Proprietary Information Withhold Under 10 CFR 2.390(d)(1)
This letter is decontrolled when separated from Attachment 1 of Enclosure 2

1101 Market Street, Chattanooga, Tennessee 37402

CNL-15-263

December 29, 2015

10 CFR 50.90

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

Watts Bar Nuclear Plant, Unit 1
Facility Operating License Nos. NFP-90
NRC Docket No. 50-390

Subject: **Application to Revise Technical Specification 4.2.1, "Fuel Assemblies" (WBN-TS-15-03) (TAC No. MF6050) - Supplemental Information Related to the Onsite Regulatory Audit at Pacific Northwest National Laboratory**

Reference:

1. Letter From TVA to NRC, CNL-15-001, "Application to Revise Technical Specification 4.2.1, 'Fuel Assemblies,' (WBN-TS-15-03)," dated March 31, 2015 (ML15098A446)
2. Letter from TVA to NRC, CNL-15-077, "Correction to Application to Revise Technical Specification 4.2.1, 'Fuel Assemblies' (WBN-TS-15-03)," dated April 28, 2015 (ML15124A334)
3. Letter From NRC to TVA, "Watts Bar Nuclear Plant, Unit 1 - Supplemental Information Needed for Acceptance of Requested Licensing Action Regarding Application to Increase Tritium Producing Absorbing Rods (TAC NO. MF6050)," dated May 14, 2015 (ML15127A250)
4. Letter from TVA to NRC, CNL-15-092, "Response to NRC Request to Supplement the Application to Revise Technical Specification 4.2.1, 'Fuel Assemblies' (WBN-TS-15-03)," dated May 27, 2015 (ML15147A611)
5. Letter from TVA to NRC, CNL-15-093, "Response to NRC Request to Supplement Application to Revise Technical Specification 4.2.1, 'Fuel Assemblies' (WBN-TS-15-03) - Radiological Protection and Radiological Consequences," dated June 15, 2015 (ML15167A359)

6. Electronic Mail from Jeanne Dion (NRC) to Clinton Szabo (TVA), Gordon Arent (TVA), and Robert H. Bryan, Jr. (TVA), "Request for Additional Information Regarding Tritium production License Amendment (TAC No. MF6050)," dated August 14, 2015 (ML15226A466)

7. Letter from TVA to NRC, CNL-15-172, "Application to Revise Technical Specification 4.2.1, "Fuel Assemblies" (WBN-TS-15-03) (TAC No. MF6050) - Response to NRC Request for Additional Information - Reactor Systems Branch," dated September 14, 2015 (ML15258A204)

8. Letter from NRC to TVA, "Watts Bar Nuclear Plant, Unit 1 - Audit Report Related to License Amendment Request to Revise Technical Specification 4.2.1, Fuel Assemblies (CAC No. MF6050)," dated December 23, 2015 (ML15345A424)

By letter dated March 31, 2015 (Reference 1), Tennessee Valley Authority (TVA) submitted a license amendment request (LAR) to revise Watts Bar Nuclear Plant (WBN), Unit 1 Technical Specification (TS) 4.2.1, "Fuel Assemblies," to increase the maximum number of Tritium Producing Burnable Absorber Rods (TPBARs) that can be irradiated per cycle from 704 to 1,792. The proposed change also revises TS 3.5.1, "Accumulators," Surveillance Requirement (SR) 3.5.1.4 and TS 3.5.4, "Refueling Water Storage Tank (RWST)," SR 3.5.4.3 to delete outdated information related to the Tritium Production Program. TVA provided a correction letter on April 28, 2015 (Reference 2).

By letter dated May 14, 2015 (Reference 3), the Nuclear Regulatory Commission (NRC) requested that TVA provide additional information to supplement the LAR. TVA provided the requested supplemental information in TVA letters dated May 27, 2015, and June 15, 2015 (References 4 and 5, respectively).

By electronic mail dated August 14, 2015 (Reference 6), the Nuclear Regulatory Commission (NRC) requested that TVA provide additional information to support the NRC review of the LAR. TVA submitted the response to the requests for additional information (RAIs) by letter dated September 14, 2015 (Reference 7). In RAI item 2, the staff requested more information regarding revised lithium leaching assumptions used in the post-Loss of Coolant Accident (LOCA) subcriticality assessment referenced in the March 31, 2015, LAR. TVA stated that the assumptions were based on a series of tests performed at the Pacific Northwest National Laboratory (PNNL).

On November 3 and 4, 2015, NRC performed an onsite regulatory audit at the PNNL facilities to obtain and review information regarding how TVA resolved item 2 in the staff's RAI dated August 14, 2015, regarding the leach rate tests. During the audit exit meeting, the NRC identified two open items.

Audit Open Item 1 - Certain sections of the TPBAR Burst test documentation, TTP-1-3010, are needed to complete the safety review of the LAR. TVA should submit the following pages from TTP-1-3010, Revision 0, "Phase Four Full-Length Burst Testing," on the docket:

- Statistical Reanalysis of Mark 9.2 and Mark 8.1 TPBAR Test Pellet Length Loss (page v)

- Pellet Length Effect on Mark 9.2 TPBAR Burst Testing (page vi)
- Section 3.0 Description of SMART Facility (pages 5-9)
- Section 4.0 Test Method (pages 10-11)
- Subsection 5.3 Mark 9.2 Test Article Burst Test Summaries (pages 19-32)

Audit Open Item 2 - In the post-LOCA subcriticality analysis, one of the assumptions is that the TPBARs have a 12-inch gap in absorber material resulting from a postulated bursting of all TPBARs. This gap is located at the same axial elevation for all TPBAR-bearing fuel assemblies. Westinghouse provided information during the audit to justify the conservatism of this assumption based on the fact that the most reactive axial node for all fuel assemblies is located within the region where the 12-inch gap in TPBAR absorber material is modeled. This information should be submitted on the docket to support the staff's findings, as well as a discussion of how this assumption in the post-LOCA subcriticality analysis would be assessed if future TPBAR core designs do not demonstrate similar uniformity in the axial location of the most reactive node for all fuel assemblies.

By letter dated December 23, 2015 (Reference 8), the NRC requested that TVA provide docketed responses for the above audit open items. TVA agreed to provide the docketed responses by December 31, 2015.

Enclosure 1 provides the sections of TTP-1-3010 requested in Audit Open Item 1. Enclosure 2 provides the information provided by Westinghouse requested in Audit Open Item 2, as well as a discussion of how this assumption in the post-LOCA subcriticality analysis would be assessed if future TPBAR core designs do not demonstrate similar uniformity in the axial location of the most reactive node for all fuel assemblies.

Attachment 1 of Enclosure 2 contains information that Westinghouse Electric Company (Westinghouse) considers to be proprietary in nature and subsequently, pursuant to 10 CFR 2.390, "Public inspections, exemptions, requests for withholding," paragraph (a)(4), it is respectfully requested that such information be withheld from public disclosure. Attachment 2 of the enclosure contains the non-proprietary version of the Attachment 1 information with the proprietary material removed, and is suitable for public disclosure. Attachment 3 of the enclosure provides the affidavit supporting this request.

Consistent with the standards set forth in Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50.92(c), TVA has determined that the additional information, as provided in this letter, does not affect the no significant hazards consideration associated with the proposed application previously provided in Reference 1.

Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and the enclosures to the Tennessee Department of Environment and Conservation.
There are no new regulatory commitments associated with this submittal. Please address any questions regarding this request to Mr. Edward D. Schrull at (423) 751-3850.

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

Respectfully,

J. W. Shea
Vice President, Nuclear Licensing

Enclosure

cc: See Page 4
Enclosure: 1 Excerpts from TTP-1-3010, Revision 0, "PHASE FOUR FULL-LENGTH BURST TESTING"
2. Supplemental Information for the Watts Bar, Unit 1 1,792 TPBAR License Amendment Request

Enclosures
cc (Enclosures):

NRC Regional Administrator - Region II
NRC Resident Inspector – Watts Bar Nuclear Plant
NRC Project Manager – Watts Bar Nuclear Plant
Director, Division of Radiological Health - Tennessee State Department of Environment and Conservation

ENCLOSURE 1

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
UNIT 1

Excerpts from TTP-1-3010, Revision 0, "PHASE FOUR FULL-LENGTH BURST TESTING"
(26 pages including cover page)

TRITIUM TECHNOLOGY PROGRAM

EXCERPTS FROM TTP-1-3010, Revision 0
"PHASE FOUR FULL-LENGTH BURST TESTING"

Revision 0

Prepared By:	EF Love, Design Task Manager	11/16/15 Date
Reviewed By:	Mat R. McEA for TM Brewer, Lead Quality Engineer	16 NOV 15 Date
	BD Reid, Derivative Classifier	11/17/15 Date
Approved By:	CK Thornhill, TTP Project Manager	11/17/15 Date

1.0 INTRODUCTION

The following document has been prepared for the sole purpose of summarizing pertinent information from the subject test report. This summary was prepared at the request of the Nuclear Regulatory Commission (NRC) during an audit at the Pacific Northwest National Laboratory (PNNL).

This document contains unmodified excerpts from TTP-1-3010, *Phase Four Full-Length Burst Testing.* It does not provide a full and complete description of the tests or testing; its use shall be limited in purpose to support the NRC audit. PNNL staff shall not use this document as reference for any Tritium Producing Burnable Absorber Rod (TPBAR) design or any other TPBAR related purpose.

2.0 ATTACHMENTS

A TTP-1-3010, Rev. 0 – Page v

B TTP-1-3010, Rev. 0 – Page vi

C TTP-1-3010, Rev. 0 – Section 3.0, Page 5-9

D TTP-1-3010, Rev. 0 – Section 4.0, Page 10-11

E TTP-1-3010, Rev. 0 – Section 5.3, Page 19-32

Statistical Reanalysis of Mark 9.2 and Mark 8.1 TPBAR Burst Tests Pellet Length Loss

The results of the Mark 9.2 and Mark 8.1 TPBAR LBLOCA burst test pellet-length losses were reanalyzed taking pressure into account. It was noted that the pellet length lost increased as pressure increased. Therefore, the confidence statements should depend on pressure. The results compare closely to the previous analyses that were not pressure dependent as discussed in Section 5.5 of the report. The current LBLOCA analysis of record requires that pellet length loss from all TPBARs in the core shall not exceed an average of 12.0 inches during a LBLOCA with a confidence criterion of 95:50.

The worst-case pressure dependent results for the Mark 9.2 TPBAR LBLOCA burst tests are as follows. At the 95% one-sided confidence level, the average pellet length loss is less than 9.96 inches at a pressure of 4000 psi which meets the LBLOCA analysis of record requirement (i.e., the 95:50 loss is estimated to be 9.96 inches). Further, at the 95% confidence level, no more than 12.0 inches of pellet length loss occurs in 93.34% of the TPBARs at a pressure of 4000 psi. At the 90% one-sided confidence level, the average pellet length loss is less than 9.69 inches at a pressure of 4000 psi. Based on the statistical analysis of Mark 9.2 TPBAR design burst test results, it is recommended that future designs employing a full-length getter be burst tested at approximately 4000 psi only.

The worst-case pressure dependent results for the Mark 8.1 TPBAR LBLOCA burst tests are as follows. At the 95% one-sided confidence level, the average pellet length loss is less than 8.70 inches at a pressure of 3700 psi which meets the LBLOCA analysis of record requirement (i.e., the 95:50 loss is estimated to be 8.70 inches). Further, at the 95% confidence level, no more than 12.0 inches of pellet length loss occurs in greater than 99.99% of the TPBARs at a pressure of 3700 psi. At the 90% one-sided confidence level, the average pellet length loss is less than 8.61 inches at a pressure of 3700 psi. Based on the statistical analysis of Mark 8.1 TPBAR design burst test results, it is recommended that future designs employing multi-pencil getters be burst tested at approximately 3700 psi only.

The confidence statement comparison of pellet length loss for Mark 9.2 and Mark 8.1 at 4000 and 3700 psi respectively with the current LBLOCA analysis of record is provided in Table 2. The worst-case pressure dependent results show that the confidence criteria for Mark 9.2 and Mark 8.1 burst test performance are substantially better than the current LBLOCA analysis of record requirements.

Table 2. Mark 9.2 and Mark 8.1 TPBAR LBLOCA Burst Test Demonstrated Performance Confidence Compared to Current LBLOCA Analysis of Record Test Acceptance Criterion

Design/Pressure	Confidence Criterion	Pressure Model Worst Case Pellet Loss, Inches
Mark 9.2/4000 psi		
Test Acceptance Criterion	95:50	< 12.0
Test Demonstrated Performance	95:50	< 9.96
Test Demonstrated Performance	95:93.3	< 12.0
Mark 8.1/3700 psi		
Test Acceptance Criterion	95:50	< 12.0
Test Demonstrated Performance	95:50	< 8.70
Test Demonstrated Performance	95:99.99	< 12.0

For Mark 9.2 – 95:50 < 12.0 means the test acceptance criterion requires 95% confidence that the average pellet length loss of all the TPBARs in the core is less than 12.0 inches. 95:50 < 9.96 means the actual performance demonstrated 95% confidence that 50% of the TPBARs in the core will lose less than 9.96 inches of pellet material. 95:93.3 < 12.0 means the actual performance demonstrated a 95% confidence that 93.3% of the TPBARs in the core will lose less than 12.0 inches of pellet material.

For Mark 8.1 – 95:50 < 12.0 means the test acceptance criterion requires 95% confidence that the average pellet length loss of all the TPBARs in the core is less than 12.0 inches. 95:50 < 8.70 means the actual performance demonstrated 95% confidence that 50% of the TPBARs in the core will lose less than 8.70 inches of pellet material. 95:99.99 < 12.0 means the actual performance demonstrated a 95% confidence that 99.99% of the TPBARs in the core will lose less than 12.0 inches of pellet material.

Pellet Length Effect on Mark 9.2 TPBAR Burst Testing

The Mark 9.2 TPBAR test articles contained pellets with either approximately 1-inch or 0.32-inch lengths to cover a potential pellet length range. Actual nominal pellet length dimensions specified can be found in the fabrication drawing set as referenced in Appendix F. As can be seen in Figure 2, there is no significant effect on TPBAR burst test results due to variations in the pellet length. The pellet material loss mass values were all below the 12-inch pellet loss limit shown in Figure 2. Note that two of the Mark 9.2 burst test data points for rods with different length pellets overlap and appear to be almost one data point, causing a slight inflection in the lines joining average data points at about 3350 psi. The average for the 6 rods was almost on a linear slope, and the pellet mass loss increased with burst pressure as would be expected.

3.0 Description of SMART Facility

The Areva (formerly Framatome-ANP) Small Array Test (SMART) facility is an open-loop, high-temperature, low-pressure test facility built in 1997. It has been successfully used to perform thermal hydraulic testing on full-scale components representing commercial fuel-assembly segments. A simplified test facility process and instrumentation schematic of the test vessel and hardware is shown in Figure 3. The vessel region of the facility is shown in greater detail in Figure 4. The components of interest to the full-length burst testing included the test vessel, power supply, and Supervisory Control and Data Acquisition (SCADA) system. The steam supply, water treatment, and water supply and recovery components were not used in the burst testing. Additional details on SMART facility components used in the burst testing, including the radial and axial thermocouple locations, test assembly modifications, and existing spacer and thermocouple locations for the electrically heated bundle and shroud are provided in the Phase 1 and 2 TPBAR Full-Length Burst Test Report (McKinnon 2002). The most significant difference in the setup used for these tests was the addition of the GTGS setup for the Mark 9.1, 8.1, and 9.2 tests during Phase 4 of TPBAR burst testing.

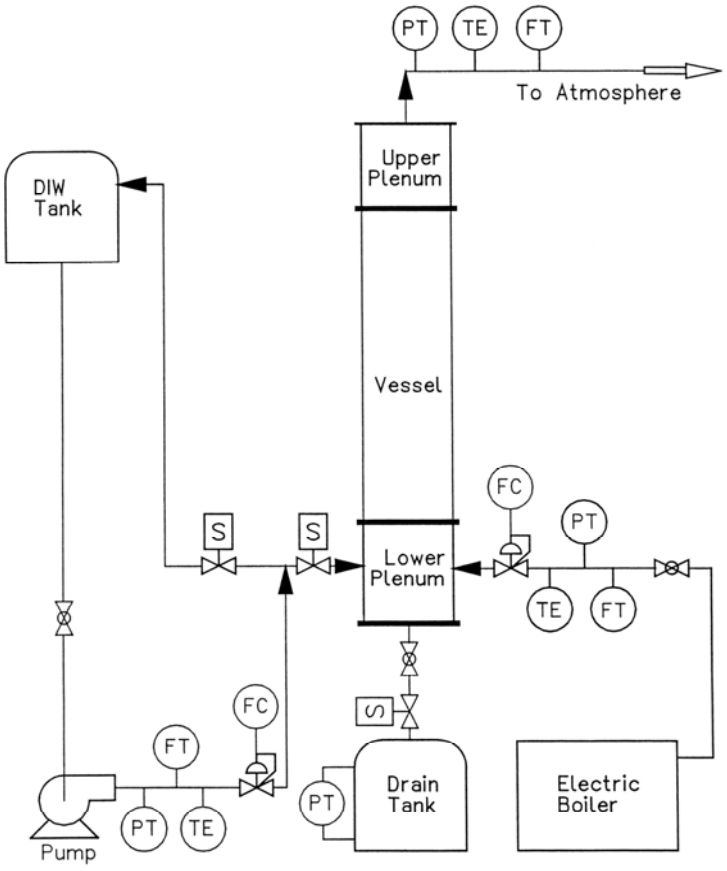

Figure 3. Simplified SMART Facility Process and Instrumentation Schematic

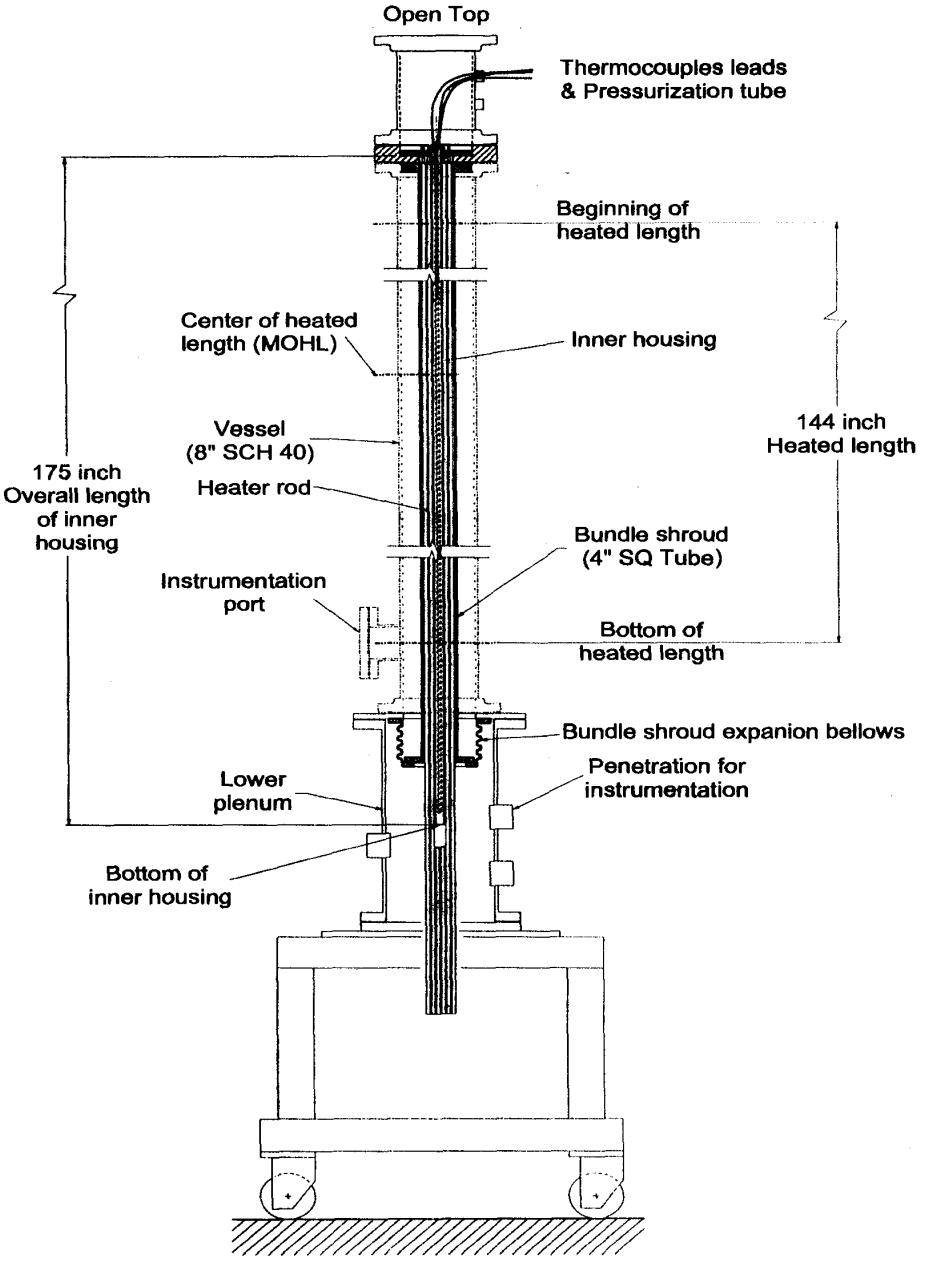

Figure 4. SMART Facility Vessel, Upper Plenum, and Lower Plenum Regions

The SMART facility was previously modified to meet the needs of the TPBAR testing program. A 6×6 simulated pressurized water reactor assembly provided the basic hardware for the test program. The 6×6

assembly used an array of 32 electrical heater rods to provide the chopped cosine axial power profile shown in Figure 5.

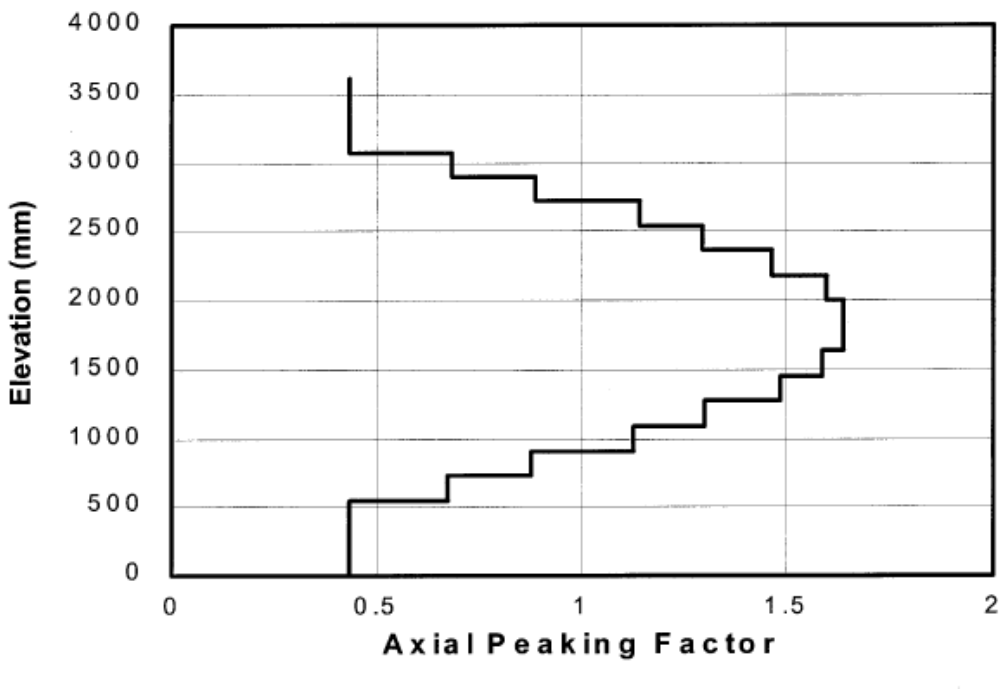

Figure 5. Axial Power Profile for Electrical Heater Rod Array

A 2×2 array of heater rods and the spacer cell structure were removed to accommodate the inner housing and TPBAR assembly for the testing. The test vessel was heavily insulated to reduce heat losses and to optimize the time-to-temperature heat-up during the test. A cross-section of the shrouded test assembly is shown in Figure 6.

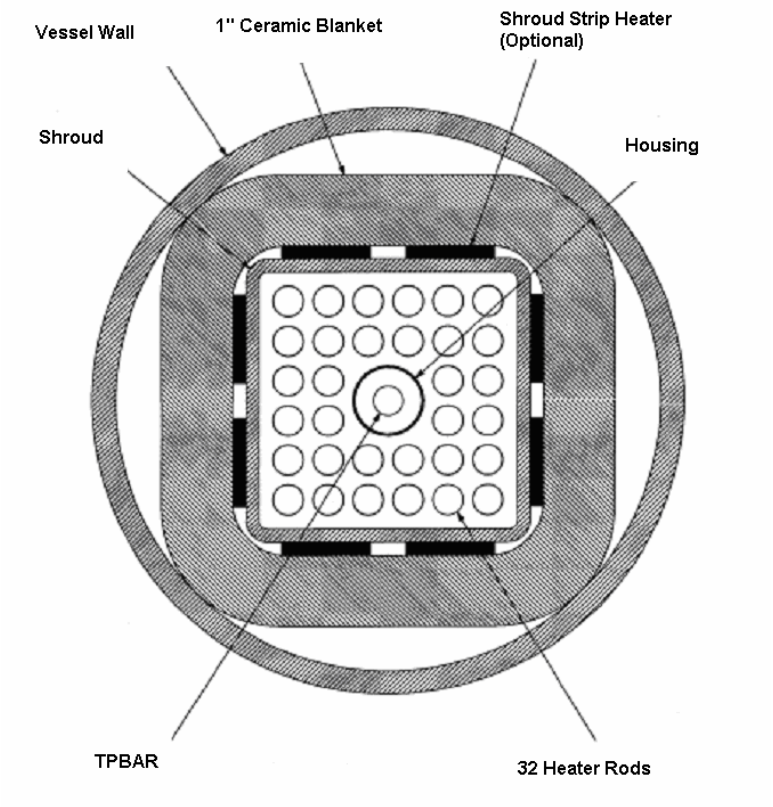

Figure 6. SMART Test Facility Cross-section

GTGS assemblies were used to test the Mark 9.1, 8.1, and 9.2 test series. The guide tubes in these assemblies were fabricated from Zircaloy-4 with a proprietary outside diameter and wall thickness. Sections of AREVA Mark BW spacers (grid straps) were attached to the guide tube using spot welds. The spacer sections were sized to fit into the housing with a similar clearance to the centering devices that were used for the previous Mark 8 test series. These spacer sections were located at the same positions as the centering devices. The guide tube was hung from the top of the housing by tabs that were formed at the top of the tube and secured with the same screws used to attach the housing end fitting. A drawing of the GTGS assembly is shown in Figure 7.

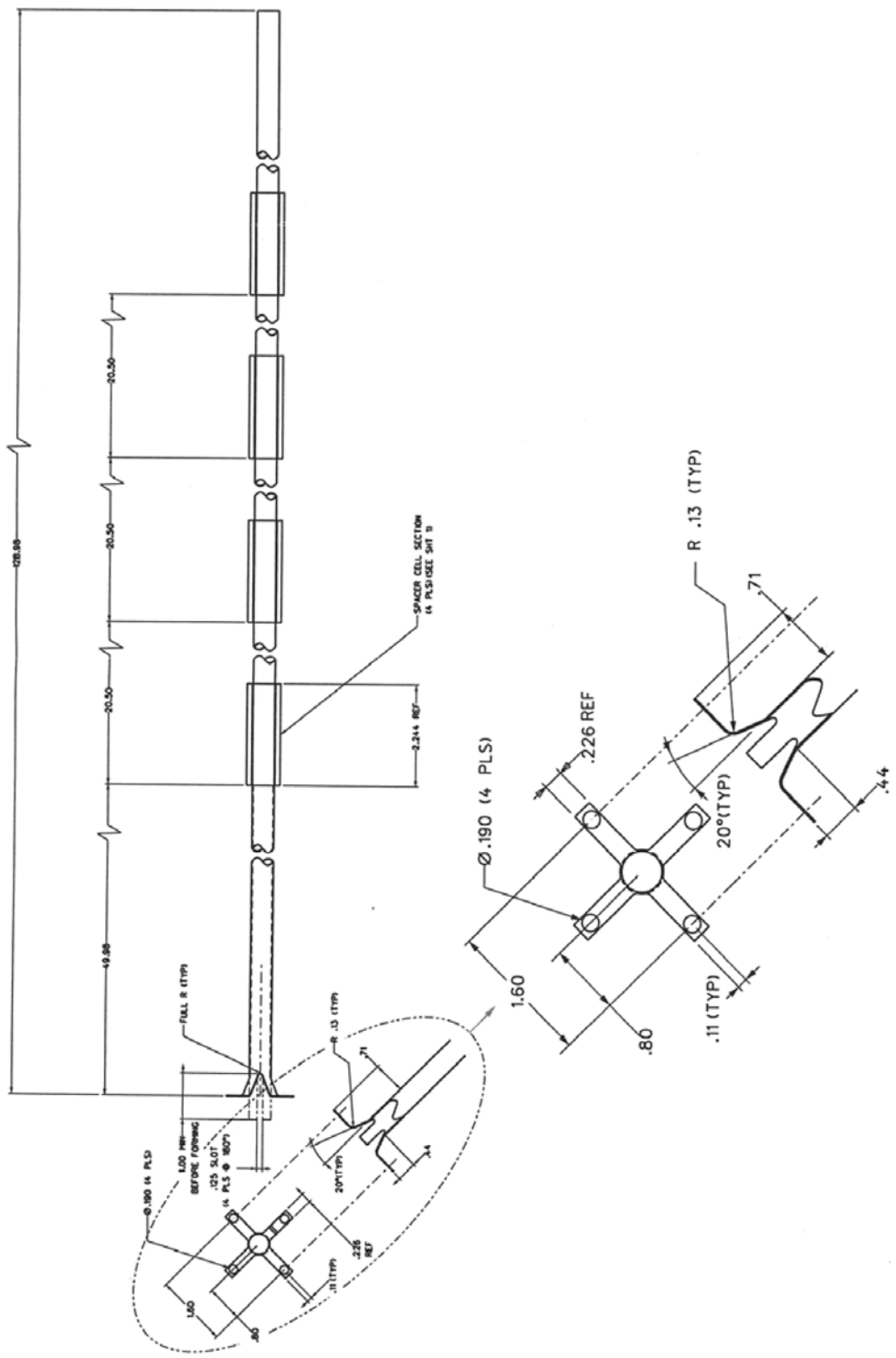

Figure 7. GTGS Assembly Drawing

4.0 Test Method

The TPBAR was initially pressurized to the cold pressure that PNNL determined would allow the TPBAR to achieve the desired burst pressure. The TPBAR was then isolated from the helium source and the system checked to verify that the assembly and associated tubing were leak tight.

The TPBAR test was initiated by starting the data recording and then bringing the temperature of the heater rods to 800°F. This was achieved by ramping power to the heater rods linearly over a 40-second time period to an output of 20 kW. Once the heater rods achieved the target value of 800°F, the power was reduced to 4 kW and held at that level for 30 minutes (1,800 seconds) to allow the heat to distribute evenly through the facility and to allow the middle of the heated length (MOHL) of the test rod to reach 800°F. Next, the power was ramped up linearly over a 10-second time period to a high power output of 70 kW and held at that level until the test bundle maximum temperature was 1,800°F (the desired result was to quickly bring up the heater-rod temperatures to near 1,800°F).

Once the maximum test-bundle temperature achieved the target value of 1,800°F, the power was reduced to 33 kW and the temperature held at 1,800°F, allowing the test bundle, inner housing, and TPBAR temperature to equalize at the MOHL until the TPBAR burst had occurred. See Figure 8 for a graphical representation of the power applied to the heater rods during testing. Figure 9 shows the temperature histories associated with the power history.

After the desired burst had occurred, the power was ramped down linearly to zero over a 10-second period, the test was terminated, and the test data were saved to disk. During the testing, the total bundle power, heater-rod temperatures, central housing temperatures, TPBAR upper plenum temperature, and TPBAR pressure were recorded.

The test assembly was removed from the SMART facility and inspected after the test was completed. First, it was weighed to determine the difference before and after the test. This defined the amount of TPBAR material that is lost from the test housing. After weighing the test assembly, the housing is dissected so that the TPBAR can be removed. This is done by locating the failure location and then measuring 6 inches on either side. The housing tube is then cut at these locations, and the loose tubing pieces are removed. Then the 12-inch section around the failure site is sliced lengthwise and flared so that it can be removed. During the housing dissection, care is taken to collect all loose pellet and zircaloy material. This material is placed into separate plastic bags and weighed. Also, during this process, digital photos were taken to document the failure appearance. A selection of these photos for every TPBAR test article failure included in the Phase 4 test is provided in Sections 5.3 and 5.4, and Appendix C and D of this report.

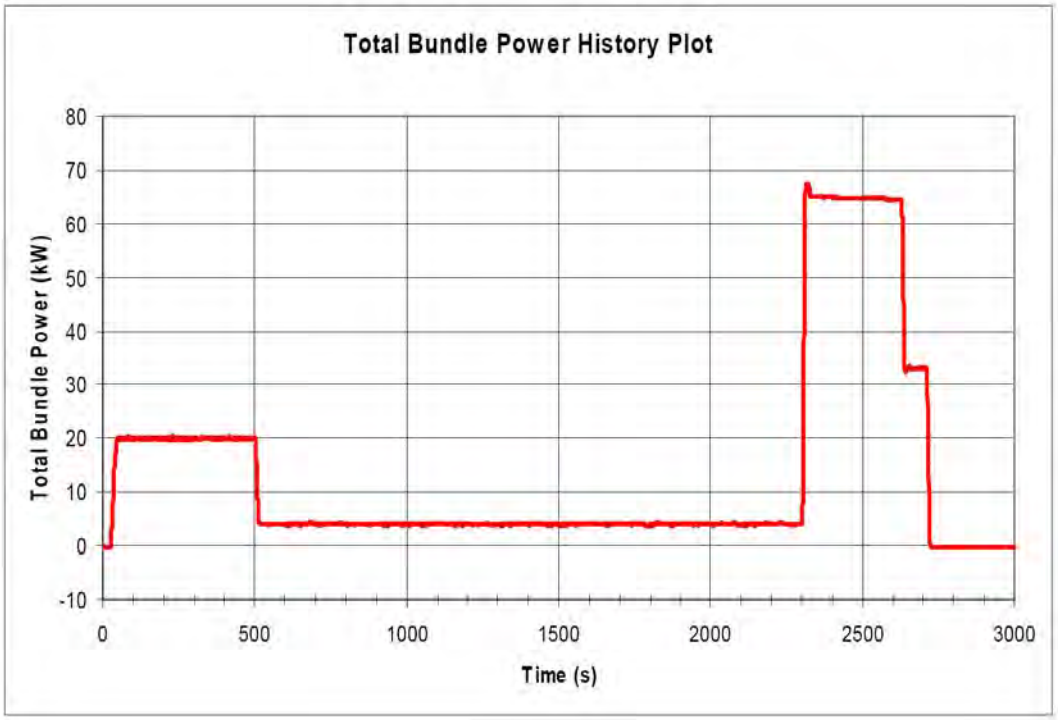

Figure 8. Total Bundle Power History Plot

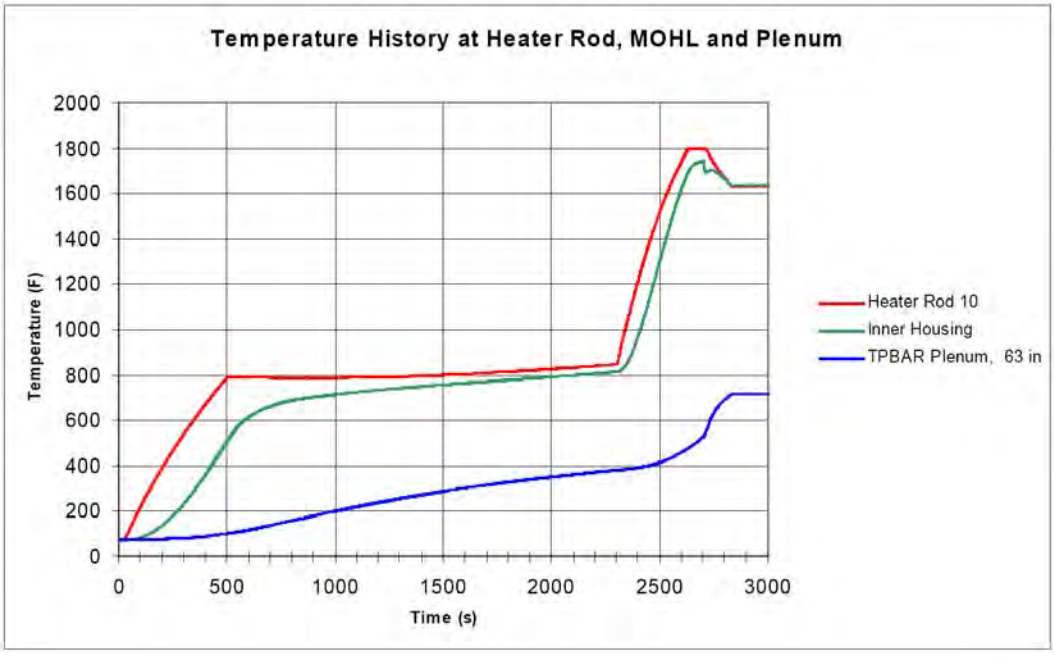

Figure 9. Temperature History at Heater Rod, MOHL and Upper Plenum

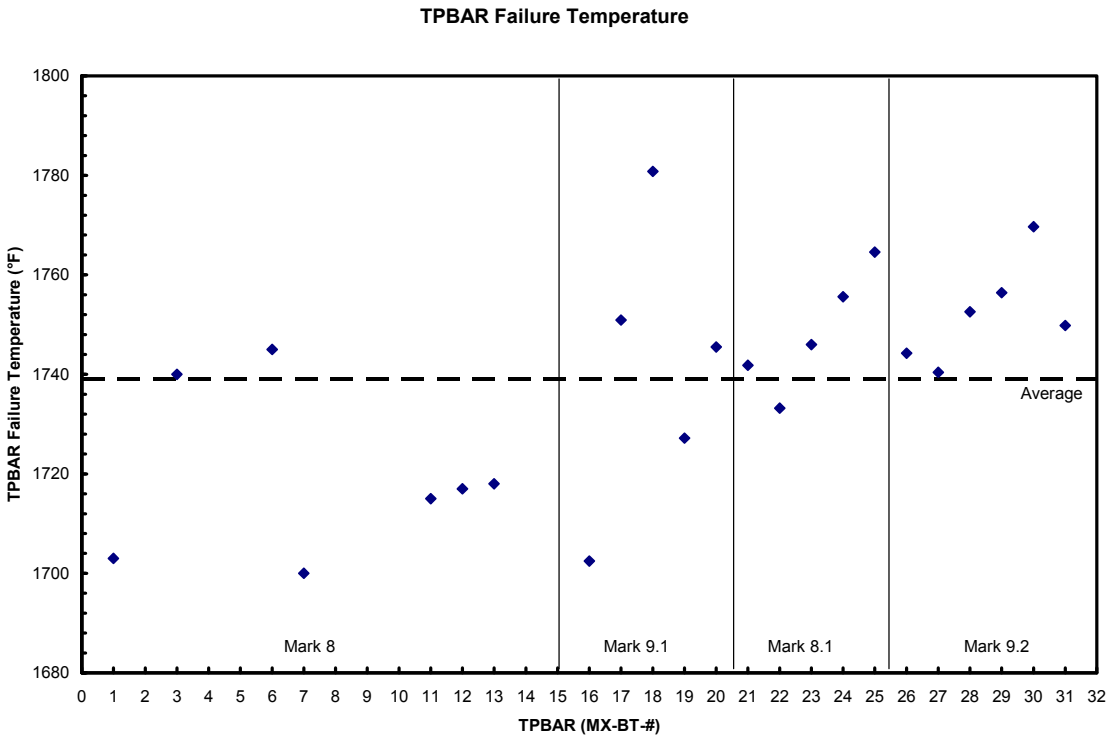

Figure 13. Test Article TPBAR Failure Temperatures

5.3 Mark 9.2 Test Article Burst Test Summaries

The scope of the Phase 4, TPBAR testing was expanded to include two new rod design variations. This section of the report provides the burst test results for the FLG TPBAR design designated as Mark 9.2. The burst test results for the multi-pencil Mark 8.1 TPBAR design are described in Section 5.4 of this report.

The Mark 9.2 design burst test series was performed as described in AREVA NP document 51-90400192-000 (Bowen 2007). As with the Mark 8.1 design burst testing, the main variation from previous Mark 8 TPBAR design burst testing was the inclusion of the GTGS configuration shown previously in Figure 7.

Six test runs were performed starting with rod M9-BT-26 and ending with rod M9-BT-31. Due to a problem with the test system, the first test on M9-BT-26 was aborted to allow the facility to cool. The test was successfully completed the following day. The target burst pressures were varied between tests. M9-BT-26 and M9-BT-27 had target burst pressures of 4000 psi. M9-BT-28, M9-BT-29, and M9-BT-31 had target burst pressures of 3300 psi. M9-BT-30 had a target burst pressure of 2600 psi.

The axial temperature profiles for the inner housing and TPBAR plenum of each Mark 9.2 TPBAR test run are provided in Figures 14, 17, 20, 23, 26, and 29. The total bundle power and TPBAR temperature and pressure histories for the duration of each TPBAR test run are given in Figures 15, 18, 21, 24, 27, and 30. Photographs of the TPBAR burst locations are shown in Figures 16, 19, 22, 25, 28, and 31.

All tests had limited amounts of material expelled and had small, well contained failure sites. Therefore, the tests results were considered acceptable.

The test assembly was removed from the SMART facility and inspected after the test was completed. First, it was weighed to determine the difference before and after the test. This defined the amount of TPBAR material that is lost from the test housing. After weighing the test assembly, the housing is dissected so that the TPBAR can be removed. This is done by locating the failure location and then measuring 6 inches on either side. The housing tube is then cut at these locations, and the loose tubing pieces are removed. Then the 12-inch section around the failure site is sliced lengthwise and flared so that it can be removed. During the housing dissection, care is taken to collect all loose pellet and zircaloy material. This material is placed into separate plastic bags and weighed. Also, during this process, digital photos were taken to document the failure appearance.

At the start of testing on rod M9-BT-26, the readings from thermocouple number 33 went off the chart. This caused the system to skip the initial heat up to 800°F at 20 kW and immediately go to the 4-kW power setting. This had occurred during the Mark 8.1 testing. In that case, the facility was cooled and the rod tested the same day. Unfortunately, the Mark 8.1 rod burst slightly below its target pressure. Therefore, it was determined that for M9-BT-26, the test would immediately be stopped and the facility allowed to cool over night. The erroneous thermocouple reading appeared to come from a loose connection on the facility. All the thermocouple connections were subsequently checked and redone. The test was repeated the following day, and it met its target burst pressure.

There was an error during the setup for testing on rod M9-BT-26. At the step where the fill-tube fitting was attached, the temporary coupling and its cap were left on. This mass was then included in the pretest mass of the assembly. The subsequent post test mass was therefore off by the mass of this coupling and cap. This increased the amount of mass lost that was initially reported to PNNL by 8.9 grams. When the problem was realized, the data were corrected. Then CR 2006-5522-FA was generated. Additional steps were added in the test checklist to be sure not to leave this fitting in place in the future and to investigate unusual weight differences. Individual test results are provided in the appendices at the end of the AREVA NP 51-9035385-000 document.

The following tables (6 through 8) summarize the failure data for the TPBAR burst test runs for the six Mark 9.2 rods that were tested during Phase 4.

Table 6. Mark 9.2 TPBAR Pellet Mass Ejected

TPBAR	Mass Difference Pre/Post Test (g)	Collected pellet material (g)	Collected Zircalloy (g)	Ejected pencil material (g)	Total lost and collected material (g)
M9-BT-26	4.2	9.3	1.1	0	14.6
M9-BT-27	2.7	9.1	1.7	0	13.5
M9-BT-28	3.4	7.4	1.8	0	12.6
M9-BT-29	2.3	8.4	0.5	0	11.2
M9-BT-30	2.3	4.5	0.2	0	7.0
M9-BT-31	2.2	6.5	2.6	0	11.3

Table 7. Mark 9.2 TPBAR Test Article Burst Details

TPBAR	Initial Pressure (PSI)	Failure Pressure (PSI)	Failure Temperature (MOHL) (˚F)	TPBAR Failure Location (in)	Failure Length (in)
M9-BT-26	2350	4037.6	1744.2	83.9	1.2
M9-BT-27	2349	4011.8	1740.4	82.0	1.8
M9-BT-28	1932	3350.6	1752.6	81.8	1.7
M9-BT-29	1927	3356.3	1756.4	82.7	1.7
M9-BT-30	1481	2638.8	1769.7	84.6	1.3
M9-BT-31	1926	3353.4	1749.8	85.0	1.9

Table 8. Mark 9.2 TPBAR Test Article Temperature Profiles at Burst

TPBAR	Time (min)	-12 inches (°F)	Diff (°F)	MOHL (°F)	Diff (°F)	+12 inches (°F)
M9-BT-26	44.9	1698.30	45.94	1744.24	47.84	1696.40
M9-BT-27	44.7	1688.87	51.54	1740.41	46.95	1693.46
M9-BT-28	45.4	1704.19	48.40	1752.59	47.11	1705.48
M9-BT-29	45.4	1708.16	48.26	1756.42	50.50	1705.92
M9-BT-30	46.3	1720.45	49.21	1769.66	51.81	1717.85
M9-BT-31	45.3	1700.38	49.43	1749.81	47.70	1702.11

TPBAR M9-BT-26 Test Results

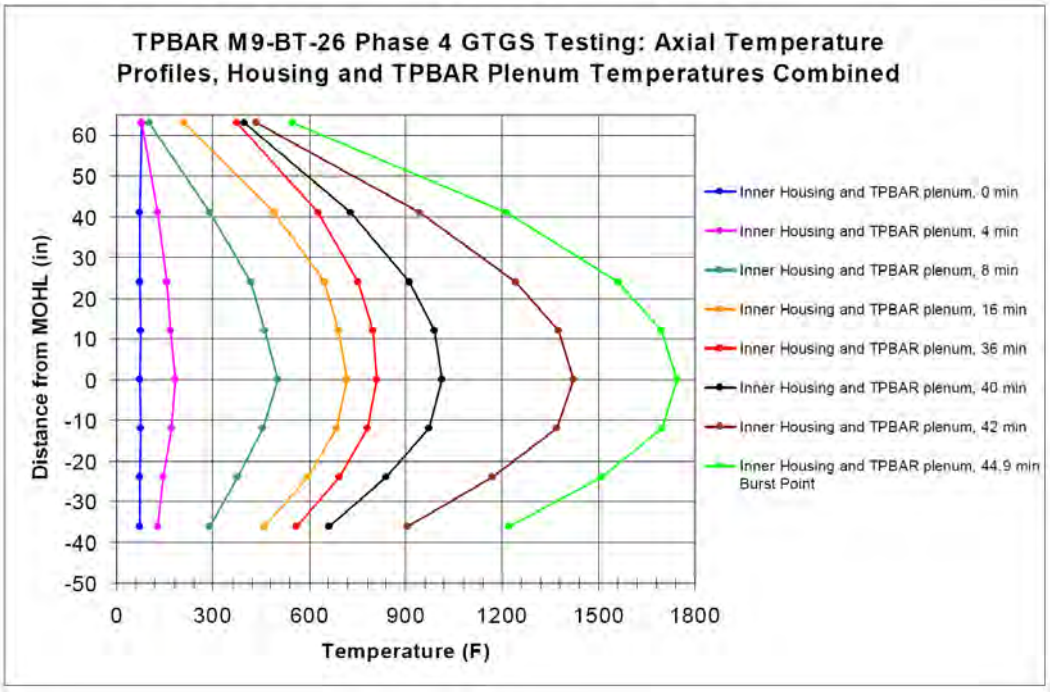

Figure 14. Axial Temperature Profiles for M9-BT-26 Burst Test

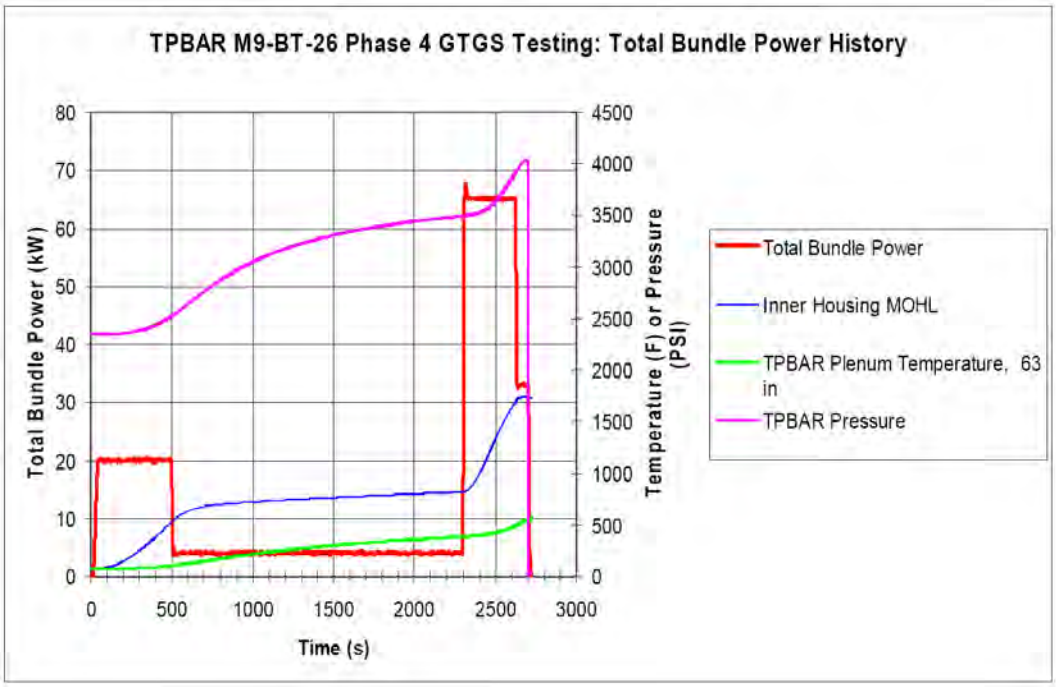

Figure 15. Temperature and Pressure Profiles for M9-BT-26 Burst Test

Figure 16. M9-BT-26 Burst Location

TPBAR M9-BT-27 Test Results

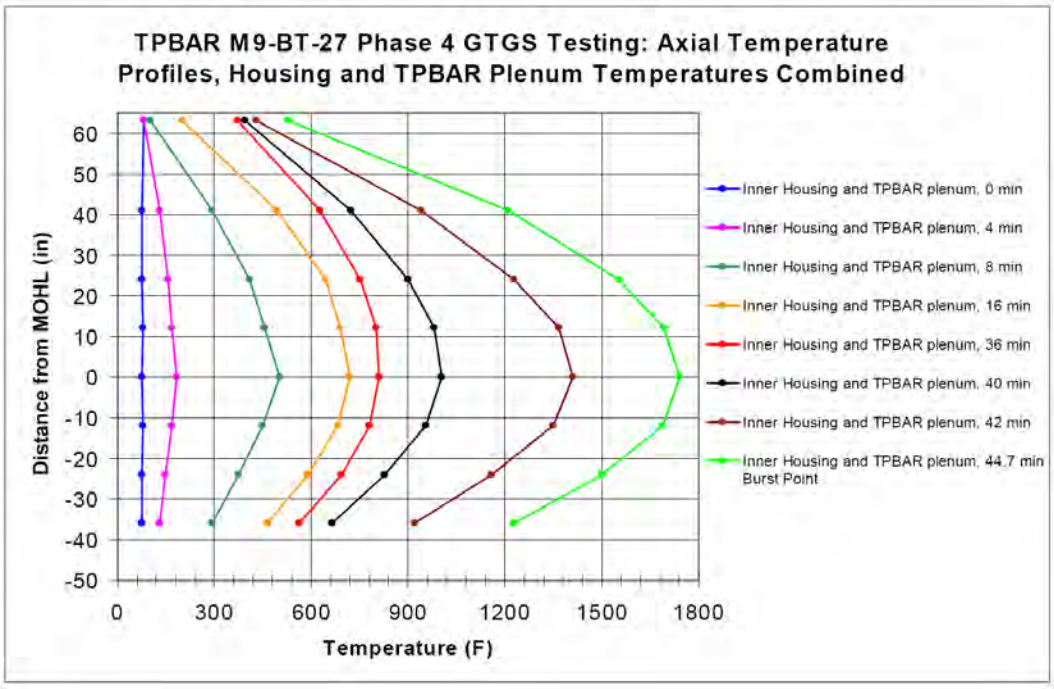

Figure 17. Axial Temperature Profiles for M9-BT-27 Burst Test

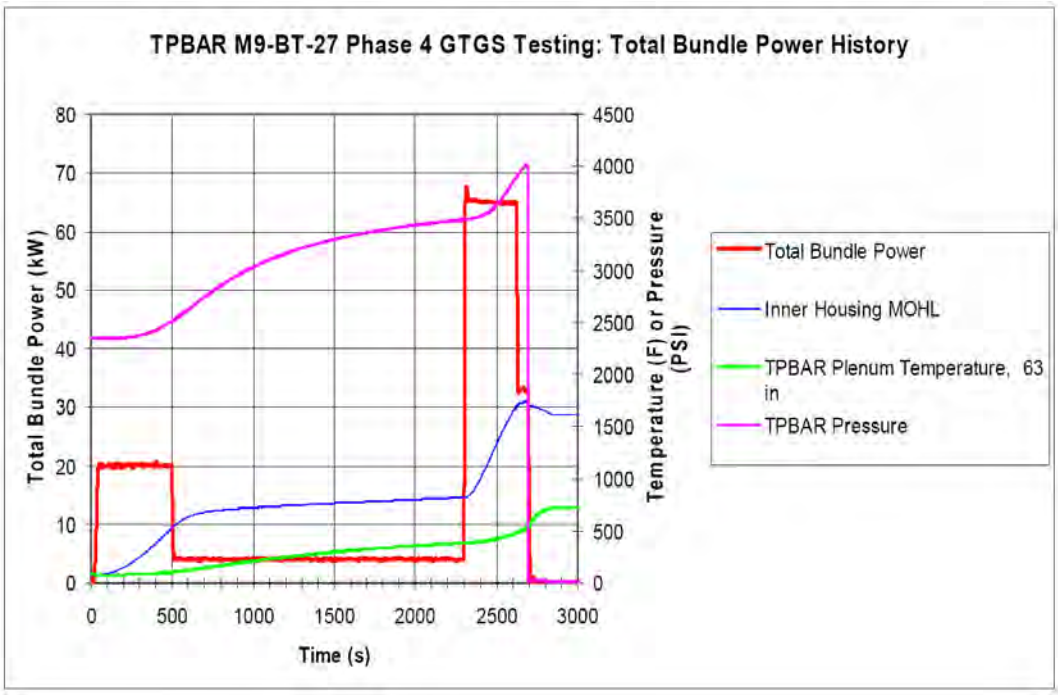

Figure 18. Temperature and Pressure Profiles for M9-BT-27 Burst Test

Figure 19. M9-BT-27 Burst Location

TPBAR M9-BT-28 Test Results

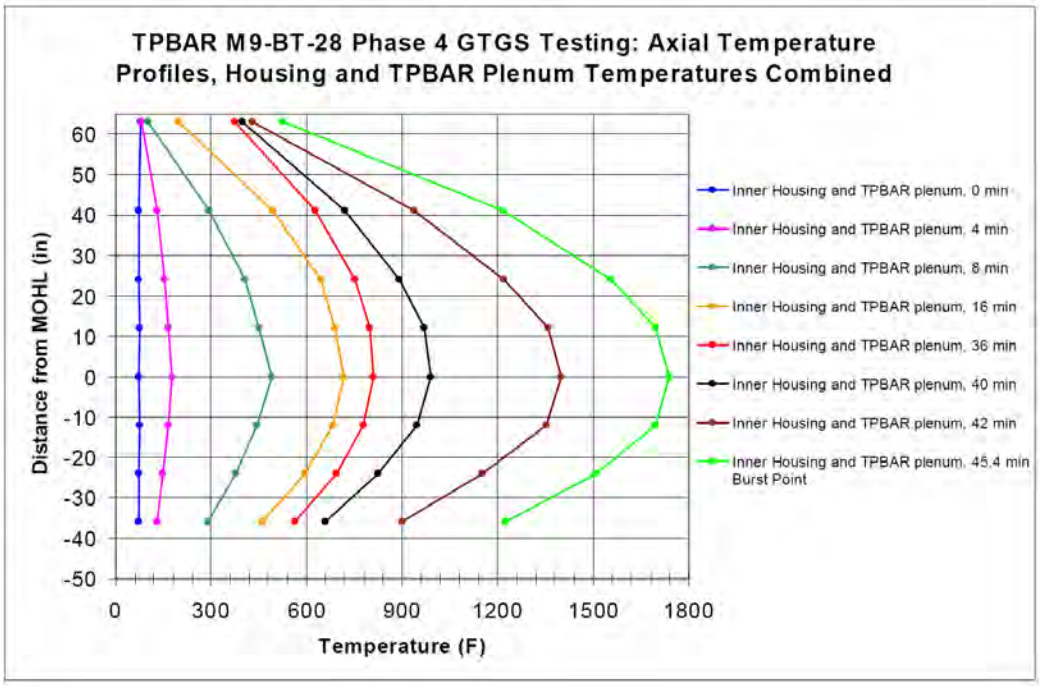

Figure 20. Axial Temperature Profiles for M9-BT-28 Burst Test

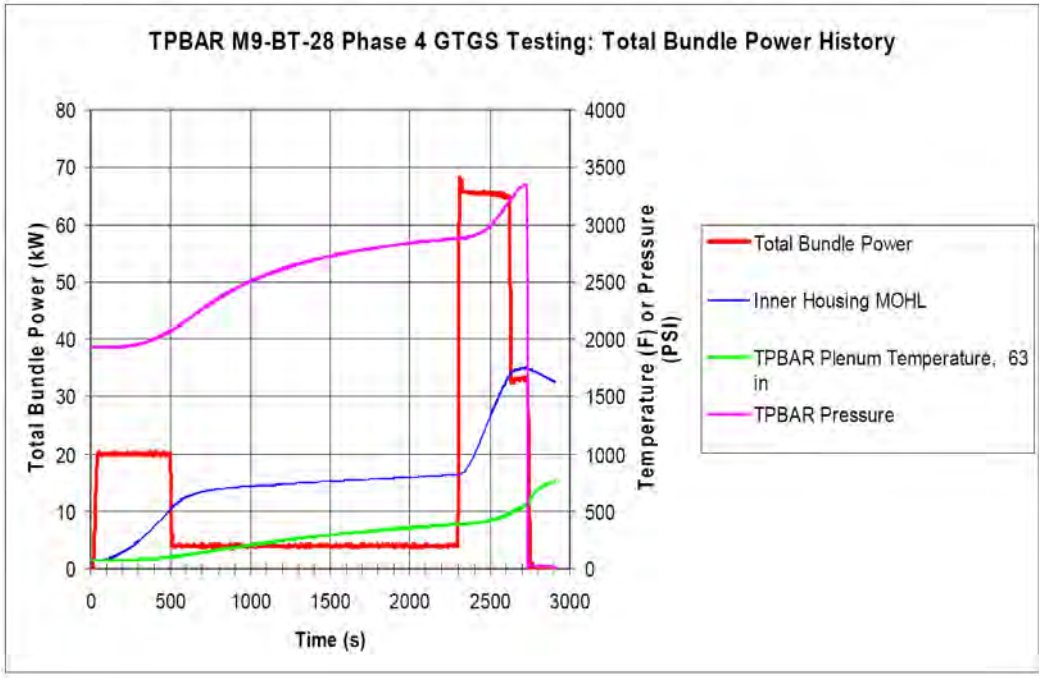

Figure 21. Temperature and Pressure Profiles for M9-BT-28 Burst Test

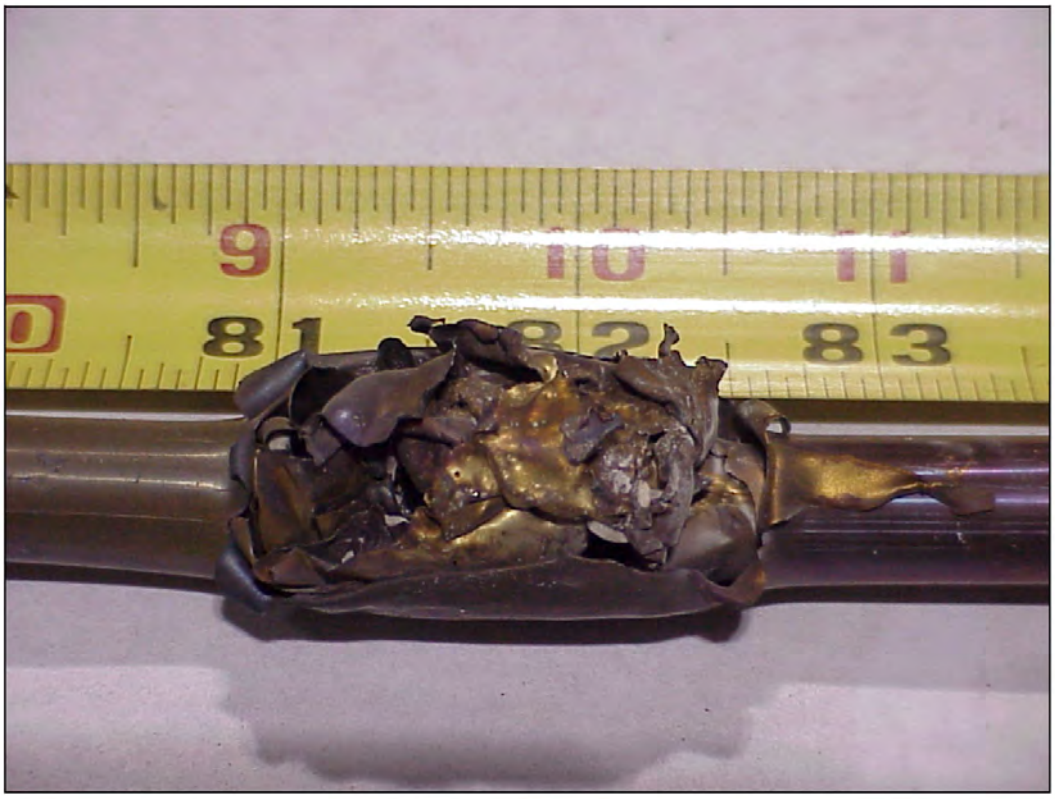

Figure 22. M9-BT-28 Burst Location

TPBAR M9-BT-29 Test Results

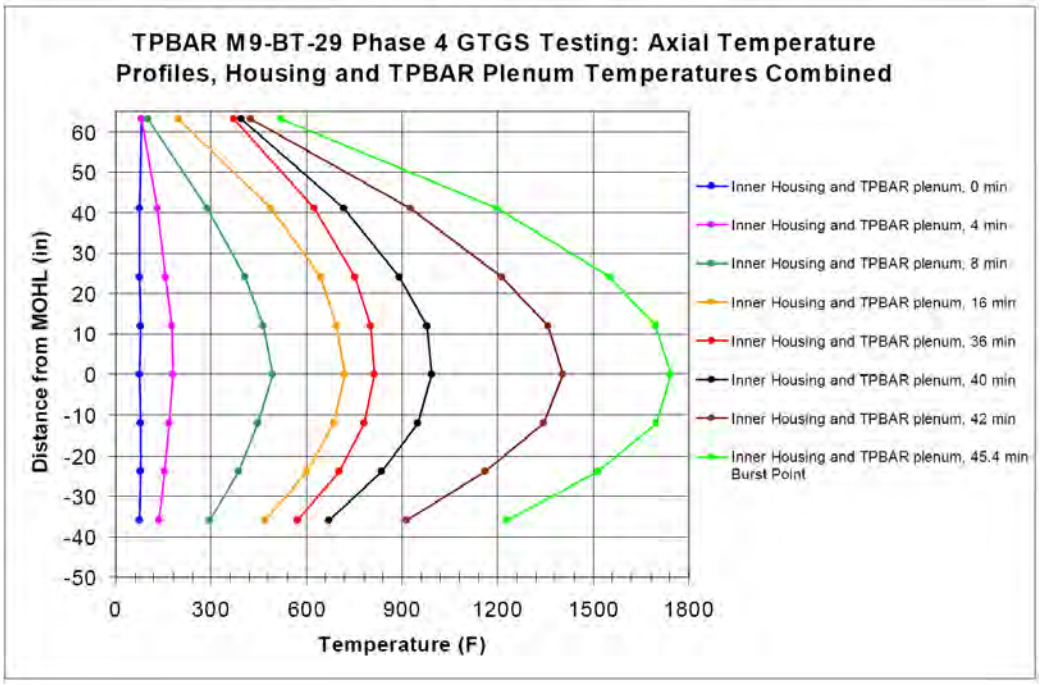

Figure 23. Axial Temperature Profiles for M9-BT-29 Burst Test

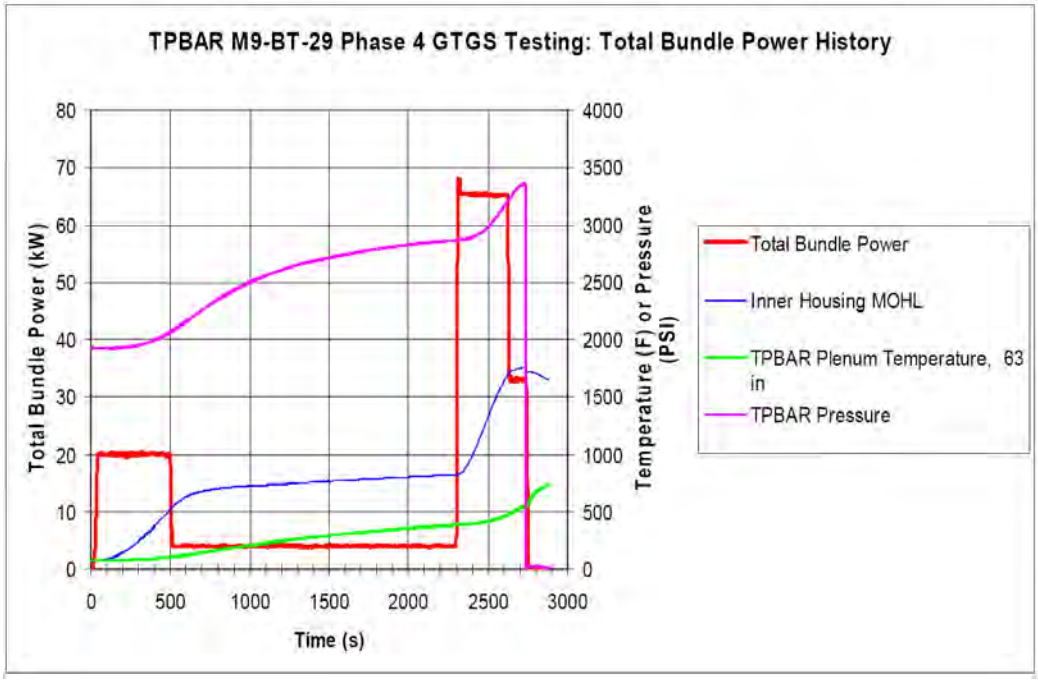

Figure 24. Temperature and Pressure Profiles for M9-BT-29 Burst Test

Figure 25. M9-BT-29 Burst Location

TPBAR M9-BT-30 Test Results

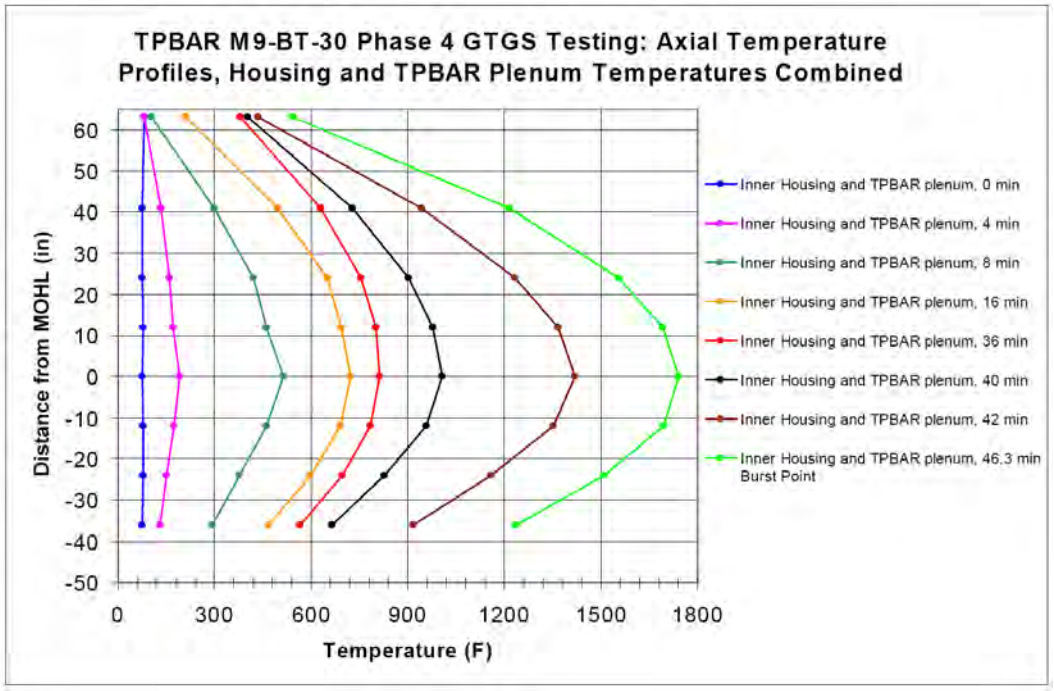

Figure 26. Axial Temperature Profiles for M9-BT-30 Burst Test

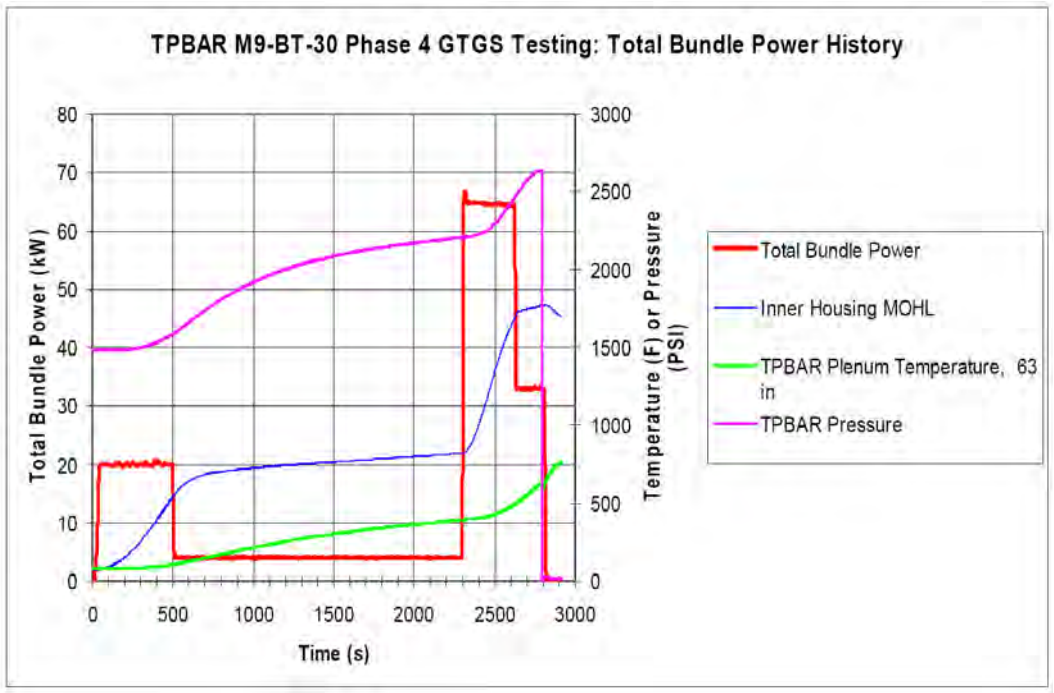

Figure 27. Temperature and Pressure Profiles for M9-BT-30 Burst Test

Figure 28. M9-BT-30 Burst Location

TPBAR M9-BT-31 Test Results

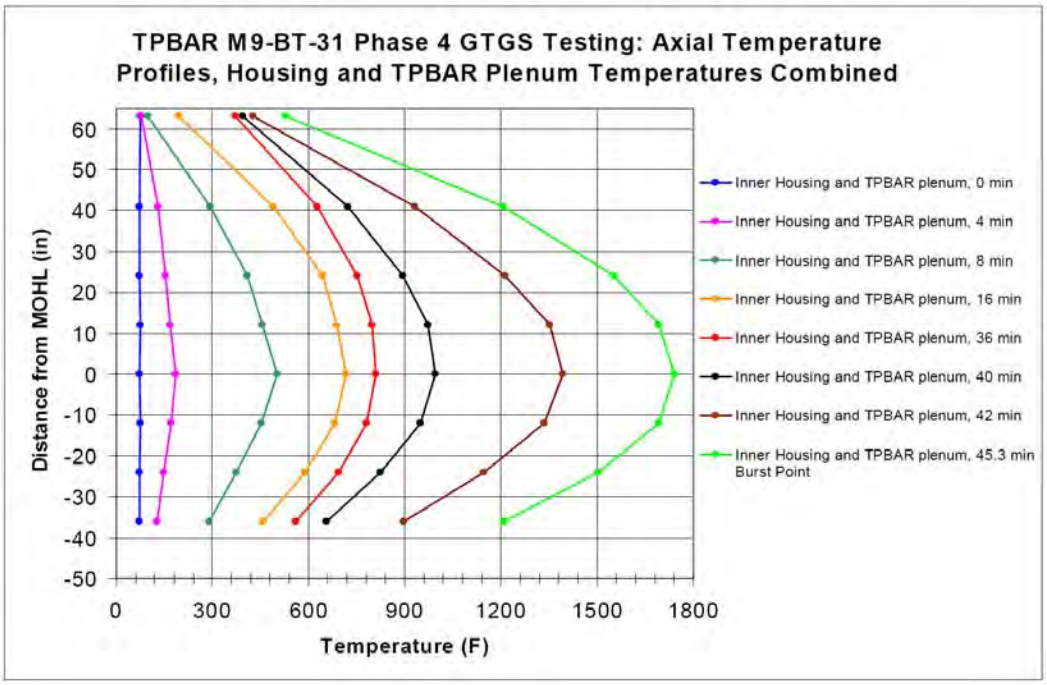

Figure 29. Axial Temperature Profiles for M9-BT-31 Burst Test

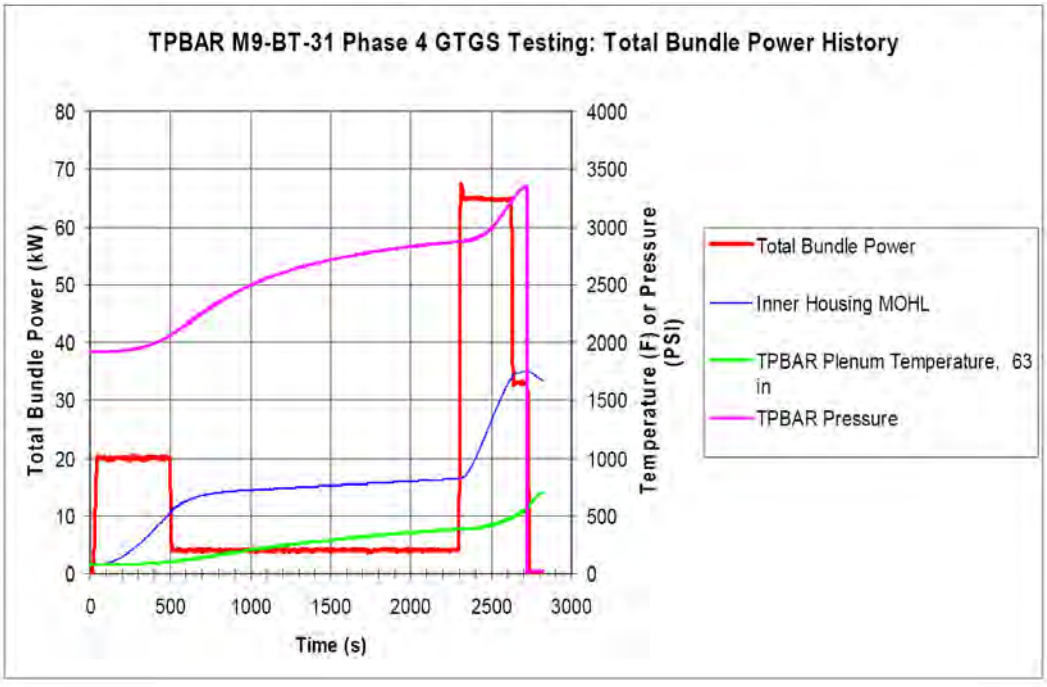

Figure 30. Temperature and Pressure Profiles for M9-BT-31 Burst Test

ENCLOSURE 2

TENNESSEE VALLEY AUTHORITY
WATTS BAR NUCLEAR PLANT
UNIT 1

Supplemental Information for the Watts Bar, Unit 1 1,792 TPBAR License Amendment Request

Attachment 1: CE-15-723-P-Attachment: "Post-LOCA Axial TPBAR Rupture Location Assessment for the Watts Bar Unit 1 1,792 TPBAR License Amendment Request," (Proprietary Version - 5 pages including cover page)
Attachment 2: CE-15-723-NP-Attachment: "Post-LOCA Axial TPBAR Rupture Location Assessment for the Watts Bar Unit 1 1,792 TPBAR License Amendment Request" (Non-Proprietary Version - 5 pages including cover page)
Attachment 3: CAW-15-4347: "Application for Withholding Proprietary Information From Public Disclosure - CE-15-723-P-Attachment" (8 pages including cover page)

NF-TV-15-81
December 17, 2015

CE-15-723-P-Attachment

ATTACHMENT 1

CE-15-723-P-Attachment: "Post-LOCA Axial TPBAR Rupture Location Assessment for the Watts Bar Unit 1 1,792 TPBAR License Amendment Request"

(Proprietary Version)

NF-TV-15-81
December 17, 2015

CE-15-723-NP-Attachment

ATTACHMENT 2

CE-15-723-NP-Attachment: "Post-LOCA Axial TPBAR Rupture Location Assessment for the Watts Bar Unit 1 1,792 TPBAR License Amendment Request"

(Non-Proprietary Version)

On November 4, 2015, the USNRC concluded its audit of the TPBAR burst/pellet leaching work at the PNNL facility in Richland, Washington. One of the open items that arose out of this audit pertained to the TPBAR pellet ejection assumption:

> Audit Open Item 2
>
> In the post-LOCA subcriticality analysis, one of the assumptions is that the TPBARs have a 12-inch gap in absorber material resulting from a postulated bursting of all TPBARs. This gap is located at the same axial elevation for all TPBAR-bearing fuel assemblies. Westinghouse provided information during the audit to justify the conservatism of this assumption based on the fact that the most reactive axial node for all fuel assemblies is located within the region where the 12-inch gap in TPBAR absorber material is modeled. This information should be submitted on the docket to support the staff's findings, as well as a discussion of how this assumption in the post-LOCA subcriticality analysis would be assessed if future TPBAR core designs do not demonstrate similar uniformity in the axial location of the most reactive node for all fuel assemblies.

A formal analysis was performed to demonstrate what was stated informally during the audit. The most limiting 12 inch axial position of the individual assemblies with TPBARs was determined to be identical to the break locations as determined by the core average power distribution (Table 1). Therefore, due to the very pronounced core average power shape, the assembly axial peaks are intrinsically being captured.

A further sensitivity was performed to change the break location in some of the TPBAR assemblies to test the coplanar effect whereby a mesh with lower power would produce a higher core reactivity response at a different mesh plane due to the presence of a TPBAR failed in a neighboring assembly. This sensitivity concluded that the results are [

] [a,c]

Table 1: Assembly Axial Power Distributions for the 1792 TPBAR Core

a,c

Table 1: Assembly Axial Power Distributions for the 1792 TPBAR Core (cont'd)

a,c

[ ]

a,c

Table 1: Assembly Axial Power Distributions for the 1792 TPBAR Core (cont'd)

a,c

ATTACHMENT 3

CAW-15-4347: "Application for Withholding Proprietary Information From Public Disclosure - CE-15-723-P-Attachment"

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Cranberry Township, Pennsylvania 16066
USA

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CAW-15-4347

December 17, 2015

APPLICATION FOR WITHHOLDING PROPRIETARY INFORMATION FROM PUBLIC DISCLOSURE

Subject: CE-15-723-P-Attachment, "Post-LOCA Axial TPBAR Rupture Location Assessment for the Watts Bar Unit 1 1,792 TPBAR License Amendment Request" (Proprietary)

The Application for Withholding Proprietary Information from Public Disclosure is submitted by Westinghouse Electric Company LLC (Westinghouse), pursuant to the provisions of paragraph (b)(1) of Section 2.390 of the Commission's regulations. It contains commercial strategic information proprietary to Westinghouse and customarily held in confidence.

The proprietary information for which withholding is being requested in the above-referenced report is further identified in Affidavit CAW-15-4347 signed by the owner of the proprietary information, Westinghouse Electric Company LLC. The Affidavit, which accompanies this letter, sets forth the basis on which the information may be withheld from public disclosure by the Commission and addresses with specificity the considerations listed in paragraph (b)(4) of 10 CFR Section 2.390 of the Commission's regulations.

Accordingly, this letter authorizes the utilization of the accompanying Affidavit by the Tennessee Valley Authority.

Correspondence with respect to the proprietary aspects of the Application for Withholding or the Westinghouse Affidavit should reference CAW-15-4347, and should be addressed to James A. Gresham, Manager, Regulatory Compliance, Westinghouse Electric Company, 1000 Westinghouse Drive, Building 3 Suite 310, Cranberry Township, Pennsylvania 16066.

James A. Gresham, Manager
Regulatory Compliance

CAW-15-4347
December 17, 2015

AFFIDAVIT

COMMONWEALTH OF PENNSYLVANIA:

ss

COUNTY OF BUTLER:

I, James A. Gresham, am authorized to execute this Affidavit on behalf of Westinghouse Electric Company LLC (Westinghouse), and that the averments of fact set forth in this Affidavit are true and correct to the best of my knowledge, information, and belief.

James A. Gresham, Manager
Regulatory Compliance

(1) I am Manager, Regulatory Compliance, Westinghouse Electric Company LLC (Westinghouse), and as such, I have been specifically delegated the function of reviewing the proprietary information sought to be withheld from public disclosure in connection with nuclear power plant licensing and rule making proceedings, and am authorized to apply for its withholding on behalf of Westinghouse.

(2) I am making this Affidavit in conformance with the provisions of 10 CFR Section 2.390 of the Commission's regulations and in conjunction with the Westinghouse Application for Withholding Proprietary Information from Public Disclosure accompanying this Affidavit.

(3) I have personal knowledge of the criteria and procedures utilized by Westinghouse in designating information as a trade secret, privileged or as confidential commercial or financial information.

(4) Pursuant to the provisions of paragraph (b)(4) of Section 2.390 of the Commission's regulations, the following is furnished for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld.

(i) The information sought to be withheld from public disclosure is owned and has been held in confidence by Westinghouse.

(ii) The information is of a type customarily held in confidence by Westinghouse and not customarily disclosed to the public. Westinghouse has a rational basis for determining the types of information customarily held in confidence by it and, in that connection, utilizes a system to determine when and whether to hold certain types of information in confidence. The application of that system and the substance of that system constitute Westinghouse policy and provide the rational basis required.

Under that system, information is held in confidence if it falls in one or more of several types, the release of which might result in the loss of an existing or potential competitive advantage, as follows:

(a) The information reveals the distinguishing aspects of a process (or component, structure, tool, method, etc.) where prevention of its use by any of

Westinghouse's competitors without license from Westinghouse constitutes a competitive economic advantage over other companies.

(b) It consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), the application of which data secures a competitive economic advantage, e.g., by optimization or improved marketability.

(c) Its use by a competitor would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing a similar product.

(d) It reveals cost or price information, production capacities, budget levels, or commercial strategies of Westinghouse, its customers or suppliers.

(e) It reveals aspects of past, present, or future Westinghouse or customer funded development plans and programs of potential commercial value to Westinghouse.

(f) It contains patentable ideas, for which patent protection may be desirable.

(iii) There are sound policy reasons behind the Westinghouse system which include the following:

(a) The use of such information by Westinghouse gives Westinghouse a competitive advantage over its competitors. It is, therefore, withheld from disclosure to protect the Westinghouse competitive position.

(b) It is information that is marketable in many ways. The extent to which such information is available to competitors diminishes the Westinghouse ability to sell products and services involving the use of the information.

(c) Use by our competitor would put Westinghouse at a competitive disadvantage by reducing his expenditure of resources at our expense.

(d) Each component of proprietary information pertinent to a particular competitive advantage is potentially as valuable as the total competitive advantage. If competitors acquire components of proprietary information, any one component may be the key to the entire puzzle, thereby depriving Westinghouse of a competitive advantage.

(e) Unrestricted disclosure would jeopardize the position of prominence of Westinghouse in the world market, and thereby give a market advantage to the competition of those countries.

(f) The Westinghouse capacity to invest corporate assets in research and development depends upon the success in obtaining and maintaining a competitive advantage.

(iv) The information is being transmitted to the Commission in confidence and, under the provisions of 10 CFR Section 2.390, is to be received in confidence by the Commission.

(v) The information sought to be protected is not available in public sources or available information has not been previously employed in the same original manner or method to the best of our knowledge and belief.

(vi) The proprietary information sought to be withheld in this submittal is that which is appropriately marked in CE-15-723-P-Attachment, "Post-LOCA Axial TPBAR Rupture Location Assessment for the Watts Bar Unit 1 1,792 TPBAR License Amendment Request" (Proprietary), for submittal to the Commission, being transmitted by the Tennessee Valley Authority letter and Application for Withholding Proprietary Information from Public Disclosure, to the Document Control Desk. The proprietary information as submitted by Westinghouse is that associated with information requested by the Nuclear Regulatory Commission from the Tennessee Valley Authority, and may be used only for that purpose.

(a) This information is part of that which will enable Westinghouse to

(i) Perform the safety analysis for TPBARs at Watts Bar Unit 1.

(b) Further, this information has substantial commercial value as follows:

(i) Westinghouse plans to sell the use of similar information to its customers for the purpose of determining design margins.

(ii) Westinghouse can sell support and defense of industry guidelines and acceptance criteria for plant-specific applications.

(iii) The information requested to be withheld reveals the distinguishing aspects of a methodology which was developed by Westinghouse.

Public disclosure of this proprietary information is likely to cause substantial harm to the competitive position of Westinghouse because it would enhance the ability of competitors to provide similar technical evaluation justifications and licensing defense services for commercial power reactors without commensurate expenses. Also, public disclosure of the information would enable others to use the information to meet NRC requirements for licensing documentation without purchasing the right to use the information.

The development of the technology described in part by the information is the result of applying the results of many years of experience in an intensive Westinghouse effort and the expenditure of a considerable sum of money.

In order for competitors of Westinghouse to duplicate this information, similar technical programs would have to be performed and a significant manpower effort, having the requisite talent and experience, would have to be expended.

Further the deponent sayeth not.

PROPRIETARY INFORMATION NOTICE

Transmitted herewith are proprietary and non-proprietary versions of a document, furnished to the NRC in connection with requests for generic and/or plant-specific review and approval.

In order to conform to the requirements of 10 CFR 2.390 of the Commission's regulations concerning the protection of proprietary information so submitted to the NRC, the information which is proprietary in the proprietary versions is contained within brackets, and where the proprietary information has been deleted in the non-proprietary versions, only the brackets remain (the information that was contained within the brackets in the proprietary versions having been deleted). The justification for claiming the information so designated as proprietary is indicated in both versions by means of lower case letters (a) through (f) located as a superscript immediately following the brackets enclosing each item of information being identified as proprietary or in the margin opposite such information. These lower case letters refer to the types of information Westinghouse customarily holds in confidence identified in Sections (4)(ii)(a) through (4)(ii)(f) of the Affidavit accompanying this transmittal pursuant to 10 CFR 2.390(b)(1).

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