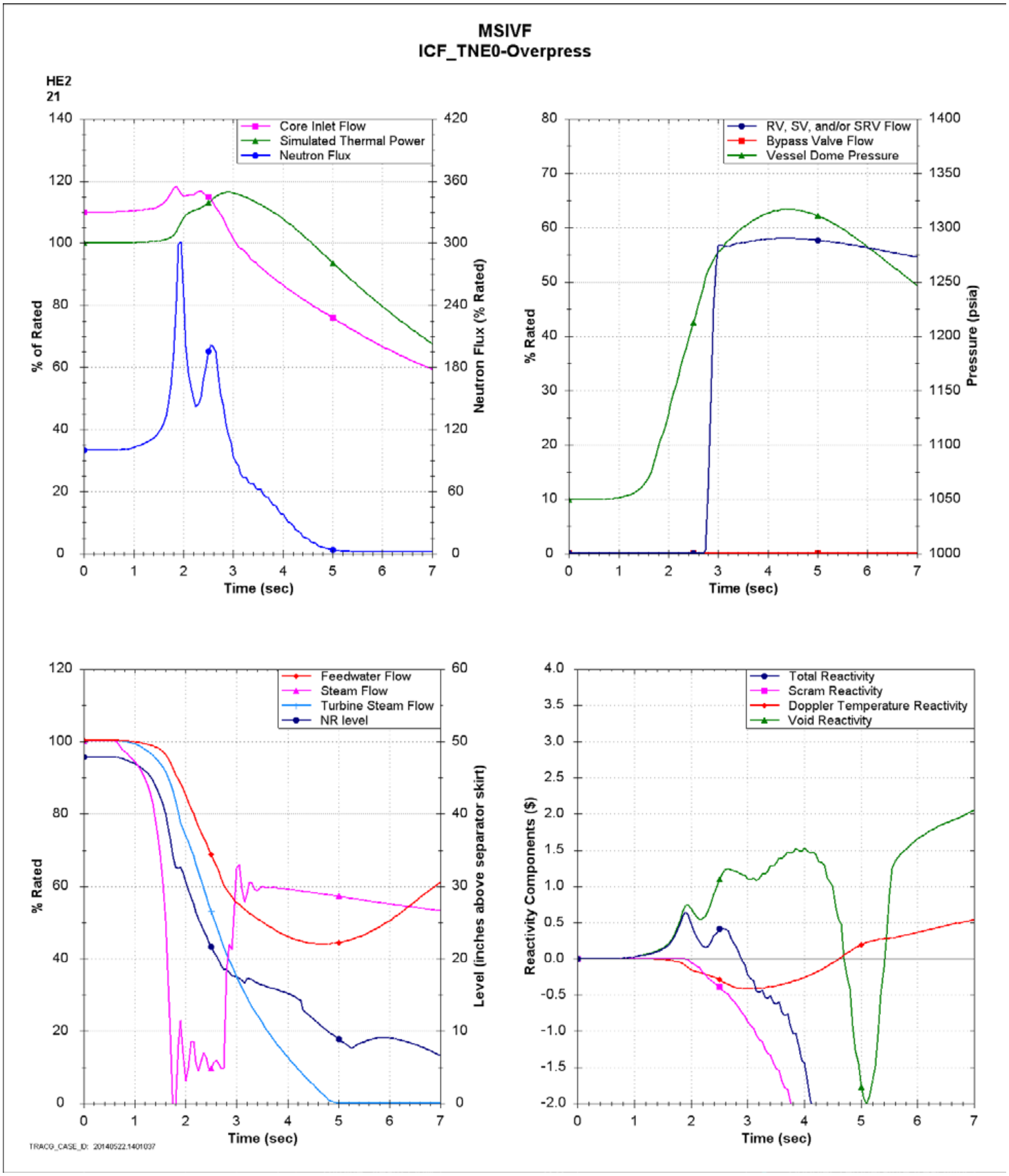

Figure 14 Plant Response to MSIV Closure (Flux Scram) – ICF (HBB)

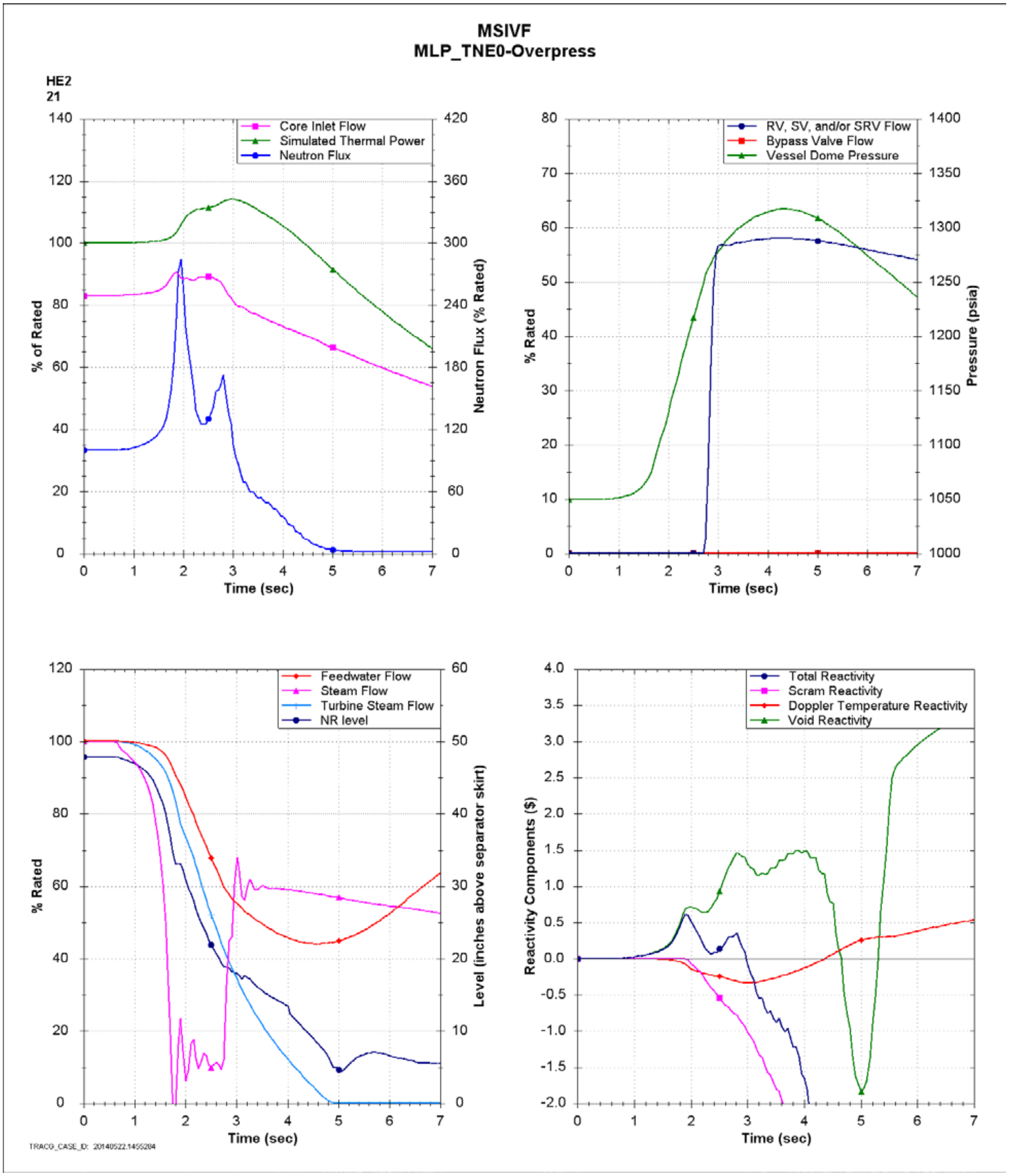

Figure 15 Plant Response to MSIV Closure (Flux Scram) – MELLLA+ (HBB)

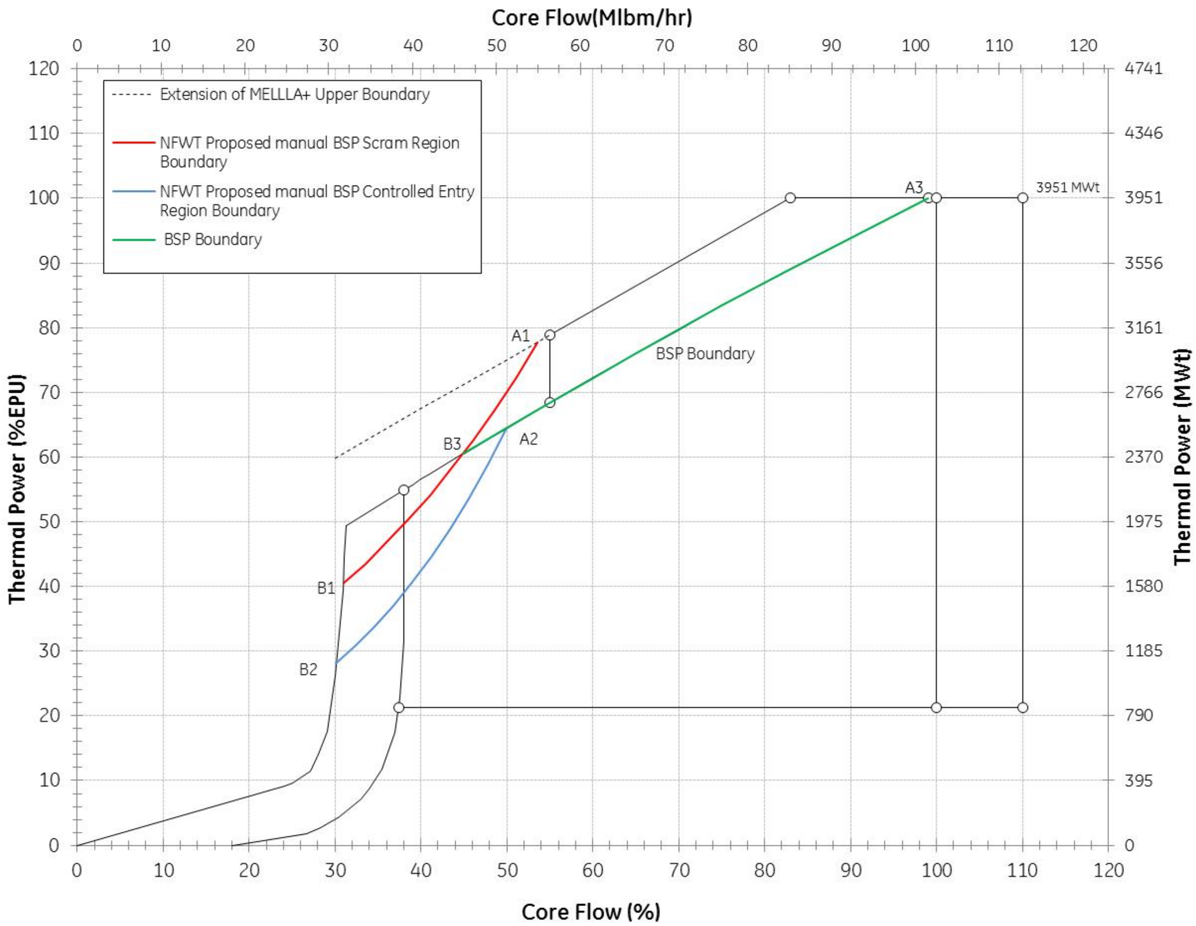

Figure 16 Manual BSP Regions and BSP Boundary for Normal Feedwater Temperature Operation

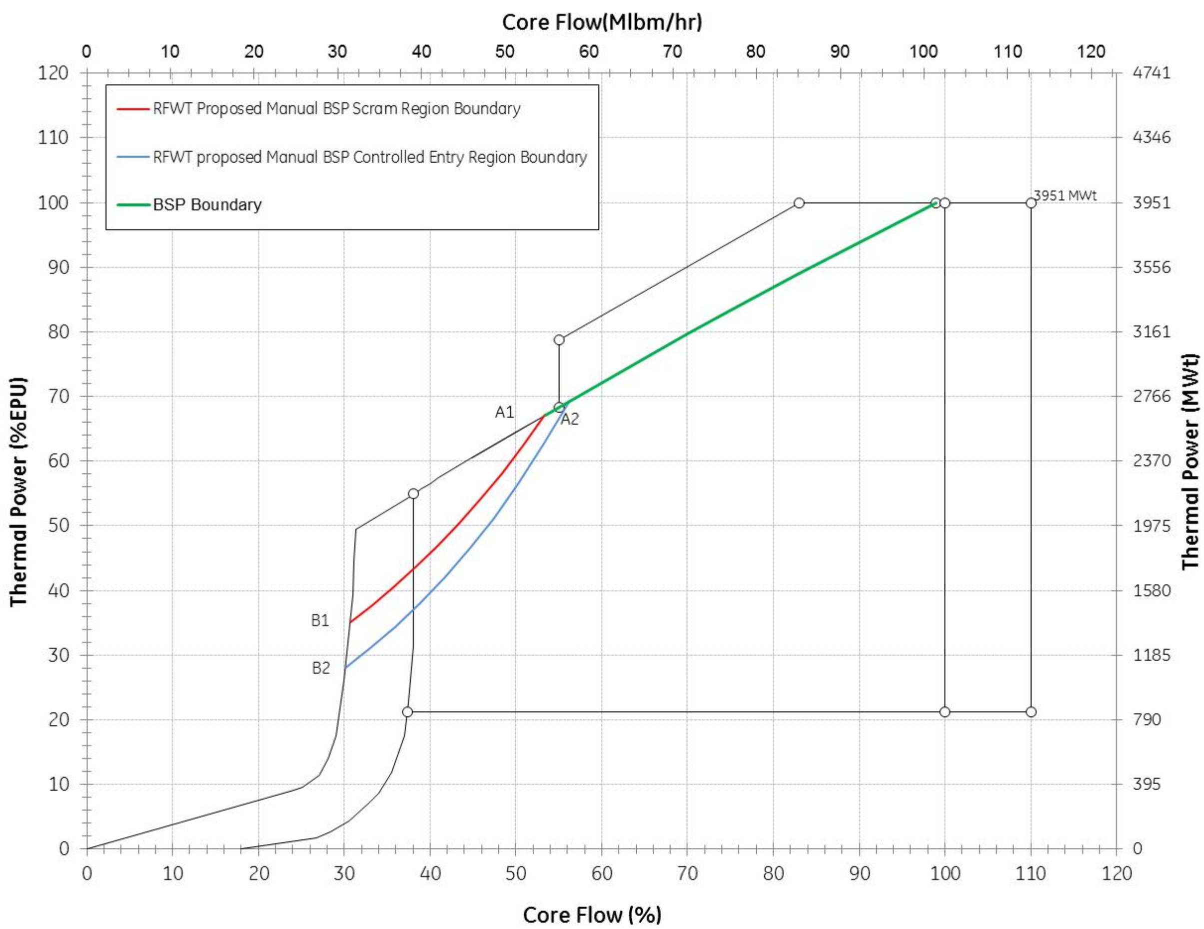

Figure 17 Manual BSP Regions and BSP Boundary for Reduced Feedwater Temperature Operation

Appendix A
Analysis Conditions

The reactor operating conditions used in the reload licensing analysis for this plant and cycle are presented in Table A-1. The pressure relief and safety valve configuration for this plant are presented in Table A-2. Additionally, the operating flexibility options listed in Section 8 are supported by the reload licensing analysis.

Table A-1 Reactor Operating Conditions

	Analysis Value[16]			
Parameter	**ICF NFWT**	**MLP NFWT**	**ICF RFWT**	**MEL RFWT**
Thermal power, MWt	3951.0	3951.0	3951.0	3951.0
Core flow, Mlb/hr	112.8	85.1	112.8	101.5
Reactor pressure (core mid-plane), psia	1067.0	1061.9	1049.2	1047.2
Inlet enthalpy, Btu/lb	524.5	515.1	513.1	508.9
Non-fuel power fraction [17]	N/A	N/A	N/A	N/A
Steam flow, Mlb/hr	16.18	16.14	14.55	14.53
Dome pressure, psig	1034.8	1034.7	1018.6	1018.4
Turbine pressure, psig	963.8	964.1	960.7	960.6

Table A-2 Pressure Relief and Safety Valve Configuration

Valve Type	**Number of Valves**	**Lowest Setpoint (psig)**
Safety/Relief Valve	11	1169.1
Spring Safety Valve	3	1297.8

[16] The label MLP indicates MELLLA+ flow and the label MEL indicates MELLLA flow.
[17] For TRACG methodology, the direct moderator heating is a function of moderator density.

Appendix B
Thermal-Mechanical Compliance

A thermal-mechanical compliance check is performed for all analyzed transients to assure that the fuel will operate without violating the thermal-mechanical design limits. These limits are designed such that reactor operation within these limits provides assurance that the fuel will not exceed any thermal-mechanical design or licensing limits during all modes of operation. The fuel thermal-mechanical limits are met for the current cycle.

Appendix C
Decrease in Core Coolant Temperature Event

The Loss-of-Feedwater Heating event was analyzed at 100% rated power using the BWR Simulator Code. The use of this code is consistent with the approved methodology. The transient plots, neutron flux and heat flux values normally reported in Section 9 are not an output of the BWR Simulator Code; therefore, those items are not included in this document. The OLMCPR result is shown in Section 11. The Inadvertent HPCI start-up event with a Level 8 turbine trip OLMCPR results are summarized in Section 11.

Appendix D
Off-Rated Limits

Off-Rated Power Dependent Limits

The off-rated power dependent limits to be applied for Equipment In-Service, TBVOOS, and RPTOOS are documented in Reference D-1. The Kp/MCPRp and LHGRFACp limits provided in Reference D-1 have been validated for this cycle. However, the power dependent limits are adjusted for updated values of Pbypass and RPmin.

The MCPRp limits provided in Reference D-1 are based on a SLMCPR of 1.10; therefore, the below Pbypass MCPRp limits have been scaled for the cycle-specific SLMCPR in Section 11.

The off-rated power dependent limits support PROOS at power levels >90% rated thermal power in all application conditions. The off-rated power dependent limits support PLUOOS at power levels < 55% rated thermal power and >90% rated thermal power in all application conditions. The conclusions in Reference D-2 remain valid.

MCPRp Limits for: Equipment In Service			
Limits for Power < 26.7%			
Flow > 60.0%		**Flow ≤ 60.0%**	
Power (%)	**Limit** *MCPRp*	**Power (%)**	**Limit** *MCPRp*
23.0	2.99	23.0	2.67
26.7	2.83	26.7	2.60
Limits for Power ≥ 26.7%			
Power (%)		**Limit** *Kp*	
26.7		1.352	
40.0		1.352	
55.0		1.317	
65.0		1.131	
85.0		1.082	
100.0		1.000	

MCPRp Limits for: **TBV Out-of-Service**			
Limits for Power < 26.7%			
Flow > 60.0%		**Flow ≤ 60.0%**	
Power (%)	**Limit** *MCPRp*	**Power (%)**	**Limit** *MCPRp*
23.0	4.15	23.0	3.64
26.7	3.78	26.7	3.25
Limits for Power ≥ 26.7%			
Power (%)		**Limit** *Kp*	
26.7		1.659	
40.0		1.479	
55.0		1.373	
65.0		1.155	
85.0		1.082	
100.0		1.000	

MCPRp Limits for: **EOC RPT Out-of-Service**			
Limits for Power < 26.7%			
Flow > 60.0%		**Flow ≤ 60.0%**	
Power (%)	**Limit** *MCPRp*	**Power (%)**	**Limit** *MCPRp*
23.0	2.99	23.0	2.67
26.7	2.83	26.7	2.60
Limits for Power ≥ 26.7%			
Power (%)		**Limit** *Kp*	
26.7		1.352	
40.0		1.352	
55.0		1.317	
65.0		1.131	
85.0		1.082	
100.0		1.000	

LHGRFACp Limits for: Equipment In Service			
Limits for Power < 26.7%			
Flow > 60.0%		**Flow ≤ 60.0%**	
Power (%)	**Limit**	**Power (%)**	**Limit**
23.0	0.508	23.0	0.508
26.7	0.522	26.7	0.522
Limits for Power ≥ 26.7%			
Power (%)		**Limit**	
26.7		0.748	
40.0		0.756	
55.0		0.771	
65.0		0.817	
85.0		0.959	
100.0		1.000	

LHGRFACp Limits for: TBV Out-of-Service			
Limits for Power < 26.7%			
Flow > 60.0%		**Flow ≤ 60.0%**	
Power (%)	**Limit**	**Power (%)**	**Limit**
23.0	0.410	23.0	0.397
26.7	0.417	26.7	0.442
Limits for Power ≥ 26.7%			
Power (%)		**Limit**	
26.7		0.635	
40.0		0.655	
55.0		0.714	
65.0		0.817	
85.0		0.930	
100.0		1.000	

LHGRFACp Limits for: EOC RPT Out-of-Service			
Limits for Power < 26.7%			
Flow > 60.0%		**Flow ≤ 60.0%**	
Power (%)	**Limit**	**Power (%)**	**Limit**
23.0	0.508	23.0	0.508
26.7	0.522	26.7	0.522
Limits for Power ≥ 26.7%			
Power (%)		**Limit**	
26.7		0.748	
40.0		0.756	
55.0		0.771	
65.0		0.817	
85.0		0.959	
100.0		1.000	

Off-Rated Flow Dependent Limits

The off-rated flow dependent limits are documented in Reference D-1. The MCPRf and LHGRFACf limits provided in Reference D-1 have been validated for this cycle. The flow dependent limits are based on a single pump runout with no mechanical scoop tube setpoint. The flow dependent limits are based on a bounding pump runout limited to 100% rated core flow. Flow dependent limits are provided for operation up to a maximum of 110% rated core flow.

The MCPRf limits provided in Reference D-1 are based on a SLMCPR of 1.12; the MCPRf limits have been scaled for the cycle-specific SLMCPR in Section 11.

MCPRf Limits for: Equipment In Service	
Limits for a Maximum Runout Flow of 110.0%	
Flow (%)	**Limit** *MCPRf*
30.0	1.57
79.0	1.28
110.0	1.28

MCPRf Limits for: TBV Out-of-Service	
Limits for a Maximum Runout Flow of 110.0%	
Flow (%)	**Limit** *MCPRf*
30.0	1.57
79.0	1.28
110.0	1.28

MCPRf Limits for: EOC RPT Out-of-Service	
Limits for a Maximum Runout Flow of 110.0%	
Flow (%)	**Limit** *MCPRf*
30.0	1.57
79.0	1.28
110.0	1.28

LHGRFACf Limits for: Equipment In Service	
Limits for a Maximum Runout Flow of 110.0%	
Flow (%)	**Limit**
30.0	0.706
70.0	0.973
80.0	1.000
110.0	1.000

LHGRFACf Limits for: TBV Out-of-Service	
Limits for a Maximum Runout Flow of 110.0%	
Flow (%)	**Limit**
30.0	0.706
70.0	0.973
80.0	1.000
110.0	1.000

LHGRFACf Limits for: EOC RPT Out-of-Service	
Limits for a Maximum Runout Flow of 110.0%	
Flow (%)	**Limit**
30.0	0.706
70.0	0.973
80.0	1.000
110.0	1.000

References

D-1. *Peach Bottom Atomic Power Station Units 2 and 3 TRACG Implementation for Reload Licensing Transient Analysis*, 0000-0135-9000-R0, August 2011.

D-2. *Evaluation of Power Load Unbalance Out-of-Service and Pressure Regulator Out-of-Service between 90% and 100% RTP for Peach Bottom Units 2 and 3*, 0000-0163-9619-R0, July 2013.

Appendix E
TRACG04 AOO Supplementary Information

Reference E-1 provides the results of the evaluations supporting the application of TRACG04 for AOO analyses for Peach Bottom. Section 11 of this report presents the MCPR limits based on the TRACG04 methodology of Reference E-2.

The safety evaluation report for licensing topical report NEDE-32906P (Reference E-2) concluded that the application of TRACG04 methods to AOO and overpressure transient analyses were acceptable subject to certain limitations and conditions. Peach Bottom Unit 2 Cycle 21 MELLLA+ is in compliance with these limitations and conditions.

References

E-1. *Peach Bottom Atomic Power Station Units 2 and 3 TRACG Implementation for Reload Licensing Transient Analysis*, 0000-0135-9000-R0, August 2011.

E-2. *Migration to TRACG04/PANAC11 from TRACG02/PANAC10 for TRACG AOO and ATWS Overpressure Transients*, NEDE-32906P, Supplement 3-A, Revision 1, April 2010.

Appendix F
Interim Methods LTR (NEDC-33173P-A Revision 4)
Supplemental Information

The safety evaluation for licensing topical report NEDC-33173P-A Revision 4 (Reference F-1) concluded that the application of GEH/GNF methods to expanded operating domains was acceptable subject to certain limitations and conditions. Several of these limitations and conditions request that additional, application-specific information be provided in the SRLR. The information provided below responds to these requests for the identified items.

Limitation and Condition 9.5 (SLMCPR 2)

Limitation and Condition 9.5 states:

> *"For operation at MELLLA+, including operation at the EPU power levels at the achievable core flow state-point, a 0.01 value shall be added to the cycle-specific SLMCPR value for power-to-flow ratios up to 42 MWt/Mlbm/hr, and a 0.02 value shall be added to the cycle-specific SLMCPR value for power-to-flow ratios above 42 MWt/Mlbm/hr."*

For operation at MELLLA+, a 0.02 value was added to the cycle specific SLMCPR. The SLMCPR values reported in Section 11 reflect this adder.

Limitation and Condition 9.8 (ECCS-LOCA 2)

Limitation and Condition 9.8 states:

> *"The ECCS-LOCA will be performed for all statepoints in the upper boundary of the expanded operating domain, including the minimum core flow statepoints, the transition statepoint, as defined in Reference F-2 and the 55 percent core flow statepoint. The plant-specific application will report the limiting ECCS-LOCA results as well as the rated power and flow results. The SRLR will include both the limiting statepoint ECCS-LOCA results and the rated conditions ECCS-LOCA results."*

This limitation and condition is satisfied by the Appendix K PCTs reported in Reference 1 in Section 16.4. Detail to appear in the SRLR conforms to direction resolved with NRC Staff during review process (see RAI 25.b). The SRLR reports the bounding Licensing Basis PCT for all statepoints analyzed.

Limitation and Condition 9.10/9.11 (Transient LHGR 2/3)

Limitation and Condition 9.10 states:

> *"Each EPU and MELLLA+ fuel reload will document the calculation results of the analyses demonstrating compliance to transient T-M acceptance criteria. The plant T-M response will be provided with the SRLR or COLR, or it will be reported directly to the NRC as an attachment to the SRLR or COLR."*

Limitation and Condition 9.11 states:

> *"To account for the impact of the void history bias, plant-specific EPU and MELLLA+ applications using either TRACG or ODYN will demonstrate an equivalent to 10 percent margin to the fuel centerline melt and the 1 percent cladding circumferential plastic strain acceptance criteria due to pellet-cladding mechanical interaction for all of limiting AOO transient events, including equipment out-of-service. Limiting transients in this case, refers to transients where the void reactivity coefficient plays a significant role (such as pressurization events). If the void history bias is incorporated into the transient model within the code, then the additional 10 percent margin to the fuel centerline melt and the 1 percent cladding circumferential plastic strain is no longer required."*

Appendix B documents the fact that the results for all analyzed transients demonstrate compliance with thermal-mechanical acceptance criteria.

Table F-1 summarizes the percent margin to the Thermal Overpower and Mechanical Overpower acceptance criteria.

As referenced in Appendix E (Reference E-2) the void history bias was incorporated into the transient model within the TRACG04 code, and therefore the 10 percent margin to the fuel centerline melt and the 1 percent cladding circumferential plastic strain acceptance criteria is no longer required.

Table F-1 Margin to the Thermal Overpower and Mechanical Overpower Acceptance Criteria

Criteria	GNF2
Thermal Overpower	0.9%
Mechanical Overpower	17.7%

Limitation and Condition 9.17 (Steady-State 5 Percent Bypass Voiding)

Limitation and Condition 9.17 states:

> *"The instrumentation specification design bases limit the presence of bypass voiding to 5 percent (LRPM (sic) levels). Limiting the bypass voiding to less than 5 percent for long term steady operation ensures that instrumentation is operated within the specification. For EPU and MELLLA+ operation, the bypass voiding will be evaluated on a cycle-specific basis to confirm that the void fraction remains below 5 percent at all LPRM levels when operating at steady-state conditions within the MELLLA+ upper boundary. The highest calculated bypass voiding at any LPRM level will be provided with the plant-specific SRLR."*

The bypass voiding was evaluated for the licensed core loading and confirmed that the bypass void fraction remained below 5 percent at all LPRM levels when operating at steady-state conditions within the licensed upper boundary.

Limitation and Condition 9.18 (Stability Setpoints Adjustment)

Limitation and Condition 9.18 states:

> *"The NRC staff concludes that the presence bypass voiding at the low-flow conditions where instabilities are likely can result in calibration errors of less than 5 percent for OPRM cells and less than 2 percent for APRM signals. These calibration errors must be accounted for while determining the setpoints for any detect and suppress long term methodology. The calibration values for the different long-term solutions are specified in the associated sections of this SE, discussing the stability methodology."*

This limitation and condition is not applicable to DSS-CD because the significant conservatisms in the current licensing methodology and associated MCPR margins are more than sufficient to compensate for the overall uncertainty in the OPRM instrumentation.

Limitation and Condition 9.19 (Void-Quality Correlation 1)

Limitation and Condition 9.19 states:

> *"For applications involving PANCEA(sic)/ODYN/ISCOR/TASC for operation at EPU and MELLLA+, an additional 0.01 will be added to the OLMCPR, until such time that GE expands the experimental database supporting the Findlay-Dix void-quality correlation to demonstrate the accuracy and performance of the void-quality correlation based on experimental data representative of the current fuel designs and operating conditions during steady-state, transient, and accident conditions."*

The OLMCPR limitation requiring an additional 0.01 adder on the OLMCPR does not apply to EPU or MELLLA+ licensing calculations when TRACG04 methods are used (Reference F-3). Therefore, the OLMCPR adder is not applied to Peach Bottom Unit 2 Cycle 21.

References

F-1. *Applicability of GE Methods to Expanded Operating Domains,* NEDC-33173P-A, Revision 4, November 2012.

F-2. *General Electric Boiling Water Reactor Maximum Extended Load Line Limit Analysis Plus,* NEDC-33006P-A, Revision 3, June 2009.

F-3. *Migration to TRACG04 / PANAC11 from TRACG02 / PANAC10 for TRACG AOO and ATWS Overpressure Transients*, NEDE-32906P, Supplement 3-A, Revision 1, April 2010.

Appendix G
MELLLA+ LTR (NEDC-33006P-A Revision 3) Supplemental Information

The safety evaluation for licensing topical report NEDC-33006P-A Revision 3 (Reference G-1) approved the operation of GE BWRs in the MELLLA+ expanded operating domain, subject to certain limitations and conditions. Several of these limitations and conditions request that additional, application-specific information be provided in the SRLR. The information provided below responds to these requests for the identified items.

Limitation and Condition 12.6 (SLMCPR Statepoints and CF Uncertainty)

Limitation and Condition 12.6 states:

> *"Until such time when the SLMCPR methodology (References G-2 and G-3) for off-rated SLMCPR calculation is approved by the staff for MELLLA+ operation, the SLMCPR will be calculated at the rated statepoint (120 percent P/100 percent CF), the plant-specific minimum CF statepoint (e.g., 120 percent P/80 percent CF), and at the 100 percent OLTP at 55 percent CF statepoint. The currently approved off-rated CF uncertainty will be used for the minimum CF and 55 percent CF statepoints. The uncertainty must be consistent with the CF uncertainty currently applied to the SLO operation or as NRC-approved for MELLLA+ operation. The calculated values will be documented in the SRLR."*

As requested, the SLMCPR calculated results at specified off-rated power/flow conditions are reported in Table G-1 below, including the low CF statepoint.

Table G-1 Two-Loop SLMCPR Results for MELLLA+ Conditions

Power (% Rated)	Flow (% Rated)	SLMCPR
100	100	1.07
100	83	1.12
78.8	55	1.13
100	110	1.07

Limitation and Condition 12.10.b (ECCS-LOCA Off-Rated Multiplier)

Limitation and Condition 12.10.b states:

> *"LOCA analysis is not performed on cycle-specific basis; therefore, the thermal limits applied in the M+SAR LOCA analysis for the 55 percent CF MELLLA+ statepoint and/or the transition statepoint must be either bounding or consistent with cycle-specific off-rated limits. The COLR and the SRLR will contain confirmation that the off-rated limits assumed in the ECCS-LOCA analyses bound the cycle-specific off-rated limits calculated for the MELLLA+ operation. Every future cycle reload shall confirm that the cycle-specific off-rated thermal limits applied at the 55 percent CF and/or the transition statepoints are consistent with those assumed in the plant-specific ECCS-LOCA analyses."*

The off-rated limits assumed in the ECCS-LOCA analyses are confirmed to be consistent with the cycle-specific off-rated LHGR multipliers calculated for the MELLLA+ operation. The off-rated LHGR multipliers provide adequate protection for the MELLLA+ operation.

Limitation and Condition 12.18.d (ATWS TRACG Analysis)

Limitation and Condition 12.18.d states:

> *"In general, the plant-specific application will ensure that operation in the MELLLA+ domain is consistent with the assumptions used in the ATWS analysis, including equipment out of service (e.g., FWHOOS, SLO, SRVs, SLC pumps, and RHR pumps, etc.). If assumptions are not satisfied, operation in MELLLA+ is not allowed. The SRLR will specify the prohibited flexibility options for plant-specific MELLLA+ operation, where applicable. For key input parameters, systems and engineering safety features that are important to simulating the ATWS analysis and are specified in the Technical Specification (TS) (e.g., SLCS parameters, ATWS RPT, etc.), the calculation assumptions must be consistent with the allowed TS values and the allowed plant configuration. If the analyses deviate from the allowed TS configuration for long term equipment out of service (i.e., beyond the TS LCO), the plant-specific application will specify and justify the deviation. In addition, the licensee must ensure that all operability requirements are met (e.g., NPSH) by equipment assumed operable in the calculations."*

This ATWS TRACG Analysis limitation and condition requires that the SRLR specify the prohibited flexibility options for plant-specific MELLLA+ operation, where applicable, as expressed by EOOS options in Section 8.

References

G-1. *General Electric Boiling Water Reactor Maximum Extended Load Line Limit Analysis Plus,* NEDC-33006P-A, Revision 3, June 2009.

G-2. *Methodology and Uncertainties for Safety Limit MCPR Evaluations,* NEDC-32601P-A, August 1999.

G-3. *Power Distribution Uncertainties for Safety Limit MCPR Evaluations,* NEDC-32694P-A, August 1999.

Appendix H
List of Acronyms

Acronym	Description
ΔCPR	Delta Critical Power Ratio
Δk	Delta k-effective
2RPT (2PT)	Two Recirculation Pump Trip
ABSP	Automated Backup Stability Protection
ADS	Automatic Depressurization System
ADSOOS	Automatic Depressurization System Out of Service
AOO	Anticipated Operational Occurrence
APRM	Average Power Range Monitor
ARTS	APRM, Rod Block and Technical Specification Improvement Program
BOC	Beginning of Cycle
BSP	Backup Stability Protection
BWROG	Boiling Water Reactor Owners Group
COLR	Core Operating Limits Report
CPR	Critical Power Ratio
DIRPT	Delta MCPR over Initial MCPR for a two-Recirculation Pump Trip
DIVOM	Delta CPR over Initial MCPR vs. Oscillation Magnitude
DR	Decay Ratio
DS/RV	Dual Mode Safety/Relief Valve
ECCS	Emergency Core Cooling System
EIS	Equipment in Service
ELLLA	Extended Load Line Limit Analysis
EOC	End of Cycle (including all planned cycle extensions)
EOR	End of Rated (All Rods Out 100%Power / 100%Flow / NFWT)
EPU	Extended Power Uprate
ER	Exclusion Region
FFWTR	Final Feedwater Temperature Reduction
FMCPR	Final MCPR
FOM	Figure of Merit
FW	Feedwater
FWCF	Feedwater Controller Failure
FWHOOS	Feedwater Heaters Out of Service
FWTR	Feedwater Temperature Reduction
GESTAR	General Electric Standard Application for Reactor Fuel
GETAB	General Electric Thermal Analysis Basis
GSF	Generic Shape Function
HAL	Haling Burn
HBB	Hard Bottom Burn
HBOM	Hot Bundle Oscillation Magnitude
HCOM	Hot Channel Oscillation Magnitude
HFCL	High Flow Control Line
HPCI	High Pressure Coolant Injection

Acronym	Description
ICA	Interim Corrective Action
ICF	Increased Core Flow
IMCPR	Initial MCPR
IVM	Initial Validation Matrix
Kf	Off-rated flow dependent OLMCPR multiplier
Kp	Off-rated power dependent OLMCPR multiplier
L8	Turbine Trip on high water level (Level 8)
LCF	Low Core Flow
LFWH	Loss of Feedwater Heating
LHGR	Linear Heat Generation Rate
LHGRFACf	Off-rated flow dependent LHGR multiplier
LHGRFACp	Off-rated power dependent LHGR multiplier
LOCA	Loss of Coolant Accident
LOSC	Loss of Stator Cooling
LPRM	Local Power Range Monitor
LRWHBP	Load Rejection with Half Bypass
LRNBP	Load Rejection without Bypass
LTR	Licensing Topical Report
MAPFACf	Off-rated flow dependent MAPLHGR multiplier
MAPFACp	Off-rated power dependent MAPLHGR multiplier
MAPLHGR	Maximum Average Planar Linear Heat Generation Rate
MCPR	Minimum Critical Power Ratio
MCPRf	Off-rated flow dependent OLMCPR
MCPRp	Off-rated power dependent OLMCPR
MELLLA	Maximum Extended Load Line Limit Analysis
MELLLA+	MELLLA Plus
MOC	Middle of Cycle
MRB	Maximal Region Boundaries
MSF	Modified Shape Function
MSIV	Main Steam Isolation Valve
MSIVOOS	Main Steam Isolation Valve Out of Service
MSR	Moisture Separator Reheater
MSROOS	Moisture Separator Reheater Out of Service
MTU	Metric Ton Uranium
MWd	Megawatt day
MWd/ST	Megawatt days per Standard Ton
MWd/MT	Megawatt days per Metric Ton
MWt	Megawatt Thermal
N/A	Not Applicable
NBP	No Bypass
NCL	Natural Circulation Line
NFWT	Normal Feedwater Temperature
NOM	Nominal Burn
NTR	Normal Trip Reference
OLMCPR	Operating Limit MCPR

Acronym	Description
OOS	Out of Service
OPRM	Oscillation Power Range Monitor
Pbypass	Reactor power level below which the TSV position and the TCV fast closure scrams are bypassed
P_{dome}	Peak Dome Pressure
P_{sl}	Peak Steam Line Pressure
P_{v}	Peak Vessel Pressure
PCT	Peak Clad Temperature
PHE	Peak Hot Excess
PLHGR	Peak Linear Heat Generation Rate
PLU	Power Load Unbalance
PLUOOS	Power Load Unbalance Out of Service
PRFDS	Pressure Regulator Failure Downscale
PROOS	Pressure Regulator Out of Service
Q/A	Heat Flux
RBM	Rod Block Monitor
RC	Reference Cycle
RCF	Rated Core Flow
RDF	Recirculation Drive Flow
RFWT	Reduced Feedwater Temperature
RPS	Reactor Protection System
RPT	Recirculation Pump Trip
RPTOOS	Recirculation Pump Trip Out of Service
RTP	Rated Thermal Power
RV	Relief Valve
RVM	Reload Validation Matrix
RWE	Rod Withdrawal Error
SC	Standard Cycle
SL	Safety Limit
SLMCPR	Safety Limit Minimum Critical Power Ratio
SLO	Single Loop Operation
SRI	Select Rod Insert
SRLR	Supplemental Reload Licensing Report
S/RV (SRV)	Safety/Relief Valve
SRVOOS	Safety/Relief Valve(s) Out of Service
SS	Steady State
SSV	Spring Safety Valve
STU	Short Tons (or Standard Tons) of Uranium
STP	Simulated Thermal Power
TBSOOS	Turbine Bypass System Out of Service
TBV	Turbine Bypass Valve
TBVO	Turbine Bypass Valves Open
TBVOOS	Turbine Bypass Valves Out of Service
TCV	Turbine Control Valve
TCVOOS	Turbine Control Valve Out of Service

Acronym	Description
TCVSC	Turbine Control Valve Slow Closure
TLO	Two Loop Operation
TOPPS	Tracking Over-Power Protection System
TRF	Trip Reference Function
TSIP	Technical Specifications Improvement Program
TSV	Turbine Stop Valve
TSVOOS	Turbine Stop Valve Out of Service
TT	Turbine Trip
TTWHBP	Turbine Trip with Half Bypass
TTNBP	Turbine Trip without Bypass
UB	Under Burn