Harris Nuclear Plant
License Amendment Request for
Pressurizer and Steam Generator
Safety Valves Lift Settings

June 11, 2015

DUKE ENERGY®

Duke Energy Participants

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Agenda

- Description of Change
- Background
- Licensing Approach
- Technical Analysis
- Conclusion

Description of Change
Current Conditions

- TS 3.4.2.1 RCS Safety Valves, Modes 4 and 5
  - LCO: A minimum of one pressurizer code safety valve shall be OPERABLE with a lift setting of 2485 psig **+/- 1%**
- TS 3.4.2.2 RCS Safety Valves, Modes 1, 2, and 3
  - LCO: All pressurizer code safety valves shall be OPERABLE with a lift setting of 2485 psig **+/- 1%**
- Surveillance Requirements in accordance with IST program
- TS 3.7.1.1 Turbine Cycle Safety Valves, Modes 1, 2, and 3
  - LCO: All main steam line Code safety valves associated with each steam generator shall be OPERABLE with lift settings as specified in Table 3 7-2

Description of Change
Current Conditions

Table 3.7-2

Steam Line Safety Valves per Loop

Valve Number Steam Generator			Lift Setting (+/- 1%)	Orifice Size (in^2)
A	B	C		
1MS-43	1MS-44	1MS-45	1170 psig	16.0
1MS-46	1MS-47	1MS-48	1185 psig	16.0
1MS-49	1MS-50	1MS-51	1200 psig	16.0
1MS-52	1MS-53	1MS-54	1215 psig	16.0
1MS-55	1MS-56	1MS-57	1230 psig	16.0

Description of Change Proposed

- TS 3.4.2.1 RCS Safety Valves, Modes 4 and 5
  - LCO: A minimum of one pressurizer code safety valve shall be OPERABLE with a lift setting of 2485 psig **+/- 3%**
- TS 3.4.2.2 RCS Safety Valves, Modes 1, 2, and 3
  - LCO: All pressurizer code safety valves shall be OPERABLE with a lift setting of 2485 psig **+/- 3%**
- TS 3.7.1.1 Turbine Cycle Safety Valves, Modes 1, 2, and 3
  - Table 3 7-2 Lift Setting tolerance changed to **+/- 3%**

Description of Change
Proposed

New FSAR 15.2.3 Turbine Trip Analysis for primary and secondary system overpressure evaluations

- Uses Duke Energy methodology similar to that licensed for use at Catawba, McGuire, and Oconee not currently described in the Harris FSAR.
- Therefore, the new analysis is not eligible for implementation under 10 CFR 50.59.

Background

- HNP TS Safety Valve Tolerance More Restrictive than ASME Code Requirements
- Main Steam Safety Valve History (15 valves total)
  - 5 valves tested every operating cycle per IST program
  - Frequently found one of five slightly outside 1% tolerance, but rarely were any outside 3%
  - Currently testing at increased frequency to compensate for drift outside 1% over 4 ½ year period.
- Pressurizer Safety Valve History (3 valves total)
  - One valve removed every refueling outage and tested at vendor facility
  - As-found condition outside of 1% tolerance on several occasions, but rarely were any outside 3%

Licensing Approach

- Determine FSAR analyses potentially affected
- Document justification for those analyses (remain bounding, remains non-limiting, or analyze)
- Reanalyze FSAR 15.2.3 turbine trip for primary and secondary overpressure (NRC approval required)
- Document acceptable results for FSAR 5.2.2 (NRC approval required)
- Other associated changes will be implemented under 10 CFR 50.59

Technical Approach

- Scope of Reviews
  - Each FSAR Chapter 15.0 Event
  - Mass and Energy Releases (FSAR Chapter 6.0)
  - OPΔT and OTΔT Reactor Trip Equations
  - Core Safety Limit Lines (TS Figure 2.1-1)
  - Offsite Doses
  - PSV evaluation (TMI II.D.1)

Analytical Methods and Inputs Used in Review

- Existing Methods Used exclusive of turbine trip
- AFW flow decreased for events that involved steam pressure at MSSV setting
- Turbine Trip used new DE analysis

Results (Except turbine trip)

- OPΔT and OTΔT Equations
- Core Safety Limit Lines
- No impact to dose analysis
- FSAR Non-LOCA events:
  - Bounded by Current Analysis
  - Bounded by Overpressure from Turbine Trip
  - Specified Acceptable Fuel Design Limits not affected

LOCA

- No impact to Large Break LOCA
- Small Break LOCA reanalyzed
  - Higher MSSV setpoint
  - AFW flow decrease due to higher SG pressure
  - PCT increase of 32°F

Level of Detail in LAR

Table D-1 Summary of FSAR Chapter 15 Event Dispositions

FSAR Section	Event Description	ANS Condition	NRC-Approved T/H Methodology	Disposition
15.1.1	Feedwater System Malfunctions that Result in a Decrease in Feedwater Temperature	II (AOO)	Reference D-8	FSAR does not contain a thermal-hydraulic transient response for this event. Event bounded by FSAR 15.1.3.
15.1.2	Feedwater System Malfunctions that Result in an Increase In Feedwater Flow	II (AOO)	Reference D-8	System transient bounded by AOR.
15.1.3	Excessive Increase in Secondary Steam Flow	II (AOO)	Reference D-8	System transient bounded by AOR.
15.1.4	Inadvertent Opening of a Steam Generator Relief or Safety Valve	II (AOO)	Reference D-8	At Power: Bounded by FSAR 15.1.3 After reactor trip: bounded by FSAR 15.1.5
15.1.5	Steam System Piping Failure	IV (PA)	Reference D-10	System transient bounded by AOR.

FSAR Analyses With Discussion

- PSV evaluation (TMI II.D.1)
- Steam Generator Tube Rupture
- LOCA
- Station Blackout
- Containment Analysis mass and energy release
- ATWS

Summary of Analyses Exclusive of Turbine Trip

- Methods approved by NRC
- Changes within 50.59

Turbine Trip Reanalysis

- Harris FSAR Section 15.2.3 turbine trip analysis is reanalyzed to evaluate changes to the primary and secondary system safety valve tolerances
- Two cases are analyzed for this event:
  - one challenging the primary overpressurization criterion
  - one challenging secondary system overpressurization criterion
- Sensitivity case is performed to confirm the requirements of Standard Review Plan, Chapter 5.2.2 - Overpressure Protection, continue to be satisfied
- An evaluation of the DNB analysis is also performed

Turbine Trip Analysis Methods

- Turbine trip reanalysis is performed using the RETRAN-3D computer code
- RETRAN-3D modeling based on previously approved Duke Energy methodology DPC-NE-3000-P-A
- Harris RETRAN-3D plant model is assessed against the existing AREVA turbine trip analysis of record
- Analysis approach is based on guidance provided by Duke Energy methodology report DPC-NE-3002-A

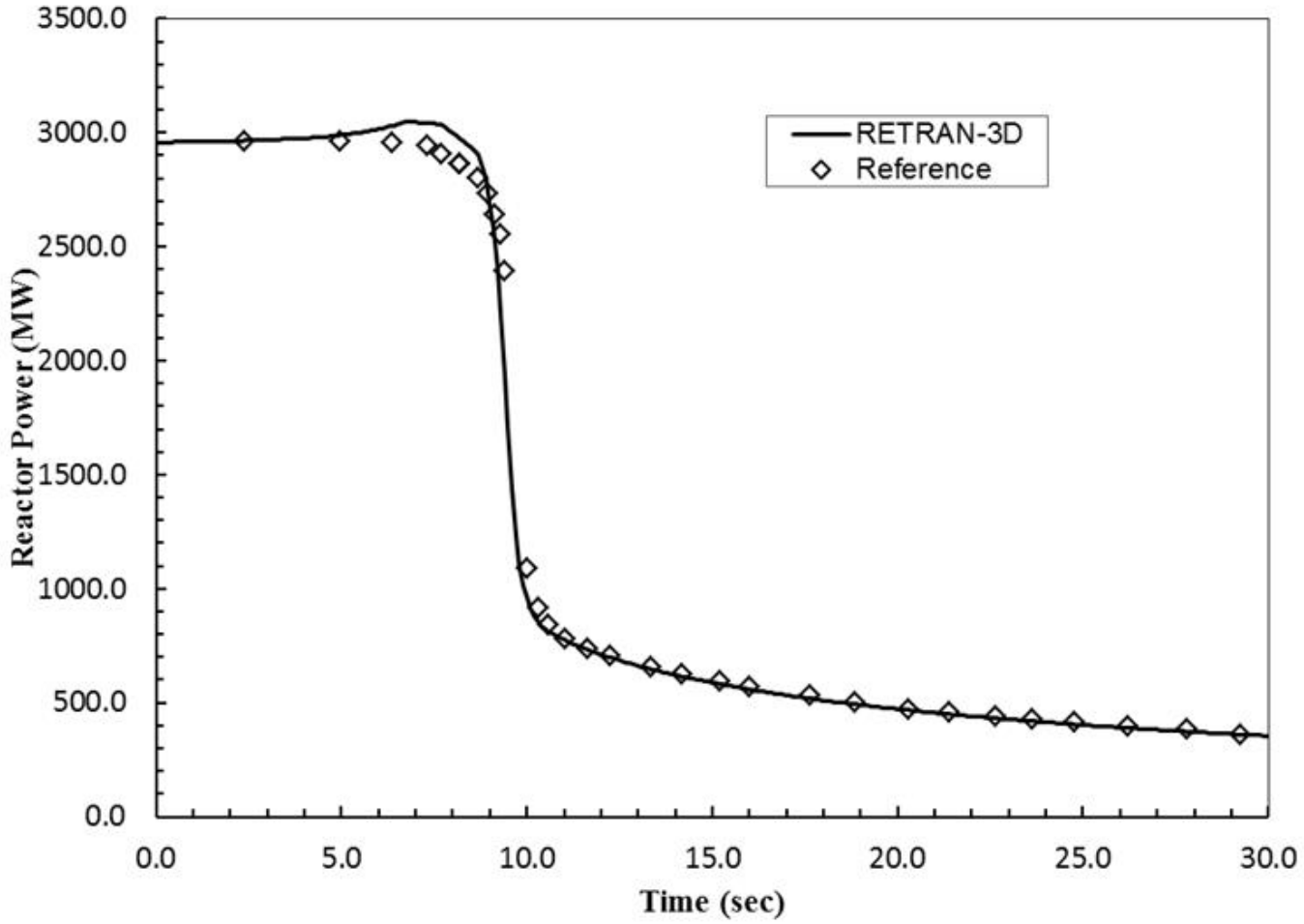
Turbine Trip Benchmark Analysis

- Benchmark calculations completed for two cases from FSAR §15.2.3
  - Primary and secondary overpressurization
- Match key analysis inputs and modeling assumptions
- Following slides compare sequence of events and transient response for each case

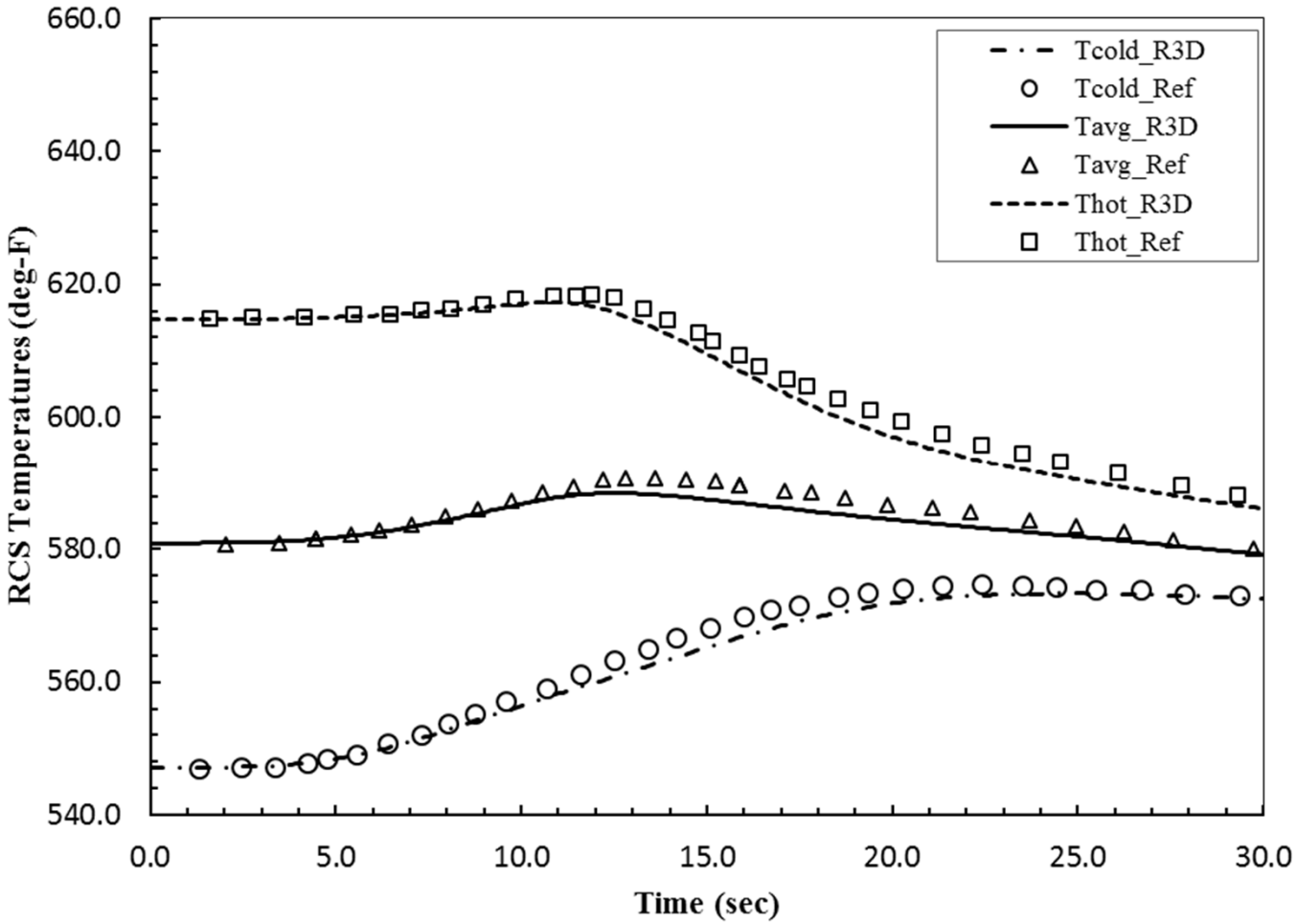
Turbine Trip Benchmark Analysis
Primary Overpressurization Sequence of Events

Event	Event Time, s	
	AOR	RETRAN-3D
Turbine Trip	0.0	0.01
Reactor Trip Signal – High Pressure	5.03	4.74
PSV Setpoint Reached	6.5	6.0
Scram Initiation	7.04	6.74
Peak Primary Side Pressure	7.8	7.7
SG 1st bank MSSVs open	8.4	8.7
SG 2nd bank MSSVs open	9.3	10.4
SG 3rd bank MSSVs open	10.8	11.7
SG 4th bank MSSVs open	---	---
SG 5th bank MSSVs open	---	---

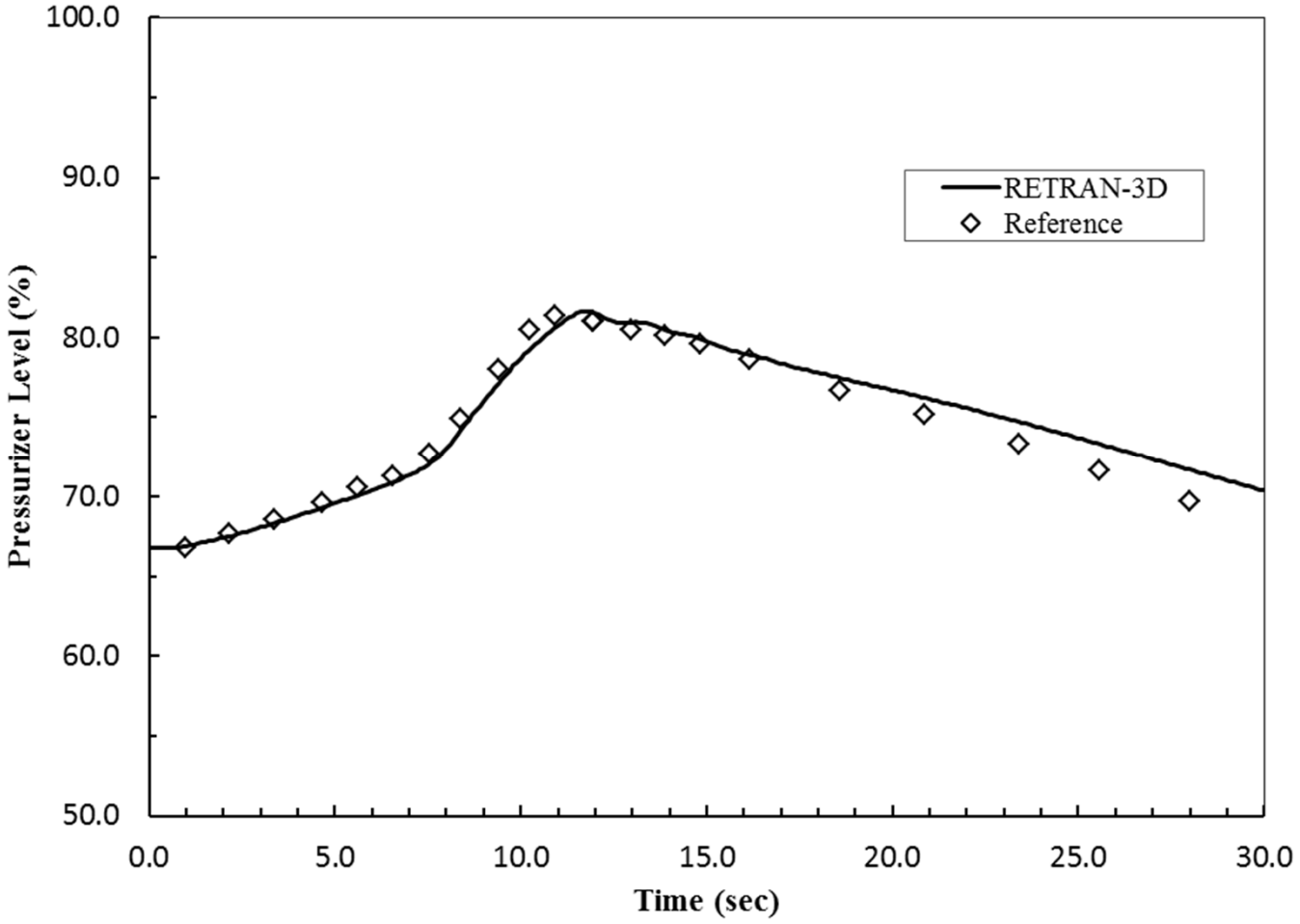
HNP Turbine Trip – Primary Overpressurization Reactor Power



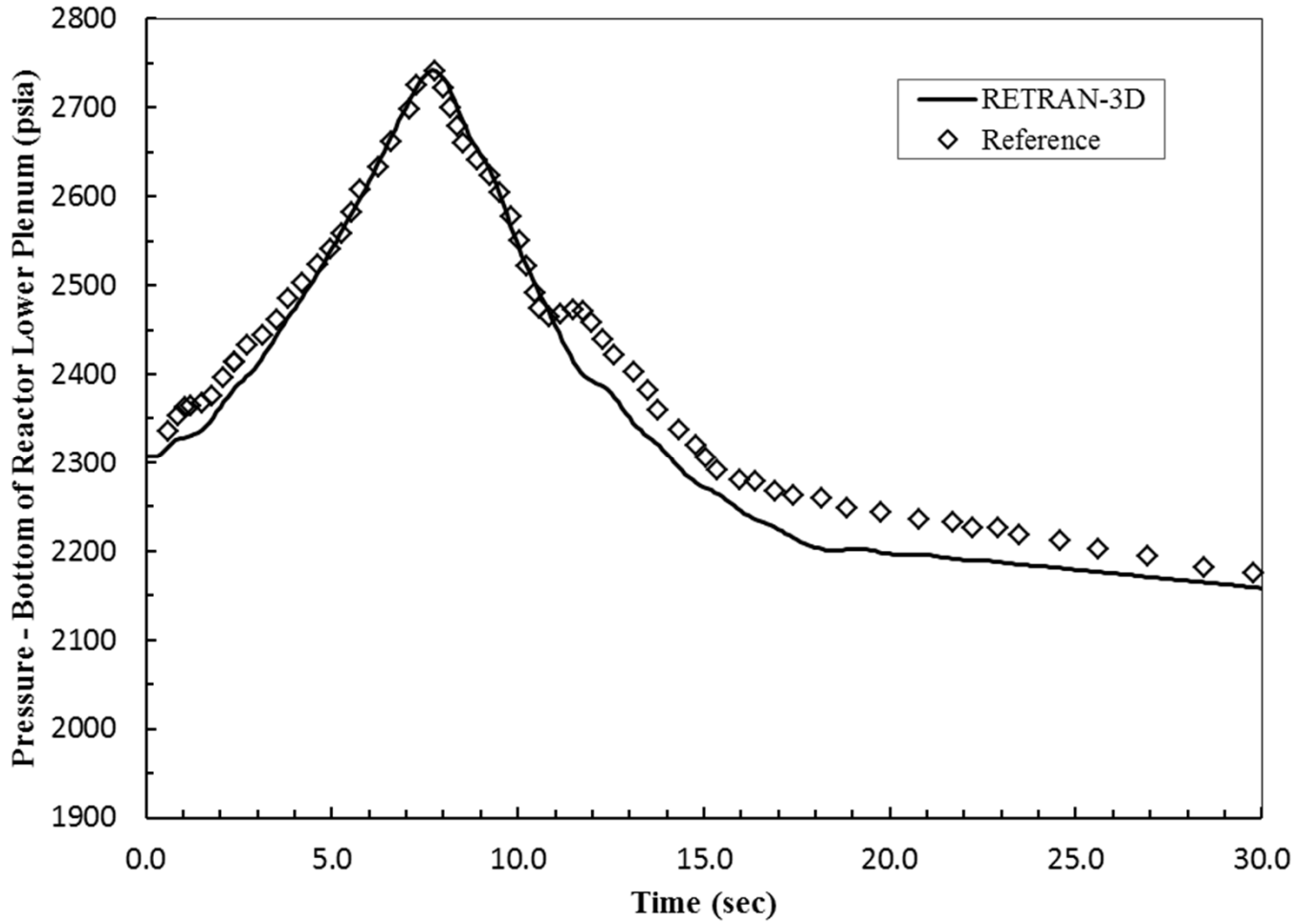
Turbine Trip Benchmark Analysis
Primary Overpressurization



Turbine Trip Benchmark Analysis
Primary Overpressurization



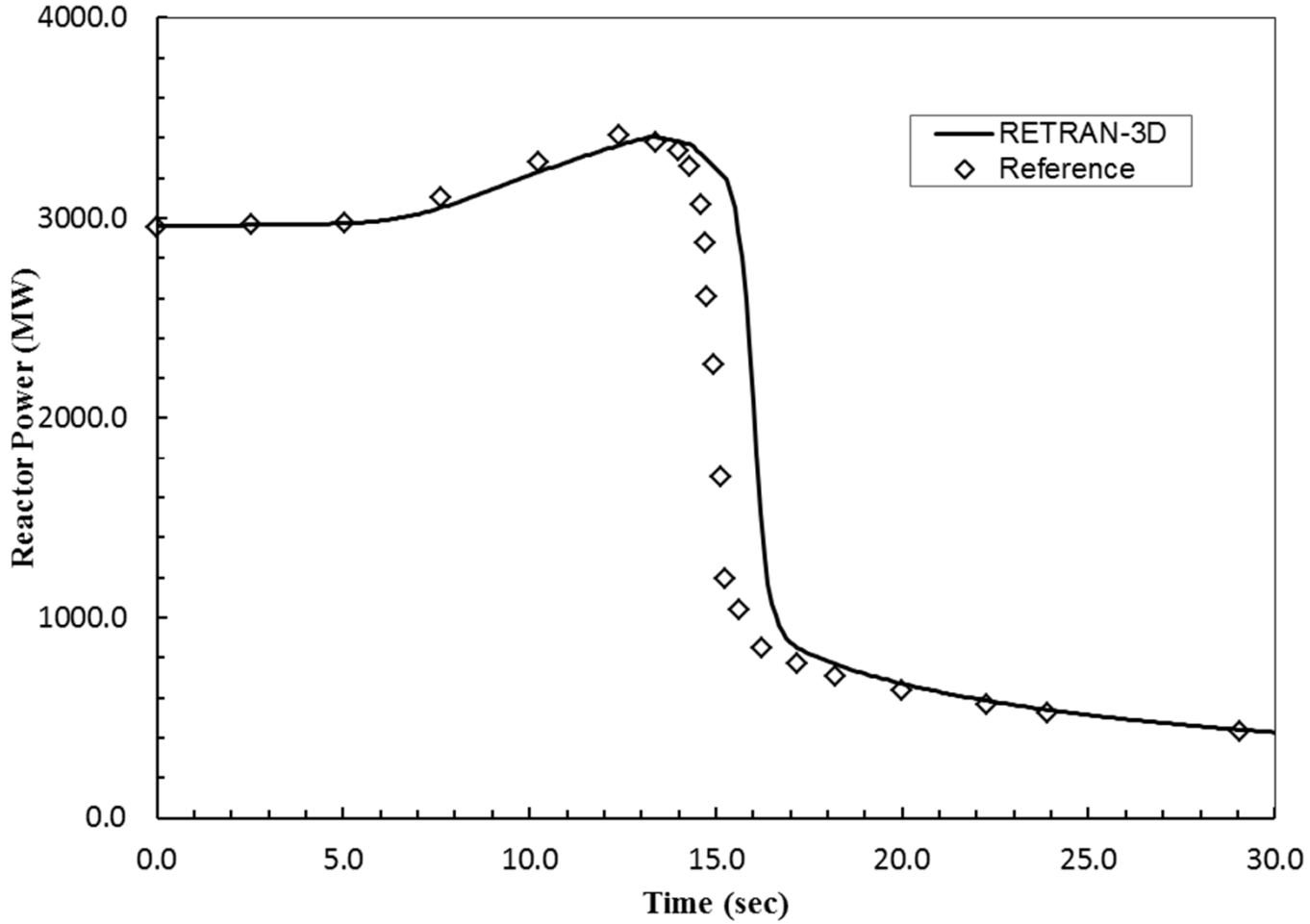
Turbine Trip Benchmark Analysis
Primary Overpressurization



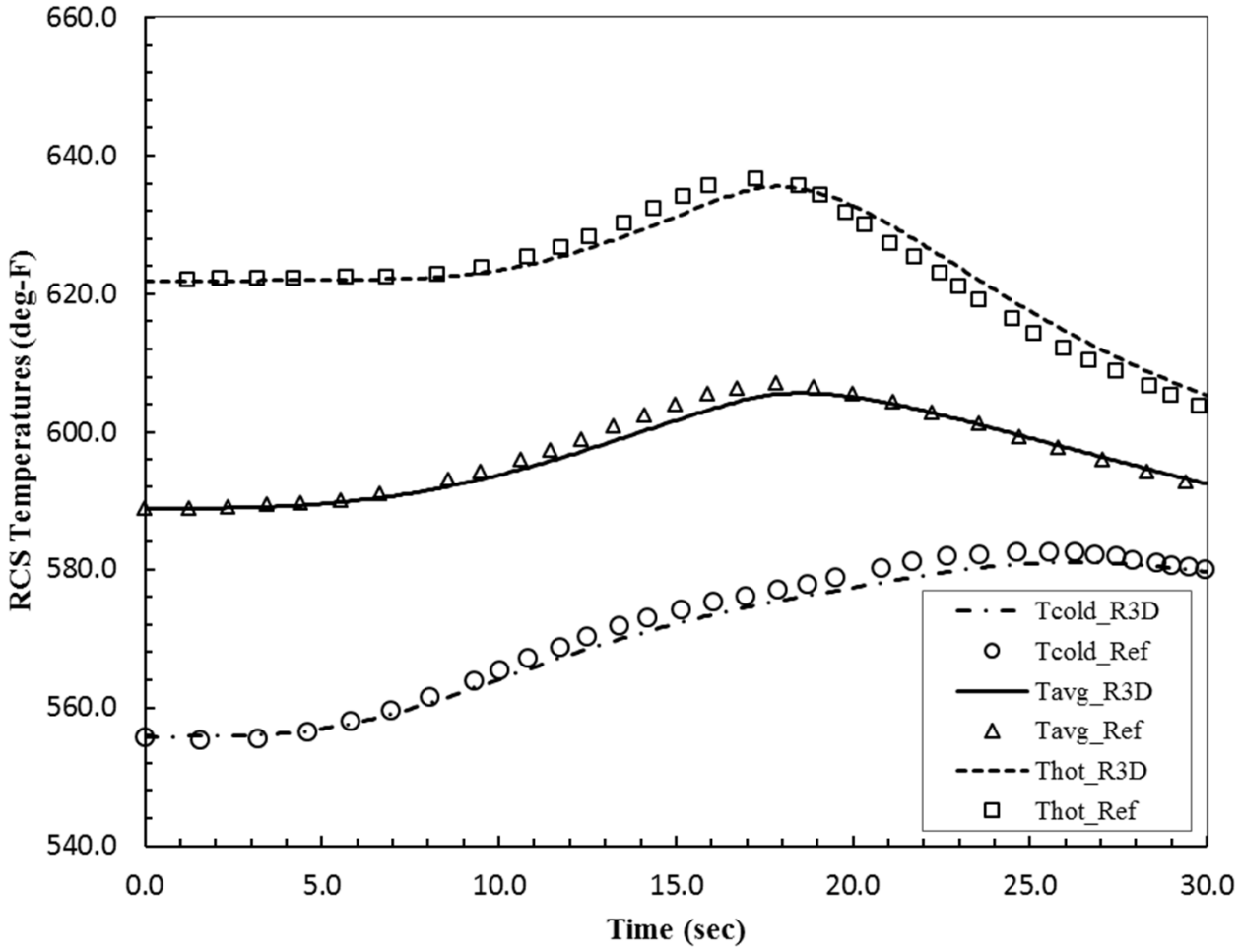
Turbine Trip Benchmark Analysis
Secondary Overpressurization Sequence of Events

Event	Event Time, s	
	AOR	RETRAN-3D
Turbine Trip	0.0	0.01
Pressurizer spray on	1.0	0.9
Pressurizer compensated PORV open	1.2	1.2
Pressurizer uncompensated PORV open	4.3	4.0
SG 1st bank MSSVs open	5.4	5.3
SG 2nd bank MSSVs open	6.5	5.9
SG 3rd bank MSSVs open	7.9	7.0
SG 4th bank MSSVs open	10.1	9.7
OTΔT trip signal	11.16	12.06
Reactor scram	12.41	13.32
SG 5th bank MSSVs open	13.2	13.8
Peak pressurizer level	16.2	17.7 (98.7%)
Peak secondary side pressure	18.9	19.3

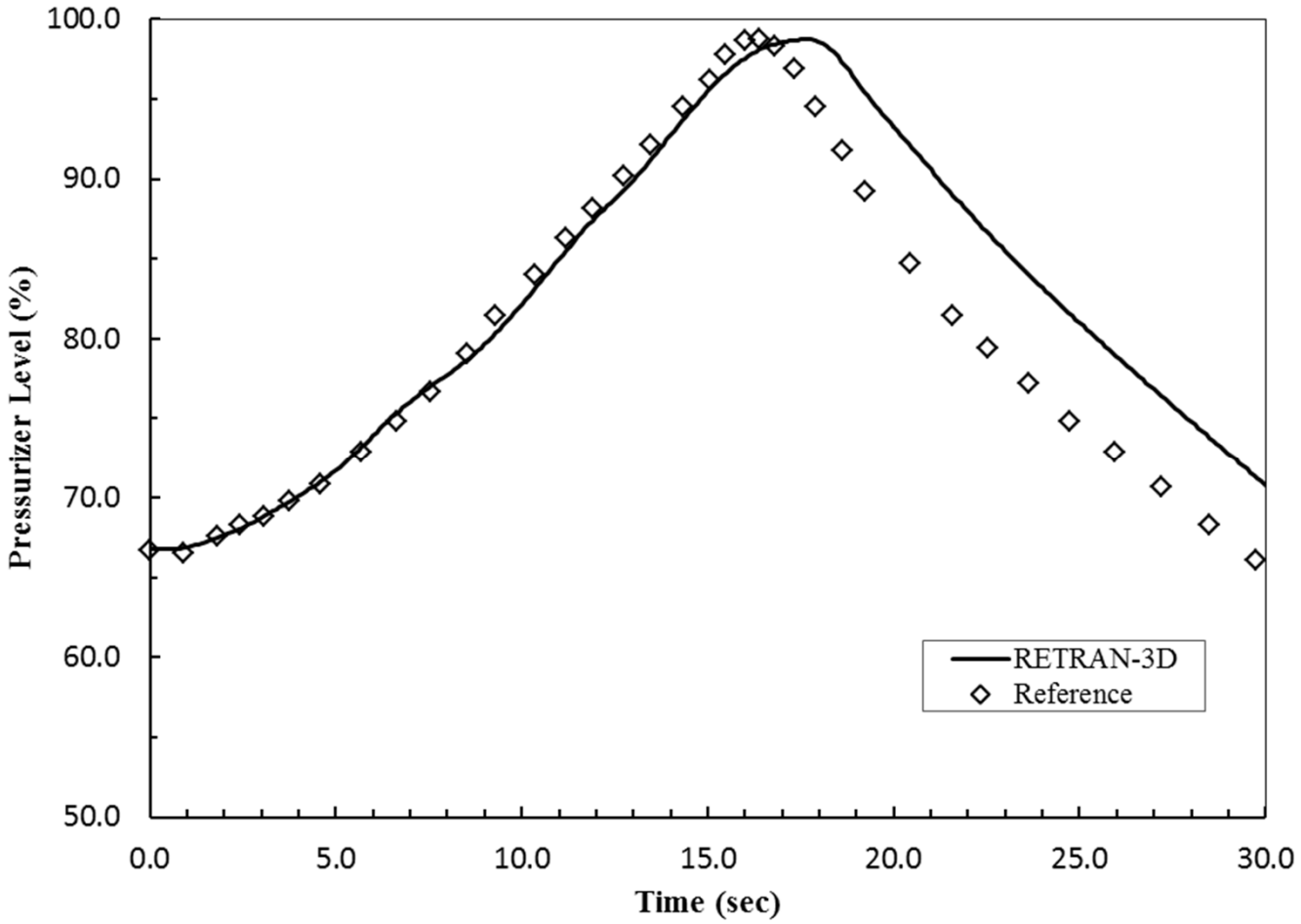
Turbine Trip Benchmark Analysis
Secondary Overpressurization



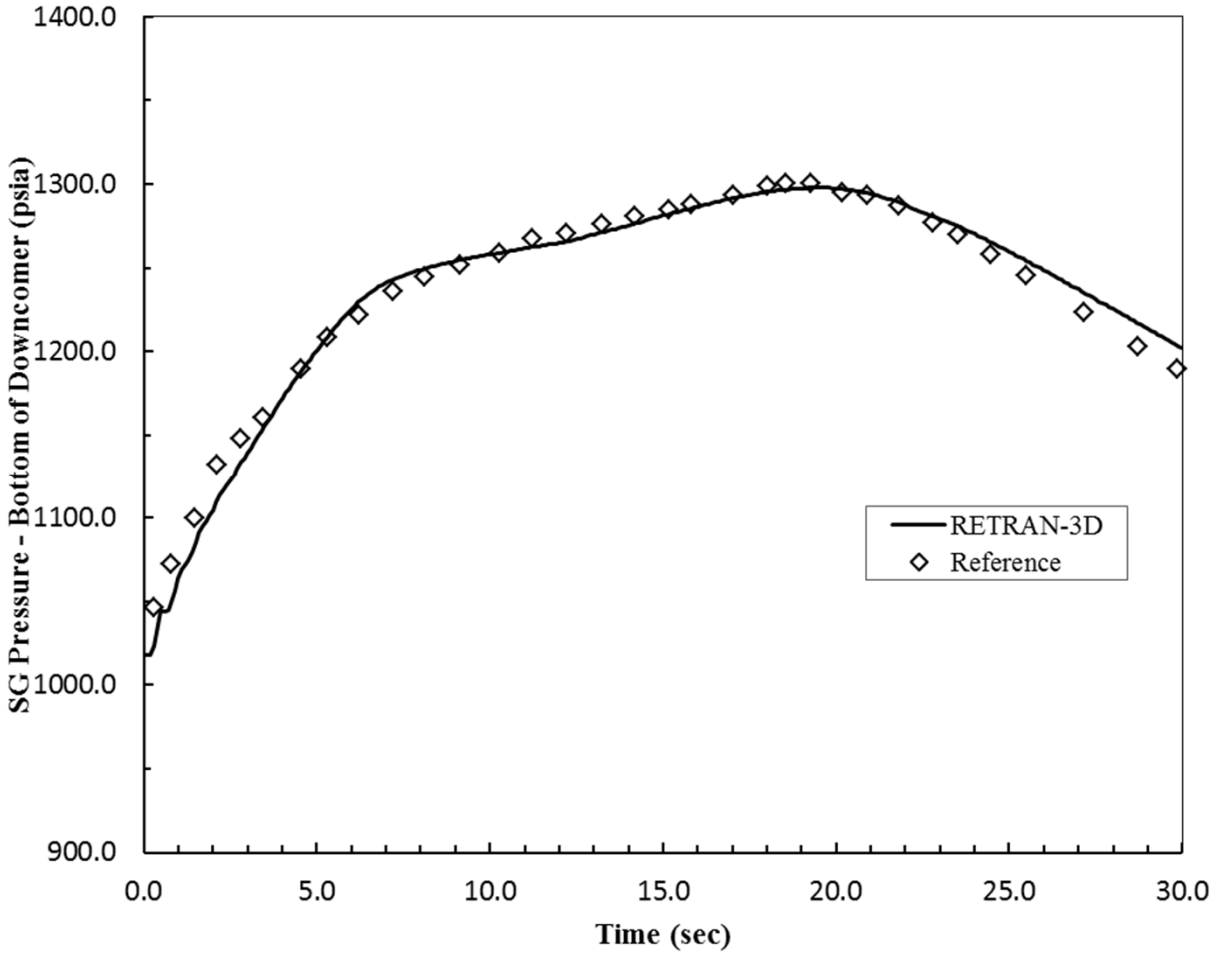
Turbine Trip Benchmark Analysis
Secondary Overpressurization



Turbine Trip Benchmark Analysis
Secondary Overpressurization



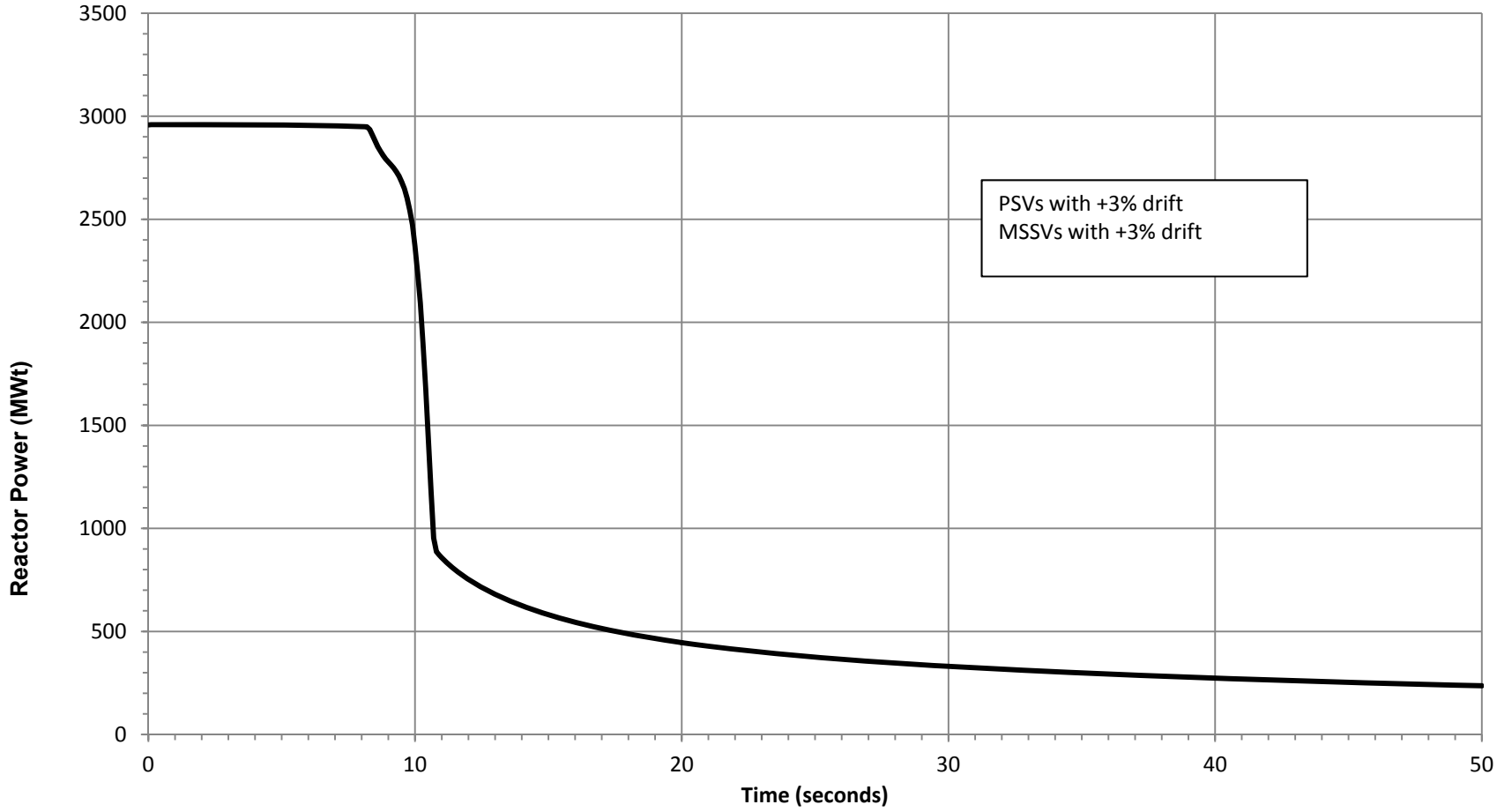
Turbine Trip Benchmark Analysis
Secondary Overpressurization



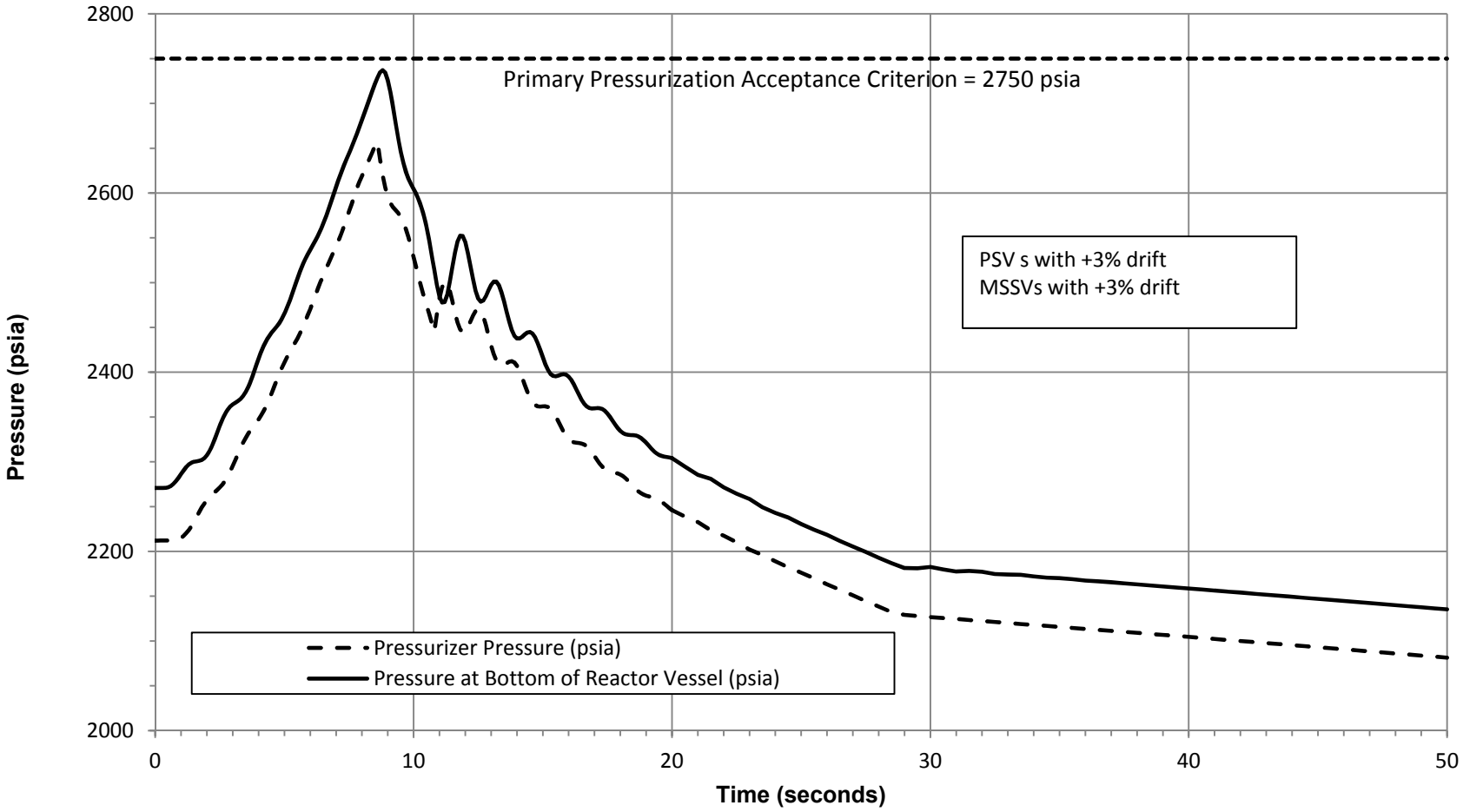
Turbine Trip Reanalysis

- The trip setpoints and time delays assumed in the analysis of this event are unchanged from the current FSAR analysis
- No credit is taken for the operation of the Steam Dump System or steam generator Power Operated Relief Valves (PORVs)
- No credit is taken for the reactor trip on the turbine trip
- Trip signals that are expected
  - high pressurizer pressure, over-temperature ΔT, high neutron flux, high pressurizer water level and low-low steam generator water level
- Revised turbine trip analysis evaluated a pressurizer and main steam safety valve tolerance of ±3%.

Primary System Overpressurization



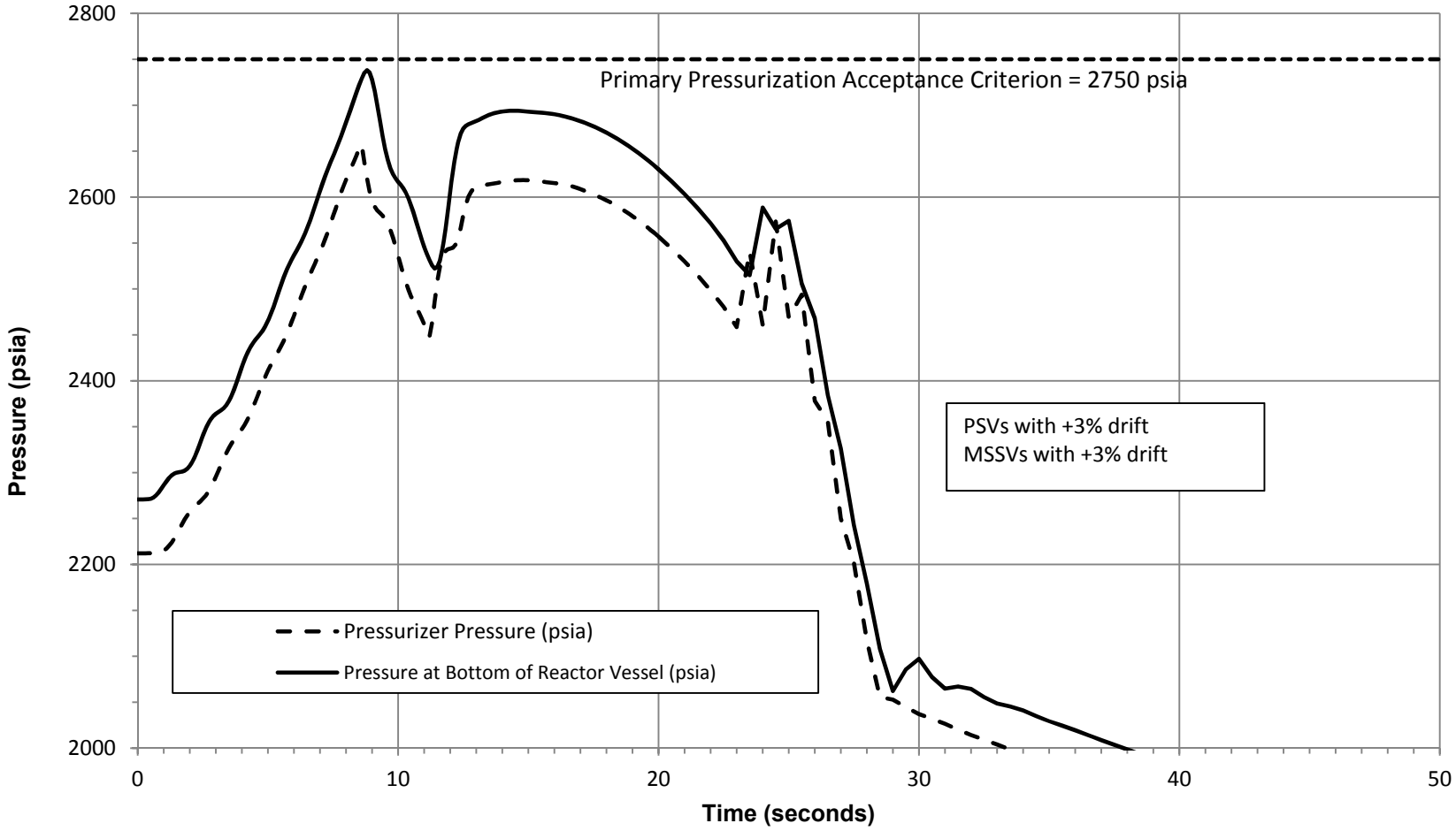
Primary System Overpressurization



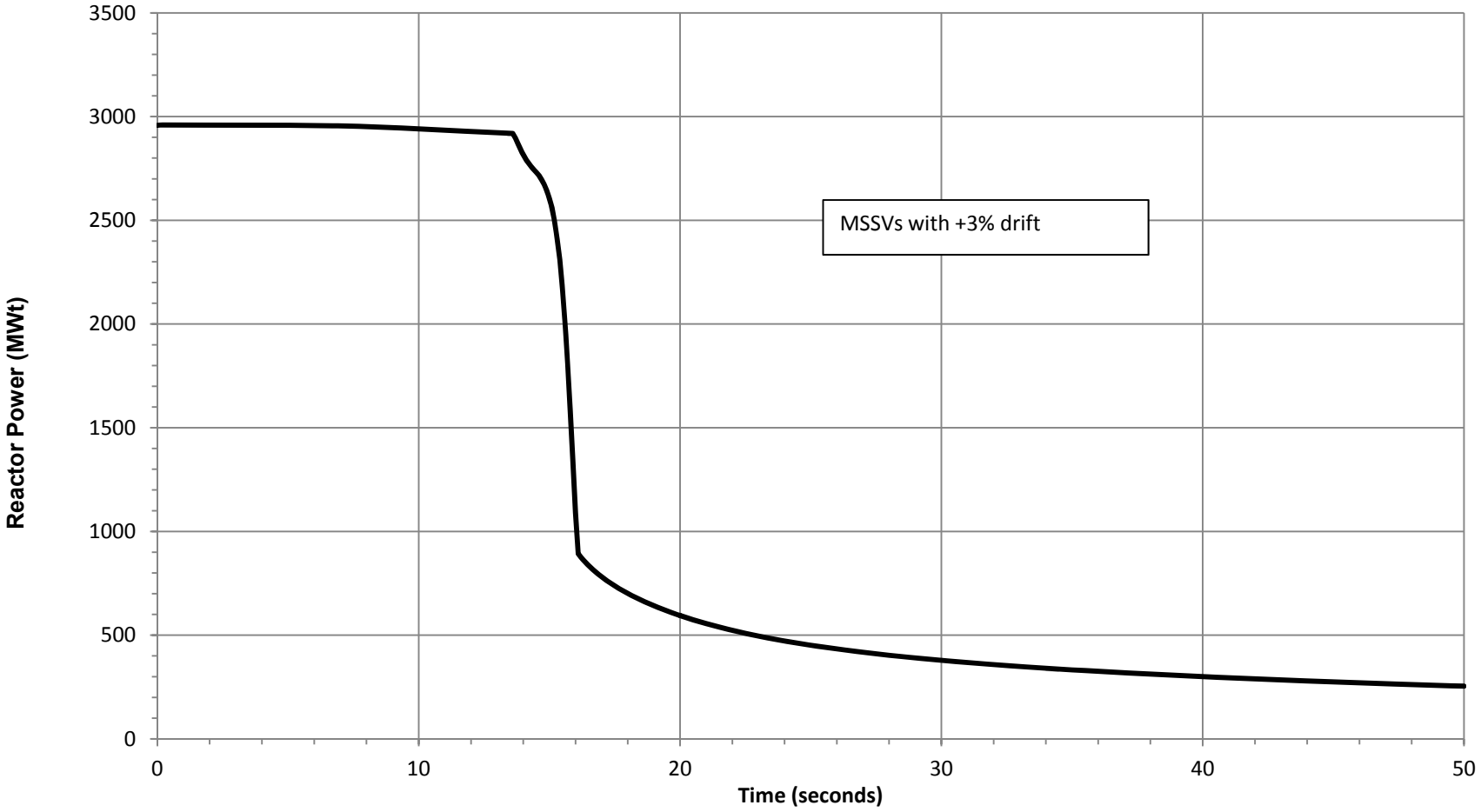
Turbine Trip Event Summary
Primary System Overpressurization – No High PZR Pressure Trip

Event	Time (sec)
Turbine trips	0.0
PSVs open	7.8
Peak primary pressure at bottom of reactor vessel reached	8.81
PSVs close	11.2
PSVs open	12.5
Bank 1 MSSVs open	12.8
Bank 2 MSSVs open	13.7
Bank 3 MSSVs open	15.0
Bank 4 MSSVs open	17.0
High pressurizer level trip signal reached	19.64
Bank 5 MSSVs open	20.3
Reactor trips on high pressurizer level (control rod motion starts)	21.64
PSVs close	23.2
PSVs open	24.5
PSVs close	25.8
Bank 5 MSSVs close	41.0
Bank 4 MSSVs close	42.8
Bank 3 MSSVs close	46.3
SI signal on low pressurizer pressure Auxiliary feedwater on SI signal	49.5
End of simulation	50.0

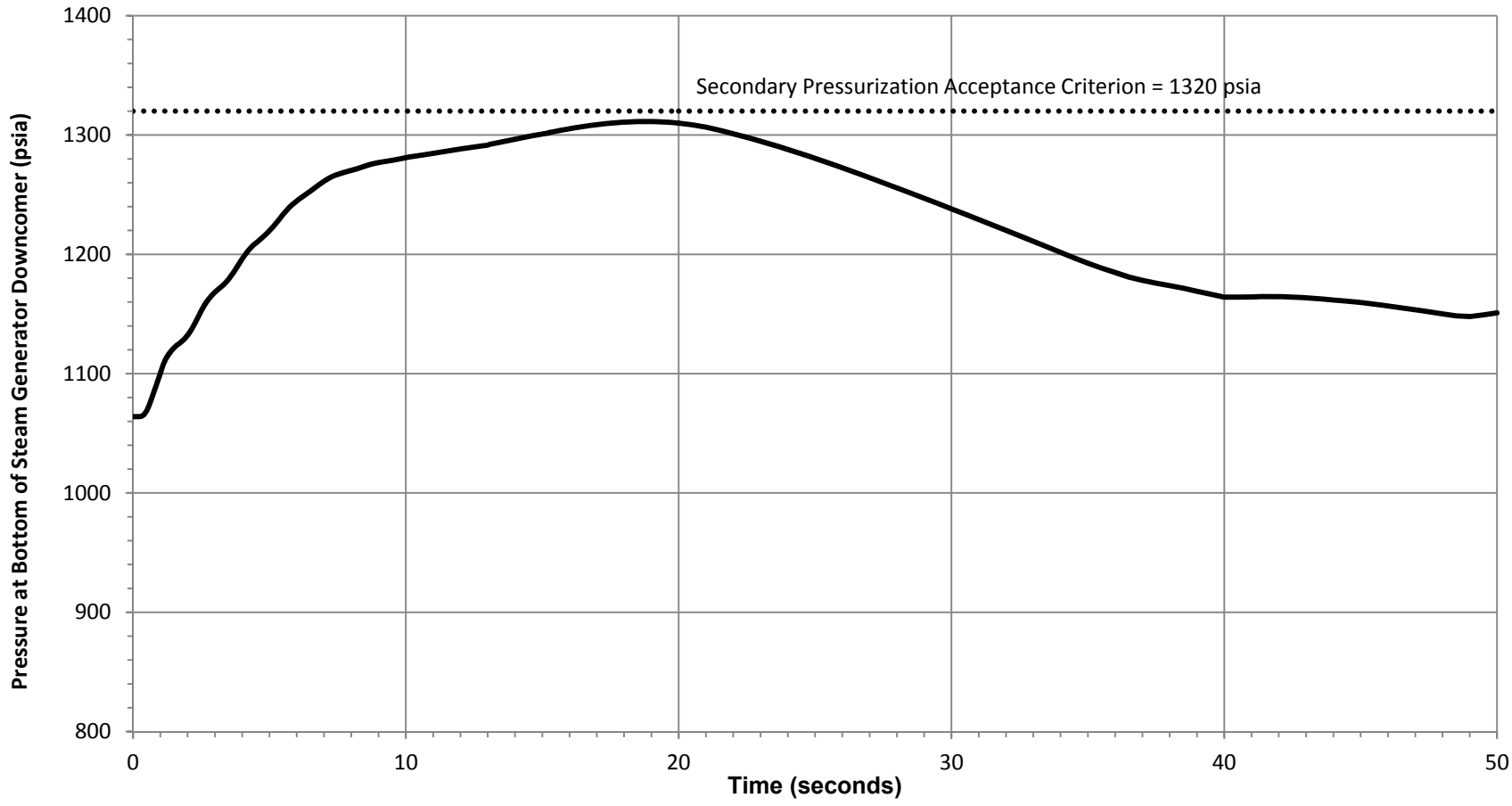
Primary System Overpressurization
SRP 5.2.2 Sensitivity Case



Secondary System Overpressurization



Secondary System Overpressurization



DNB Evaluation

- Sensitivity cases with different MSSV drift setpoints have been performed using the HNP RETRAN-3D model for the DNB analysis.
- The sensitivity study result shows that the DNBR results are insensitive to the MSSV setpoints
- The MSSV setpoint tolerance has no negative impact on the MDNBR results
- The current HNP DNB analysis remains valid for the MSSV setpoint tolerance change

Turbine Trip Summary

- Turbine trip event has been reanalyzed to evaluate changes to the primary and secondary system safety valve tolerances
- Cases analyzed demonstrate that the acceptance criteria are satisfied assuming a safety valve tolerance of ± 3%
- Sensitivity case demonstrates the design and sizing of the pressurizer safety valves meets the overpressure design criterion cited in SRP Chapter 5.2.2

Conclusion

- Technical Specification 3.4.2 and 3.7.1.1 changes requested to increase pressurizer and main steam safety valve lift setting tolerances from 1% to 3%
- NRC approval requested for FSAR 15.2.3 Turbine Trip Analysis for primary and secondary overpressure
- Proposed changes continue to provide adequate protection to public health and safety.
- Accelerated review and approval of nine months requested to eliminate need for interim increased test frequencies.