TVA

Tennessee Valley Authority, 1101 Market Street, Chattanooga, Tennessee 37402

July 3, 2013

10 CFR 50.90

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

Sequoyah Nuclear Plant, Units 1 and 2
Facility Operating License Nos. DPR-77 and DPR-79
NRC Docket Nos. 50-327 and 50-328

Subject: **Application to Modify Ice Condenser Technical Specifications to Address Revisions in Westinghouse Mass and Energy Release Calculation (SQN-TS-12-04)**

In accordance with the provisions of 10 CFR 50.90, "Application for amendment of license, construction permit, or early site permit," the Tennessee Valley Authority (TVA) is submitting a request for an amendment to Facility Operating License Nos. DPR-77 and DPR-79 for the Sequoyah Nuclear Plant (SQN), Units 1 and 2.

The proposed changes would revise SQN Units 1 and 2 Technical Specifications (TSs) 3/4.6.5, "Ice Condenser," to increase the total ice weight from 2,225,880 pounds to 2,540,808 pounds. This change is necessary to address the issues raised in Nuclear Safety Advisory Letter (NSAL) 11-5, "Westinghouse LOCA Mass and Energy Release Calculation Issues." The issues identified in NSAL-11-5 affected plant-specific loss of coolant accident (LOCA) mass and energy release calculation results that are used as input to the containment integrity response analyses. The basis for the proposed change is provided in WCAP-12455, Revision 1, Supplement 2R, "Tennessee Valley Authority Sequoyah Nuclear Plant Units 1 and 2 Containment Integrity Reanalyses Engineering Report."

The changes in the LOCA mass and energy release calculations and the associated changes to the SQN containment integrity response analyses resulted in TSs Limiting Condition for Operation 3.6.5.1.d being non-conservative with respect to the required total ice weight. The non-conservative SQN TSs are being addressed within the TVA Corrective Action Program and administrative controls have been established in accordance with Nuclear Regulatory Commission (NRC) Administrative Letter 98-10.

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The enclosure provides a description of the proposed changes, technical evaluation of the proposed changes, regulatory evaluation, and a discussion of environmental considerations. Attachment 1 to the enclosure provides the existing TSs pages marked-up to show the proposed changes. Attachment 2 to the enclosure provides the existing Bases pages marked-up to show the proposed changes for information only. Attachment 3 to the enclosure provides the retyped TSs pages incorporating the proposed changes. Attachment 4 to the enclosure provides the retyped Bases pages incorporating the proposed changes for information only. Attachment 5 to the enclosure provides WCAP-12455, Revision 1, Supplement 2R (redacted to exclude the SQN Updated Final Safety Analysis Report (UFSAR) and TSs markups). UFSAR changes will be processed in accordance with the TVA program requirements.

TVA requests approval of the proposed license amendment by May 31, 2014, consistent with the expected approval of the conversion of the SQN TSs to the Improved Standard Technical Specifications, with the conversion submittal expected later this month.

TVA has determined that there are no significant hazards considerations associated with the proposed change and that the change qualifies for a categorical exclusion from environmental review pursuant to the provisions of 10 CFR 51.22(c)(9).

The SQN Plant Operations Review Committee and the Nuclear Safety Review Board have reviewed this proposed change and determined that operation of SQN in accordance with the proposed change will not endanger the health and safety of the public.

Additionally, in accordance with 10 CFR 50.91(b)(1), TVA is sending a copy of this letter and the enclosure to the Tennessee Department of Environment and Conservation.

There are no regulatory commitments associated with this submittal. Please address any questions regarding this request to Clyde Mackaman at (423) 751-2834.

I declare under penalty of perjury that the foregoing is true and correct. Executed on this 3rd day of July 2013.

Respectfully,

J.W. Shea
Vice President, Nuclear Licensing

Enclosure
cc: See Page 3

Enclosure:
Evaluation of Proposed Change

cc (Enclosure):

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

ENCLOSURE

TENNESSEE VALLEY AUTHORITY
SEQUOYAH NUCLEAR PLANT
UNITS 1 AND 2

EVALUATION OF PROPOSED CHANGE

Subject: **Application to Modify Ice Condenser Technical Specifications to Address Revisions in Westinghouse Mass and Energy Release Calculation (SQN-TS-12-04)**

ATTACHMENTS

1. Proposed TS Changes (Mark-Ups) for SQN, Units 1 and 2
2. Proposed TS Bases Changes (Mark-Ups) for SQN, Units 1 and 2 (For Information Only)
3. Proposed TS Changes (Final Typed) for SQN, Units 1 and 2
4. Proposed TS Bases Changes (Final Typed) for SQN, Units 1 and 2 (For Information Only)
5. Topical Report WCAP-12455, Revision 1, Supplement 2R

1.0 SUMMARY DESCRIPTION

This evaluation supports a request to amend Appendix A of Facility Operating License Nos. DPR-77 and DPR-79 for the Sequoyah Nuclear Plant (SQN), Units 1 and 2, by revising Units 1 and 2 Technical Specifications (TSs) 3/4.6.5, "Ice Condenser." The proposed changes would revise TSs Limiting Condition for Operation (LCO) 3.6.5.1.d and TSs Surveillance Requirement (SR) 4.6.5.1.d.2 to raise the overall ice condenser ice weight from 2,225,880 pounds (lbs) to 2,540,808 lbs and to raise the minimum TSs ice basket weight from 1145 lbs to 1307 lbs, respectively. The associated TSs Bases sections are also revised to include these changes in ice weight values.

The non-conservative TSs are being addressed within the Tennessee Valley Authority (TVA) Corrective Action Program and administrative controls have been established in accordance with Nuclear Regulatory Commission (NRC) Administrative Letter 98-10.

2.0 DETAILED DESCRIPTION

The ice bed consists of borated ice stored in 1944 baskets within the ice condenser. The primary purpose of the ice condenser is to provide a large heat sink in the event of a release of energy from a design basis loss of coolant accident (LOCA) or main steam line break (MSLB) in containment. The LOCA requires the greatest amount of ice compared to other accident scenarios; therefore, the ice weight is based on the LOCA analysis. The amount of ice in the bed has no affect on the initiation of an accident, but rather on the mitigation of the accident. The borated solution formed by meltdown of the ice absorbs and retains iodine released during the accident and prevents dilution of the borated water injected from the refueling water storage tank and accumulators. This solution also contributes to the inventory of water used for long-term heat removal from the reactor core and containment atmosphere.

The ice absorbs energy and limits the containment peak pressure and temperature during the accident. Limiting the pressure reduces the release of fission product radioactivity from containment to the environment in the event of a design basis accident. The current ice weight value is supported by the containment integrity analysis documented in the SQN Updated Final Safety Analysis Report (UFSAR) (Reference 1), Section 6.2, "Containment Systems." The TSs surveillance limits on total ice weight and on ice basket weight are intended to ensure that sufficient ice is present in an appropriate distribution to perform this function. The TSs surveillance limits are currently an "as-left" measurement and include margin for ice sublimation and measurement error.

Westinghouse Electric Company (WEC) has identified several issues that affected the plant-specific LOCA mass and energy release calculation results that are used as input to the containment integrity response analysis. These issues were originally reported in WEC Nuclear Safety Advisory Letter NSAL-11-5 (Reference 2).

A containment integrity reanalysis (WCAP-12455, Revision 1, Supplement 2R (Reference 3)) was performed to implement corrections to the mass and energy release calculation. In addition to the changes associated with NSAL-11-5, the appropriate conditions relative to NSAL-06-6 (Reference 4) were also addressed. The revised analysis determined that an increase in the analytical ice weight value is necessary to maintain the calculated containment peak pressure below the design limit. This increase in the analytical ice weight value results in TSs LCO 3.6.5.1.d being non-conservative with respect to the required total ice weight.

The non-conservative TSs are being addressed within the TVA Corrective Action Program and administrative controls have been established in accordance NRC Administrative Letter 98-10. To address the non-conservative TSs, TVA is proposing a change to TSs 3/4.6.5.1 to increase the licensing basis minimum ice weight.

The proposed changes do not incorporate industry Technical Specifications Task Force (TSTF) 429-A, "Ice Mass Determination Surveillance Requirements," Revision 3. TVA is evaluating TSTF-429-A for incorporation as part of the project to convert the SQN TSs to the Improved Standard Technical Specifications.

Section 2.1 includes a description of the current TSs LCO and TSs SR affected by this proposed amendment. Section 2.2 describes the proposed revision to the TSs LCO and TSs SR. Section 2.3 discusses the bases for the proposed changes. The revised containment integrity analysis is provided in Attachment 5 of this enclosure.

The TVA process governing the processing and submittal of TSs changes and License Amendment Requests requires that the appropriate organizations (e.g., Operations, Training, Engineering, Maintenance, Chemistry, Radiation Protection, and Work Control) identify the documents that are affected by each proposed change to the TSs and Operating Licenses. Among the items that are considered are training, plant modifications, procedures, special implementation constraints, design documents, surveillance instructions associated with TSs SRs, Technical Requirements Manual, TSs Bases, and Updated Final Safety Analysis Report (UFSAR). The process requires that procedures and design document changes necessary to support TSs Operability are approved prior to implementation of the license amendment. The process also provides assurance that the remaining changes, if any, are scheduled tracked for configuration control.

2.1 Current Technical Specifications

TSs LCO 3.6.5.1.d currently requires:

> "A total ice weight of at least 2,225,880 pounds at a 95% level of confidence, and"

TSs SR 4.6.5.1.d.2 currently requires:

> "At least once per 18 months by:
>
> 1. Deleted.
>
> 2. Weighing a representative sample of at least 144 ice baskets and verifying that each basket contains at least 1145 lbs of ice. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall be constituted of one basket each from Radial Rows 1, 2, 4, 6, 8 and 9 (or from the same row of an adjacent bay if a basket from a designated row cannot be obtained for weighing) within each bay. If any basket is found to contain less than 1145 pounds of ice, a representative sample of 20 additional baskets

from the same bay shall be weighed. The minimum average weight of ice from the 20 additional baskets and the discrepant basket shall not be less than 1145 pounds/basket at a 95% level of confidence.

The ice condenser shall also be subdivided into 3 groups of baskets, as follows: Group 1 - bays 1 through 8, Group 2 - bays 9 through 16, and Group 3 - bays 17 through 24. The minimum average ice weight of the sample baskets from Radial Rows 1, 2, 4, 6, 8 and 9 in each group shall not be less than 1145 pounds/basket at a 95% level of confidence.

The minimum total ice condenser ice weight at a 95% level of confidence shall be calculated using all ice basket weights determined during this weighing program and shall not be less than 2,225,880 pounds."

2.2 Requested Technical Specification Changes

The proposed change modifies TSs LCO 3.6.5.1.d and SR 4.6.5.1.d.2 to address the increase in the analytical ice weight value obtained from the revised containment integrity response analysis.

The proposed change modifies TSs LCO 3.6.5.1.d and SR 4.6.5.1.d.2 as follows (revised text is in bold italics):

- TSs LCO 3.6.5.1.d is revised to read:

  "A total ice weight of at least ***2,540,808*** pounds at a 95% level of confidence, and"

- TSs SR 4.6.5.1.d.2 is revised to read:

  "Weighing a representative sample of at least 144 ice baskets and verifying that each basket contains at least ***1307*** lbs of ice. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall be constituted of one basket each from Radial Rows 1, 2, 4, 6, 8 and 9 (or from the same row of an adjacent bay if a basket from a designated row cannot be obtained for weighing) within each bay. If any basket is found to contain less than ***1307*** pounds of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The minimum average weight of ice from the 20 additional baskets and the discrepant basket shall not be less than ***1307*** pounds/basket at a 95% level of confidence.

  The ice condenser shall also be subdivided into 3 groups of baskets, as follows: Group 1 - bays 1 through 8, Group 2 - bays 9 through 16, and Group 3 - bays 17 through 24. The minimum average ice weight of the sample baskets from Radial Rows 1, 2, 4, 6, 8 and 9 in each group shall not be less than ***1307*** pounds/basket at a 95% level of confidence.

  The minimum total ice condenser ice weight at a 95% level of confidence shall be calculated using all ice basket weights determined during this weighing program and shall not be less than ***2,540,808*** pounds."

In addition, several minor editorial changes, consisting of grammatical and punctuation corrections have been incorporated as follows:

- SQN Unit 1 TS SR 4.6.5.1.e.2 is revised by addition of a period.
- SQN Unit 2 TS SR 4.6.5.1.a is revised to read "At least once per 12 hours ***by*** verifying that the maximum ice bed temperature is less than or equal to 27°F."
- SQN Unit 2 TS SR 4.6.5.1.e.2 is revised by addition of a period.
- SQN Unit 2 TS SR 4.6.5.1.f Note is revised by addition of a period.

2.3 Bases for Proposed Changes

WEC identified several issues that affected the plant-specific LOCA mass and energy release calculation results that are used as input to the containment integrity response analysis.

A containment integrity reanalysis (WCAP-12455, Revision 1, Supplement 2R) was performed to implement corrections to the mass and energy release calculation. The revised analysis determined that an increase in the analytical ice weight value is necessary to maintain the calculated containment peak pressure below the design limit.

For TSs LCO 3.6.5.1.d, the proposed modification raises the required total ice weight from 2,225,880 lbs to 2,540,808 lbs. For TSs SR 4.6.5.1.d.2, the proposed modification raises the minimum ice basket weight from 1145 lbs to 1307 lbs per basket.

Markups of the affected TSs pages are provided in Attachment 1.

Corresponding changes will also be made to the TSs Bases. Markups of the proposed TSs Bases changes are provided in Attachment 2 for information only. The changes to the TSs Bases are controlled by TSs 6.8.4.j, "Technical Specification (TS) Bases Control Program."

3.0 TECHNICAL EVALUATION

The following evaluation describes the results of the current analysis, aspects of the revised analysis, the effects of the increase in ice weight, and differences between the revised analysis and the as-built plant.

<u>Current Analytical Basis</u>

The current containment integrity analysis for SQN Units 1 and 2 is documented in WCAP-12455, Revision 1, Supplement 1R (September 2001). The analysis utilizes a WEC computer model (LOTIC-1) to calculate the peak containment pressure following a LOCA inside containment. The calculated peak pressure for SQN Units 1 and 2 is 11.44 pounds per square inch gauge (psig), which is below the containment design pressure of 12.0 psig. The assumption contained in the LOTIC-1 computer model for this analysis includes an initial ice weight in the ice condenser of 1,916,000 lbs. A discussion of the SQN design basis analysis (WCAP-12455) is contained in UFSAR Section 6.2.1.3.

Description of Revised Analysis

A reanalysis of the SQN containment integrity analysis was performed to account for a correction to the mass and energy release calculation. The revised analysis is provided in Attachment 5 to this enclosure as WCAP-12455, Revision 1, Supplement 2R, "Tennessee Valley Authority Sequoyah Nuclear Plant Units 1 and 2 Containment Integrity Reanalyses Engineering Report," dated April 2012. The revised analysis determined that an ice weight of 2,187,250 lbs will limit containment peak pressure to 11.33 psig in the event of a LOCA.

In addition, the revised containment pressure analysis preserves the containment spray switchover interval relationship between ice bed meltout time and containment spray switchover time. The time interval between the completion of containment spray recirculation switchover and the ice bed meltout represents margin to the acceptance criteria.

The SQN TSs specify minimum operational ice weight values that provide margins above the analytical minimum ice weight values. The TSs minimum ice weight ensures that adequate ice is available over an entire 18 month fuel cycle. Currently, the SQN TSs minimum ice weight is 1145 lbs of ice per basket and a minimum total ice weight in the ice condenser of 2,225,880 lbs. These weights include a 15 percent conservative allowance for ice loss through sublimation and an additional 1 percent conservative allowance to account for systematic error in weighing instruments. The sublimation and instrument error allowances are retained in the proposed TSs requirements. Therefore, considering these conservative allowances, the proposed minimum total ice weight of 2,540,808 lbs conservatively bounds the new analytical minimum of 2,187,250 lbs.

Evaluation of Effects of Increased Ice Weight

As part of the original ice condenser qualification program, seismic testing of ice baskets was conducted at the Westinghouse Waltz Mill facility. Ice condenser qualification program test results were reported in WCAP-8110, "Test Plans and Results for the Ice Condenser System," (Reference 5) and supplements. The purpose of the testing was to obtain test data to qualify the ice basket design as being capable of resisting anticipated seismic excitations. The seismic load testing was performed with a consideration of 3,000,000 lbs of ice uniformly distributed across the 1944 ice baskets, or approximately 1543.2 lbs of ice in each ice basket. As the ice weight proposed in this license amendment request (and the amount of ice currently loaded in the SQN Unit 1 and Unit 2 ice condensers) is below the ice weight used in the seismic load testing, the results of the original ice condenser qualification program remain valid.

The additional ice being loaded into the ice condenser will not adversely affect the iodine removal qualities of the melting ice. The containment is designed such that the only significant flow path from the lower to the upper compartment is through the ice bed. Immediately following a LOCA, a large pressure differential exists between the lower and upper compartment; thereby providing flow through the ice bed. Later in the transient, flow is provided by two containment air return fans which circulate upper containment air into the lower compartment. Since essentially all flow between the lower and upper compartments must pass through the ice bed, the ice bed also serves as a removal mechanism for fission products postulated to be dispersed in the containment atmosphere. Radioiodine in its various forms is the fission product of primary concern in the evaluation of fission product transport and removal following a LOCA. The major benefit of the ice bed is its capacity to absorb molecular iodine from the containment atmosphere. To enhance this iodine absorption capacity of the ice, the ice solution is adjusted to an alkaline pH which promotes iodine hydrolysis to non-volatile forms. Therefore, the proposed increase in the weight of ice results in increasing the capacity of the ice bed to absorb iodine.

The ice condenser utilizes borated ice, which upon bulk melting, delivers an aqueous solution containing boron to the containment sump. The additional ice required by the reanalysis is also required to be borated by TSs LCO 3.6.5.1. Therefore, the boron concentration of the recirculated primary coolant is not diminished by the additional quantity of ice associated with the proposed minimum ice weight.

<u>Evaluation of Differences between As-Built Plant and WCAP 12455, Revision 1</u>

The WCAP-12455, Revision 1, Supplement 2R, SQN containment integrity analysis demonstrated that the ice condensers were adequately sized for the original Model 51 steam generators (SGs) for Units 1 and 2. However, the Model 51 SGs were replaced with Model 57AG SGs during the Spring 2003 refueling outage (1RFO13) for Unit 1 and the Fall 2012 refueling outage (2RFO18) for Unit 2. The WCAP-12455, Revision 1, Supplement 2R, analysis bounds the Model 57AG SGs because:

1. The primary side volume of the Model 57AG SGs is essentially equivalent to that of the Model 51 SGs and the initial primary fluid temperatures are unchanged. Thus, the mass and energy releases following a large break LOCA are not significantly affected by the replacement of the Model 51 SGs with the Model 57AG SGs.

2. The Model 57AG SGs are essentially equivalent to the Model 51 SGs with respect to sensible heat cooling. Because the rest of the Reactor Coolant System (RCS) sensible heat is unchanged, the RCS total system sensible heat remains unchanged for the Model 57AG SGs.

3. The initial secondary side mass is greater for the Model 51 SGs as compared with the Model 57AG SGs. Therefore, the initial energy of the secondary fluid for the analysis bounds the Model 57AG SGs.

Therefore, based on the above assessment, TVA has concluded that the results of the analysis provided in WCAP-12455, Revision 1, Supplement 2R, are valid for Model 57AG SGs.

The WCAP-12455, Revision 1, Supplement 2R, SQN containment integrity analysis bounds both Units 1 and 2 for reloads utilizing Mark-BW17 fuel with up to 96 fresh assemblies. However, the NRC approved the use of AREVA NP Inc. (AREVA NP) Advanced W17 High Thermal Performance (HTP) fuel as documented in a Safety Evaluation dated September 26, 2012 (Reference 6), for Units 1 and 2 (Amendments 331 and 324, respectively). AREVA Advanced W17 HTP fuel was loaded into Unit 2 during the Cycle 18 refueling outage (Fall 2012). Unit 1 is scheduled to load AREVA Advanced W17 HTP fuel during the Cycle 19 refueling outage (Fall 2013).

The important aspects of the fuel change that could affect the containment integrity analysis include the changes in the flow characteristics past the fuel, the RCS operating average temperature (T_{avg}), the core-stored energy and fuel-heat capacity, and the decay heat. These aspects were discussed in AREVA NP report ANP-2986, "Sequoyah HTP Fuel Transition," Revision 3. ANP-2986 was reviewed by the NRC in support of the Amendments to transition to AREVA Advanced W17 HTP fuel.

- There are very small deviations in flow characteristics past the fuel. However, for an ice condenser design, because the peak pressure occurs late in the transient, well after the ice bed has melted out, the single effect of small deviations in flow is insignificant relative to containment integrity and the required ice weight.

- Total energy content, or total energy available for release to containment remains unchanged from the previous analysis. The RCS T_{avg} remains at 578.2°F.

- The change from Mark-BW fuel to Advanced W17 HTP fuel results in a negligible difference in the mechanical heat capacity of the fuel.

- Initial fuel stored energy is dependent upon fuel and clad temperature. Transients initiated from zero power assume fuel temperatures that are initially in equilibrium with the RCS temperature, independent of fuel type. Transients initiated at power; however, require an estimate of the initial fuel temperature based on power, fuel pin dimension, and material properties. The initial stored energy at power for the two assembly designs (Mark-BW and Advanced W17 HTP) is assessed by considering cladding characteristics and fuel rod power density. There is no difference in fuel rod dimensions or material, thus there is no effect on the energy present in the Advanced W17 HTP fuel rods relative to the current Mark-BW fuel design. Regarding fuel power density, the fuel pellet radius (and hence, assembly loading) is identical to the Advanced W17 HTP fuel relative to the Mark-BW assembly, thus there is no difference in power density when operated at the same power output. Accordingly, there is no significant change in the amount of stored energy in either the fuel clad or the fuel rod for the Advanced W17 HTP fuel assembly. Thus, the fuel initial stored energy for the Mark-BW assembly remains applicable to the Advanced W17 HTP fuel assembly design.

Therefore, based on the above assessment, TVA has concluded that the analysis provided in WCAP-12455, Revision 1, Supplement 2R, bounds the use of AREVA Advanced W17 HTP fuel.

<u>Evaluation of Current Cycles of Operation</u>

TVA has determined that, as a result of the reanalysis, the SQN Units 1 and 2 TSs specify non-conservative values for the ice condenser ice weight. The non-conservative TSs values are being addressed within the TVA Corrective Action Program and are being administratively controlled in accordance with NRC Administrative Letter 98-10, as follows.

TVA adds ice to the SQN ice condensers each refueling outage to ensure that the TSs minimum ice weight is achieved prior to startup (this ice weight is referred to as the as-left value) in accordance with the applicable surveillance procedure. As a conservative measure, TVA adds additional ice to the ice condensers over and above the TSs minimum. The addition of ice over the TSs minimum is a TVA maintenance practice (servicing plan) that is based on historical ice weight data and visual inspection history of the ice baskets. During the last refueling outages (1RFO18 for Unit 1, and 2RFO18 for Unit 2), TVA continued this practice by adding additional ice to the ice condensers as part of the TVA servicing plan.

The additional ice weight provided an as-left ice weight of 2,650,762 lbs for Unit 1 at the start of Cycle 19 operation, for an average as-left ice weight per basket of 1363.5 lbs (95 percent level of confidence). The as-left ice weight for Unit 2 at the start of Cycle 19 operation was 2,722,958 lbs, for an average as-left ice weight per basket of 1400.7 lbs(95 percent level of confidence).

Although the proposed TSs change increases the TSs minimum ice weight from 2,225,880 lbs to 2,540,808 lbs, the as-left ice weight values for 1RFO18 and 2RFO18, as provided above, ensure that sufficient ice is present to support safe operation through the current cycles.

<u>Summary</u>

The proposed changes correct non-conservative TSs requirements and provide assurance that the peak containment pressure following a postulated LOCA remains within the analytical and design containment pressure limit. The margin of safety to the containment design pressure is restored by the proposed TSs changes. Accordingly, justification exists for increasing the SQN TSs total minimum ice weight to 2,540,808 lbs and a minimum ice basket weight of 1307 lbs.

4.0 REGULATORY EVALUATION

4.1 Applicable Regulatory Requirements and Criteria

The ice condenser at SQN is designed to comply with the following applicable regulations and requirements:

- 10 CFR 50, Appendix A, General Design Criterion (GDC) 16, "Containment Design," requires that reactor containment and associated systems be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require.

- GDC 38, "Containment Heat Removal," requires that the nuclear power plant containment structure and its internal compartments can accommodate, with sufficient margin, the calculated pressure and temperature conditions resulting from any LOCA with consideration of the effects of potential energy sources such as the SGs. Suitable redundancy in components and features, and suitable interconnections, leak detection, isolation, and containment capabilities shall be provided to assure that for onsite electric power system operation (assuming offsite power is not available) and for offsite electric power system operation (assuming onsite power is not available) the system safety function can be accomplished, assuming a single failure.

- GDC 50, "Containment Design Basis," requires that a system to remove heat from the reactor containment be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident and maintain them at acceptably low levels.

- 10 CFR Part 50, Appendix K, "ECCS Evaluation Models," provides requirements to assure that all the energy sources have been considered in the LOCA analysis.

The LOCA mass and energy analysis was performed in accordance with the criteria shown in Standard Review Plan (SRP) Section 6.2.1.3. In the analysis, the relevant requirements of GDC 50 and 10 CFR Part 50 Appendix K were included by confirmation that the calculated pressure is less than the design pressure, and because all available sources of energy have been included. These sources include: reactor power, decay heat, core stored energy, energy stored in the reactor vessel and internals, metal-water reaction energy, and stored energy in the secondary system.

The containment integrity peak pressure analysis was performed in accordance with the criteria shown in the SRP Section 6.2.1.1.B, for ice condenser containments. Conformance to GDCs 16, 38, and 50 is demonstrated by showing that the containment design pressure is not exceeded at any time in the transient. A calculated peak containment pressure of less than or equal to 12.0 psig demonstrates compliance with the containment design pressure criterion for SQN Units 1 and 2. The analysis also demonstrates that the containment heat removal systems function to rapidly reduce the containment pressure and temperature in the event of a LOCA.

4.2 Precedent

The NRC has previously approved a License Amendment Request correcting non-conservative minimum ice weights for SQN Units 1 and 2 (Amendments 279 and 270, respectively), as documented in a Safety Evaluation dated September 30, 2002 (Reference 8). This previous request was based on a containment integrity reanalysis to implement corrections to the LOTIC-I computer code input assumptions that account for a mass and energy interface error discovered by WEC. The interface between two computer models (i.e., computer model for LOCA mass and energy release for containment design and the computer model for long-term ice condenser containment {LOTIC-1}) contained an incorrect input assumption regarding the separation of steam and water from the two-phase mixture released downstream of a primary reactor coolant pipe break following a postulated LOCA. This resulted in erroneous treatment of the two-phase mixture which caused the calculated peak pressure inside containment to be non-conservatively low. The reanalysis determined that an increase in the analytical ice mass value was necessary to retain the current calculated peak pressure. Although the input error that resulted in the previous amendment is different than the errors corrected by the reanalysis provided in the proposed amendment request, both required a containment integrity reanalysis that resulted in non-conservative TSs ice weight values.

4.3 Significant Hazard Consideration

The Tennessee Valley Authority (TVA) proposes to modify Sequoyah Nuclear Plant (SQN) Unit 1 and Unit 2 Technical Specifications (TSs) 3/4.6.5, "Ice Condenser," Limiting Condition for Operation (LCO) 3.6.5.1.d and Surveillance Requirement

(SR) 4.6.5.1.d.2 to raise the overall ice condenser weight from 2,225,880 pounds (lbs) to 2,540,808 lbs and to raise the minimum ice basket weight from 1145 lbs to 1307 lbs. These changes are being proposed to address the increase in the analytical ice weight value obtained from the revised containment integrity response analyses and to resolve the resulting non-conservative TSs.

TVA has concluded that the changes to SQN Unit 1 and Unit 2 TSs 3/4.6.5 do not involve a significant hazards consideration. TVA's conclusion is based on its evaluation in accordance with 10 CFR 50.91(a)(1) of the three standards set forth in 10 CFR 50.92, "Issuance of Amendment," as discussed below:

1. *Does the proposed amendment involve a significant increase in the probability or consequence of an accident previously evaluated?*

   Response: No.

   The analyzed accidents of consideration in regards to changes affecting the ice condenser are a loss of coolant accident (LOCA) and a main steam line break (MSLB) inside containment. The ice condenser is a passive system and is not postulated as being the initiator of any LOCA or MSLB and is designed to remain functional following a design basis earthquake. In addition, the ice condenser does not interconnect or interact with any systems that have an interface with the reactor coolant or main steam systems.

   For SQN, the LOCA is the more severe accident in terms of containment pressure and ice bed melt out, and is therefore the more limiting accident. The revised SQN LOCA containment integrity analysis determined that the post-LOCA peak containment pressure is below the containment design pressure and that the margin to ice meltout is maintained. The analysis assumes an ice weight that ensures sufficient heat removal capability is available from the ice condenser to limit the accident peak pressure inside containment.

   TVA has evaluated the effects of the increased ice condenser ice weight and determined that the increase in ice weight does not invalidate the ice condenser seismic qualification, does not adversely affect the capacity of the ice bed to absorb iodine during a LOCA, and does not diminish the boron concentration of the recirculated primary coolant during a LOCA. TVA has also evaluated differences between the as-built plant and the assumptions of the revised analysis and determined that the results of the revised analysis remain valid for Model 57AG steam generators and for AREVA Advanced W17 High Thermal Performance (HTP) fuel.

   The proposed changes reflect the ice weight assumed in the containment integrity analysis including conservative allowances for sublimation and weighing instrument systematic error. Accordingly, the proposed changes ensure that ice weight values maintain margin between the calculated peak containment accident pressure and the containment design pressure. The results of the analysis and the margins are maintained; therefore, the consequences of a previously evaluated accident are not adversely affected by the proposed changes.

Because 1) the ice condenser is not an accident initiator, 2) the results of the revised analysis remain valid for Model 57AG steam generators and for AREVA Advanced W17 High Thermal Performance (HTP) fuel, and 3) the proposed changes to the TSs are limited to revision of the ice weight values to reflect the revised containment integrity analysis, there is no change in the probability of an accident previously evaluated in the SQN Updated Final Safety Analysis Report (UFSAR).

Based on the above discussions, the proposed changes do not involve an increase in the probability or consequences of an accident previously evaluated.

2. *Does the proposed amendment create the possibility of a new or different kind of accident from any accident previously evaluated?*

   Response: No.

   The ice condenser serves to limit the peak pressure inside containment following a LOCA or MSLB. The proposed changes are limited to the revision of the minimum ice weights specified in the TSs. The revised containment pressure analysis determined that sufficient ice would be present to maintain the peak containment pressure below the containment design pressure. No new modes of operation, accident scenarios, failure mechanisms, or limiting single failures are introduced as a result of this proposed change.

   TVA has evaluated the effects of the increased ice condenser ice weight and determined that the increase in ice weight does not invalidate the ice condenser seismic qualification, does not adversely affect the capacity of the ice bed to absorb iodine during a LOCA, and does not diminish the boron concentration of the recirculated primary coolant during a LOCA. TVA has also evaluated differences between the as-built plant and the assumptions of the revised analysis and determined that the results of the revised analysis remain valid for Model 57AG steam generators and for AREVA Advanced W17 High Thermal Performance (HTP) fuel. Because sufficient ice weight is available to maintain the peak containment pressure below the containment design pressure, the results of the revised analysis remain valid for Model 57AG steam generators and for AREVA Advanced W17 High Thermal Performance (HTP) fuel, and the increase in ice weight does not invalidate the ice condenser seismic qualification, the increased ice weight does not create the possibility of an accident that is different than any already evaluated in the SQN UFSAR.

   Therefore, the proposed changes do not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. *Does the proposed amendment involve a significant reduction in a margin of safety?*

   Response: No.

   The operability of the ice bed ensures that the required ice inventory will 1) be distributed evenly through the containment bays, 2) contain sufficient boron to preclude dilution of the containment sump following the LOCA and 3) contain sufficient heat removal capability to condense the reactor system volume released during a LOCA. These conditions are consistent with the assumptions used in the accident analyses.

The revised analysis demonstrates that the ice condensers will continue to preclude over-pressurizing the lower containment and continue to absorb sufficient heat energy to assist in precluding containment vessel failure. TVA has evaluated the effects of the increased ice condenser ice weight and determined that the increase in ice weight does not invalidate the ice condenser seismic qualification, does not adversely affect the capacity of the ice bed to absorb iodine during a LOCA, and does not diminish the boron concentration of the recirculated primary coolant during a LOCA.

The proposed changes are required to resolve non-conservative TSs currently addressed by administrative controls established in accordance with Nuclear Regulatory Commission (NRC) Administrative Letter 98-10. The revised containment integrity response analysis requires an increase in the required ice weight to ensure that the post-LOCA peak containment pressure remains within the design limits. As a result, the proposed changes restore margin between the accident peak pressure and the containment design pressure and resolve non-conservative TSs ice weight values currently under administrative controls. Accordingly, the proposed changes do not involve a significant reduction in a margin of safety.

4.4 Conclusions

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

A review has determined that the proposed amendment would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20. However, the proposed amendment does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluents that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed amendment meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed amendment.

6.0 REFERENCES

1. Sequoyah Nuclear Plant, Units 1 and 2, Updated Final Safety Analysis Report.
2. NSAL-11-5, "Westinghouse LOCA Mass and Energy Release Analysis," dated July 26, 2011.

3. WCAP-12455, Revision 1, Supplement 2R, "Tennessee Valley Authority Sequoyah Nuclear Plant Units 1 and 2 Containment Integrity Reanalyses Engineering Report," dated April 2012. (Provided as Attachment 5 to this LAR submittal.)

4. NSAL-06-6, "LOCA Mass and Energy Release Analysis," dated June 6, 2006

5. WCAP-8110, "Test Plans and Results for the Ice Condenser System," dated April 16, 1973.

6. NRC Safety Evaluation, "Sequoyah Nuclear Plant, Units 1 and 2 – Issuance of Amendments to revise the Technical Specification to Allow Use of AREVA Advanced W17 High Thermal Performance Fuel (TS-SQN-2011-07) (TAC Nos. ME6538 and ME6539)," dated September 26, 2012 (ADAMS Accession Number ML12249A394).

7. ANP-2986, Revision 3, "Sequoyah HTP Fuel Transition," dated July 2011 (ADAMS Accession Number ML 11210B532)

8. NRC Safety Evaluation, "Sequoyah Nuclear Plants, Units 1 and 2 – Issuance of Amendments Regarding Ice Condenser Basket Weight (TAC Nos. MB3682 and MB3683) (TS 01-04)," dated September 30, 2002 (ADAMS Accession Number ML022730675).

ATTACHMENT 1

Proposed TS Changes (Mark-Ups) for SQN Units 1 and 2

Proposed TS Changes (Mark-Ups) for SQN Unit 1

CONTAINMENT SYSTEMS

3/4.6.5 ICE CONDENSER

ICE BED

LIMITING CONDITION FOR OPERATION

3.6.5.1. The ice bed shall be OPERABLE with:

a. The stored ice having a boron concentration of $\geq$ 1800 ppm and $\leq$ 2500 ppm boron as sodium tetraborate and a pH of 9.0 to 9.5,

b. Flow channels through the ice condenser,

c. A maximum ice bed temperature of less than or equal 27°F,

d. A total ice weight of at least ~~2,225,880~~ 2,540,808 pounds at a 95% level of confidence, and

e. 1944 ice baskets.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

With the ice bed inoperable, restore the ice bed to OPERABLE status within 48 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.6.5.1 The ice condenser shall be determined OPERABLE:

a. At least once per 12 hours by verifying that the maximum ice bed temperature is less than or equal to 27°F.

b. At least once per 18 months by verifying, by visual inspection, accumulation of ice on structural members comprising flow channels through the ice bed is $\leq$ 15 percent blockage of the total flow area for each safety analysis section.

SURVEILLANCE REQUIREMENTS (Continued)

c. At least once per 40 months by lifting and visually inspecting the accessible portions of at least two ice baskets from each 1/3 of the ice condenser and verifying that the ice baskets are free of detrimental structural wear, cracks, corrosion or other damage. The ice baskets shall be raised at least 10 feet for this inspection.

d. At least once per 18 months by:

1. Deleted.

2. Weighing a representative sample of at least 144 ice baskets and verifying that each basket contains at least ~~1145~~ 1307 lbs of ice. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall be constituted of one basket each from Radial Rows 1, 2, 4, 6, 8 and 9 (or from the same row of an adjacent bay if a basket from a designated row cannot be obtained for weighing) within each bay. If any basket is found to contain less than ~~1145~~ 1307 pounds of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The minimum average weight of ice from the 20 additional baskets and the discrepant basket shall not be less than ~~1145~~ 1307 pounds/basket at a 95% level of confidence.

   The ice condenser shall also be subdivided into 3 groups of baskets, as follows: Group 1 - bays 1 through 8, Group 2 - bays 9 through 16, and Group 3 - bays 17 through 24. The minimum average ice weight of the sample baskets from Radial Rows 1, 2, 4, 6, 8 and 9 in each group shall not be less than ~~1145~~ 1307 pounds/basket at a 95% level of confidence.

   The minimum total ice condenser ice weight at a 95% level of confidence shall be calculated using all ice basket weights determined during this weighing program and shall not be less than ~~2,225,880~~ 2,540,808 pounds.

e. At least once per 54 months by chemical analysis of the stored ice in at least one randomly selected ice basket from each ice condenser bay verify:

1. Ice bed boron concentration is ≥ 1800 ppm and ≤ 2500 ppm as sodium tetraborate and;

2. pH is ≥ 9.0 and ≤ 9.5.

NOTE: The requirements of this SR are satisfied if the boron concentration and pH values obtained from averaging the individual sample results are within the limits specified above.

f. Each ice addition verify, by chemical analysis, that ice added to the ice condenser meets the boron concentration and pH requirements of SR 4.6.5.1.e.

NOTE: The chemical analysis may be performed on either the liquid solution or the resulting ice.

Proposed TS Changes (Mark-Ups) for SQN Unit 2

3/4.6.5 ICE CONDENSER

ICE BED

LIMITING CONDITION FOR OPERATION

3.6.5.1. The ice bed shall be OPERABLE with:

a. The stored ice having a boron concentration of ≥ 1800 ppm and ≤ 2500 ppm boron as sodium tetraborate and a pH of 9.0 to 9.5,

b. Flow channels through the ice condenser,

c. A maximum ice bed temperature of less than or equal 27°F,

d. A total ice weight of at least ~~2,225,880~~ 2,540,808 pounds at a 95% level of confidence, and |

e. 1944 ice baskets.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

With the ice bed inoperable, restore the ice bed to OPERABLE status within 48 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.6.5.1 The ice condenser shall be determined OPERABLE:

a. At least once per 12 hours by verifying that the maximum ice bed temperature is less than or equal to 27°F. |

b. At least once per 18 months by verifying, by visual inspection, accumulation of ice on structural members comprising flow channels through the ice bed is ≤ 15 percent blockage of the total flow area for each safety analysis section.

SURVEILLANCE REQUIREMENTS (Continued)

c. At least once per 40 months by lifting and visually inspecting the accessible portions of at least two ice baskets from each 1/3 of the ice condenser and verifying that the ice baskets are free of detrimental structural wear, cracks, corrosion or other damage. The ice baskets shall be raised at least 10 feet for this inspection.

d. At least once per 18 months by:

1. Deleted.

2. Weighing a representative sample of at least 144 ice baskets and verifying that each basket contains at least ~~1145~~ 1307 lbs of ice. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall be constituted of one basket each from Radial Rows 1, 2, 4, 6, 8 and 9 (or from the same row of an adjacent bay if a basket from a designated row cannot be obtained for weighing) within each bay. If any basket is found to contain less than ~~1145~~ 1307 pounds of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The minimum average weight of ice from the 20 additional baskets and the discrepant basket shall not be less than ~~1145~~ 1307 pounds/basket at a 95% level of confidence.

   The ice condenser shall also be subdivided into 3 groups of baskets, as follows: Group 1 - bays 1 through 8, Group 2 - bays 9 through 16, and Group 3 - bays 17 through 24. The minimum average ice weight of the sample baskets from Radial Rows 1, 2, 4, 6, 8 and 9 in each group shall not be less than ~~1145~~ 1307 pounds/basket at a 95% level of confidence.

   The minimum total ice condenser ice weight at a 95% level of confidence shall be calculated using all ice basket weights determined during this weighing program and shall not be less than ~~2,225,880~~ 2,540,808 pounds.

e. At least once per 54 months by chemical analysis of the stored ice in at least one randomly selected ice basket from each ice condenser bay verify:

1. Ice bed boron concentration is ≥ 1800 ppm and ≤ 2500 ppm as sodium tetraborate and;

2. pH is ≥ 9.0 and ≤ 9.5.

NOTE: The requirements of this SR are satisfied if the boron concentration and pH values obtained from averaging the individual sample results are within the limits specified above.

f. Each ice addition verify, by chemical analysis, that ice added to the ice condenser meets the boron concentration and pH requirements of SR 4.6.5.1.e.

NOTE: The chemical analysis may be performed on either the liquid solution or the resulting ice.

ATTACHMENT 2

Proposed TS Bases Changes (Mark-Ups) for SQN Units 1 and 2

(For Information Only)

Proposed TS Bases Changes (Mark-Ups) for SQN Unit 1

(For Information Only)

3/4.6.4 COMBUSTIBLE GAS CONTROL

The hydrogen mixing systems are provided to ensure adequate mixing of the containment atmosphere following a LOCA. This mixing action will prevent localized accumulations of hydrogen from exceeding the flammable limit.

The operability of at least 66 of 68 ignitors in the hydrogen mitigation system will maintain an effective coverage throughout the containment. This system of ignitors will initiate combustion of any significant amount of hydrogen released after a degraded core accident. This system is to ensure burning in a controlled manner as the hydrogen is released instead of allowing it to be ignited at high concentrations by a random ignition source.

3/4.6.5 ICE CONDENSER

The requirements associated with each of the components of the ice condenser ensure that the overall system will be available to provide sufficient pressure suppression capability to limit the containment peak pressure transient to less than 12 psig during LOCA conditions.

3/4.6.5.1 ICE BED

The OPERABILITY of the ice bed ensures that the required ice inventory will 1) be distributed evenly through the containment bays, 2) contain sufficient boron to preclude dilution of the containment sump following the LOCA and 3) contain sufficient heat removal capability to condense the reactor system volume released during a LOCA. These conditions are consistent with the assumptions used in the accident analyses.

The minimum weight figure of ~~1145~~ 1307 pounds of ice per basket contains a 15% conservative allowance for ice loss through sublimation which is a factor of 15 higher than assumed for the ice condenser design. The minimum weight figure of ~~2,225,880~~ 2,540,808 pounds of ice also contains an additional 1% conservative allowance to account for systematic error in weighing instruments. In the

Proposed TS Bases Changes (Mark-Ups) for SQN Unit 2

(For Information Only)

3/4.6.4 COMBUSTIBLE GAS CONTROL

The hydrogen mixing systems are provided to ensure adequate mixing of the containment atmosphere following a LOCA. This mixing action will prevent localized accumulations of hydrogen from exceeding the flammable limit.

The operability of at least 66 of 68 igniters in the hydrogen control distributed ignition system will maintain an effective coverage throughout the containment. This system of ignitors will initiate combustion of any significant amount of hydrogen released after a degraded core accident. This system is to ensure burning in a controlled manner as the hydrogen is released instead of allowing it to be ignited at high concentrations by a random ignition source.

3/4.6.5 ICE CONDENSER

The requirements associated with each of the components of the ice condenser ensure that the overall system will be available to provide sufficient pressure suppression capability to limit the containment peak pressure transient to less than 12 psig during LOCA conditions.

3/4.6.5.1 ICE BED

The OPERABILITY of the ice bed ensures that the required ice inventory will 1) be distributed evenly through the containment bays, 2) contain sufficient boron to preclude dilution of the containment sump following the LOCA and 3) contain sufficient heat removal capability to condense the reactor system volume released during a LOCA. These conditions are consistent with the assumptions used in the accident analyses.

The minimum weight figure of ~~1145~~ 1307 pounds of ice per basket contains a 15% conservative allowance for ice loss through sublimation ~~which is a factor of 15 higher than~~ assumed for the ice condenser design. The minimum weight figure of ~~2,225,880~~ 2,540,808 pounds of ice also contains an additional 1% conservative allowance to account for systematic error in weighing instruments. In the

ATTACHMENT 3

Proposed TS Changes (Final Typed) for SQN, Units 1 and 2

Proposed TS Changes (Final Typed) for SQN Unit 1

CONTAINMENT SYSTEMS

3/4.6.5 ICE CONDENSER

ICE BED

LIMITING CONDITION FOR OPERATION

3.6.5.1. The ice bed shall be OPERABLE with:

a. The stored ice having a boron concentration of ≥ 1800 ppm and ≤ 2500 ppm boron as sodium tetraborate and a pH of 9.0 to 9.5,

b. Flow channels through the ice condenser,

c. A maximum ice bed temperature of less than or equal 27°F,

d. A total ice weight of at least 2,540,808 pounds at a 95% level of confidence, and

e. 1944 ice baskets.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

With the ice bed inoperable, restore the ice bed to OPERABLE status within 48 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.6.5.1 The ice condenser shall be determined OPERABLE:

a. At least once per 12 hours by verifying that the maximum ice bed temperature is less than or equal to 27°F.

b. At least once per 18 months by verifying, by visual inspection, accumulation of ice on structural members comprising flow channels through the ice bed is ≤ 15 percent blockage of the total flow area for each safety analysis section.

SURVEILLANCE REQUIREMENTS (Continued)

c. At least once per 40 months by lifting and visually inspecting the accessible portions of at least two ice baskets from each 1/3 of the ice condenser and verifying that the ice baskets are free of detrimental structural wear, cracks, corrosion or other damage. The ice baskets shall be raised at least 10 feet for this inspection.

d. At least once per 18 months by:

1. Deleted.

2. Weighing a representative sample of at least 144 ice baskets and verifying that each basket contains at least 1307 lbs of ice. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall be constituted of one basket each from Radial Rows 1, 2, 4, 6, 8 and 9 (or from the same row of an adjacent bay if a basket from a designated row cannot be obtained for weighing) within each bay. If any basket is found to contain less than 1307 pounds of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The minimum average weight of ice from the 20 additional baskets and the discrepant basket shall not be less than 1307 pounds/basket at a 95% level of confidence.

   The ice condenser shall also be subdivided into 3 groups of baskets, as follows: Group 1 - bays 1 through 8, Group 2 - bays 9 through 16, and Group 3 - bays 17 through 24. The minimum average ice weight of the sample baskets from Radial Rows 1, 2, 4, 6, 8 and 9 in each group shall not be less than 1307 pounds/basket at a 95% level of confidence.

   The minimum total ice condenser ice weight at a 95% level of confidence shall be calculated using all ice basket weights determined during this weighing program and shall not be less than 2,540,808 pounds.

e. At least once per 54 months by chemical analysis of the stored ice in at least one randomly selected ice basket from each ice condenser bay verify:

1. Ice bed boron concentration is ≥ 1800 ppm and ≤ 2500 ppm as sodium tetraborate and;

2. pH is ≥ 9.0 and ≤ 9.5.

NOTE: The requirements of this SR are satisfied if the boron concentration and pH values obtained from averaging the individual sample results are within the limits specified above.

f. Each ice addition verify, by chemical analysis, that ice added to the ice condenser meets the boron concentration and pH requirements of SR 4.6.5.1.e.

NOTE: The chemical analysis may be performed on either the liquid solution or the resulting ice.

Proposed TS Changes (Final Typed) for SQN Unit 2

3/4.6.5 ICE CONDENSER

ICE BED

LIMITING CONDITION FOR OPERATION

3.6.5.1. The ice bed shall be OPERABLE with:

a. The stored ice having a boron concentration of ≥ 1800 ppm and ≤ 2500 ppm boron as sodium tetraborate and a pH of 9.0 to 9.5,

b. Flow channels through the ice condenser,

c. A maximum ice bed temperature of less than or equal 27°F,

d. A total ice weight of at least 2,540,808 pounds at a 95% level of confidence, and

e. 1944 ice baskets.

APPLICABILITY: MODES 1, 2, 3 and 4.

ACTION:

With the ice bed inoperable, restore the ice bed to OPERABLE status within 48 hours or be in at least HOT STANDBY within the next 6 hours and in COLD SHUTDOWN within the following 30 hours.

SURVEILLANCE REQUIREMENTS

4.6.5.1 The ice condenser shall be determined OPERABLE:

a. At least once per 12 hours by verifying that the maximum ice bed temperature is less than or equal to 27°F.

b. At least once per 18 months by verifying, by visual inspection, accumulation of ice on structural members comprising flow channels through the ice bed is ≤ 15 percent blockage of the total flow area for each safety analysis section.

SURVEILLANCE REQUIREMENTS (Continued)

c. At least once per 40 months by lifting and visually inspecting the accessible portions of at least two ice baskets from each 1/3 of the ice condenser and verifying that the ice baskets are free of detrimental structural wear, cracks, corrosion or other damage. The ice baskets shall be raised at least 10 feet for this inspection.

d. At least once per 18 months by:

   1. Deleted.

   2. Weighing a representative sample of at least 144 ice baskets and verifying that each basket contains at least 1307 lbs of ice. The representative sample shall include 6 baskets from each of the 24 ice condenser bays and shall be constituted of one basket each from Radial Rows 1, 2, 4, 6, 8 and 9 (or from the same row of an adjacent bay if a basket from a designated row cannot be obtained for weighing) within each bay. If any basket is found to contain less than 1307 pounds of ice, a representative sample of 20 additional baskets from the same bay shall be weighed. The minimum average weight of ice from the 20 additional baskets and the discrepant basket shall not be less than 1307 pounds/basket at a 95% level of confidence.

      The ice condenser shall also be subdivided into 3 groups of baskets, as follows: Group 1 - bays 1 through 8, Group 2 - bays 9 through 16, and Group 3 - bays 17 through 24. The minimum average ice weight of the sample baskets from Radial Rows 1, 2, 4, 6, 8 and 9 in each group shall not be less than 1307 pounds/basket at a 95% level of confidence.

      The minimum total ice condenser ice weight at a 95% level of confidence shall be calculated using all ice basket weights determined during this weighing program and shall not be less than 2,540,808 pounds.

e. At least once per 54 months by chemical analysis of the stored ice in at least one randomly selected ice basket from each ice condenser bay verify:

   1. Ice bed boron concentration is ≥ 1800 ppm and ≤ 2500 ppm as sodium tetraborate and;

   2. pH is ≥ 9.0 and ≤ 9.5.

NOTE: The requirements of this SR are satisfied if the boron concentration and pH values obtained from averaging the individual sample results are within the limits specified above.

f. Each ice addition verify, by chemical analysis, that ice added to the ice condenser meets the boron concentration and pH requirements of SR 4.6.5.1.e.

NOTE: The chemical analysis may be performed on either the liquid solution or the resulting ice.

ATTACHMENT 4

Proposed TS Bases Changes (Final Typed) for SQN Units 1 and 2

(For Information Only)

Proposed TS Bases Changes (Final Typed) for SQN Unit 1

(For Information Only)

3/4.6.4 COMBUSTIBLE GAS CONTROL

The hydrogen mixing systems are provided to ensure adequate mixing of the containment atmosphere following a LOCA. This mixing action will prevent localized accumulations of hydrogen from exceeding the flammable limit.

The operability of at least 66 of 68 ignitors in the hydrogen mitigation system will maintain an effective coverage throughout the containment. This system of ignitors will initiate combustion of any significant amount of hydrogen released after a degraded core accident. This system is to ensure burning in a controlled manner as the hydrogen is released instead of allowing it to be ignited at high concentrations by a random ignition source.

3/4.6.5 ICE CONDENSER

The requirements associated with each of the components of the ice condenser ensure that the overall system will be available to provide sufficient pressure suppression capability to limit the containment peak pressure transient to less than 12 psig during LOCA conditions.

3/4.6.5.1 ICE BED

The OPERABILITY of the ice bed ensures that the required ice inventory will 1) be distributed evenly through the containment bays, 2) contain sufficient boron to preclude dilution of the containment sump following the LOCA and 3) contain sufficient heat removal capability to condense the reactor system volume released during a LOCA. These conditions are consistent with the assumptions used in the accident analyses.

The minimum weight figure of 1307 pounds of ice per basket contains a 15% conservative allowance for ice loss through sublimation which is a factor of 15 higher than assumed for the ice condenser design. The minimum weight figure of 2,540,808 pounds of ice also contains an additional 1% conservative allowance to account for systematic error in weighing instruments. In the

Proposed TS Bases Changes (Final Typed) for SQN Unit 2

(For Information Only)

3/4.6.4 COMBUSTIBLE GAS CONTROL

The hydrogen mixing systems are provided to ensure adequate mixing of the containment atmosphere following a LOCA. This mixing action will prevent localized accumulations of hydrogen from exceeding the flammable limit.

The operability of at least 66 of 68 igniters in the hydrogen control distributed ignition system will maintain an effective coverage throughout the containment. This system of ignitors will initiate combustion of any significant amount of hydrogen released after a degraded core accident. This system is to ensure burning in a controlled manner as the hydrogen is released instead of allowing it to be ignited at high concentrations by a random ignition source.

3/4.6.5 ICE CONDENSER

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The minimum weight figure of 1307 pounds of ice per basket contains a 15% conservative allowance for ice loss through sublimation which is a factor of 15 higher than assumed for the ice condenser design. The minimum weight figure of 2,540,808 pounds of ice also contains an additional 1% conservative allowance to account for systematic error in weighing instruments. In the

ATTACHMENT 5

Topical Report WCAP-12455, Revision 1, Supplement 2R

WESTINGHOUSE NON-PROPRIETARY CLASS 3

WCAP-12455
Revision 1
Supplement 2R

TENNESSEE VALLEY AUTHORITY SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2 CONTAINMENT INTEGRITY REANALYSES ENGINEERING REPORT

R. B. Lukas
J. A. Kolano
K. W. Bonadio

April, 2012

Westinghouse Electric Company LLC
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EXECUTIVE SUMMARY

Loss-of-Coolant Accident (LOCA) Containment Integrity Analyses have been updated to support recent changes to the Westinghouse computer code, EPITOME, i.e. NSAL-11-5 (Reference 9). The analyses conducted are consistent with current licensed methodology. In addition, for a comprehensive reconciliation of all issues relative to the LOCA mass and energy release analysis of record (AOR) all appropriate corrections relative to NSAL-06-6 (Reference 10) were also addressed.

The objective of this effort was to determine an ice weight that preserved the current LOCA containment integrity pressure margin. Additionally, the containment spray switchover interval (>150 seconds) relationship between ice bed meltout time and containment spray switchover time was to be preserved.

The results of the analysis support the following:

- An ice mass of 2,187,250 lbms
- A calculated containment peak pressure of 11.33 psig occurring at 6651.46 seconds
- Ice bed meltout occurred at 3273.7 seconds (containment spray switchover is completed at 3113 seconds thus the containment spray switchover ice bed meltout relationship is 160.7 seconds).

  The ice bed mass of 2,187,250 lbms equates to an average of 1125.13 lbm per basket. This average value recognizes that all baskets may not have the same initial weight nor have the same sublimation rate. To ensure that a sufficient quantity of ice exists in each basket to survive the blowdown phase of a LOCA, a minimum amount of ice per basket to survive the blowdown would be approximately 325.7 lbm, based on Table 2-3. To ensure that an adequate distribution of ice exists in the Ice Condenser to prevent early burn-through of a localized area, 325.7 lbm of ice should be the minimum weight of ice per basket at any time while also ensuring that the average weight per basket remains above 1125.13 lbm.

Table of Contents

[WCAP-12455, Revision 1, Supplement 2R is redacted to exclude the SQN FSAR and TS markups. TS markups are included as Attachment 1 of the Enclosure. UFSAR changes will be processed in accordance with the TVA program requirements.]

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF CONTENTS

LIST OF TABLES

TABLE OF CONTENTS

LIST OF FIGURES

1.0 INTRODUCTION

Loss-of-Coolant Accident (LOCA) Containment Integrity Analyses have been updated to support recent changes to the Westinghouse computer code, EPITOME, i.e., NSAL-11-5 (Reference 9). In addition, for a comprehensive reconciliation of all issues relative to the LOCA mass and energy release analysis of record (AOR) all appropriate corrections relative to NSAL-06-6 (Reference 10) were also addressed. The analysis includes newly generated mass and energy releases (Appendix A).

A containment integrity analysis is performed during nuclear plant design to ensure that the pressure inside containment will remain below the containment building design pressure if a loss-of-coolant accident (LOCA) inside containment should occur during plant operation. The analysis ensures that the containment heat removal capability is sufficient to remove the maximum possible discharge of mass and energy to containment from the Nuclear Steam Supply System without exceeding the acceptance criteria (design pressure; 12 psig).

The analysis was completed to provide the analytical basis for a change to the Sequoyah design basis ice mass of 2,187,250 pounds with minimal impact on current margins in peak calculated containment pressure and ice bed meltout time to containment spray switchover time.

In addition to the design basis (Reference 3), this analysis accounted for:

- An increased accumulator water temperature of 130 °F
- Revised initial conditions (Table 1-1)
- Revised plant specific decay heat curve (Table 1-2)

1.1 PURPOSE OF ANALYSIS

The purpose of this program was to reanalyze the containment integrity response in order to incorporate the issues reported in NSAL-11-5 and NSAL-06-6. The objective of performing the long-term LOCA mass and energy release and LOCA containment integrity analysis was to minimize the effect on the initial analytical ice mass, to maintain the current time interval (150 seconds, minimum) relationship between containment spray switchover time and ice bed meltout time, and to provide peak pressure margin to design pressure.

This program will provide the analytical basis and the results which show that the containment design pressure is not exceeded in the event of a LOCA. The conclusions presented will demonstrate, with respect to LOCA, that containment integrity has not been compromised. This containment analysis bounds both Units 1 and 2 with Model 51 steam generators.

Rupture of any of the piping carrying pressurized high temperature reactor coolant, termed a LOCA, will result in release of steam and water into the containment. This, in turn, will result in an increase in the containment pressure and temperature. The mass and energy release rates described in Appendix A form the basis for computations to evaluate the structural integrity of the containment following a postulated accident to satisfy the Nuclear Regulatory acceptance criteria, General Design Criterion 38. Section 2.0 presents the Containment Pressure Calculations.

TABLE 1-1

SEQUOYAH UNITS 1 AND 2
SYSTEM PARAMETERS
INITIAL CONDITIONS

PARAMETERS	VALUE
Core Thermal Power (MWt)	3455
Reactor Coolant System Flowrate, per Loop (gpm)	91400.
Vessel Outlet Temperature* (°F) (without uncertainty allowance)	609.7
Core Inlet Temperature* (°F) (without uncertainty allowance)	546.2
Vessel Average Temperature (°F)	578.2
Initial Steam Generator Steam Pressure (psia)	870
Steam Generator Design	Model 51
Steam Generator Tube Plugging (%)	0
Initial Steam Generator Secondary Side Mass (lbm)	114075
Accumulator	
Water Volume (ft^3)	1039
N_2 Cover Gas Pressure (psig)	668
Temperature (°F)	130
Safety Injection Delay (sec) (includes time to reach pressure setpoint; 27.0 second delay plus 2.76 seconds to reach pressure setpoint)	29.76

* (analysis value includes an additional +5.5°F allowance for instrument error and deadband)

TABLE 1-2

SEQUOYAH UNITS 1 AND 2
SYSTEM PARAMETERS
DECAY HEAT CURVE

Time (sec)	Decay Heat Generation Rate (Btu/Btu)
10	0.050708
14	0.048246
20	0.045658
40	0.040710
60	0.037863
80	0.03588
100	0.034382
140	0.032242
200	0.030132
400	0.026430
600	0.024288
800	0.022747
1000	0.021503
1600	0.018850
2000	0.017588
4000	0.014057
6000	0.012379
8000	0.011403
10000	0.010732
16000	0.0098865
20000	0.0093675
40000	0.0079143
60000	0.00714
80000	0.0066015
100000	0.0062030
140000	0.0056076
200000	0.0049979
400000	0.0038661
600000	0.0032651
800000	0.0028811
1000000	0.0026162
1400000	0.0022614
2000000	0.0019338
4000000	0.0013904
6000000	0.0011374
8000000	0.00098265
10000000	0.00087175

Key Assumptions

-18 month fuel cycle
-Standard and V5H fuel
-End of Cycle Core Average Burnup of 52,687 Mwd/MTU
-Low bound for enrichment: 3.0%

2.0 LOCA CONTAINMENT INTEGRITY ANALYSIS

2.1 Description of LOTIC-1 Model and Interface Issue

The LOTIC code is described in Reference 4.

The LOTIC model of the containment consists of five distinct control volumes: the upper compartment, the lower compartment, the portion of the ice bed from which the ice has melted, the portion of the ice bed containing unmelted ice, and the dead ended compartment. The ice condenser control volume with unmelted and melted ice is further subdivided into six subcompartments to allow for maldistribution of break flow to the ice bed.

The conditions in these compartments are obtained as a function of time by the use of fundamental equations solved through numerical techniques. These equations are solved for three phases in time. Each phase corresponds to a distinct physical characteristic of the problem. Each of these phases has a unique set of simplifying assumptions based on test results from the ice condenser test facility (Reference 5). These phases are the blowdown period, the depressurization period, and the long term.

The most significant simplification of the problem is the assumption that the total pressure in the containment is uniform. This assumption is justified by the fact that after the initial blowdown of the Reactor Coolant System, the remaining mass and energy released from this system into the containment are small and very slowly changing. The resulting flow rates between the control volumes will also be relatively small. These flow rates then are unable to maintain significant pressure differences between the compartments.

In the control volumes, which are always assumed to be saturated, steam and air are assumed to be uniformly mixed and at the control volume temperature. The air is considered a perfect gas, and the thermodynamic properties of steam are taken from the American Society of Mechanical Engineers (ASME) steam table.

The condensation of steam is assumed to take place in a condensing node located, for the purpose of calculation, between the two control volumes in the ice storage compartment. The exit temperature of the air leaving this node is set equal to a specific value that is equal to the temperature of the ice filled control volume of the ice storage compartment. Lower compartment exit temperature is used if the ice bed section is melted.

2.2 Containment Pressure Calculation

The following are the major input assumptions used in the LOTIC analysis for the pump suction pipe rupture case with the steam generators considered as an active heat source for the Sequoyah Nuclear Plant Containment:

1. Minimum safeguards are employed in all calculations, e.g., one of two spray pumps and one of two spray heat exchangers; one of two residual heat removal (RHR) pumps and one of two RHR heat exchangers providing flow to the core; one of two safety injection pumps and one of two centrifugal charging pumps; and one of two air return fans.

2. 2,187,250 lbm of ice initially in the ice condenser.

3. The blowdown, reflood, and post reflood mass and energy releases described in Appendix A herein were used.

4. Blowdown and post-blowdown ice condenser drain temperature of 190°F and 130°F are used. (These values are based on the Long-Term Waltz-Mill ice condenser test data described in Reference 5.)

5. Nitrogen from the accumulators in the amount of 3479 lbs. is included in the calculations.

6. Hydrogen gas was added to the containment in the amount of 21,366 Standard Cubic Feet (SCF) over 24 hours. Sources accounted for were radiolysis in the core and sump post-LOCA, corrosion of plant materials (Aluminum, Zinc, and painted surfaces found in containment), reaction of 1% of the Zirconium fuel rod cladding in the core, and hydrogen gas assumed to be dissolved in the Reactor Coolant System water. (This bounds tritium producing core designs)

7. Essential service water temperature of 87°F is used on the spray heat exchanger and the component cooling heat exchanger.

8. The air return fan is assumed to be effective 10 minutes after the transient is initiated.

9. No maldistribution of steam flow to the ice bed is assumed. (This assumption is conservative, contributes to early ice bed meltout time.)

10. No ice condenser bypass is assumed. (This assumption depletes the ice in the shortest time and is thus conservative.)

11. The initial conditions in the containment are a temperature of 100°F in the lower and dead-ended volumes, 80°F in the upper volume and 15°F in the ice condenser. (Note: The 80°F temperature in the upper compartment is a reduction from the 85°F lower Technical Specification limit to account for the upper plenum volume of the ice condenser which is included in the upper

compartment volume for the analysis. The volume is adjusted to maximize air mass and the compression ratio.) All volumes are at a pressure of 0.3 psig and a 10% relative humidity, except the ice condenser which is at 100% relative humidity.

12. The minimum Emergency Core Cooling System (ECCS) and Containment Spray flow rates versus time assumed in the peak containment pressure calculations were calculated based upon the assumption of loss of offsite power (See Reference 1, Table 3-1).

13. Containment structural heat sinks are assumed with conservatively low heat transfer rates. (See Tables 2-1 and 2-2) Note: The Dead-Ended compartment structural heat sinks were conservatively neglected.

14. The Containment compartment volumes were based on the following: Upper Compartment 651,000 ft^3; Lower Compartment 248,500 ft^3; and Dead-Ended Compartment 129,900 ft^3.

15. The operation of one containment spray heat exchanger (Overall conductance (UA) = 2.953 * 10^6 Btu/hr-°F) for containment cooling and the operation of one RHR heat exchanger (UA = 1.402 * 10^6 Btu/hr-°F) for core cooling. The component cooling heat exchanger was modeled at 2.793 * 10^6 Btu/hr-°F. All heat exchangers were modeled as strictly counterflow heat exchangers.

16. The air return fan returns air at a rate of 40,000 cfm from the upper to the lower compartment.

17. An active sump volume of 38,400 ft^3 is used.

18. 100.7% of 3455 MWt power is used in the calculations.

19. Subcooling of emergency core cooling (ECC) water from the RHR heat exchanger is assumed.

20. Nuclear service water flow to the containment spray heat exchanger was modeled as 3400 gpm. Also, the nuclear service water flow to the component cooling heat exchanger was modeled as 4000 gpm.

21. Decay Heat Model - On November 2, 1978 the Nuclear Power Plant Standards Committee (NUPPSCO) of the American Nuclear Society (ANS) approved ANS Standard 5.1 for the determination of decay heat. This standard was used in the mass and energy release model with the following input specific for the Sequoyah Units 1 and 2. The primary assumptions which make this calculation specific for the Sequoyah Units 1 and 2 are the enrichment factor, minimum/maximum new fuel loadng per cycle, and a conservative end of cycle core average burnup. A conservative lower bound for enrichment of 3% was used. Table 1-2 lists the decay heat curve used in the Sequoyah Ice Weight Optimization analysis.

Significant assumptions in the generation of the decay heat curve:

A. Decay heat sources considered are fission product decay and heavy element decay of U-239 and N_p-239.

B. Decay heat power from the following fissioning isotopes are included; U-238, U-235, and Pu-239.

C. Fission rate is constant over the operating history of maximum power level.

D. The factor accounting for neutron capture in fission products has been taken from Equation 11 of Reference 2 (up to 10,000 seconds) and Table 10 of Reference 2 (beyond 10,000 seconds).

E. The fuel has been assumed to be at full power for 1096 days.

F. The number of atoms of U-239 produced per second has been assumed to be equal to 70% of the fission rate.

G. The total recoverable energy associated with one fission has been assumed to be 200 MeV/fission.

H. Two sigma uncertainty (two times the standard deviation) has been applied to the fission product decay.

22. Core stored energy based on the time in life for maximum fuel densification. The assumptions used to calculate the fuel temperatures for the core stored energy calculation account for appropriate uncertainties associated with the models in the PAD code (e.g., calibration of the thermal model, pellet densification model, cladding creep model, etc.). In addition, the fuel temperatures for the core stored energy calculation account for appropriate uncertainties associated with manufacturing tolerances (e.g., pellet as-built density). The total uncertainty for the fuel temperature calculation is a statistical combination of these effects and is dependent upon fuel type, power level, and burnup.

23. Reloads utilizing Mark-BW17 fuel with up to 96 fresh assemblies are bounded based on the evaluation provided in Reference 8.

The minimum time at which the RHR pumps can be diverted to the RHR sprays are specified in the plant operating procedures as 60 minutes after the accident.

2.3 Structural Heat Removal

Provision is made in the containment pressure analysis for heat storage in interior and exterior walls. Each wall is divided into a number of nodes. For each node, a conservation of energy equation expressed in finite difference form accounts for transient conduction into and out of the node and temperature rise of the node for the containment structural heat sinks used in the analysis. The heat sink and material property data used are found in Tables 2-1 and 2-2.

The heat transfer coefficient to the containment structure is based primarily on the work of Tagami (Reference 7). When applying the Tagami correlations, a conservative limit was placed on the lower compartment stagnant heat transfer coefficients. They were limited to a steam-air ratio of 1.4 according to the Tagami correlation. The imposition of this limitation is to restrict the use of the Tagami correlation within the test range of steam-air ratios where the correlation was derived.

With these assumptions, the heat removal capability of the containment is sufficient to absorb the energy releases and still keep the maximum calculated pressure below the design pressure.

2.4 Analysis Results

The results of the analysis show that the maximum calculated containment pressure is 11.33 psig, for the double-ended pump suction minimum safeguards break case. This pressure peak occurs at approximately 6651.46 seconds, with ice bed meltout at approximately 3273.7 seconds.

The ice bed meltout occurred at 3273.7 seconds, containment spray switchover to sump recirculation is completed at 3113 seconds, thus the containment spray switchover ice bed meltout time relationship is 160.7 seconds.

The following plots show the containment integrity transient, as calculated by the LOTIC-1 code.

Figure 2-1, Containment Pressure Transient
Figure 2-2, Upper Compartment Temperature Transient
Figure 2-3, Lower Compartment Temperature Transient
Figure 2-4, Active and Inactive Sump Temperature Transient
Figure 2-5, Ice Melt Transient

Tables 2-3 and 2-4 give energy accountings at various points in the transient. Table 2-5 provides the sequence of events, which includes results calculated in Appendix A.

2.5 Relevant Acceptance Criteria

The LOCA mass and energy analysis has been performed in accordance with the criteria shown in Standard Review Plan (SRP) subsection 6.2.1.3. In this analysis, the relevant requirements of General Design Criterion (GDC) 50 and the Code of Federal Regulations (CFR) 10 CFR Part 50 Appendix K have been included by confirmation that the calculated pressure is less than the design pressure, and because all available sources of energy have been included. These sources include reactor power, decay heat, core stored energy, energy stored in the reactor vessel and internals, metal-water reaction energy, and stored energy in the secondary system.

The containment integrity peak pressure analysis has been performed in accordance with the criteria shown in the SRP Section 6.2.1.1.b, for ice condenser containments. Conformance to GDC's 16, 38, and 50 is demonstrated by showing that the containment design pressure is not exceeded at any time in the transient. This analysis also demonstrates that the containment heat removal systems function to rapidly reduce the containment pressure and temperature in the event of a LOCA.

A calculated peak containment pressure of 12.0 psig or less will demonstrate satisfaction of the criteria for Sequoyah Units 1 and 2 relative to containment design pressure. In addition, the margin of time between the completion of containment spray realignment and ice bed meltout of ≥ 150 seconds (based upon an initial ice mass of approximately 2,187,250 lbm) is met.

2.6 Conclusions

Based upon the information presented in this report, it may be concluded that operation with an initial ice weight of 2,187,250 pounds for the Sequoyah Nuclear Plant is acceptable. Operation with an initial ice mass of 2,187,250 pounds results in a calculated peak containment pressure of 11.33 psig, as compared to the design pressure of 12.0 psig. Further, the ice bed mass of 2,187,250 lbm equates to an approximate average of 1,125.13 lbm per basket. This average value recognizes that all baskets may not have the same initial weight nor have the same sublimation rate. To ensure that a sufficient quality of ice exists in each basket to survive the blowdown phase of a LOCA, a minimum amount of ice per basket to survive the blowdown would be approximately 325.7 lbm, based on Table 2-4. To ensure that an adequate distribution of ice exists in the ice condenser to prevent early burn-through of a localized area, 325.7 lbm of ice should be the minimum weight per basket at any time while also ensuring that the average weight per basket remains above 1,125.13 lbm.

3.0 REFERENCES

1. WCAP-12455, Revision 1, "TENNESSEE VALLEY AUTHORITY SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2 CONTAINMENT INTEGRITY ANALYSES FOR ICE WEIGHT OPTIMIZATION ENGINEERING REPORT," September 1995.

2. ANSI/ANS-5.11979, "American National Standard for Decay Heat Power in Light Water Reactors," August 1979.

3. WCAP-12455, Revision 1, Supplement 1R, "TENNESSEE VALLEY AUTHORITY SEQUOYAH NUCLEAR PLANT UNITS 1 AND 2 CONTAINMENT INTEGRITY REANALYSES ENGINEERING REPORT," September, 2001.

4. "Long Term Ice Condenser Containment Code - LOTIC Code," WCAP-8354-P-A, April 1976 (Proprietary), WCAP-8355-A (Non-Proprietary).

5. WCAP-8110, Supplement 6, (Non-Proprietary), "Test Plans and Results for the Ice Condenser system, Ice condenser Full-Scale Section Test at the Waltz Mill Facility," May 1974.

6. "Westinghouse LOCA Mass and Energy Release Model for Containment Design March 1979 Version," WCAP-10325-P-A, May 1983 (Proprietary), WCAP-10326-A (Non-Proprietary).

7. Tagami, Takasi, Interim Report on Safety Assessments and Facilities Establishment Project in Japan for Period Ending June, 1965 (No. 1).

8. TVA-01-113, John W Irons (W) to Mr. D. L. Lundy (TVA), "Tennessee Valley Authority, Sequoyah Units 1 and 2, Transmittal - Wesdyne Letter NDP-01-0367, 'Revision to LOCA M&E Confirmation for Sequoyah Tritium Production Core Designs,' " August 21, 2001.

9. NSAL-11-5, "Westinghouse LOCA Mass and Energy Release Calculation Issues," July 26, 2011.

10. NSAL-06-6, "LOCA Mass and Energy Release Analysis," June 6, 2006.

Table 2-1 Sequoyah Units 1 and 2
Structural Heat Sink Table

	Upper Compartment	Area (Ft^2)	Thickness (Ft)
1.	Operating Deck	4,880	
	Concrete		1.007
2.	Crane Wall	18,280	
	Paint		0.0005
	Concrete		1.2985
3.	Refueling Canal (Steel Lined)	3,840	
	Stainless Steel		0.02083
	Concrete		1.5
4.	Operating Deck	760	
	Paint		0.00125
	Concrete		1.5
5.	Containment Shell & Misc. Steel	49,960	
	Paint		0.000625
	Steel		0.0403
6.	Misc. Steel	2,260	
	Paint		0.000625
	Steel		0.121
Lower Compartment			
7.	Operating Deck, Crane Wall & Interior Concrete	32,200	
	Concrete		1.415
8.	Area in Contact with Sump Water	15,540	
	Concrete		1.604
9.	Interior Concrete	3,590	
	Paint		0.0011
	Concrete		1.499
10.	Reactor Cavity	2,270	
	Stainless Steel		0.02082
	Concrete		2.0

Table 2-1 Sequoyah Units 1 and 2
Structural Heat Sink Table (Continued)

Lower Compartment (Continued)		**Area (Ft^2)**	**Thickness (Ft)**
11.	Containment Shell & Misc. Steel	19,500	
	Paint		0.000625
	Steel		0.04953
12.	Misc. Steel	9,000	
	Paint		0.000625
	Steel		0.1008
Ice Condenser			
13.	Ice Basket	149,600	
	Steel		0.00663
14.	Lattice Frames	75,865	
	Steel		0.0217
15.	Lower Support Structure	28,670	
	Steel		0.0587
16.	Ice Condenser Floor	3,336	
	Paint		0.000833
	Concrete		0.33
17.	Containment Wall Panels & Containment Shell	19,100	
	Steel & Insulation		1.0
	Steel		0.0625
18.	Crane Wall Panels & Crane Wall	13,055	
	Composite Panel (Steel and Insulation)		1.2
	Concrete		1.0

Table 2-2 Sequoyah Units 1 and 2 Material Properties Table

Material	Thermal Conductivity Btu/hr - ft -°F	Volumetric Heat Btu/ft^3 -°F
Paint$_1$	0.2	14.0
Paint$_2$	0.0833	28.4
Concrete	0.8	28.8
Stainless Steel	9.4	56.35
Carbon Steel	26.0	56.35
Steel and Insulation Composite Panel on Steel (Ice Condenser)	0.15	2.75
Steel and Insulation Composite Panel on Concrete (Ice Condenser)	0.25	3.663

Note: Paint$_1$ = on steel   Paint$_2$ = on concrete

Table 2-3 Sequoyah Units 1 and 2 Energy Accounting

	Approx† End of Blowdown (t = 10.0 Seconds)	Approx†† End of Reflood (t = 228.39 Seconds)
	(In Millions of Btus)	
Ice Heat Removal	196.117	250.993
Structural Heat Sinks *	18.039	60.016
RHR Heat Exchanger Heat Removal *	0.00	0.00
Spray Heat Exchanger Heat Removal *	0.00	0.00
Energy Content of Sump	183.698	231.827
Ice Melted (Pounds)(10^6)	0.63315	0.85287

* Integrated Energies

†- End of Blowdown is redefined in LOTIC-1 to occur at 10 seconds, per results from the Waltz Mill Ice condenser test.

††- The approximate time is the time closest to the event that is captured in the LOTIC-1 code major print out. Table 2-5 provides the actual sequence of events.

Table 2-4 Sequoyah Units 1 and 2
Energy Accounting

	Approx† Time of Ice Melt (t = 3273.7 Seconds)	Approx† Time of Peak Pressure (t = 6651.46 Seconds)
	(In Millions of Btus)	
Ice Heat Removal	584.247	584.247
Structural Heat Sinks *	79.786	118.74
RHR Heat Exchanger Heat Removal *	15.757	44.786
Spray Heat Exchanger Heat Removal *	2.809	66.032
Energy Content of Sump	656.573	676.972
Ice Melted (Pounds)(10^6)	2.187250	2.187250

* Integrated Energies

†- The approximate time is the time closest to the event that is captured in the LOTIC-1 code major print out. Table 2-5 provides the actual sequence of events.

Table 2-5 Sequoyah Units 1 and 2 Double Ended Pump Suction LOCA Minimum Safeguards Sequence of Events

Event	Time (sec)
Rupture	0.00
Accumulator Flow Starts	14.4
End of Blowdown	32.60
Assumed Initiation of ECCS	29.76
Accumulators Empty	62.138
End of Reflood	228.388
Assumed Initiation of Spray System	250.0
Low Level Alarm from Refueling Water Storage Tank	1681.0
Start of ECCS Cold Leg Recirculation	1691
Low-Low Level Alarm from RWST - Sprays Stopped	2803.0
Spray Pumps Restart in Recirculation Mode	3113.0
Ice Bed Meltout	3273.7
RHR Spray Realignment	3600.0
Peak Containment Pressure	6651.46

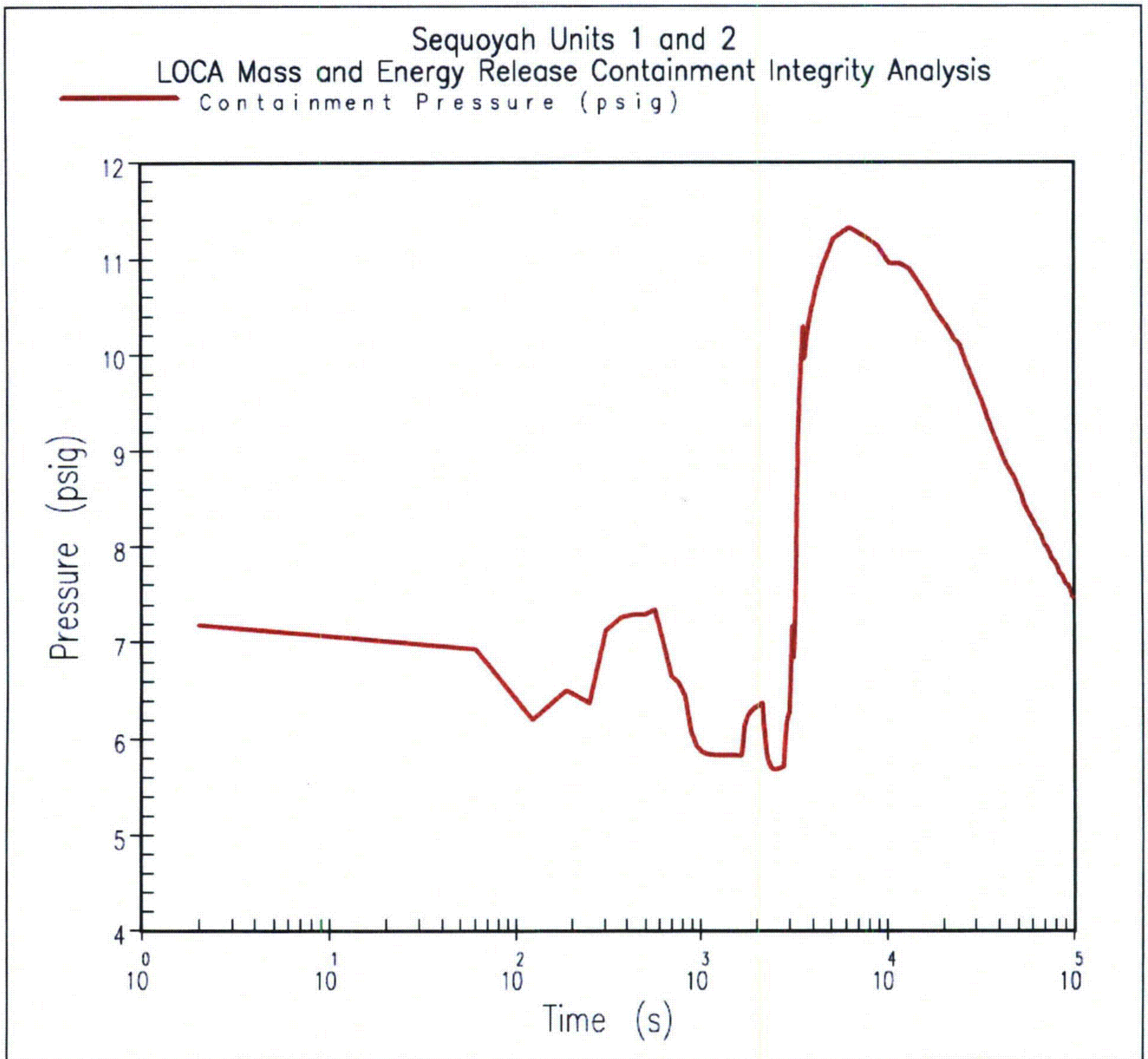

Sequoyah Units 1 and 2
LOCA Mass and Energy Release Containment Integrity Analysis
Containment Pressure (psig)
Pressure (psig)
12
11
10
9
8
7
6
5
4
10^0
10^1
10^2
10^3
10^4
10^5
Time (s)

Figure 2-1

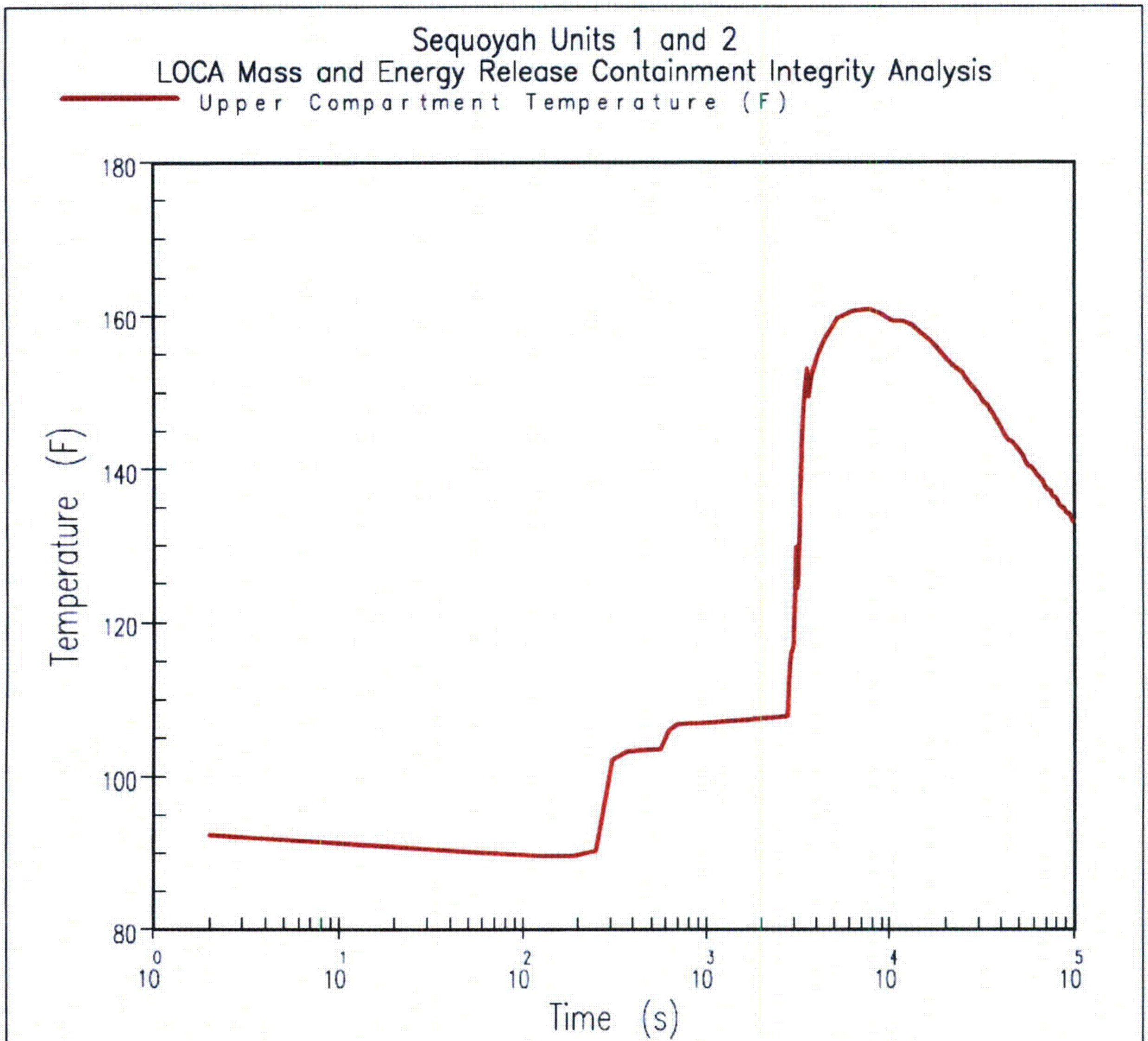

Sequoyah Units 1 and 2
LOCA Mass and Energy Release Containment Integrity Analysis
Upper Compartment Temperature (F)
Temperature (F)
180
160
140
120
100
80
10^0
10^1
10^2
10^3
10^4
10^5
Time (s)

Figure 2-2

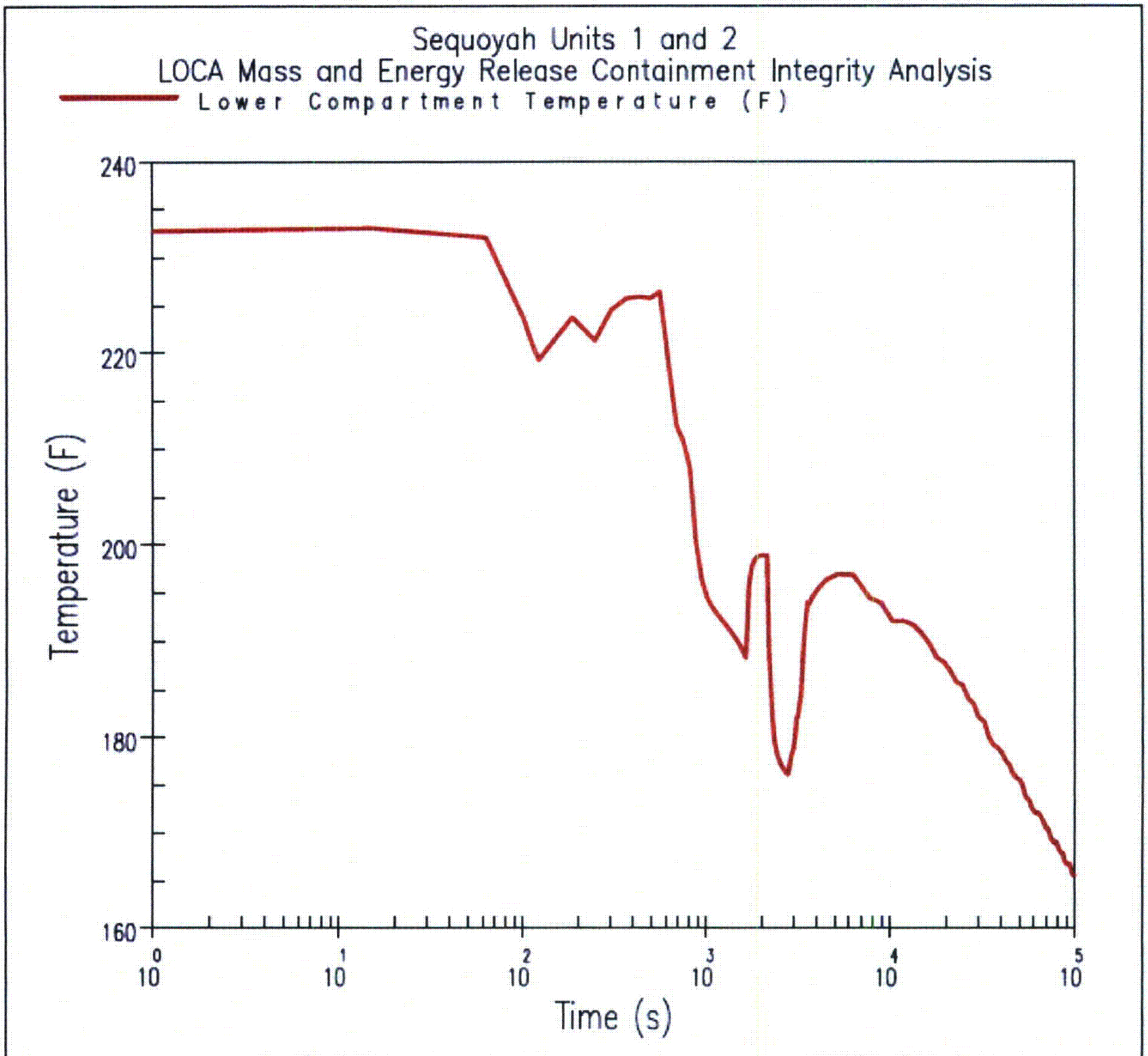

Sequoyah Units 1 and 2
LOCA Mass and Energy Release Containment Integrity Analysis
Lower Compartment Temperature (F)
240
220
200
180
160
Temperature (F)
10^0
10^1
10^2
10^3
10^4
10^5
Time (s)

Figure 2-3

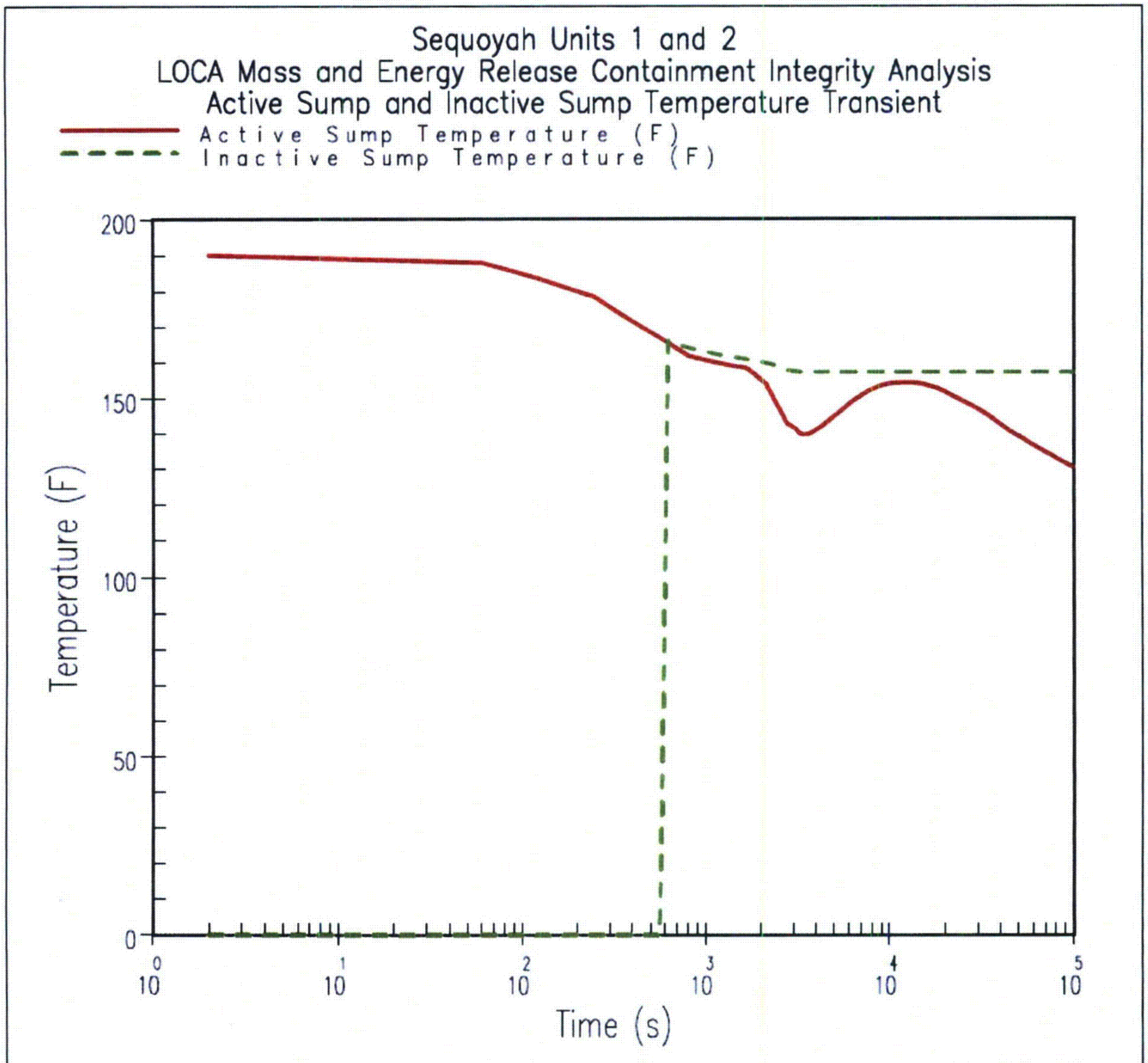

Sequoyah Units 1 and 2
LOCA Mass and Energy Release Containment Integrity Analysis
Active Sump and Inactive Sump Temperature Transient
Active Sump Temperature (F)
Inactive Sump Temperature (F)
Temperature (F)
200
150
100
50
0
Time (s)
10^0
10^1
10^2
10^3
10^4
10^5

Figure 2-4

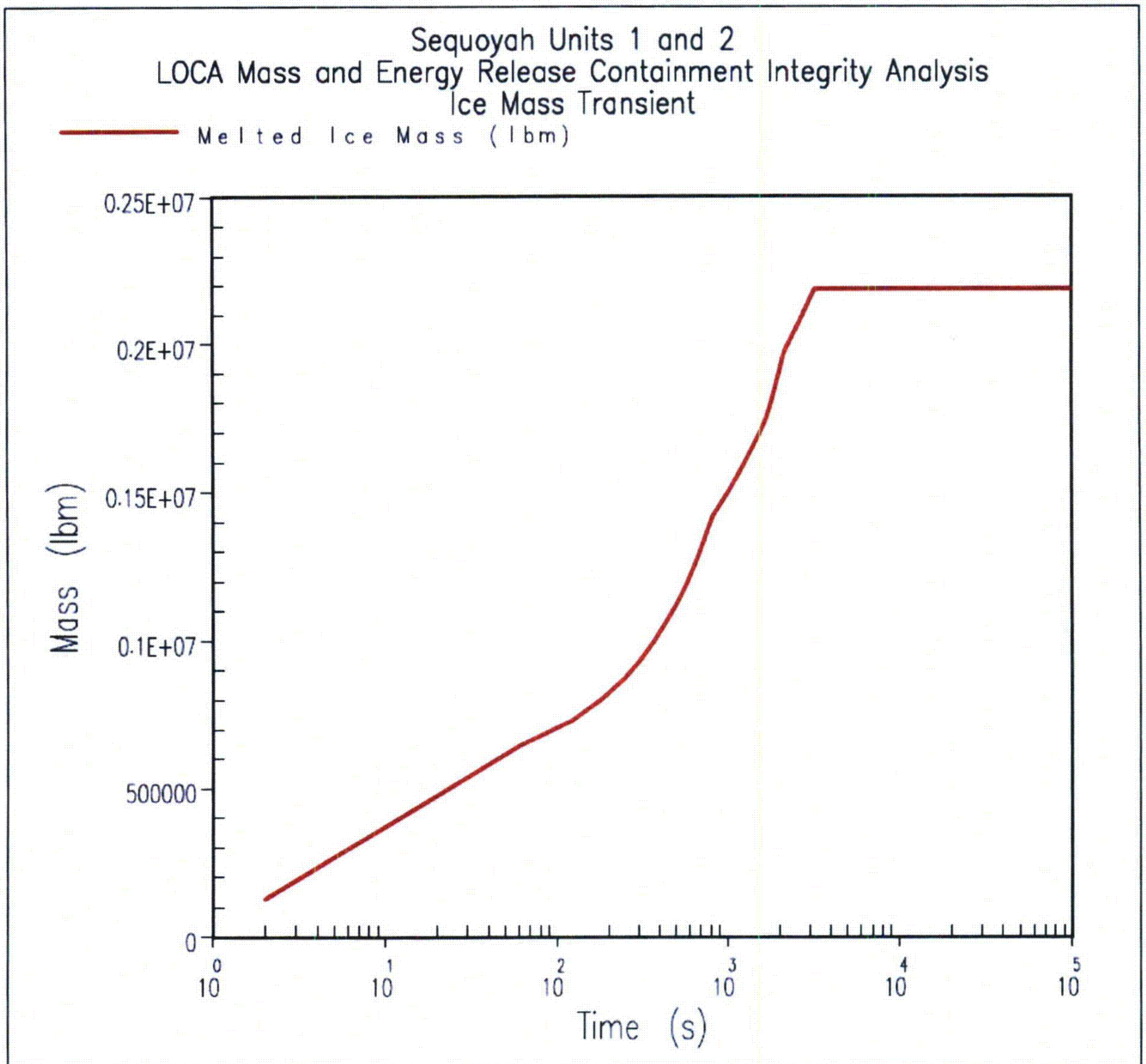

Sequoyah Units 1 and 2
LOCA Mass and Energy Release Containment Integrity Analysis
Ice Mass Transient
Melted Ice Mass (lbm)
0.25E+07
0.2E+07
0.15E+07
0.1E+07
500000
0
Mass (lbm)
10^0
10^1
10^2
10^3
10^4
10^5
Time (s)

Figure 2-5

APPENDIX A – LOCA Mass and Energy Release

Introduction

The evaluation model used for the long-term LOCA mass and energy release calculations is the March 1979 model described in Reference 1. This evaluation model has been reviewed and approved by the Nuclear Regulatory Commission (NRC) (References 1 and 2), and has been used in the analysis of other ice condenser plants.

This report section presents the long-term LOCA mass and energy releases that were generated in support of recent issues reported in NSAL-11-5 (Reference 11) and NSAL-06-6 (Reference 12). These mass and energy releases are then subsequently used in the LOTIC-1 computer code (Reference 3) for containment integrity analysis peak pressure calculations.

Purpose of Analysis

The purpose of the analysis was to calculate the long-term LOCA mass and energy releases and the subsequent containment integrity response in order to support recent changes to the Westinghouse computer code, EPITOME, i.e., NSAL-11-5 (Reference 11). In addition, for a comprehensive reconciliation of all issues relative to the LOCA mass and energy release analysis of record (AOR) all appropriate corrections relative to NSAL-06-6 (Reference 12) were also addressed. This effort will address current Sequoyah Units 1 and 2 specific plant conditions and revised models as a means of using available analytical margins and minimizing the effect on the amount of ice required in the ice condenser. The objective of performing the long-term LOCA mass and energy release and LOCA containment integrity analysis will be to minimize the effect on the initial ice mass, to maintain the current time interval (150 seconds, minimum) relationship between containment spray switchover time and ice bed meltout time, and to provide peak pressure margin to design pressure.

A key element in minimizing the impact on initial ice mass was reducing the energy available to containment in the event of a LOCA. Areas such as core stored energy, decay heat, and available steam generator metal heat were investigated and available margins were implemented into the analysis. These margins combined with a better segmental representation of the mass and energy release transient from the computer models resulted in margins that reduced energy input into containment.

The following are the analytical bases and the results, which show that the containment design pressure is not exceeded in the event of a LOCA. The conclusions presented will demonstrate, with respect to a LOCA, that containment integrity has not been compromised. Further, since the LOCA requires the greatest amount of ice compared to other accident scenarios, the initial ice mass based on LOCA results will be acceptable for the other accident scenarios.

Rupture of any of the piping carrying pressurized high temperature reactor coolant, termed a LOCA, will result in release of steam and water into the containment. This will lead to an increase in the containment pressure and temperature. The mass and energy release rates described in this document form the basis of further computations to evaluate the structural integrity of the containment following a postulated accident in order to satisfy the Nuclear Regulatory Commission (NRC) acceptance criterion, General Design Criterion 38. Subsection

1.4 presents the long-term LOCA mass and energy release analysis for containment pressurization evaluations. Section 2 presents the LOCA containment pressure calculations.

System Characteristics and Modeling Assumptions

The mass and energy release analysis is sensitive to the assumed characteristics of various plant systems, in addition to other key modeling assumptions. Some of the most critical items are Reactor Coolant System (RCS) initial conditions, core decay heat, safety injection flow, and metal and steam generator heat release modeling. Specific assumptions concerning each of these items are discussed below. Tables 1-1 through 1-3 present key data assumed in the analysis. The data provided in References 2 and 3 was used, in part, to develop the plant data presented in Tables 1-1 through 1-3.

For the long-term mass and energy release calculations, operating temperatures to bound the highest average coolant temperature range were used. The core rated power of 3,455 MWt adjusted for calorimetric error (+0.7 percent of power) was modeled in the analysis. The use of higher temperatures is conservative because the initial fluid energy is based on coolant temperatures, which are at the maximum levels attained in steady-state operation. Additionally, an allowance of +5.5°F is reflected in the vessel/core temperature in order to account for instrument error and deadband. The initial RCS pressure in this analysis is based on a nominal value of 2,250 psia. Also included is an allowance of +50 psi, which accounts for the measurement uncertainty on pressurizer pressure. The selection of 2,300 psia as the limiting pressure is considered to affect the blowdown phase results only, since this represents the initial pressure of the RCS. The RCS rapidly depressurizes from this value until the point at which it equilibrates with containment pressure.

The rate at which the RCS depressurizes is initially more severe at the higher RCS pressure. Additionally, the RCS has a higher fluid density at the higher pressure (assuming a constant temperature) and subsequently has a higher RCS mass available for releases. Therefore, 2,300 psia initial pressure was selected as the limiting case for the long-term LOCA mass and energy release calculations. These assumptions conservatively maximize the mass and energy in the RCS.

The selection of the fuel design features for the long-term LOCA mass and energy calculation is consistent with the analysis of record (Reference 10), based on the need to conservatively maximize the core stored energy. The margin in core stored energy was chosen to be +15 percent. Thus, the analysis fuel conditions were adjusted to provide a bounding analysis for Westinghouse Standard 17X17 and V5H fuel for Sequoyah Units 1and 2. The following items serve as the basis to ensure conservatism in the core stored energy calculation:

- A conservatively high reload core loading
- Time of maximum fuel densification, that is, highest beginning-of-life (BOL) temperatures
- Irradiated fuel assemblies assumed to have an average burnup >15,000 MWD/MTU

Regarding safety injection flow, the mass and energy calculation considered the historically limiting configuration of minimum safety injection flow.

The following summarized assumptions were employed to ensure that the mass and energy releases were conservatively calculated, thereby maximizing energy release to containment:

1. Maximum expected operating temperature of the reactor coolant system (RCS) (100-percent full-power conditions)

2. An allowance in temperature for instrument error and deadband assumed on the vessel/core inlet temperature (+5.5°F)

3. Margin in volume of 3 percent (which is composed of a 1.6-percent allowance for thermal expansion, and a 1.4-percent allowance for uncertainty)

4. Core rated power of 3,455 MWt

5. Allowance for calorimetric error (+0.7 percent of power)

6. Conservative coefficient of heat transfer (that is, steam generator primary/secondary heat transfer and RCS metal heat transfer)

7. Core-stored energy based on the time in life for maximum fuel densification. The assumptions used to calculate the fuel temperatures for the core-stored energy calculation account for appropriate uncertainties associated with the models in the PAD code (such as calibration of the thermal model, pellet densification model, or cladding creep model). In addition, the fuel temperatures for the core-stored energy calculation account for appropriate uncertainties associated with manufacturing tolerances (such as pellet as-built density). The total uncertainty for the fuel temperature calculation is a statistical combination of these effects and is dependent upon fuel type, power level, and burnup.

8. An allowance for RCS initial pressure uncertainty (+50 psi)

9. A maximum containment backpressure equal to design pressure

10. The steam generator metal mass was modeled to include all portions of the steam generators that are in contact with the fluid on the secondary side. In active portions of the steam generators such as the elliptical head, upper shell, and miscellaneous internals (poor heat transfer due to location) were conservatively assumed available for release to containment.

11. A provision for modeling steam flow in the secondary side through the steam generator turbine stop valve was conservatively addressed only at the start of the event. A turbine stop valve isolation time equal to 1.19 seconds was used.

12. As noted in Section 2.4 of Reference 4, the option to provide more specific modeling pertaining to decay heat has been exercised to specifically reflect the Sequoyah Nuclear

Plant Units 1 and 2 core heat generation, while retaining the two sigma uncertainty to assure conservatism (see Table 1-2).

13. Steam generator tube plugging leveling (0-percent uniform)

    a. Maximizes reactor coolant volume and fluid release

    b. Maximizes heat transfer area across the steam generators tubes

    c. Reduces coolant loop resistance, which reduces the Δp upstream of the break and increases break flow

Therefore, based on the previously noted conditions and assumptions, a bounding analysis of the Sequoyah Nuclear Plant Units 1 and 2 (assuming Model 51 steam generators) was performed for the release of mass and energy from the RCS in the event of a LOCA.

LOCA Mass and Energy Release Phases

The containment system receives mass and energy releases following a postulated rupture in the RCS. These releases continue over a time period, which is typically divided into four phases:

1. Blowdown – the period of time from accident initiation (when the reactor is at steady-state operation) to the time that the RCS and containment reach an equilibrium state at containment design pressure.

2. Refill – the period of time when the reactor vessel lower plenum is being filled by accumulator and Emergency Core Cooling System (ECCS) water. At the end of blowdown, a large amount of water remains in the cold legs, downcomer, and lower plenum. To conservatively consider the refill period for the purpose of containment mass and energy releases, it is assumed that this water is instantaneously transferred to the lower plenum along with sufficient accumulator water to completely fill the lower plenum. This allows an uninterrupted release of mass and energy to containment. Therefore, the refill period is conservatively neglected in the mass and energy release calculation.

3. Reflood – begins when the water from the reactor vessel lower plenum enters the core and ends when the core is completely quenched.

4. Post-reflood (froth) – describes the period following the reflood transient. For the pump suction break, a two-phase mixture exits the core, passes through the hot legs, and is superheated in the steam generators prior to release to containment. After the broken loop steam generator cools, the break flow becomes two-phase.

Computer Codes

The Reference 1 mass and energy release evaluation model is comprised of mass and energy release versions of the following codes: SATAN-VI, WREFLOOD, FROTH, and EPITOME. These codes were used to calculate the long-term LOCA mass and energy releases for

Sequoyah Units 1 and 2.

The SATAN-VI code calculates blowdown (the first portion of the thermal-hydraulic transient following break initiation), including pressure, enthalpy, density, mass, energy flow rates, and energy transfer between primary and secondary systems as a function of time.

The WREFLOOD code addresses the portion of the LOCA transient where the core reflooding phase occurs after the RCS has depressurized (blowdown) due to the loss of water through the break and when water supplied by the ECCS refills the reactor vessel and provides cooling to the core. The most important feature is the steam/water mixing model (see subsection Reflood Mass and Energy Release Data).

The FROTH code models the post-reflood portion of the transient. The FROTH code is used for the steam generator heat addition calculation from the broken and intact loop steam generators.

The EPITOME code continues the FROTH post-reflood portion of the transient from the time at which the secondary side equilibrates to containment design pressure to the end of the transient. It also compiles a summary of data on the entire transient, including formal instantaneous mass and energy release tables and mass and energy balance tables with data at critical times.

Break Size and Location

Generic studies (Reference 1, Section 3.3) have been performed with respect to the effect of postulated break size on the LOCA mass and energy releases. The double-ended guillotine break has been found to be limiting due to larger mass flow rates during the blowdown phase of the transient. During the reflood and froth phases, the break size has little effect on the releases.

Three distinct locations in the RCS loop can be postulated for pipe rupture:

1. Hot leg (between vessel and steam generator)
2. Cold leg (between pump and vessel)
3. Pump suction (between steam generator and pump)

The limiting break location analyzed for the EPITOME reanalysis is the double-ended pump suction guillotine (DEPSG) (10.46 ft^2). Break mass and energy releases have been calculated for the blowdown, reflood, and post-reflood phases of the LOCA for each case analyzed. The following paragraphs provide a discussion on each break location.

The hot leg double-ended guillotine has been shown in previous studies (Reference 1, Section 3.3) to result in the highest blowdown mass and energy release rates. Although the core flooding rate would be the highest for this break location, the amount of energy released from the steam generator secondary is minimal because the majority of the fluid that exits the core bypasses the steam generators, venting directly to containment. As a result, the reflood mass and energy releases are reduced significantly as compared to either the pump suction or cold leg break locations, where the core exit mixture must pass through the steam generators before venting through the break. For the hot leg break, generic studies have confirmed that there is no reflood peak (that is, from the end of the blowdown period the containment pressure would continually decrease). The mass and energy releases for the hot leg break have not been included in the scope of this containment integrity analysis because, for the hot leg break, only the blowdown phase of the transient is of any significance. Since there are no reflood or post-reflood phases to consider, the limiting peak pressure calculated would be the compression peak pressure and not the peak pressure following ice bed meltout.

The cold leg break location has been found in previous studies (Reference 1, Section 3.3) to be much less limiting in terms of the overall containment energy releases. The cold leg blowdown is faster than that of the pump suction break, and more mass is released into the containment. However, the core heat transfer is greatly reduced, and this results in a considerably lower energy release into containment. Studies have determined that the blowdown transient for the cold leg is less limiting than that for the pump suction break. During cold leg reflood, the flooding rate is greatly reduced and the energy release rate into the containment is reduced. Therefore, the cold leg break is not included in the scope of this program.

The pump suction break combines the effects of the relatively high core flooding rate, as in the hot leg break, and the addition of the stored energy in the steam generators. As a result, the pump suction break yields the highest energy flow rates during the post-blowdown period by including all of the available energy of the RCS in calculating the releases to containment. This break has been determined to be the limiting break for the Westinghouse-design ice condenser plants.

In summary, the analysis of the limiting break location for an ice condenser containment has been performed and is shown in this report. The DEPSG break has historically been considered to be the limiting break location, by virtue of its consideration of all energy sources in the RCS. This break location provides a mechanism for the release of the available energy in the RCS, including both the broken and intact loop steam generators.

Application of Single-Failure Criteria

An analysis of the effects of the single-failure criteria has been performed on the mass and energy release rates for the DEPSG break. An inherent assumption in the generation of the mass and energy release is that offsite power is lost. This results in the actuation of the emergency diesel generators, required to power the Safety Injection System. This is not an issue for the blowdown period, which is limited by the compression peak pressure.

The limiting minimum safety injection case has been analyzed for the effects of a single-failure. In the case of minimum safeguards, the single failure postulated to occur is the loss of an emergency diesel generator. This results in the loss of one pumped safety injection train, that is, ECCS pumps and heat exchangers.

Mass and Energy Release Data

Blowdown Mass and Energy Release Data

The February 1978 version of the SATAN-VI code is used for computing the blowdown transient (Reference 4). This version of SATAN-VI is licensed with the Reference 1 model and has been used for previous Sequoyah Nuclear Plant Units 1 and 2 LOCA mass and energy release calculations.

The SATAN-VI code utilizes the control volume (element) approach with the capability for modeling a large variety of thermal fluid system configurations. The fluid properties are considered uniform and thermodynamic equilibrium is assumed in each element. A point kinetics model is used with weighted feedback effects.

The major feedback effects include moderator density, moderator temperature, and Doppler broadening. A critical flow calculation for subcooled (modified Zaloudek), two-phase (Moody), or superheated break flow is incorporated into the analysis. The methodology for the use of this model is described in Reference 1.

Table A-1 presents the calculated LOCA mass and energy releases for the blowdown phase of the DEPSG break. For the pump suction breaks, break path 1 in the mass and energy release tables refers to the mass and energy exiting from the steam generator side of the break; break path 2 refers to the mass and energy exiting from the pump side of the break.

Reflood Mass and Energy Release Data

The WREFLOOD code used for computing the reflood transient is a modified version of that used in the 1981 ECCS evaluation model, Reference 4.

The WREFLOOD code consists of two basic hydraulic models – one for the contents of the reactor vessel and one for the coolant loops. The two models are coupled through the interchange of the boundary conditions applied at the vessel outlet nozzles and at the top of the downcomer. Additional transient phenomena, such as pumped safety injection and accumulators, reactor coolant pump performance, and steam generator release are included as auxiliary equations that interact with the basic models as required. The WREFLOOD code permits the capability to calculate variations (during the core reflooding transient) of basic parameters such as core flooding rate, core and downcomer water levels, fluid thermodynamic conditions (pressure, enthalpy, density) throughout the primary system, and mass flow rates through the primary system. The code permits hydraulic modeling of the two flow paths available for discharging steam and entrained water from the core to the break; that is, the path through the broken loop and the path through the unbroken loops.

A complete thermal equilibrium mixing condition for the steam and emergency core cooling injection water during the reflood phase has been assumed for each loop receiving ECCS water. This is consistent with the usage and application of the Reference 1 mass and energy release evaluation model. Even though the Reference 1 model credits steam/mixing only in the intact loop and not in the broken loop, justification, applicability, and NRC approval for using the mixing model in the broken loop has been documented (Reference 5). This assumption is justified and supported by test data, and is summarized as follows.

The model assumes a complete mixing condition (thermal equilibrium) for the steam/water interaction. The complete mixing process is made up of two distinct physical processes. The first is a two-phase interaction with condensation of steam by cold ECCS water. The second is a single-phase mixing of condensate and ECCS water. Since the steam release is the most important influence to the containment pressure transient, the steam condensation part of the mixing process is the only part that need be considered. (Any spillage directly heats only the sump.)

The most applicable steam/water mixing test data has been reviewed for validation of the containment integrity reflood steam/water mixing model. This data is generated in 1/3 scale tests (Reference 6), which are the largest scale data available and thus most clearly simulate the flow regimes and gravitational effects that would occur in a pressurized water reactor (PWR). These tests were designed specifically to study the steam/water interaction for PWR reflood conditions.

From the entire series of 1/3 scale tests, one group corresponds almost directly to containment integrity reflood conditions. The injection flow rates from this group cover all phases and mixing conditions calculated during the reflood transient. The data from these tests were reviewed and discussed in detail in Reference 1. For all of these tests, the data clearly indicate the occurrence of very effective mixing with rapid steam condensation. The mixing model used in the containment integrity reflood calculation is therefore wholly supported by the 1/3 scale steam/water mixing data.

Additionally, the following justification is also noted. The post-blowdown limiting break for the containment integrity peak pressure analysis is the DEPSG break. For this break, there are two flow paths available in the RCS by which mass and energy may be released to containment. One is through the outlet of the steam generator, the other is via reverse flow through the reactor coolant pump. Steam that is not condensed by ECCS injection in the intact RCS loops passes around the downcomer and through the broken loop cold leg and pump in venting to containment. This steam also encounters ECCS injection water as it passes through the broken loop cold leg, complete mixing occurs, and a portion of it is condensed. It is this portion of steam, which is condensed, for which this analysis takes credit. This assumption is justified based upon the postulated break location and the actual physical presence of the ECCS injection nozzle. A description of the test and test results is contained in References 1 and 6.

Table A-2 presents the calculated mass and energy release for the reflood phase of the pump suction double ended rupture with minimum safety injection.

The transients of the principal parameters during reflood are given in Table A-5.

Post-Reflood Mass and Energy Release Data

The FROTH code (Reference 7) is used for computing the post-reflood transient.

The FROTH code calculates the heat release rates resulting from a two-phase mixture level present in the steam generator tubes. The mass and energy releases that occur during this phase are typically superheated due to the depressurization and equilibration of the broken loop and intact loop steam generators. During this phase of the transient, the RCS has equilibrated with the containment pressure, but the steam generators contain a secondary inventory at an enthalpy that is much higher than the primary side. Therefore, a significant amount of reverse heat transfer occurs. Steam is produced in the core due to core decay heat. For a pump suction break, a two-phase fluid exits the core, flows through the hot legs, and becomes superheated as it passes through the steam generator. Once the broken loop cools, the break flow becomes two-phase. The methodology for the use of this model is described in Reference 1.

After steam generator depressurization/equilibration, the mass and energy release available to containment is generated directly from core boiloff/decay heat.

Table A-3 presents the two-phase post-reflood (froth) mass and energy release data for the pump suction double-ended break case.

Decay Heat Model

The American Nuclear Society (ANS) Standard 5.1 (Reference 8) was used in the LOCA mass and energy release model for the determination of decay heat energy. This standard was validated by the Nuclear Power Plant Standards committee (NUPPSCO) in October 1978 and subsequently approved. The official standard (Reference 8) was issued in August 1979.

Significant assumptions in the generation of the decay heat curve are the following:

1. Decay heat sources considered are fission product decay and heavy element decay of U-239 and Np-239.
2. Decay heat power from the following fissioning isotopes are included: U-238 (Reference 1), U-235. and Pu-239 (fissioning isotopes) are included.
3. Fission rate is constant over the operating history of maximum power level.
4. The factor accounting for neutron capture in fission products has been taken from Equation 11, of Reference 8 (up to 10,000 seconds) and Table 10 of Reference 8 (beyond 10,000 seconds).
5. The fuel has been assumed to be at full power for 1,096 days.
6. The number of atoms of U-239 produced per second has been assumed to be equal to 70 percent of the fission rate.
7. The total recoverable energy associated with one fission has been assumed to be 200 MeV/fission.
8. Two sigma uncertainty (two times the standard deviation) has been applied to the fission product decay.

Steam Generator Equilibration and Depressurization

Steam generator equilibration and depressurization is the process by which secondary-side energy is removed from the steam generators in stages. The FROTH computer code calculates the heat removal from the secondary mass until the secondary temperature is saturated at the containment design pressure. After the FROTH calculations, steam generator secondary energy is removed until the steam generator reaches T_{sat} at the user-specified intermediate equilibration pressure, when the secondary pressure is assumed to reach the actual containment pressure. The heat removal of the broken loop steam generator and intact loop steam generators are calculated separately.

During the FROTH calculations, steam generator heat removal rates are calculated using the secondary-side temperature, primary-side temperature, and a secondary-side heat transfer coefficient determined using a modified McAdam's correlation (Reference 9). Steam generator energy is removed during the FROTH transient until the secondary-side temperature reaches saturation temperature at the containment design pressure. The constant heat removal rate used is based on the final heat removal rate calculated by FROTH. The remaining steam generator energy available to be released is determined by calculating the difference in secondary energy available at the containment design pressure and that at the (lower) user-specified equilibration pressure, assuming saturated conditions. This energy is then divided by the energy removal rate, resulting in an equilibration time. The steam generator energy equilibrium model in the FROTH computer code as described above has been reviewed and approved by the NRC in References 1 and 3.

Sources of Mass and Energy

The sources of mass considered in the LOCA mass and energy release analysis are given in Table A-4a.

These sources are the RCS, accumulators, and pumped safety injection. The energy inventories considered in the LOCA mass and energy release analysis are given in Table A-4b. The energy sources include:

- RCS water
- Accumulator water
- Pumped injection water
- Decay heat
- Core-stored energy
- RCS metal – primary metal (includes steam generator tubes)
- Steam generator metal (includes transition cone, shell, wrapper, and other internals)
- Steam generator secondary energy (includes fluid mass and steam mass)
- Secondary transfer of energy (feedwater into and steam out of the steam generator secondary)

The mass and energy inventories are presented at the following times, as appropriate:

- Time zero (initial conditions)
- End of blowdown time
- End of refill time
- End of reflood time
- Time of broken loop steam generator equilibration to pressure setpoint
- Time of intact loop steam generator equilibration to pressure setpoint

The sequence of events for the DEPSG case is shown in Table 2-5.

The energy release from the Zirc-water reaction is considered as part of the Reference 1 methodology. Based on the way that the energy in the fuel is conservatively released to the vessel fluid, the fuel cladding temperature does not increase to the point were the Zirc-water reaction is significant. This is in contrast to the Code of Federal Regulations (CFR) 10 CFR 50.46 analyses, which are biased to calculate high fuel rod cladding temperatures and therefore a non-significant Zirc-water reaction. For the LOCA mass and energy calculation, the energy created by the Zirc-water reaction value is small and is not explicitly provided in the energy balance tables. The energy that is determined is part of the mass and energy releases and, therefore, is already included in the LOCA mass and energy release.

The consideration of the various energy sources in the mass and energy release analysis provides assurance that all available sources of energy have been included in this analysis. Therefore, the review guidelines presented in Standard Review Plan (SRP) Section 6.2.1.3 have been satisfied.

References

1. WCAP-10325-P-A, May 1983 (Proprietary) and WCAP-10326-A (Non-Proprietary), "Westinghouse LOCA Mass and Energy Release Model for Containment Design March 1979 Version."
2. Letter from Herbert N. Berkow (NRC) to James A. Gresham (Westinghouse), Subject – Acceptance of Clarifications of Topical Report WCAP-10325-P-A, "Westinghouse LOCA Mass and Energy Release Model for Containment Design – March 1979 Version" (TAC No. MC7980), October 18, 2005.
3. WCAP-8354-P-A, April 1976 (Proprietary) and WCAP-8355-A (Non-Proprietary), "LONG TERM ICE CONDENSER CONTAINMENT CODE – LOTIC CODE."
4. WCAP-9220-P-A, February 1978 (Proprietary) and WCAP-9221-A (Non-Proprietary), "Westinghouse ECCS Evaluation Model February 1978 Version."
5. Docket No. 50-315, "Amendment No. 126, Facility Operating License No. DPR-58 (TAC No. 71062), for D.C. Cook Nuclear Plant Unit 1," June 9, 1989.
6. EPRI 294-2, "Mixing of Emergency Core Cooling Water with Steam; 1/3-Scale Test and Summary," (WCAP-8423), Final Report, June 1975.
7. WCAP-8264-P-A, Revision 1, August 1975 (Proprietary) and WCAP-8312-A, Revision 2 (Non-Proprietary) "TOPICAL REPORT WESTINGHOUSE MASS AND ENERGY RELEASE DATA FOR CONTAINMENT DESIGN."
8. ANSI/ANS-5.1-1979, "American National Standard for Decay Heat Power in Light Water Reactors," August 1979.
9. W. H. McAdam, "Heat Transmission," McGraw-Hill 3rd edition, 1954, p.172.
10. WCAP-12455, Revision 1, Supplement 1R, "Tennessee Valley Authority Sequoyah Nuclear Plant Units 1 and 2 Containment Integrity Reanalysis Engineering Report," September 2001.
11. NSAL-11-5, "Westinghouse LOCA Mass and Energy Release Calculation Issues," July 26, 2011.
12. NSAL-06-6, "LOCA Mass and Energy Release Analysis," June 6, 2006.

Table 1-1 System Parameters Initial Conditions

Parameters	Value
Core Thermal Power (MWt)	3,455
Reactor Coolant System Flow Rate, per Loop (gpm)	91,400
Vessel Outlet Temperature[1] (°F)	609.7
Core Inlet Temperature[1] (°F)	546.7
Vessel Average Temperature[1] (°F)	578.2
Initial Steam Generator Steam Pressure (psia)	870
Steam Generator Design	Model 51
Steam Generator Tube Plugging (%)	0
Initial Steam Generator Secondary-Side Mass (lbm)	114075
Accumulator	
Water Volume (ft^3)	1,017.977/tank plus 21.7 (average) per line
N2 Cover Gas Pressure (psig)	662
Temperature (°F)	130
Safety Injection Delay (sec) (includes time to reach pressure setpoint)	27.76
Auxiliary Feedwater Flow (gpm/steam generator)	220

Note:

1. Analysis value includes an additional +5.5°F allowance for instrument error and dead band.

Table 1-2 System Parameters Decay Heat Curve	
Time (sec)	**Decay Heat (Btu/Btu)**
10.	0.050708
14.	0.048246
20.	0.045658
40.	0.04071
60.	0.037863
80.	0.03588
100.	0.034382
140.	0.032242
200.	0.030132
400.	0.02643
600.	0.024288
800.	0.022747
1000.	0.021503
1600.	0.01885
2000.	0.017588
4000.	0.014057
6000.	0.012379
8000.	0.011403
10000.	0.010732
16000.	0.0098865
20000.	0.0093675
40000.	0.0079143
60000.	0.00714
80000.	0.0066015
100000.	0.006203
140000.	0.0056076
200000.	0.0049979
400000.	0.0038661
600000.	0.0032651
800000.	0.0028811
1000000.	0.0026162
1400000.	0.0022614
2000000.	0.0019338
4000000.	0.0013904
6000000.	0.0011374
8000000.	0.00098265
10000000.	0.00087175
Key Assumptions: -18 month fuel cycle -Standard and V5H fuel -End of Cycle Core Average Burnup of 52,687 Mwd/MTU -Low bound for enrichment: 3.0%	

Table 1-3	**Safety Injection Flow Minimum Safety Injection**
Injection Mode	
RCS Pressure (psig)	**Total Flow (gpm)**
0	4,957.1
12	4,810.0
20	4,711.9
40	4,445.9
60	4,132.9
80	3,771.2
100	3,364.8
120	2,933.3
140	2,413.7
160	1,697.9
180	966.3
200	959.6
Injection Mode (Post-Reflood Phase)	
RCS Pressure (psia)	**Total Flow (gpm)**
12	4,810.0
Recirculation Mode (w/o Residual Heat Removal (RHR) Spray)	
RCS Pressure (psia)	**Total Flow (gpm)**
0	3,299
Recirculation Mode (w/ RHR Spray)	
RCS Pressure (psia)	**Total Flow (gpm)**
0	1,060

Table A-1
Blowdown Mass and Energy Releases – Double Ended Pump Suction Guillotine Break
Minimum Safeguards

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
0.00	0.00	0.00	0.00	0.00
0.001	93249.42	50938.13	40054.44	21818.81
0.002	41152.75	22417.50	40842.54	22246.94
0.003	41141.70	22412.23	40592.11	22109.43
0.004	41134.13	22408.72	40320.20	21960.02
0.10	40891.81	22339.72	21377.56	11637.80
0.20	41705.34	22924.22	23139.12	12603.89
0.30	45544.16	25240.80	23234.93	12664.09
0.40	45989.63	25738.36	22734.99	12402.57
0.50	44830.42	25362.08	21889.73	11949.34
0.60	44474.57	25427.63	21111.59	11530.27
0.70	44544.55	25714.86	20407.38	11148.84
0.80	44011.13	25627.73	19834.30	10837.90
0.90	43015.55	25249.53	19449.22	10630.41
1.00	41990.20	24845.02	19222.29	10509.09
1.10	41056.61	24496.30	19077.42	10432.05
1.20	40117.14	24156.02	18977.71	10378.64
1.30	39068.37	23759.87	18909.65	10341.87
1.40	37890.70	23284.76	18887.22	10329.96
1.50	36683.83	22775.97	18896.56	10335.50
1.60	35566.85	22299.66	18896.27	10335.55
1.70	34509.38	21844.42	18874.33	10323.54
1.80	33448.61	21374.70	18846.85	10308.47
1.90	32372.45	20888.14	18830.52	10299.78
2.00	31236.44	20353.30	18814.04	10291.20
2.10	30133.32	19826.74	18766.48	10265.47
2.20	28992.67	19256.49	18698.96	10228.77
2.30	27861.59	18675.09	18524.81	10132.98
2.40	26296.69	17776.07	18156.14	9931.47
2.50	23203.75	15788.55	17962.04	9826.48
2.60	21046.33	14439.97	17763.83	9718.76
2.70	20879.45	14461.42	17546.81	9600.61
2.80	20259.13	14089.86	17315.77	9474.92
2.90	19472.10	13586.70	17087.23	9350.82
3.00	18927.23	13253.66	16845.67	9219.61
3.10	18354.97	12890.29	16610.29	9091.92
3.20	17697.56	12458.21	16387.44	8971.18
3.30	17074.66	12045.71	16182.45	8860.37

Table A-1
Blowdown Mass and Energy Releases – Double Ended Pump Suction Guillotine Break Minimum Safeguards (Continued)

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
3.40	16485.00	11650.29	15996.05	8759.87
3.50	15917.33	11265.78	15810.52	8659.77
3.60	15371.61	10895.25	15629.12	8561.89
3.70	14882.03	10564.19	15470.89	8476.80
3.80	14475.38	10289.23	15324.45	8398.16
3.90	14118.87	10045.69	15177.32	8318.96
4.00	13793.01	9820.55	15034.40	8242.04
4.20	13273.32	9456.20	14791.62	8111.84
4.40	12866.23	9159.16	14555.23	7984.70
4.60	12541.02	8912.55	14340.57	7869.53
4.80	12293.69	8711.24	14062.03	7718.76
5.00	12094.72	8538.99	13666.34	7503.71
5.20	11951.21	8400.36	15167.29	8337.35
5.40	11824.04	8268.64	15424.36	8476.14
5.60	11689.57	8129.57	15056.48	8275.32
5.80	11661.91	8060.04	14860.29	8169.71
6.00	11786.90	8079.69	14778.43	8126.62
6.20	11998.57	8154.86	14620.43	8042.36
6.40	12902.49	8708.97	14459.57	7956.75
6.60	12849.16	8634.05	14479.96	7971.44
6.80	11855.54	8374.10	14272.42	7858.62
7.00	10177.67	7767.17	14089.06	7759.11
7.20	9600.23	7482.42	13992.38	7707.05
7.40	9786.14	7500.83	13866.82	7638.13
7.60	10202.59	7634.50	13709.16	7550.61
7.80	10744.80	7845.00	13559.85	7467.29
8.00	11409.86	8126.22	13417.08	7387.52
8.20	12199.16	8484.19	13251.89	7295.18
8.40	13098.18	8918.05	13078.15	7198.25
8.60	14098.08	9423.62	12910.84	7105.15
8.80	15003.46	9878.24	12739.81	7010.01
9.00	15673.43	10205.84	12567.44	6914.18
9.20	16130.44	10423.72	12393.80	6817.57
9.40	16418.41	10552.48	12215.26	6718.25
9.60	16557.48	10599.89	12035.97	6618.50
9.80	16613.10	10606.62	11855.46	6518.08
10.00	16607.96	10581.91	11671.15	6415.51
10.20	16550.66	10527.93	11486.24	6312.61

Table A-1
Blowdown Mass and Energy Releases – Double Ended Pump Suction Guillotine Break Minimum Safeguards (Continued)

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
10.40	16327.70	10371.18	11300.84	6209.38
10.60	15845.23	10056.44	11122.79	6110.21
10.80	15347.17	9738.98	10948.38	6012.95
11.00	14109.76	8946.62	10774.34	5916.00
11.20	11332.26	7206.91	10733.55	5893.02
11.40	9330.42	6046.85	10887.84	5977.42
11.60	9576.45	6299.34	10447.73	5730.74
11.80	9721.87	6354.70	10435.43	5727.21
12.00	8681.77	5723.38	10669.23	5858.06
12.20	8526.37	5761.00	10232.07	5611.50
12.40	8091.39	5612.17	10296.88	5650.40
12.60	7794.29	5485.53	10155.80	5570.46
12.80	7641.84	5394.78	10058.09	5514.31
13.00	7526.40	5312.20	9934.15	5444.71
13.20	7405.18	5227.10	9892.79	5420.69
13.40	7271.44	5143.98	9739.05	5334.00
13.60	7141.77	5070.52	9698.44	5311.69
13.80	7003.75	4994.93	9563.10	5235.76
14.00	6860.24	4917.83	9465.51	5181.92
14.20	6699.99	4823.53	9322.39	5102.02
14.40	6546.15	4722.07	9220.82	5045.07
14.60	6414.69	4616.30	9085.35	4968.62
14.80	6309.06	4515.13	9014.74	4914.45
15.00	6228.67	4428.35	8926.65	4830.14
15.20	6160.70	4350.95	8969.18	4800.23
15.40	6092.55	4277.23	8936.39	4723.15
15.60	6024.64	4211.66	9045.15	4722.79
15.80	5947.94	4148.60	8992.02	4648.43
16.00	5863.68	4088.21	9073.77	4655.58
16.20	5776.15	4031.69	8966.84	4573.25
16.40	5685.80	3977.58	8881.04	4506.25
16.60	5607.40	3934.65	8906.77	4499.14
16.80	5529.88	3898.66	8475.47	4268.78
17.00	5490.97	3916.48	8953.15	4502.40
17.20	5374.99	3927.45	7785.34	3907.74
17.40	5200.64	3927.38	9453.15	4730.87
17.60	4976.52	3910.32	7268.96	3642.84
17.80	4773.18	3903.97	9404.24	4618.29

Table A-1
Blowdown Mass and Energy Releases – Double Ended Pump Suction Guillotine Break
Minimum Safeguards (Continued)

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
18.00	4480.60	3831.55	12664.71	6319.95
18.20	4163.33	3747.79	9629.69	4889.21
18.40	4117.50	3886.96	5599.13	2817.08
18.60	3794.77	3793.33	10445.61	4966.77
18.80	3436.53	3652.49	9754.74	4748.39
19.00	3350.20	3716.24	4335.74	2109.93
19.20	3007.86	3506.07	10705.91	4724.58
19.40	2674.15	3251.59	8243.44	3671.47
19.60	2441.71	3003.17	4847.00	2172.56
19.80	2244.68	2773.05	3692.51	1624.36
20.00	2048.09	2539.09	6289.06	2517.54
20.20	1866.02	2319.91	6901.94	2720.99
20.40	1709.50	2130.40	5362.97	2103.45
20.60	1567.83	1957.72	4902.79	1906.24
20.80	1430.99	1790.68	4725.18	1803.93
21.00	1320.45	1654.93	4278.50	1599.18
21.20	1212.55	1521.87	3883.96	1415.17
21.40	1112.38	1398.05	3536.62	1251.21
21.60	1014.58	1276.71	3245.04	1113.14
21.80	923.29	1163.29	3056.42	1016.25
22.00	844.87	1065.83	2834.86	914.15
22.20	777.19	981.20	2690.37	842.36
22.40	719.61	909.92	2558.47	779.12
22.60	681.20	862.00	2450.55	727.02
22.80	640.31	810.73	2364.26	684.31
23.00	601.71	762.31	2293.61	648.71
23.20	563.75	714.68	2237.85	619.43
23.40	526.88	668.36	2197.02	595.98
23.60	488.94	620.54	2163.09	575.81
23.80	451.03	572.73	2126.16	556.17
24.00	410.64	521.82	2071.39	533.33
24.20	375.44	477.54	2004.79	508.87
24.40	350.17	445.62	1963.01	491.70
24.60	323.81	412.29	1899.62	469.74
24.80	297.16	378.59	1816.37	444.03
25.00	274.73	350.18	1742.96	421.63
25.20	256.56	327.18	1777.25	425.03
25.40	242.44	309.29	1802.27	425.81

Table A-1
Blowdown Mass and Energy Releases – Double Ended Pump Suction Guillotine Break Minimum Safeguards (Continued)

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
25.60	234.06	298.71	1812.95	423.21
25.80	239.29	305.51	1841.65	424.70
26.00	229.56	293.09	2057.95	468.74
26.20	225.30	287.71	2346.84	527.97
26.40	220.59	281.77	2614.80	581.16
26.60	216.13	276.14	0.00	0.00
26.80	212.97	272.16	0.00	0.00
27.00	210.13	268.58	0.00	0.00
27.20	205.10	262.20	0.00	0.00
27.40	197.71	252.82	0.00	0.00
27.60	189.99	243.00	0.00	0.00
27.80	184.59	236.16	0.00	0.00
28.00	181.26	231.95	0.00	0.00
28.20	177.59	227.29	0.00	0.00
28.40	173.10	221.59	0.00	0.00
28.60	173.70	222.38	0.00	0.00
28.80	169.12	216.58	0.00	0.00
29.00	166.72	213.54	0.00	0.00
29.20	162.49	208.16	0.00	0.00
29.40	158.25	202.76	0.00	0.00
29.60	150.14	192.41	0.00	0.00
29.80	141.64	181.57	0.00	0.00
30.00	131.45	168.56	0.00	0.00
30.20	120.40	154.46	0.00	0.00
30.40	110.03	141.22	0.00	0.00
30.60	99.83	128.20	0.00	0.00
30.80	92.21	118.46	0.00	0.00
31.00	85.04	109.29	0.00	0.00
31.20	73.88	95.02	0.00	0.00
31.40	63.66	81.95	0.00	0.00
31.60	55.10	70.98	0.00	0.00
31.80	44.30	57.13	0.00	0.00
32.00	33.83	43.69	0.00	0.00
32.20	23.11	29.90	0.00	0.00
32.40	6.66	8.64	0.00	0.00
32.60	0.00	0.00	0.00	0.00

Table A-2
Reflood Mass and Energy Releases – Double Ended Pump Suction Guillotine Break Minimum Safeguards

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
33.05	0.00	0.00	165.95	12.12
33.25	0.00	0.00	165.95	12.12
33.35	0.00	0.00	165.95	12.12
33.45	0.00	0.00	165.95	12.12
33.50	0.00	0.00	165.95	12.12
33.64	26.50	30.81	165.95	12.12
33.74	11.41	13.26	165.95	12.12
33.84	12.50	14.53	165.95	12.12
33.96	17.81	20.71	165.95	12.12
34.06	22.87	26.58	165.95	12.12
34.16	26.78	31.13	165.95	12.12
34.29	30.45	35.40	165.95	12.12
34.39	33.28	38.69	165.95	12.12
34.49	35.93	41.78	165.95	12.12
34.59	38.46	44.72	165.95	12.12
34.69	40.87	47.53	165.95	12.12
34.79	43.20	50.24	165.95	12.12
34.89	45.44	52.84	165.95	12.12
34.99	47.60	55.36	165.95	12.12
35.09	50.20	58.39	165.95	12.12
35.19	52.25	60.77	165.95	12.12
35.29	53.69	62.46	165.95	12.12
35.39	56.08	65.24	165.95	12.12
35.44	56.55	65.79	165.95	12.12
35.49	57.97	67.44	165.95	12.12
35.59	59.73	69.49	165.95	12.12
35.69	61.09	71.07	165.95	12.12
36.69	77.44	90.14	165.95	12.12
37.69	91.00	105.99	165.95	12.12
38.69	103.12	120.15	165.95	12.12
39.69	174.43	203.80	2061.51	259.43
40.79	349.63	411.66	4659.50	673.36
41.19	353.32	416.07	4704.26	683.43
41.79	352.31	414.88	4691.97	683.64
42.79	348.47	410.29	4644.46	677.83
43.79	344.31	405.32	4592.06	670.93
44.79	340.15	400.34	4538.71	663.77
45.79	336.06	395.45	4485.60	656.57

Table A-2
Reflood Mass and Energy Releases – Double Ended Pump Suction Guillotine Break Minimum Safeguards (Continued)

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
46.79	332.09	390.71	4433.27	649.43
46.99	331.31	389.78	4422.93	648.02
47.79	328.25	386.11	4381.96	642.41
48.79	324.54	381.68	4331.81	635.54
49.79	320.96	377.41	4282.94	628.83
50.79	317.53	373.31	4235.37	622.30
51.79	314.23	369.37	4189.09	615.94
52.79	311.05	365.58	4144.09	609.75
53.79	307.99	361.93	4100.32	603.74
54.69	305.15	358.54	4062.13	598.48
54.79	304.80	358.13	4057.97	597.92
55.79	301.42	354.10	4017.01	592.34
56.79	298.14	350.21	3977.15	586.93
57.79	294.97	346.43	3938.35	581.66
58.79	291.90	342.78	3900.57	576.53
59.79	288.92	339.24	3863.76	571.54
60.79	286.03	335.81	3827.89	566.67
61.79	283.23	332.48	3792.92	561.93
62.79	348.11	409.45	288.70	170.36
63.59	390.23	460.23	307.49	198.83
63.79	391.54	461.83	308.07	199.79
64.79	387.47	456.98	306.32	197.44
65.79	380.54	448.68	303.33	193.16
66.79	373.89	440.71	300.43	189.01
67.79	367.70	433.31	297.69	185.10
68.79	362.09	426.59	295.14	181.48
69.79	356.77	420.21	292.71	178.05
70.79	351.64	414.08	290.39	174.77
71.29	349.08	411.02	289.26	173.15
71.79	346.58	408.03	288.14	171.57
72.79	341.73	402.23	285.97	168.48
73.79	336.93	396.49	283.81	165.43
74.79	332.67	391.40	281.88	162.69
75.79	328.75	386.71	280.09	160.17
76.79	325.00	382.23	278.33	157.76
77.79	321.48	378.03	276.68	155.49
78.79	318.16	374.06	275.11	153.34
79.79	314.98	370.27	273.61	151.29

Table A-2
Reflood Mass and Energy Releases – Double Ended Pump Suction Guillotine Break Minimum Safeguards (Continued)

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
80.79	311.95	366.64	272.17	149.31
81.79	309.03	363.17	270.79	147.42
82.79	306.22	359.82	269.46	145.60
83.79	303.10	356.10	268.22	143.92
84.79	300.08	352.51	267.03	142.29
85.79	297.18	349.06	265.89	140.74
86.79	294.39	345.74	264.80	139.24
87.79	291.70	342.55	263.74	137.81
88.79	289.11	339.47	262.73	136.43
89.79	286.62	336.51	261.76	135.11
90.39	285.17	334.78	261.19	134.34
90.79	284.22	333.66	260.82	133.83
91.79	281.91	330.91	259.92	132.61
92.79	279.68	328.26	259.06	131.44
93.79	277.53	325.72	258.23	130.31
95.79	273.47	320.90	256.66	128.18
97.79	269.71	316.43	255.21	126.22
99.79	266.21	312.28	253.87	124.40
101.79	262.95	308.42	252.62	122.71
103.79	259.92	304.82	251.46	121.14
105.79	257.10	301.48	250.39	119.70
107.79	254.49	298.39	249.40	118.36
109.79	252.07	295.52	248.48	117.12
111.79	249.83	292.86	247.63	115.97
113.79	247.75	290.40	246.85	114.92
113.89	247.65	290.28	246.81	114.86
115.79	245.83	288.13	246.13	113.94
117.79	244.06	286.03	245.46	113.04
119.79	242.42	284.09	244.84	112.21
121.79	240.91	282.30	244.27	111.44
123.79	239.52	280.66	243.75	110.74
125.79	238.25	279.15	243.27	110.09
127.79	237.08	277.77	242.83	109.50
129.79	236.01	276.50	242.42	108.95
131.79	235.03	275.34	242.05	108.45
133.79	234.14	274.28	241.71	108.00
135.79	233.32	273.32	241.40	107.58
137.79	232.59	272.45	241.12	107.20

Table A-2
Reflood Mass and Energy Releases – Double Ended Pump Suction Guillotine Break Minimum Safeguards (Continued)

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
139.79	231.92	271.66	240.86	106.86
140.69	231.64	271.33	240.75	106.71
141.79	231.32	270.96	240.63	106.55
143.79	231.38	271.02	240.85	106.56
145.79	231.55	271.23	241.48	106.63
147.79	231.99	271.74	242.57	106.83
149.79	232.65	272.52	244.04	107.15
151.79	233.45	273.47	245.80	107.54
153.79	234.32	274.50	247.77	107.97
155.79	235.21	275.55	249.87	108.40
157.79	236.06	276.56	252.06	108.83
159.79	236.85	277.50	254.29	109.23
161.79	237.56	278.34	256.54	109.60
163.79	238.18	279.07	258.79	109.93
165.79	238.70	279.69	261.06	110.22
167.79	239.13	280.19	263.33	110.47
168.79	239.31	280.40	264.46	110.58
169.79	239.46	280.59	265.60	110.69
171.79	239.71	280.88	267.88	110.87
173.79	239.87	281.07	270.18	111.01
175.79	239.94	281.16	272.50	111.13
177.79	239.94	281.15	274.83	111.22
179.79	239.85	281.05	277.19	111.28
181.79	239.69	280.86	279.58	111.32
183.79	239.45	280.58	282.00	111.34
185.79	239.09	280.15	284.37	111.31
187.79	238.66	279.64	286.77	111.26
189.79	238.16	279.05	289.20	111.19
191.79	237.59	278.37	291.66	111.10
193.79	236.95	277.61	294.15	111.00
195.79	236.18	276.71	296.61	110.85
197.59	235.45	275.84	298.86	110.72
197.79	235.37	275.74	299.11	110.70
199.79	234.49	274.71	301.65	110.54
201.79	233.54	273.58	304.27	110.37
203.79	232.52	272.37	306.94	110.18
205.79	231.43	271.08	309.67	109.99
207.79	230.27	269.72	312.46	109.80

Table A-2
Reflood Mass and Energy Releases – Double Ended Pump Suction Guillotine Break
Minimum Safeguards (Continued)

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
209.79	229.05	268.27	315.31	109.60
211.79	227.76	266.75	318.23	109.40
213.79	226.41	265.14	321.20	109.19
215.79	224.98	263.46	324.24	108.99
217.79	223.49	261.69	327.34	108.78
219.79	221.91	259.82	330.49	108.57
221.79	220.21	257.82	333.45	108.31
223.79	218.40	255.68	336.32	108.02
225.79	216.54	253.48	339.21	107.73
227.79	214.62	251.21	342.12	107.45
228.39	214.03	250.51	343.00	107.36

Table A-3
Post Reflood Mass and Energy Releases – Double Ended Pump Suction Guillotine Break
Minimum Safeguards

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
228.40	219.51	272.26	444.34	117.73
233.40	218.53	271.05	445.32	117.82
238.40	218.53	271.05	445.32	117.70
243.40	217.54	269.81	446.32	117.80
248.40	217.50	269.77	446.35	117.69
253.40	217.45	269.70	446.41	117.58
258.40	216.41	268.42	447.44	117.68
263.40	216.32	268.31	447.53	117.59
268.40	216.21	268.17	447.64	117.49
273.40	216.08	268.00	447.78	117.40
278.40	214.98	266.64	448.87	117.51
283.40	214.81	266.43	449.04	117.43
288.40	214.61	266.18	449.24	117.36
293.40	214.38	265.90	449.47	117.29
298.40	214.13	265.59	449.72	117.22
303.40	212.95	264.12	450.90	117.35
308.40	212.65	263.76	451.20	117.29
313.40	212.33	263.36	451.52	117.24
318.40	211.98	262.93	451.87	117.20
323.40	211.60	262.45	452.25	117.16
328.40	211.19	261.95	452.66	117.12
333.40	210.75	261.40	453.10	117.10
338.40	210.28	260.81	453.57	117.08
343.40	209.77	260.19	454.08	117.06
348.40	209.24	259.52	454.62	117.06
353.40	209.49	259.83	454.36	116.88
358.40	208.87	259.06	454.98	116.89
363.40	208.20	258.24	455.65	116.91
368.40	207.51	257.37	456.35	116.94
373.40	207.56	257.45	456.29	116.81
378.40	206.77	256.46	457.08	116.85
383.40	206.71	256.39	457.14	116.74
388.40	205.81	255.27	458.04	116.81
393.40	205.63	255.04	458.22	116.73
398.40	205.37	254.72	458.48	116.66
403.40	205.12	254.42	458.73	116.60
408.40	204.10	253.15	459.75	116.70
413.40	203.75	252.71	460.11	116.66

Table A-3
Post Reflood Mass and Energy Releases – Double Ended Pump Suction Guillotine Break Minimum Safeguards (Continued)

	Break Path No.1		Break Path No.2	
Time	Flow	Energy	Flow	Energy
		Thousand		Thousand
Seconds	Lbm/Sec	Btu/Sec	Lbm/Sec	Btu/Sec
418.40	203.31	252.16	460.54	116.64
423.40	203.47	252.37	460.38	116.48
428.40	202.82	251.56	461.03	116.51
433.40	202.07	250.63	461.78	116.55
438.40	201.88	250.39	461.97	116.47
443.40	201.53	249.96	462.32	116.43
448.40	201.03	249.34	462.82	116.42
453.40	200.36	248.51	463.49	116.45
458.40	200.13	248.23	463.72	116.38
463.40	199.66	247.65	464.19	116.36
468.40	199.53	247.48	464.32	116.27
473.40	199.07	246.91	464.78	116.25
478.40	198.27	245.92	465.58	116.30
483.40	198.16	245.78	465.69	116.21
488.40	197.51	244.97	466.34	116.23
493.40	197.23	244.63	466.62	116.17
498.40	196.61	243.86	467.24	116.18
503.40	196.31	243.48	467.55	116.13
508.40	195.80	242.85	468.05	116.12
513.40	195.13	242.03	468.72	116.14
518.40	195.00	241.87	468.85	116.05
523.40	194.36	241.07	469.49	116.06
816.35	194.36	241.07	469.49	116.06
816.45	77.12	95.45	586.73	138.94
818.40	77.08	95.40	586.77	138.89
1688.40	63.67	78.76	600.18	127.92
1690.90	63.64	78.73	391.63	116.09
1695.90	63.59	78.66	388.28	128.96
2162.84	63.59	78.66	388.28	128.96

Table A-4a
Double-Ended Pump Suction Guillotine Break

TIME (SECONDS)		0.00	32.60	32.60 +δ	228.39	816.45	2162.84
		MASS (THOUSAND LBM)					
Initial	In RCS and ACC	787.11	787.11	787.11	787.11	787.11	787.11
Added Mass	Pumped Injection	0.00	0.00	0.00	123.53	513.91	1307.68
	Total Added	0.00	0.00	0.00	123.53	513.91	1307.68
*** TOTAL AVAILABLE ***		787.11	787.11	787.11	910.64	1301.02	2094.79
Distribution	Reactor Coolant	530.58	102.80	102.90	173.78	173.78	173.78
	Accumulator	256.53	138.64	138.54	0.00	0.00	0.00
	Total Contents	787.11	241.44	241.44	173.78	173.78	173.78
Effluent	Break Flow	0.00	545.65	545.65	736.84	1127.22	1920.73
	ECCS Spill	0.00	0.00	0.00	0.00	0.00	0.00
	Total Effluent	0.00	545.65	545.65	736.84	1127.22	1920.73
*** TOTAL ACCOUNTABLE ***		787.11	787.09	787.09	910.62	1301.00	2094.51

Table A-4b
Double-Ended Pump Suction Guillotine Break (Continued)

TIME (SECONDS)		0.00	32.60	32.60+δ	228.39	816.45	2162.84
		ENERGY (MILLIONS BTU)					
Initial Energy	In RCS, ACC, S GEN	886.10	886.10	886.10	886.10	886.10	886.10
Added Energy	Pumped Injection	0.00	0.00	0.00	9.02	37.53	101.78
	Decay Heat	0.00	8.98	8.98	30.71	80.15	166.97
	Heat From Secondary	0.00	3.83	3.83	3.83	14.67	34.29
	Total Added	0.00	12.81	12.81	43.56	132.35	303.05
*** TOTAL AVAILABLE ***		886.10	898.91	989.91	929.66	1018.45	1189.15
Distribution	Reactor Coolant	309.01	17.85	17.86	35.91	35.91	35.91
	Accumulator	25.57	13.82	13.81	0.00	0.00	0.00
	Core Stored	24.81	12.72	12.72	3.92	3.64	3.49
	Primary Metal	157.46	147.29	147.29	130.66	81.39	57.46
	Secondary Metal	93.54	93.06	93.06	83.90	63.87	38.55
	Steam Generator	275.71	285.60	285.60	253.97	199.54	139.20
	Total Contents	886.10	570.33	570.33	508.36	384.36	274.61
Effluent	Break Flow	0.00	327.99	327.99	420.45	633.24	926.07
	ECCS Spill	0.00	0.00	0.00	0.00	0.00	0.00
	Total Effluent	0.00	327.99	327.99	420.45	633.24	926.07
*** TOTAL ACCOUNTABLE ***		886.10	898.32	898.32	928.81	1017.60	1200.68

Table A-5
Double-Ended Pump Suction Guillotine Break – Minimum Safeguards

TIME	FLOODING		CARRYOVER FRACTION	CORE HEIGHT	DOWNCOMER HEIGHT	FLOW FRAC	TOTAL	INJECTION ACCUM	SPILL	ENTHALPY
(SECONDS)	TEMP (°F)	RATE (IN/SEC)		(FT)	(FT)		(POUNDS MASS PER SECOND)			(BTU/LBM)
32.6	201.6	0.000	0.000	0.00	0.00	0.250	0.0	0.0	0.0	0.00
33.3	200.0	22.557	0.000	0.56	1.12	0.000	7452.1	6788.2	0.0	97.30
33.5	198.8	25.915	0.000	1.08	1.19	0.000	7397.1	6733.2	0.0	97.28
33.8	198.4	2.350	0.085	1.28	1.85	0.242	7328.1	6664.2	0.0	97.26
34.0	198.5	2.354	0.104	1.30	2.16	0.279	7301.9	6638.0	0.0	97.25
35.4	198.8	1.878	0.320	1.50	5.78	0.362	7059.7	6395.8	0.0	97.16
36.7	199.2	1.816	0.438	1.62	8.80	0.375	6869.8	6205.9	0.0	97.10
40.8	200.2	3.721	0.627	1.96	16.11	0.577	5493.1	4885.3	0.0	96.72
41.2	200.3	3.667	0.640	2.01	16.12	0.578	5438.3	4831.5	0.0	96.70
42.8	200.6	3.426	0.677	2.17	16.12	0.577	5289.6	4681.3	0.0	96.61
47.0	201.7	3.085	0.718	2.51	16.12	0.575	4987.0	4372.8	0.0	96.39
54.7	204.5	2.765	0.744	3.00	16.12	0.571	4556.9	3934.7	0.0	96.03
61.8	207.4	2.565	0.754	3.40	16.12	0.564	4245.3	3617.6	0.0	95.73
62.8	207.9	3.061	0.754	3.45	16.10	0.603	612.6	0.0	0.0	73.03
63.6	208.3	3.326	0.749	3.50	16.02	0.606	590.4	0.0	0.0	73.03
63.8	208.4	3.331	0.749	3.51	15.99	0.606	589.4	0.0	0.0	73.03
71.3	212.6	2.952	0.756	4.00	15.28	0.602	604.8	0.0	0.0	73.03
80.8	217.7	2.627	0.762	4.53	14.75	0.600	617.9	0.0	0.0	73.03
90.4	222.0	2.405	0.767	5.00	14.48	0.596	625.0	0.0	0.0	73.03
101.8	226.3	2.225	0.771	5.51	14.39	0.591	630.4	0.0	0.0	73.03
113.9	230.2	2.100	0.775	6.00	14.49	0.587	634.0	0.0	0.0	73.03
127.8	233.9	2.011	0.778	6.53	14.76	0.584	636.5	0.0	0.0	73.03
140.7	236.9	1.962	0.782	7.00	15.10	0.582	637.7	0.0	0.0	73.03
145.8	238.0	1.958	0.783	7.18	15.24	0.583	637.7	0.0	0.0	73.03
155.8	239.9	1.972	0.784	7.54	15.50	0.586	636.9	0.0	0.0	73.03
167.8	241.9	1.983	0.786	7.97	15.74	0.592	635.9	0.0	0.0	73.03
168.8	242.1	1.983	0.786	8.00	15.76	0.592	635.9	0.0	0.0	73.03

Table A-5
Double-Ended Pump Suction Guillotine Break – Minimum Safeguards (Continued)

TIME	FLOODING		CARRYOVER FRACTION	CORE HEIGHT	DOWNCOMER HEIGHT	FLOW FRAC	TOTAL	INJECTION ACCUM	SPILL	ENTHALPY
(SECONDS)	TEMP (°F)	RATE (IN/SEC)		(FT)	(FT)		(POUNDS MASS PER SECOND)			(BTU/LBM)
183.8	244.3	1.961	0.788	8.53	15.94	0.598	635.7	0.0	0.0	73.03
197.6	243.9	1.917	0.787	9.00	16.04	0.602	636.4	0.0	0.0	73.03
213.8	243.9	1.834	0.787	9.54	16.10	0.604	638.2	0.0	0.0	73.03
228.4	244.3	1.731	0.789	10.00	16.12	0.604	640.7	0.0	0.0	73.03

APPENDIX B – FSAR Markups

[WCAP-12455, Revision 1, Supplement 2R is redacted to exclude the SQN FSAR markups. UFSAR changes will be processed in accordance with the TVA program requirements.]

APPENDIX C – Tech Spec Markups

[WCAP-12455, Revision 1, Supplement 2R is redacted to exclude the TS markups. TS markups are included as Attachment 1 of the Enclosure.]

APPENDIX D – EQ Data

Containment Pressure and Temperatures for 30-Day Transient

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
2.00	7.1790	92.4450	232.8	189.9485	0.0000
61.02	6.9239	90.0982	232.2	187.7964	0.0000
123.61	6.1944	89.6768	219.2541	183.4635	0.0000
188.61	6.4976	89.7168	223.7086	180.4525	0.0000
250.82	6.3645	90.3415	221.2266	178.3928	0.0000
309.36	7.1162	102.1327	224.5054	175.3263	0.0000
373.36	7.2584	103.2078	225.7065	172.6521	0.0000
438.36	7.2842	103.3346	225.8822	170.3957	0.0000
502.36	7.2845	103.3917	225.7389	168.5248	0.0000
567.36	7.3397	103.4423	226.3929	166.9008	0.0000
631.36	6.9856	105.9283	219.0252	165.4671	166.0074
696.36	6.6448	106.6898	212.4420	164.0860	165.2994
760.36	6.5751	106.7645	210.8727	162.8050	164.6285
823.50	6.4408	106.8147	208.0685	161.7182	164.0131
887.50	6.0700	106.8447	200.2544	161.3248	163.5898
952.50	5.9174	106.8806	196.4739	160.9434	163.2291
1016.50	5.8584	106.9206	194.6480	160.5958	162.9198
1081.50	5.8354	106.9623	193.6040	160.2728	162.6398
1145.50	5.8273	107.0030	192.8988	159.9839	162.3904
1210.50	5.8246	107.0434	192.3056	159.7184	162.1590
1274.50	5.8239	107.0819	191.7594	159.4832	161.9494
1339.50	5.8238	107.1199	191.2080	159.2691	161.7529
1404.50	5.8235	107.1567	190.6452	159.0787	161.5708
1468.50	5.8229	107.1918	190.0740	158.9129	161.4043
1533.50	5.8220	107.2265	189.4737	158.7655	161.2470
1597.50	5.8206	107.2596	188.8613	158.6397	161.1029
1662.50	5.8188	107.2922	188.2165	158.5306	160.9667
1723.43	6.1299	107.3298	195.6645	158.1024	160.8631
1788.43	6.2306	107.3671	197.6953	157.3890	160.7543
1852.43	6.2773	107.3985	198.4368	156.7206	160.6316
1917.43	6.3044	107.4282	198.7137	156.0723	160.4934
1981.43	6.3236	107.4563	198.8116	155.4619	160.3463
2011.93	6.3315	107.4693	198.8273	155.1803	160.2728
2027.93	6.3352	107.4761	198.8280	155.0350	160.2335
2044.18	6.3391	107.4829	198.8292	154.8890	160.1930
2060.18	6.3429	107.4895	198.8308	154.7468	160.1527
2076.43	6.3468	107.4962	198.8327	154.6041	160.1113
2092.43	6.3506	107.5028	198.8349	154.4651	160.0701

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
2108.68	6.3545	107.5095	198.8373	154.3254	160.0278
2124.68	6.3583	107.5159	198.8399	154.1895	159.9858
2140.93	6.3622	107.5225	198.8426	154.0530	159.9428
2157.18	6.3661	107.5290	198.8455	153.9180	159.8993
2172.96	6.2646	107.5349	196.3064	153.6721	159.8635
2189.21	6.1543	107.5389	193.4475	153.3558	159.8291
2205.21	6.0655	107.5424	191.0399	153.0462	159.7937
2221.46	5.9917	107.5459	188.9545	152.7338	159.7564
2237.46	5.9322	107.5497	187.2057	152.4282	159.7184
2253.71	5.8826	107.5539	185.6942	152.1202	159.6786
2269.71	5.8425	107.5584	184.4280	151.8191	159.6382
2285.96	5.8091	107.5632	183.3334	151.5156	159.5961
2301.96	5.7822	107.5681	182.4155	151.2191	159.5534
2318.21	5.7598	107.5733	181.6207	150.9202	159.5090
2334.21	5.7418	107.5786	180.9525	150.6282	159.4643
2350.46	5.7270	107.5840	180.3721	150.3339	159.4178
2366.46	5.7151	107.5895	179.8822	150.0464	159.3711
2382.71	5.7055	107.5951	179.4547	149.7566	159.3226
2398.71	5.6979	107.6006	179.0919	149.4736	159.2740
2414.96	5.6919	107.6063	178.7732	149.1883	159.2237
2430.96	5.6873	107.6119	178.5007	148.9096	159.1734
2447.21	5.6838	107.6176	178.2594	148.6287	159.1213
2463.21	5.6813	107.6232	178.0512	148.3542	159.0693
2479.46	5.6796	107.6289	177.8649	148.0777	159.0156
2495.71	5.6785	107.6346	177.7000	147.8033	158.9612
2511.71	5.6781	107.6402	177.5551	147.5351	158.9068
2527.96	5.6781	107.6458	177.4231	147.2649	158.8509
2543.96	5.6785	107.6514	177.3055	147.0009	158.7951
2560.21	5.6792	107.6570	177.1968	146.7348	158.7377
2576.21	5.6802	107.6624	177.0985	146.4748	158.6806
2592.46	5.6814	107.6680	177.0063	146.2128	158.6219
2608.46	5.6829	107.6734	176.9217	145.9568	158.5635
2624.71	5.6845	107.6789	176.8412	145.6987	158.5035
2640.71	5.6862	107.6843	176.7663	145.4466	158.4439
2656.96	5.6881	107.6897	176.6940	145.1924	158.3828
2672.96	5.6901	107.6950	176.6259	144.9441	158.3221
2689.21	5.6921	107.7003	176.5595	144.6938	158.2598
2705.21	5.6943	107.7056	176.4962	144.4491	158.1980
2721.46	5.6964	107.7109	176.4338	144.2026	158.1347
2737.46	5.6987	107.7160	176.3739	143.9617	158.0719
2753.71	5.7009	107.7213	176.3144	143.7188	158.0077
2769.71	5.7032	107.7264	176.2569	143.4815	157.9439
2785.96	5.7056	107.7315	176.1993	143.2423	157.8787

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
2801.96	5.7079	107.7365	176.1433	143.0085	157.8141
2818.21	5.8241	109.9618	176.2986	142.9221	157.7963
2834.46	5.9225	111.7245	176.5482	142.8442	157.7811
2850.46	5.9989	113.0079	176.8302	142.7677	157.7660
2866.71	6.0599	113.9696	177.1248	142.6903	157.7507
2882.71	6.1073	114.6689	177.4058	142.6143	157.7356
2898.96	6.1455	115.1959	177.6722	142.5373	157.7203
2914.96	6.1755	115.5841	177.9106	142.4617	157.7052
2931.21	6.2002	115.8826	178.1267	142.3851	157.6898
2947.21	6.2201	116.1087	178.3136	142.3100	157.6747
2963.46	6.2369	116.2887	178.4784	142.2340	157.6593
2979.46	6.2509	116.4307	178.6176	142.1593	157.6441
2995.71	6.2680	116.6376	178.7449	142.0837	157.6287
3011.71	6.3147	117.3644	178.9099	142.0097	157.6138
3027.96	6.3940	118.6262	179.1522	141.9350	157.5987
3043.96	6.4995	120.2808	179.4808	141.8618	157.5841
3060.21	6.6318	122.3014	179.9154	141.7880	157.5694
3076.21	6.7855	124.5695	180.4473	141.7157	157.5552
3092.46	6.9646	127.1145	181.0947	141.6428	157.5410
3108.46	7.1638	129.8306	181.8378	141.5715	157.5273
3124.71	6.9546	126.4060	181.9929	141.4555	157.5128
3140.96	6.8356	124.4198	181.9986	141.3114	157.4993
3156.96	6.8334	124.3098	182.0757	141.1671	157.4865
3173.21	6.8820	125.0040	182.2203	141.0235	157.4738
3189.21	6.9555	126.0642	182.4261	140.8876	157.4617
3205.46	7.0466	127.3550	182.6985	140.7563	157.4499
3221.46	7.1494	128.7736	183.0283	140.6343	157.4386
3237.71	7.2660	130.3418	183.4252	140.5186	157.4277
3253.71	7.3931	132.0049	183.8770	140.4131	157.4175
3269.96	7.7474	135.0320	184.0925	140.3172	157.4090
3285.95	8.2227	136.5623	183.8741	140.2463	157.4080
3302.20	8.3427	137.6149	184.5449	140.1779	157.4080
3318.20	8.5314	139.5029	185.2900	140.1181	157.4080
3334.45	8.7292	141.4207	186.0706	140.0667	157.4080
3350.45	8.9083	143.0600	186.8269	140.0244	157.4080
3366.70	9.0687	144.4387	187.5621	139.9886	157.4080
3382.70	9.2075	145.5606	188.2457	139.9594	157.4080
3398.95	9.3325	146.5186	188.8964	139.9346	157.4080
3414.95	9.4432	147.3299	189.4946	139.9144	157.4080
3431.20	9.5458	148.0553	190.0608	139.8976	157.4080
3447.20	9.6389	148.6972	190.5801	139.8844	157.4080
3463.45	9.7270	149.2932	191.0715	139.8738	157.4080
3479.70	9.8097	149.8456	191.5295	139.8660	157.4080

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
3495.70	9.8867	150.3555	191.9506	139.8609	157.4080
3511.95	9.9610	150.8452	192.3503	139.8580	157.4080
3527.95	10.0308	151.3039	192.7189	139.8574	157.4080
3544.20	10.0987	151.7494	193.0700	139.8589	157.4080
3560.20	10.1628	152.1702	193.3947	139.8623	157.4080
3576.45	10.2255	152.5815	193.7050	139.8678	157.4080
3592.45	10.2849	152.9718	193.9929	139.8749	157.4080
3608.70	10.1261	151.2027	193.9851	139.9060	157.4080
3624.70	9.9730	149.5654	193.8551	139.9490	157.4080
3640.95	9.9524	149.3313	193.8312	139.9876	157.4080
3656.95	9.9752	149.5548	193.8541	140.0255	157.4080
3673.20	10.0106	149.9015	193.9006	140.0656	157.4080
3689.20	10.0471	150.2496	193.9585	140.1068	157.4080
3705.45	10.0826	150.5777	194.0243	140.1503	157.4080
3721.45	10.1152	150.8708	194.0927	140.1947	157.4080
3737.70	10.1462	151.1411	194.1640	140.2411	157.4080
3753.70	10.1748	151.3846	194.2348	140.2880	157.4080
3769.95	10.2022	151.6133	194.3063	140.3366	157.4080
3785.95	10.2278	151.8233	194.3757	140.3855	157.4080
3802.20	10.2527	152.0238	194.4448	140.4360	157.4080
3818.45	10.2764	152.2132	194.5120	140.4873	157.4080
3834.45	10.2988	152.3904	194.5762	140.5385	157.4080
3850.70	10.3208	152.5620	194.6391	140.5912	157.4080
3866.70	10.3415	152.7235	194.6987	140.6437	157.4080
3882.95	10.3619	152.8808	194.7569	140.6976	157.4080
3898.95	10.3812	153.0294	194.8116	140.7512	157.4080
3915.20	10.4001	153.1745	194.8647	140.8062	157.4080
3931.20	10.4181	153.3120	194.9145	140.8607	157.4080
3947.45	10.4357	153.4465	194.9625	140.9165	157.4080
3963.45	10.4525	153.5742	195.0073	140.9719	157.4080
3979.70	10.4689	153.6993	195.0503	141.0285	157.4080
3995.70	10.4845	153.8181	195.0903	141.0845	157.4080
4047.95	10.5366	154.2356	195.2353	141.2701	157.4080
4111.95	10.5975	154.7108	195.4158	141.5025	157.4080
4176.95	10.6541	155.1441	195.5882	141.7430	157.4080
4240.95	10.7055	155.5332	195.7445	141.9831	157.4080
4305.95	10.7540	155.8969	195.8886	142.2295	157.4080
4369.95	10.7982	156.2280	196.0163	142.4738	157.4080
4434.95	10.8398	156.5399	196.1322	142.7230	157.4080
4498.95	10.8779	156.8251	196.2336	142.9689	157.4080
4563.95	10.9139	157.0944	196.3244	143.2188	157.4080
4628.95	10.9472	157.3448	196.4037	143.4682	157.4080
4692.95	10.9776	157.5741	196.4714	143.7129	157.4080

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
4757.95	11.0062	157.7906	196.5302	143.9603	157.4080
4821.95	11.0322	157.9888	196.5790	144.2024	157.4080
4886.95	11.0567	158.1758	196.6197	144.4465	157.4080
4950.95	11.0788	158.3465	196.6517	144.6847	157.4080
5235.54	11.2022	159.5145	196.8867	145.7369	157.4080
6371.44	11.3202	160.4558	196.8224	149.2974	157.4080
7771.48	11.2187	160.7224	194.4760	152.1816	157.4080
9026.86	11.1296	160.1424	193.9547	153.5479	157.4080
10434.96	10.9465	159.1693	191.9931	154.1941	157.4080
11868.75	10.9474	159.1500	192.0901	154.3831	157.4080
13365.53	10.8924	158.5767	191.6588	154.3245	157.4080
14875.67	10.7615	157.5339	190.7561	154.0589	157.4080
16438.12	10.6351	156.7615	189.7311	153.5786	157.4080
18012.33	10.4907	155.7311	188.2682	152.9264	157.4080
19726.36	10.3667	154.6700	187.8077	152.0824	157.4080
21355.87	10.2738	153.7509	186.8664	151.1940	157.4080
23127.59	10.1520	153.0158	185.7174	150.3300	157.4080
24877.85	10.0928	152.5267	185.4536	149.5050	157.4080
26728.81	9.9137	151.3217	184.0179	148.6889	157.4080
28621.39	9.7810	150.5102	183.4595	147.8570	157.4080
30453.51	9.6468	149.7602	182.0616	147.0565	157.4080
32417.30	9.5267	148.6856	181.7024	146.1947	157.4080
34397.30	9.3890	148.2091	180.1312	145.3538	157.4080
36404.20	9.2509	147.1970	179.2495	144.4813	157.4080
38411.74	9.1302	146.2360	178.8973	143.6047	157.4080
40431.14	9.0306	145.3546	178.3751	142.6951	157.4080
42400.68	8.9222	144.2827	177.5461	141.8789	157.4080
44467.69	8.8459	143.6747	177.1380	141.1571	157.4080
46525.47	8.7742	143.4911	176.2582	140.5339	157.4080
48603.46	8.7114	142.9201	175.7910	139.9382	157.4080
50648.68	8.6325	142.3340	175.5556	139.3913	157.4080
52781.41	8.5488	141.7878	174.8335	138.8591	157.4080
54859.92	8.4389	140.8991	173.7049	138.3269	157.4080
56986.12	8.3750	140.3365	173.4253	137.7898	157.4080
59113.65	8.3149	140.1905	172.5529	137.2661	157.4080
61268.13	8.2584	139.6217	172.1448	136.7452	157.4080
63399.17	8.2056	139.1037	172.1767	136.2736	157.4065
65600.54	8.1581	138.7400	171.7696	135.8315	157.3987
67858.63	8.1035	138.3372	171.2363	135.4087	157.3905
70086.82	8.0274	137.6050	170.5601	135.0097	157.3821
72374.83	7.9831	137.2401	170.4258	134.6112	157.3733
74605.16	7.9398	137.1124	169.4698	134.2267	157.3646
76888.46	7.8685	136.4008	169.0128	133.8360	157.3553

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
79195.98	7.8458	136.2510	169.1026	133.4356	157.3459
81570.92	7.7955	135.8706	168.5750	133.0278	157.3359
83923.65	7.7308	135.1797	167.9798	132.6543	157.3258
86328.31	7.7018	134.9487	167.9509	132.3104	157.3154
88683.86	7.6681	134.8637	167.1012	131.9865	157.3050
91079.38	7.6085	134.2358	166.7245	131.6668	157.2942
93496.02	7.5914	134.1661	166.8172	131.3563	157.2832
95969.01	7.5453	133.8516	166.2728	131.0381	157.2718
98448.92	7.4787	133.2049	165.5801	130.7281	157.2600
100984.41	7.4535	132.9631	165.5891	130.4042	157.2481
103508.45	7.4108	132.9286	164.6947	130.1290	157.2357
106047.45	7.3814	132.6369	164.6135	129.8522	157.2233
108631.86	7.3391	132.3499	163.8267	129.5863	157.2104
111215.54	7.3137	132.0830	163.9402	129.3161	157.1976
113795.02	7.2721	131.8201	163.1348	129.0579	157.1847
116390.88	7.2468	131.5606	163.2497	128.8067	157.1715
119057.92	7.2081	131.0531	163.0499	128.5400	157.1579
121625.90	7.1855	130.9655	162.7264	128.2956	157.1446
124326.12	7.1415	130.4891	162.3462	128.0302	157.1305
126906.34	7.1197	130.4690	161.9713	127.7823	157.1170
129627.30	7.0773	130.2332	161.2695	127.5245	157.1025
132252.23	7.0477	129.6532	161.3664	127.2540	157.0886
134892.61	7.0275	129.5392	161.1868	126.9957	157.0744
137521.58	6.9897	129.2491	160.7572	126.7455	157.0601
140222.22	6.9443	128.8158	160.1194	126.4841	157.0453
142854.95	6.9259	128.6758	160.1054	126.2392	157.0310
145530.20	6.8975	128.3739	159.6528	126.0178	157.0163
148164.08	6.8857	128.4360	159.4879	125.8225	157.0018
150809.42	6.8722	128.2253	159.4695	125.6177	156.9874
153530.73	6.8306	127.7322	158.9448	125.4268	156.9722
156318.34	6.8096	127.6611	158.8127	125.2401	156.9566
159000.34	6.7811	127.3796	158.2079	125.0481	156.9417
161805.77	6.7636	127.2470	158.3024	124.8607	156.9260
164588.19	6.7348	127.0132	157.7304	124.6716	156.9103
167389.14	6.7264	127.0234	157.7484	124.4782	156.8946
170235.39	6.6951	126.7381	157.0866	124.2820	156.8784
173066.06	6.6749	126.6465	156.8898	124.0911	156.8624
175914.63	6.6435	126.2037	156.6346	123.8925	156.8461
178732.78	6.6230	126.1010	156.2479	123.6987	156.8300
181638.55	6.6045	125.8065	156.4874	123.5004	156.8133
184499.58	6.5753	125.5569	155.9365	123.3053	156.7968
187401.84	6.5637	125.5821	155.8307	123.1075	156.7801
190281.59	6.5355	125.2152	155.6360	122.9074	156.7634

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
193235.14	6.5125	125.1617	154.9391	122.7070	156.7462
196131.58	6.4934	124.9439	154.9856	122.5088	156.7293
199080.64	6.4603	124.6038	154.3447	122.3032	156.7121
202018.55	6.4483	124.5482	154.2200	122.1104	156.6949
204937.23	6.4245	124.1470	154.0560	121.9408	156.6779
207849.45	6.4183	124.2446	153.8016	121.7984	156.6611
210787.97	6.3989	123.8982	153.7561	121.6652	156.6440
213710.81	6.3908	123.9750	153.4405	121.5423	156.6271
216661.47	6.3737	123.6529	153.4499	121.4203	156.6100
219591.75	6.3650	123.7198	153.1056	121.3036	156.5930
222552.97	6.3488	123.4076	153.1386	121.1850	156.5758
225492.59	6.3404	123.4734	152.7945	121.0700	156.5587
228463.92	6.3240	123.1578	152.8097	120.9522	156.5414
231451.63	6.3182	123.1162	152.9569	120.8359	156.5241
234399.67	6.2991	122.9063	152.4768	120.7198	156.5069
237404.84	6.2941	122.8622	152.6585	120.6032	156.4894
240365.38	6.2740	122.6520	152.1414	120.4873	156.4721
243393.42	6.2696	122.6007	152.3560	120.3708	156.4545
246371.23	6.2473	122.3842	151.7776	120.2557	156.4371
249423.23	6.2444	122.3370	152.0302	120.1400	156.4193
252401.47	6.2211	122.1997	151.3395	120.0237	156.4019
255451.42	6.2167	122.0524	151.6089	119.9042	156.3840
258447.19	6.1995	121.9927	151.0317	119.7878	156.3665
261516.84	6.1910	121.7824	151.2570	119.6675	156.3486
264528.69	6.1759	121.7516	150.7173	119.5514	156.3309
267617.31	6.1662	121.5363	150.9231	119.4313	156.3128
270646.97	6.1494	121.4863	150.3628	119.3146	156.2951
273750.09	6.1420	121.3139	150.6050	119.1949	156.2769
276798.88	6.1217	121.1921	150.0175	119.0773	156.2589
279915.31	6.1193	121.0979	150.3294	118.9572	156.2406
282971.31	6.0988	120.8894	149.7981	118.8364	156.2227
286092.44	6.0948	120.8696	149.9772	118.7153	156.2044
289177.53	6.0747	120.6540	149.5286	118.5954	156.1862
292319.66	6.0712	120.6699	149.6039	118.4770	156.1677
295471.91	6.0536	120.5764	149.0056	118.3521	156.1492
298574.06	6.0447	120.4535	149.1419	118.2326	156.1310
301743.25	6.0254	120.2492	148.6313	118.1103	156.1122
304866.91	6.0181	120.1984	148.6554	117.9878	156.0939
308051.63	5.9955	119.8981	148.2995	117.8642	156.0751
311198.59	5.9892	119.9205	148.1122	117.7422	156.0566
314395.59	5.9725	119.6107	148.1450	117.6172	156.0377
317556.25	5.9605	119.5647	147.7501	117.4955	156.0190
320776.41	5.9515	119.4052	147.9534	117.3703	156.0000

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
323956.28	5.9325	119.2104	147.5064	117.2461	155.9812
327193.94	5.9284	119.2199	147.5954	117.1222	155.9621
330391.91	5.9101	118.9687	147.3281	116.9965	155.9432
333641.91	5.9006	118.9899	147.0220	116.8734	155.9240
336841.91	5.8873	118.8196	146.8475	116.7567	155.9048
340091.91	5.8743	118.6787	146.6535	116.6397	155.8851
343291.91	5.8616	118.5489	146.4683	116.5204	155.8657
346541.91	5.8486	118.4155	146.2786	116.3966	155.8460
349741.91	5.8358	118.2834	146.0908	116.2734	155.8267
352991.91	5.8228	118.1488	145.8994	116.1474	155.8070
356241.91	5.8098	118.0139	145.7073	116.0210	155.7873
359441.91	5.7969	117.8809	145.5177	115.8963	155.7680
362691.91	5.7839	117.7457	145.3246	115.7695	155.7483
365891.91	5.7711	117.6126	145.1340	115.6445	155.7290
369141.91	5.7581	117.4773	144.9400	115.5176	155.7094
372341.91	5.7453	117.3440	144.7486	115.3925	155.6900
375591.91	5.7324	117.2087	144.5537	115.2655	155.6704
378791.91	5.7196	117.0754	144.3613	115.1404	155.6512
382041.91	5.7067	116.9399	144.1656	115.0133	155.6316
385241.91	5.6940	116.8066	143.9724	114.8882	155.6123
388491.91	5.6810	116.6711	143.7757	114.7611	155.5928
391691.91	5.6684	116.5377	143.5816	114.6359	155.5735
394941.91	5.6555	116.4022	143.3840	114.5087	155.5540
398141.91	5.6428	116.2687	143.1891	114.3835	155.5348
401391.91	5.6322	116.1423	143.0342	114.2579	155.5154
404591.91	5.6244	116.0489	142.9135	114.1534	155.4963
407841.91	5.6173	115.9631	142.7970	114.0633	155.4771
411041.91	5.6106	115.8837	142.6860	113.9834	155.4581
414291.91	5.6041	115.8059	142.5753	113.9073	155.4389
417491.91	5.5978	115.7309	142.4675	113.8352	155.4200
420741.91	5.5915	115.6558	142.3586	113.7636	155.4009
423991.91	5.5852	115.5813	142.2500	113.6929	155.3817
427191.91	5.5791	115.5083	142.1432	113.6240	155.3629
430441.91	5.5729	115.4344	142.0349	113.5543	155.3439
433641.91	5.5668	115.3618	141.9283	113.4860	155.3251
436891.91	5.5606	115.2883	141.8199	113.4168	155.3061
440091.91	5.5546	115.2159	141.7132	113.3488	155.2874
443341.91	5.5484	115.1425	141.6047	113.2798	155.2685
446541.91	5.5424	115.0703	141.4978	113.2119	155.2498
449791.91	5.5363	114.9971	141.3891	113.1431	155.2309
452991.91	5.5302	114.9249	141.2821	113.0754	155.2123
456241.91	5.5241	114.8517	141.1732	113.0066	155.1934
459441.91	5.5181	114.7797	141.0659	112.9390	155.1749

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
462691.91	5.5120	114.7066	140.9569	112.8703	155.1561
465891.91	5.5060	114.6346	140.8494	112.8027	155.1376
469141.91	5.4999	114.5615	140.7401	112.7341	155.1188
472341.91	5.4940	114.4896	140.6324	112.6666	155.1003
475591.91	5.4879	114.4165	140.5229	112.5980	155.0816
478791.91	5.4819	114.3446	140.4150	112.5305	155.0632
482041.91	5.4759	114.2716	140.3053	112.4620	155.0445
485241.91	5.4699	114.1998	140.1971	112.3946	155.0261
488491.91	5.4638	114.1268	140.0872	112.3261	155.0075
491741.91	5.4578	114.0538	139.9771	112.2577	154.9889
494941.91	5.4519	113.9820	139.8686	112.1903	154.9706
498191.91	5.4458	113.9091	139.7583	112.1219	154.9520
501391.91	5.4399	113.8373	139.6495	112.0545	154.9338
504641.91	5.4339	113.7644	139.5390	111.9861	154.9153
507841.91	5.4279	113.6927	139.4300	111.9188	154.8971
511091.91	5.4219	113.6198	139.3192	111.8505	154.8786
514291.91	5.4160	113.5481	139.2100	111.7832	154.8604
517541.91	5.4100	113.4752	139.0989	111.7149	154.8420
520741.91	5.4041	113.4035	138.9894	111.6476	154.8239
523991.91	5.3981	113.3307	138.8781	111.5793	154.8055
527191.94	5.3922	113.2590	138.7684	111.5121	154.7875
530441.94	5.3863	113.1862	138.6568	111.4438	154.7691
533641.94	5.3804	113.1145	138.5469	111.3766	154.7511
536891.94	5.3744	113.0417	138.4350	111.3083	154.7328
540091.94	5.3685	112.9700	138.3248	111.2411	154.7149
543341.94	5.3626	112.8972	138.2128	111.1729	154.6966
546541.94	5.3567	112.8256	138.1023	111.1058	154.6787
549791.94	5.3508	112.7528	137.9899	111.0375	154.6605
553041.94	5.3448	112.6801	137.8775	110.9693	154.6423
556241.94	5.3390	112.6085	137.7666	110.9022	154.6245
559491.94	5.3330	112.5357	137.6539	110.8340	154.6064
562691.94	5.3272	112.4641	137.5427	110.7669	154.5886
565941.94	5.3213	112.3914	137.4297	110.6988	154.5705
569141.94	5.3154	112.3198	137.3183	110.6317	154.5527
572391.94	5.3095	112.2471	137.2051	110.5635	154.5347
575591.94	5.3037	112.1755	137.0934	110.4964	154.5170
578841.94	5.2978	112.1028	136.9799	110.4283	154.4990
582041.94	5.2920	112.0312	136.8680	110.3612	154.4814
585291.94	5.2861	111.9585	136.7542	110.2931	154.4634
588491.94	5.2803	111.8869	136.6420	110.2261	154.4458
591741.94	5.2744	111.8142	136.5279	110.1580	154.4279
594941.94	5.2686	111.7427	136.4155	110.0909	154.4104
598191.94	5.2627	111.6700	136.3011	110.0228	154.3926

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
601391.94	5.2578	111.6021	136.2073	109.9564	154.3750
604641.94	5.2539	111.5460	136.1264	109.8969	154.3573
607841.94	5.2503	111.4945	136.0494	109.8448	154.3399
611091.94	5.2468	111.4443	135.9728	109.7955	154.3223
614291.94	5.2434	111.3960	135.8983	109.7490	154.3049
617541.94	5.2401	111.3476	135.8230	109.7029	154.2874
620791.94	5.2368	111.2998	135.7481	109.6576	154.2698
623991.94	5.2335	111.2528	135.6745	109.6133	154.2525
627241.94	5.2303	111.2054	135.5997	109.5687	154.2350
630441.94	5.2270	111.1588	135.5262	109.5249	154.2178
633691.94	5.2238	111.1115	135.4515	109.4805	154.2004
636891.94	5.2206	111.0650	135.3780	109.4369	154.1832
640141.94	5.2173	111.0179	135.3033	109.3926	154.1658
643341.94	5.2141	110.9715	135.2297	109.3491	154.1487
646591.94	5.2109	110.9244	135.1550	109.3049	154.1313
649791.94	5.2077	110.8781	135.0813	109.2615	154.1142
653041.94	5.2045	110.8311	135.0065	109.2174	154.0969
656241.94	5.2013	110.7848	134.9327	109.1740	154.0799
659491.94	5.1981	110.7378	134.8578	109.1300	154.0627
662691.94	5.1949	110.6916	134.7840	109.0867	154.0457
665941.94	5.1917	110.6446	134.7090	109.0427	154.0284
669141.94	5.1885	110.5984	134.6351	108.9994	154.0115
672391.94	5.1853	110.5515	134.5600	108.9554	153.9943
675591.94	5.1821	110.5054	134.4860	108.9122	153.9775
678841.94	5.1789	110.4585	134.4108	108.8682	153.9603
682041.94	5.1757	110.4124	134.3367	108.8250	153.9435
685291.94	5.1725	110.3655	134.2614	108.7811	153.9264
688541.94	5.1693	110.3187	134.1861	108.7373	153.9093
691741.94	5.1662	110.2726	134.1119	108.6941	153.8926
694991.94	5.1630	110.2258	134.0364	108.6502	153.8756
698191.94	5.1598	110.1797	133.9621	108.6071	153.8588
701441.94	5.1566	110.1329	133.8866	108.5632	153.8419
704641.94	5.1535	110.0869	133.8121	108.5201	153.8252
707891.94	5.1503	110.0401	133.7365	108.4763	153.8082
711091.94	5.1472	109.9940	133.6619	108.4332	153.7916
714341.94	5.1440	109.9473	133.5862	108.3894	153.7747
717541.94	5.1408	109.9013	133.5115	108.3463	153.7581
720791.94	5.1377	109.8546	133.4357	108.3026	153.7413
723991.94	5.1345	109.8086	133.3609	108.2595	153.7247
727241.94	5.1314	109.7618	133.2849	108.2157	153.7080
730441.94	5.1282	109.7159	133.2101	108.1727	153.6915
733691.94	5.1251	109.6692	133.1340	108.1290	153.6747
736891.94	5.1219	109.6232	133.0591	108.0859	153.6582

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
740141.94	5.1188	109.5765	132.9829	108.0422	153.6415
743341.94	5.1156	109.5305	132.9078	107.9992	153.6251
746591.94	5.1125	109.4839	132.8315	107.9555	153.6085
749791.94	5.1094	109.4379	132.7563	107.9125	153.5921
753041.94	5.1062	109.3913	132.6799	107.8689	153.5755
756291.94	5.1030	109.3446	132.6034	107.8252	153.5589
759491.94	5.0999	109.2987	132.5281	107.7822	153.5426
762741.94	5.0968	109.2521	132.4515	107.7386	153.5260
765941.94	5.0937	109.2062	132.3760	107.6956	153.5097
769191.94	5.0905	109.1595	132.2993	107.6520	153.4932
772391.94	5.0874	109.1136	132.2238	107.6090	153.4770
775641.94	5.0843	109.0670	132.1469	107.5654	153.4606
778841.94	5.0812	109.0211	132.0713	107.5224	153.4444
782091.94	5.0780	108.9745	131.9943	107.4788	153.4280
785291.94	5.0749	108.9286	131.9185	107.4359	153.4118
788541.94	5.0718	108.8820	131.8415	107.3923	153.3954
791741.94	5.0687	108.8362	131.7655	107.3494	153.3793
794991.94	5.0656	108.7896	131.6884	107.3058	153.3630
798191.94	5.0625	108.7437	131.6124	107.2629	153.3470
801441.94	5.0598	108.6993	131.5462	107.2197	153.3307
804641.94	5.0577	108.6624	131.4893	107.1814	153.3147
807891.94	5.0558	108.6270	131.4330	107.1461	153.2985
811091.94	5.0540	108.5932	131.3785	107.1134	153.2826
814341.94	5.0522	108.5596	131.3237	107.0812	153.2664
817591.94	5.0504	108.5264	131.2691	107.0497	153.2503
820791.94	5.0486	108.4940	131.2156	107.0191	153.2345
824041.94	5.0469	108.4612	131.1613	106.9883	153.2184
827241.94	5.0452	108.4290	131.1079	106.9580	153.2026
830491.94	5.0434	108.3963	131.0537	106.9274	153.1866
833691.94	5.0417	108.3642	131.0003	106.8973	153.1708
836941.94	5.0400	108.3317	130.9461	106.8668	153.1548
840141.94	5.0383	108.2996	130.8927	106.8368	153.1391
843391.94	5.0366	108.2671	130.8385	106.8063	153.1231
846591.94	5.0349	108.2352	130.7850	106.7764	153.1074
849841.94	5.0331	108.2027	130.7308	106.7460	153.0915
853041.94	5.0314	108.1707	130.6773	106.7161	153.0758
856291.94	5.0297	108.1383	130.6230	106.6857	153.0600
859491.94	5.0280	108.1064	130.5696	106.6558	153.0443
862741.94	5.0263	108.0740	130.5152	106.6255	153.0285
865941.94	5.0246	108.0421	130.4617	106.5956	153.0129
869191.94	5.0229	108.0097	130.4073	106.5653	152.9971
872391.94	5.0212	107.9778	130.3538	106.5355	152.9816
875641.94	5.0195	107.9454	130.2993	106.5052	152.9659

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
878841.94	5.0178	107.9136	130.2457	106.4754	152.9503
882091.94	5.0161	107.8812	130.1913	106.4451	152.9346
885341.94	5.0144	107.8489	130.1368	106.4148	152.9189
888541.94	5.0127	107.8170	130.0831	106.3851	152.9035
891791.94	5.0110	107.7847	130.0286	106.3548	152.8878
894991.94	5.0093	107.7529	129.9748	106.3250	152.8724
898241.94	5.0076	107.7206	129.9203	106.2948	152.8568
901441.94	5.0059	107.6888	129.8665	106.2651	152.8414
904691.94	5.0042	107.6565	129.8118	106.2348	152.8259
907891.94	5.0025	107.6247	129.7580	106.2051	152.8105
911141.94	5.0008	107.5924	129.7033	106.1749	152.7950
914341.94	4.9991	107.5606	129.6495	106.1452	152.7797
917591.94	4.9974	107.5284	129.5947	106.1150	152.7642
920791.94	4.9958	107.4966	129.5408	106.0853	152.7489
924041.94	4.9941	107.4643	129.4860	106.0551	152.7335
927241.94	4.9924	107.4326	129.4320	106.0254	152.7183
930491.94	4.9907	107.4003	129.3772	105.9953	152.7028
933691.94	4.9890	107.3686	129.3232	105.9656	152.6877
936941.94	4.9873	107.3363	129.2682	105.9354	152.6723
940141.94	4.9857	107.3046	129.2142	105.9058	152.6571
943391.94	4.9840	107.2724	129.1592	105.8756	152.6418
946591.94	4.9823	107.2406	129.1051	105.8459	152.6267
949841.94	4.9806	107.2084	129.0501	105.8158	152.6114
953091.94	4.9789	107.1762	128.9950	105.7857	152.5961
956291.94	4.9773	107.1445	128.9408	105.7561	152.5810
959541.94	4.9756	107.1123	128.8857	105.7259	152.5658
962741.94	4.9739	107.0806	128.8315	105.6963	152.5507
965991.94	4.9722	107.0484	128.7763	105.6662	152.5355
969191.94	4.9706	107.0167	128.7220	105.6366	152.5205
972441.94	4.9689	106.9845	128.6668	105.6065	152.5054
975641.94	4.9672	106.9528	128.6124	105.5768	152.4904
978891.94	4.9655	106.9206	128.5571	105.5468	152.4753
982091.94	4.9639	106.8889	128.5027	105.5171	152.4604
985341.94	4.9622	106.8567	128.4474	105.4871	152.4453
988541.94	4.9605	106.8251	128.3929	105.4574	152.4304
991791.94	4.9589	106.7929	128.3375	105.4274	152.4153
994991.94	4.9572	106.7612	128.2830	105.3978	152.4005
998241.94	4.9555	106.7290	128.2275	105.3677	152.3854
1001441.94	4.9542	106.6989	128.1813	105.3384	152.3707
1004691.94	4.9533	106.6734	128.1407	105.3118	152.3557
1007891.94	4.9525	106.6498	128.1019	105.2882	152.3410
1011141.94	4.9517	106.6267	128.0631	105.2656	152.3260
1014391.94	4.9510	106.6040	128.0248	105.2440	152.3111

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
1017591.94	4.9503	106.5820	127.9872	105.2231	152.2964
1020841.94	4.9496	106.5599	127.9492	105.2022	152.2816
1024041.94	4.9489	106.5381	127.9119	105.1817	152.2669
1027291.94	4.9482	106.5161	127.8740	105.1611	152.2521
1030491.94	4.9476	106.4945	127.8368	105.1408	152.2375
1033741.94	4.9469	106.4726	127.7989	105.1203	152.2227
1036941.94	4.9462	106.4511	127.7617	105.1001	152.2081
1040191.94	4.9456	106.4292	127.7239	105.0797	152.1933
1043391.94	4.9449	106.4077	127.6866	105.0595	152.1788
1046641.94	4.9442	106.3859	127.6488	105.0391	152.1641
1049841.88	4.9436	106.3644	127.6115	105.0190	152.1496
1053091.88	4.9429	106.3426	127.5737	104.9986	152.1349
1056291.88	4.9423	106.3211	127.5365	104.9785	152.1204
1059541.88	4.9416	106.2994	127.4986	104.9582	152.1057
1062741.88	4.9409	106.2779	127.4614	104.9381	152.0913
1065991.88	4.9403	106.2562	127.4235	104.9178	152.0766
1069191.88	4.9396	106.2347	127.3862	104.8977	152.0622
1072441.88	4.9390	106.2130	127.3484	104.8774	152.0476
1075641.88	4.9383	106.1916	127.3111	104.8574	152.0333
1078891.88	4.9376	106.1699	127.2732	104.8371	152.0187
1082141.88	4.9370	106.1481	127.2353	104.8167	152.0041
1085341.88	4.9363	106.1267	127.1980	104.7968	151.9898
1088591.88	4.9357	106.1050	127.1600	104.7765	151.9753
1091791.88	4.9350	106.0837	127.1227	104.7565	151.9610
1095041.88	4.9344	106.0620	127.0848	104.7362	151.9465
1098241.88	4.9337	106.0406	127.0474	104.7162	151.9322
1101491.88	4.9331	106.0189	127.0095	104.6959	151.9177
1104691.88	4.9324	105.9975	126.9721	104.6760	151.9035
1107941.88	4.9318	105.9759	126.9341	104.6557	151.8891
1111141.88	4.9311	105.9545	126.8967	104.6358	151.8749
1114391.88	4.9305	105.9328	126.8587	104.6155	151.8605
1117591.88	4.9298	105.9115	126.8213	104.5956	151.8463
1120841.88	4.9292	105.8898	126.7833	104.5753	151.8319
1124041.88	4.9285	105.8685	126.7458	104.5554	151.8178
1127291.88	4.9279	105.8469	126.7078	104.5352	151.8034
1130491.88	4.9272	105.8256	126.6703	104.5152	151.7893
1133741.88	4.9266	105.8039	126.6323	104.4950	151.7750
1136941.88	4.9259	105.7826	126.5948	104.4751	151.7609
1140191.88	4.9253	105.7610	126.5567	104.4549	151.7466
1143391.88	4.9246	105.7397	126.5192	104.4350	151.7326
1146641.88	4.9240	105.7180	126.4811	104.4148	151.7183
1149891.88	4.9233	105.6964	126.4430	104.3945	151.7041
1153091.88	4.9227	105.6751	126.4055	104.3747	151.6901

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
1156341.88	4.9220	105.6535	126.3673	104.3545	151.6759
1159541.88	4.9214	105.6322	126.3298	104.3346	151.6619
1162791.88	4.9207	105.6106	126.2916	104.3144	151.6477
1165991.88	4.9201	105.5893	126.2540	104.2945	151.6338
1169241.88	4.9194	105.5677	126.2158	104.2743	151.6196
1172441.88	4.9188	105.5464	126.1782	104.2544	151.6057
1175691.88	4.9182	105.5248	126.1400	104.2342	151.5916
1178891.88	4.9175	105.5035	126.1024	104.2144	151.5777
1182141.88	4.9169	105.4819	126.0642	104.1942	151.5636
1185341.88	4.9162	105.4607	126.0265	104.1743	151.5498
1188591.88	4.9156	105.4391	125.9882	104.1542	151.5357
1191791.88	4.9150	105.4178	125.9506	104.1343	151.5219
1195041.88	4.9143	105.3962	125.9123	104.1141	151.5079
1198241.88	4.9137	105.3750	125.8746	104.0943	151.4940
1201491.88	4.9130	105.3534	125.8363	104.0741	151.4801
1204691.88	4.9124	105.3321	125.7985	104.0543	151.4663
1207941.88	4.9117	105.3106	125.7602	104.0341	151.4523
1211191.88	4.9111	105.2890	125.7218	104.0140	151.4384
1214391.88	4.9105	105.2677	125.6841	103.9941	151.4246
1217641.88	4.9098	105.2462	125.6457	103.9740	151.4107
1220841.88	4.9092	105.2249	125.6079	103.9542	151.3970
1224091.88	4.9085	105.2033	125.5695	103.9340	151.3831
1227291.88	4.9079	105.1821	125.5317	103.9142	151.3695
1230541.88	4.9073	105.1605	125.4933	103.8940	151.3556
1233741.88	4.9066	105.1393	125.4554	103.8742	151.3419
1236991.88	4.9060	105.1177	125.4170	103.8541	151.3281
1240191.88	4.9054	105.0965	125.3791	103.8342	151.3145
1243441.88	4.9047	105.0750	125.3406	103.8141	151.3007
1246641.88	4.9041	105.0537	125.3027	103.7943	151.2871
1249891.88	4.9034	105.0322	125.2642	103.7742	151.2733
1253091.88	4.9028	105.0109	125.2263	103.7543	151.2598
1256341.88	4.9022	104.9894	125.1877	103.7342	151.2460
1259541.88	4.9015	104.9682	125.1498	103.7144	151.2325
1262791.88	4.9009	104.9466	125.1112	103.6943	151.2188
1265991.88	4.9003	104.9253	125.0732	103.6744	151.2053
1269241.88	4.8996	104.9038	125.0346	103.6543	151.1916
1272441.88	4.8990	104.8825	124.9966	103.6345	151.1782
1275691.88	4.8984	104.8610	124.9580	103.6143	151.1645
1278941.88	4.8977	104.8394	124.9193	103.5942	151.1509
1282141.88	4.8971	104.8182	124.8812	103.5744	151.1374
1285391.88	4.8964	104.7966	124.8426	103.5543	151.1238
1288591.88	4.8958	104.7754	124.8045	103.5344	151.1104
1291841.88	4.8952	104.7538	124.7658	103.5143	151.0968

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
1295041.88	4.8945	104.7326	124.7277	103.4945	151.0835
1298291.88	4.8939	104.7110	124.6889	103.4744	151.0699
1301491.88	4.8933	104.6898	124.6508	103.4546	151.0566
1304741.88	4.8926	104.6682	124.6120	103.4344	151.0431
1307941.88	4.8920	104.6470	124.5739	103.4146	151.0298
1311191.88	4.8914	104.6254	124.5351	103.3945	151.0163
1314391.88	4.8907	104.6042	124.4969	103.3747	151.0030
1317641.88	4.8901	104.5826	124.4581	103.3546	150.9895
1320841.88	4.8895	104.5614	124.4198	103.3347	150.9763
1324091.88	4.8888	104.5399	124.3810	103.3146	150.9628
1327291.88	4.8882	104.5186	124.3427	103.2948	150.9496
1330541.88	4.8876	104.4971	124.3038	103.2747	150.9362
1333741.88	4.8869	104.4759	124.2656	103.2549	150.9230
1336991.88	4.8863	104.4543	124.2267	103.2348	150.9097
1340191.88	4.8857	104.4331	124.1883	103.2150	150.8965
1343441.88	4.8850	104.4115	124.1494	103.1949	150.8831
1346691.88	4.8844	104.3900	124.1105	103.1748	150.8698
1349891.88	4.8838	104.3688	124.0721	103.1550	150.8567
1353141.88	4.8831	104.3472	124.0331	103.1348	150.8434
1356341.88	4.8825	104.3260	123.9948	103.1150	150.8303
1359591.88	4.8819	104.3045	123.9558	103.0949	150.8170
1362791.88	4.8812	104.2832	123.9173	103.0751	150.8040
1366041.88	4.8806	104.2617	123.8783	103.0550	150.7907
1369241.88	4.8800	104.2405	123.8399	103.0352	150.7777
1372491.88	4.8793	104.2189	123.8008	103.0151	150.7645
1375691.88	4.8787	104.1977	123.7623	102.9953	150.7515
1378941.88	4.8781	104.1762	123.7233	102.9752	150.7383
1382141.88	4.8774	104.1549	123.6848	102.9554	150.7253
1385391.88	4.8768	104.1334	123.6456	102.9353	150.7122
1388591.88	4.8762	104.1122	123.6071	102.9155	150.6992
1391841.88	4.8755	104.0906	123.5680	102.8954	150.6861
1395041.88	4.8749	104.0694	123.5294	102.8756	150.6732
1398291.88	4.8743	104.0479	123.4902	102.8555	150.6601
1401491.88	4.8739	104.0280	123.4586	102.8360	150.6472
1404741.88	4.8739	104.0117	123.4317	102.8186	150.6341
1407941.88	4.8739	103.9967	123.4061	102.8035	150.6213
1411191.88	4.8739	103.9822	123.3807	102.7893	150.6083
1414441.88	4.8739	103.9681	123.3555	102.7757	150.5953
1417641.88	4.8739	103.9545	123.3310	102.7627	150.5825
1420891.88	4.8739	103.9407	123.3062	102.7497	150.5695
1424091.88	4.8739	103.9273	123.2818	102.7371	150.5567
1427341.88	4.8739	103.9137	123.2571	102.7243	150.5438
1430541.88	4.8739	103.9003	123.2327	102.7118	150.5311

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
1433791.88	4.8739	103.8867	123.2081	102.6991	150.5181
1436991.88	4.8739	103.8734	123.1838	102.6867	150.5054
1440241.88	4.8739	103.8599	123.1591	102.6740	150.4925
1443441.88	4.8739	103.8466	123.1348	102.6616	150.4798
1446691.88	4.8739	103.8332	123.1102	102.6490	150.4669
1449891.88	4.8739	103.8199	123.0859	102.6366	150.4543
1453141.88	4.8739	103.8064	123.0613	102.6240	150.4414
1456341.88	4.8739	103.7932	123.0370	102.6117	150.4288
1459591.88	4.8739	103.7797	123.0123	102.5991	150.4160
1462791.88	4.8739	103.7665	122.9881	102.5867	150.4034
1466041.88	4.8739	103.7530	122.9634	102.5742	150.3905
1469241.88	4.8739	103.7398	122.9392	102.5618	150.3780
1472491.88	4.8739	103.7264	122.9145	102.5493	150.3652
1475741.88	4.8739	103.7129	122.8899	102.5367	150.3524
1478941.88	4.8739	103.6997	122.8656	102.5244	150.3399
1482191.88	4.8739	103.6863	122.8409	102.5119	150.3271
1485391.88	4.8739	103.6731	122.8166	102.4995	150.3146
1488641.88	4.8739	103.6597	122.7920	102.4870	150.3019
1491841.88	4.8739	103.6465	122.7677	102.4747	150.2894
1495091.88	4.8739	103.6331	122.7430	102.4622	150.2767
1498291.88	4.8739	103.6199	122.7188	102.4498	150.2642
1501541.88	4.8739	103.6065	122.6941	102.4373	150.2515
1504741.88	4.8739	103.5933	122.6698	102.4250	150.2390
1507991.88	4.8739	103.5799	122.6451	102.4125	150.2264
1511191.88	4.8739	103.5667	122.6208	102.4002	150.2140
1514441.88	4.8739	103.5533	122.5961	102.3877	150.2013
1517641.88	4.8739	103.5402	122.5718	102.3754	150.1889
1520891.88	4.8739	103.5268	122.5471	102.3629	150.1763
1524091.88	4.8739	103.5136	122.5228	102.3507	150.1639
1527341.88	4.8739	103.5003	122.4981	102.3382	150.1514
1530541.88	4.8739	103.4871	122.4738	102.3259	150.1390
1533791.88	4.8739	103.4737	122.4491	102.3134	150.1264
1536991.88	4.8739	103.4606	122.4248	102.3011	150.1141
1540241.88	4.8739	103.4472	122.4001	102.2887	150.1015
1543491.88	4.8739	103.4338	122.3754	102.2762	150.0890
1546691.88	4.8739	103.4207	122.3510	102.2639	150.0767
1549941.88	4.8739	103.4073	122.3263	102.2515	150.0642
1553141.88	4.8739	103.3942	122.3020	102.2392	150.0519
1556391.88	4.8739	103.3808	122.2772	102.2267	150.0394
1559591.88	4.8739	103.3677	122.2529	102.2145	150.0272
1562841.88	4.8739	103.3543	122.2282	102.2020	150.0147
1566041.88	4.8739	103.3412	122.2038	102.1898	150.0025
1569291.88	4.8739	103.3279	122.1791	102.1773	149.9901

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
1572491.88	4.8739	103.3147	122.1547	102.1650	149.9778
1575741.88	4.8739	103.3014	122.1299	102.1526	149.9654
1578941.88	4.8739	103.2883	122.1056	102.1403	149.9532
1582191.88	4.8739	103.2749	122.0808	102.1279	149.9408
1585391.88	4.8739	103.2618	122.0564	102.1157	149.9286
1588641.88	4.8739	103.2485	122.0317	102.1032	149.9163
1591841.88	4.8739	103.2353	122.0073	102.0910	149.9041
1595091.88	4.8739	103.2220	121.9825	102.0785	149.8918
1598291.88	4.8739	103.2089	121.9581	102.0663	149.8797
1601541.88	4.8739	103.1956	121.9333	102.0539	149.8674
1604741.88	4.8739	103.1824	121.9089	102.0416	149.8552
1607991.88	4.8739	103.1691	121.8841	102.0292	149.8429
1611241.88	4.8739	103.1558	121.8593	102.0168	149.8307
1614441.88	4.8739	103.1427	121.8349	102.0045	149.8186
1617691.88	4.8739	103.1294	121.8101	101.9921	149.8063
1620891.88	4.8739	103.1163	121.7857	101.9799	149.7943
1624141.88	4.8739	103.1029	121.7608	101.9675	149.7820
1627341.88	4.8739	103.0898	121.7364	101.9552	149.7700
1630591.88	4.8739	103.0765	121.7116	101.9428	149.7578
1633791.88	4.8739	103.0634	121.6871	101.9306	149.7458
1637041.88	4.8739	103.0501	121.6623	101.9182	149.7336
1640241.88	4.8739	103.0370	121.6379	101.9059	149.7216
1643491.88	4.8739	103.0237	121.6130	101.8935	149.7094
1646691.88	4.8739	103.0106	121.5885	101.8813	149.6974
1649941.88	4.8739	102.9973	121.5637	101.8689	149.6853
1653141.88	4.8739	102.9842	121.5392	101.8567	149.6733
1656391.88	4.8739	102.9709	121.5144	101.8443	149.6612
1659591.88	4.8739	102.9578	121.4899	101.8320	149.6493
1662841.88	4.8739	102.9445	121.4650	101.8196	149.6372
1666041.88	4.8739	102.9314	121.4405	101.8074	149.6253
1669291.88	4.8739	102.9181	121.4156	101.7950	149.6132
1672541.88	4.8739	102.9048	121.3907	101.7826	149.6011
1675741.88	4.8739	102.8917	121.3662	101.7704	149.5892
1678991.88	4.8739	102.8784	121.3413	101.7580	149.5772
1682191.88	4.8739	102.8653	121.3168	101.7458	149.5653
1685441.88	4.8739	102.8520	121.2919	101.7334	149.5533
1688641.88	4.8739	102.8389	121.2674	101.7212	149.5415
1691891.88	4.8739	102.8256	121.2424	101.7088	149.5295
1695091.88	4.8739	102.8125	121.2179	101.6965	149.5177
1698341.88	4.8739	102.7992	121.1930	101.6842	149.5057
1701541.88	4.8739	102.7861	121.1684	101.6719	149.4939
1704791.88	4.8739	102.7728	121.1435	101.6595	149.4819
1707991.88	4.8739	102.7597	121.1189	101.6473	149.4702

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
1711241.88	4.8739	102.7464	121.0940	101.6349	149.4582
1714441.88	4.8739	102.7333	121.0694	101.6227	149.4465
1717691.88	4.8739	102.7201	121.0445	101.6104	149.4345
1720891.88	4.8739	102.7070	121.0199	101.5981	149.4228
1724141.88	4.8739	102.6937	120.9949	101.5858	149.4109
1727341.88	4.8739	102.6806	120.9703	101.5736	149.3992
1730591.88	4.8739	102.6673	120.9453	101.5612	149.3873
1733791.88	4.8739	102.6542	120.9207	101.5490	149.3757
1737041.88	4.8739	102.6409	120.8957	101.5366	149.3638
1740291.88	4.8739	102.6276	120.8708	101.5242	149.3519
1743491.88	4.8739	102.6146	120.8461	101.5120	149.3403
1746741.88	4.8739	102.6013	120.8211	101.4996	149.3285
1749941.88	4.8739	102.5882	120.7965	101.4874	149.3168
1753191.88	4.8739	102.5749	120.7715	101.4750	149.3050
1756391.88	4.8739	102.5618	120.7468	101.4628	149.2934
1759641.88	4.8739	102.5485	120.7218	101.4504	149.2816
1762841.88	4.8739	102.5355	120.6972	101.4382	149.2701
1766091.88	4.8739	102.5222	120.6721	101.4258	149.2583
1769291.88	4.8739	102.5091	120.6475	101.4137	149.2467
1772541.88	4.8739	102.4958	120.6224	101.4013	149.2350
1775741.88	4.8739	102.4827	120.5977	101.3891	149.2234
1778991.88	4.8739	102.4694	120.5727	101.3767	149.2117
1782191.88	4.8739	102.4564	120.5480	101.3645	149.2002
1785441.88	4.8739	102.4431	120.5229	101.3521	149.1885
1788641.88	4.8739	102.4300	120.4982	101.3399	149.1770
1791891.88	4.8739	102.4167	120.4732	101.3275	149.1653
1795091.88	4.8739	102.4036	120.4485	101.3153	149.1538
1798341.88	4.8739	102.3904	120.4234	101.3030	149.1422
1801541.88	4.8739	102.3773	120.3987	101.2908	149.1307
1804791.88	4.8739	102.3640	120.3736	101.2784	149.1191
1808041.88	4.8739	102.3507	120.3484	101.2660	149.1075
1811241.88	4.8739	102.3376	120.3237	101.2538	149.0960
1814491.88	4.8739	102.3244	120.2986	101.2414	149.0844
1817691.88	4.8739	102.3113	120.2738	101.2292	149.0730
1820941.88	4.8739	102.2980	120.2487	101.2169	149.0614
1824141.88	4.8739	102.2849	120.2240	101.2047	149.0500
1827391.88	4.8739	102.2717	120.1988	101.1923	149.0385
1830591.88	4.8739	102.2586	120.1741	101.1801	149.0271
1833841.88	4.8739	102.2453	120.1489	101.1677	149.0156
1837041.88	4.8739	102.2322	120.1241	101.1555	149.0042
1840291.88	4.8739	102.2189	120.0990	101.1432	148.9927
1843491.88	4.8739	102.2059	120.0742	101.1310	148.9814
1846741.88	4.8739	102.1926	120.0490	101.1186	148.9699

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
1849941.88	4.8739	102.1795	120.0242	101.1064	148.9586
1853191.88	4.8739	102.1662	119.9990	101.0940	148.9471
1856391.88	4.8739	102.1532	119.9742	101.0819	148.9358
1859641.88	4.8739	102.1399	119.9490	101.0695	148.9243
1862841.88	4.8739	102.1268	119.9242	101.0573	148.9131
1866091.88	4.8739	102.1135	119.8990	101.0449	148.9016
1869341.88	4.8739	102.1003	119.8738	101.0325	148.8902
1872541.88	4.8739	102.0872	119.8489	101.0204	148.8790
1875791.88	4.8739	102.0739	119.8237	101.0080	148.8676
1878991.88	4.8739	102.0608	119.7989	100.9958	148.8564
1882241.88	4.8739	102.0476	119.7736	100.9834	148.8450
1885441.88	4.8739	102.0345	119.7488	100.9712	148.8338
1888691.88	4.8739	102.0212	119.7235	100.9589	148.8224
1891891.88	4.8739	102.0081	119.6986	100.9467	148.8112
1895141.88	4.8739	101.9949	119.6734	100.9343	148.7999
1898341.88	4.8739	101.9818	119.6485	100.9221	148.7887
1901591.88	4.8739	101.9685	119.6232	100.9098	148.7774
1904791.88	4.8739	101.9554	119.5983	100.8976	148.7663
1908041.88	4.8739	101.9422	119.5730	100.8852	148.7550
1911241.88	4.8739	101.9291	119.5481	100.8730	148.7439
1914491.88	4.8739	101.9158	119.5228	100.8606	148.7326
1917691.88	4.8739	101.9027	119.4979	100.8485	148.7215
1920941.88	4.8739	101.8895	119.4726	100.8361	148.7102
1924141.88	4.8739	101.8764	119.4477	100.8239	148.6992
1927391.88	4.8739	101.8631	119.4224	100.8115	148.6879
1930591.88	4.8739	101.8500	119.3974	100.7993	148.6769
1933841.88	4.8739	101.8368	119.3721	100.7870	148.6656
1937091.88	4.8739	101.8235	119.3468	100.7746	148.6544
1940291.88	4.8739	101.8104	119.3218	100.7624	148.6434
1943541.88	4.8739	101.7971	119.2965	100.7500	148.6322
1946741.88	4.8739	101.7841	119.2715	100.7379	148.6212
1949991.88	4.8739	101.7708	119.2461	100.7255	148.6100
1953191.88	4.8739	101.7577	119.2212	100.7133	148.5991
1956441.88	4.8739	101.7444	119.1958	100.7009	148.5879
1959641.88	4.8739	101.7314	119.1708	100.6888	148.5770
1962891.88	4.8739	101.7181	119.1454	100.6764	148.5658
1966091.88	4.8739	101.7050	119.1204	100.6642	148.5549
1969341.88	4.8739	101.6917	119.0950	100.6518	148.5438
1972541.88	4.8739	101.6787	119.0700	100.6397	148.5329
1975791.88	4.8739	101.6654	119.0446	100.6273	148.5218
1978991.88	4.8739	101.6523	119.0196	100.6151	148.5108
1982241.88	4.8739	101.6391	118.9942	100.6027	148.4998
1985441.88	4.8739	101.6260	118.9691	100.5906	148.4889

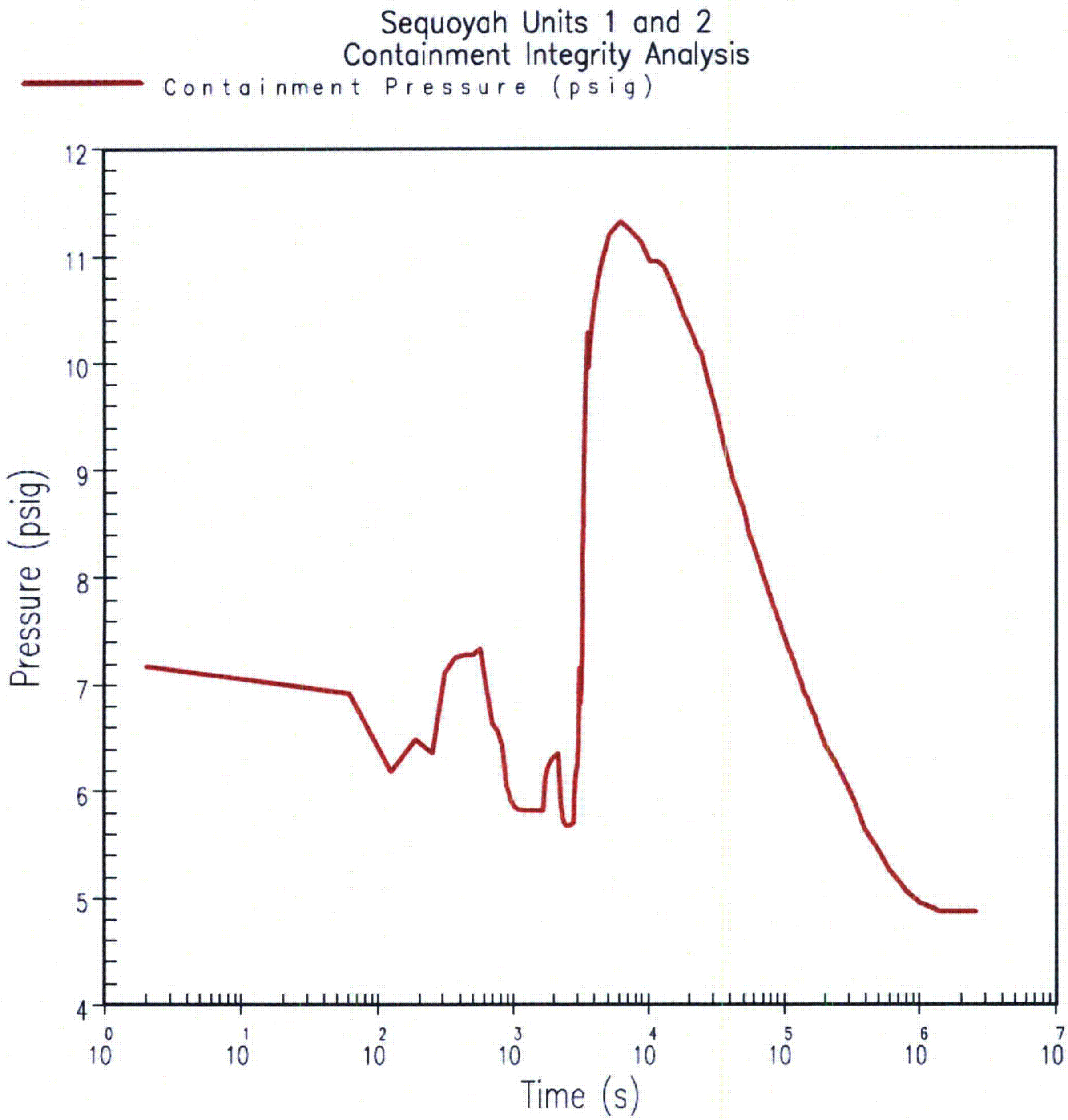
TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
1988691.88	4.8739	101.6127	118.9437	100.5782	148.4779
1991891.88	4.8739	101.5996	118.9187	100.5660	148.4670
1995141.88	4.8739	101.5864	118.8932	100.5536	148.4560
1998341.88	4.8739	101.5733	118.8682	100.5415	148.4451
2001591.88	4.8739	101.5612	118.8488	100.5293	148.4341
2004841.88	4.8739	101.5521	118.8338	100.5192	148.4231
2008041.88	4.8739	101.5441	118.8197	100.5108	148.4123
2011291.88	4.8739	101.5365	118.8058	100.5032	148.4014
2014491.88	4.8739	101.5293	118.7925	100.4962	148.3906
2017741.88	4.8739	101.5222	118.7791	100.4893	148.3797
2020941.88	4.8739	101.5153	118.7659	100.4828	148.3689
2024191.88	4.8739	101.5084	118.7527	100.4762	148.3580
2027391.88	4.8739	101.5016	118.7396	100.4699	148.3472
2030641.88	4.8739	101.4947	118.7264	100.4634	148.3363
2033841.88	4.8739	101.4880	118.7134	100.4571	148.3256
2037091.88	4.8739	101.4812	118.7002	100.4507	148.3147
2040291.88	4.8739	101.4745	118.6873	100.4445	148.3040
2043541.88	4.8739	101.4677	118.6741	100.4381	148.2932
2046741.88	4.8739	101.4610	118.6611	100.4319	148.2825
2049991.88	4.8739	101.4542	118.6480	100.4255	148.2716
2053191.88	4.8739	101.4475	118.6350	100.4193	148.2609
2056441.88	4.8739	101.4408	118.6219	100.4130	148.2501
2059641.88	4.8739	101.4341	118.6090	100.4067	148.2394
2062891.88	4.8739	101.4273	118.5958	100.4004	148.2286
2066141.88	4.8739	101.4206	118.5827	100.3941	148.2178
2069341.88	4.8739	101.4139	118.5698	100.3879	148.2072
2072591.88	4.8739	101.4072	118.5566	100.3816	148.1964
2075791.88	4.8739	101.4005	118.5437	100.3754	148.1857
2079041.88	4.8739	101.3938	118.5306	100.3691	148.1750
2082241.88	4.8739	101.3872	118.5177	100.3629	148.1644
2085491.88	4.8739	101.3804	118.5045	100.3566	148.1536
2088691.88	4.8739	101.3738	118.4916	100.3505	148.1430
2091941.88	4.8739	101.3671	118.4785	100.3442	148.1322
2095141.88	4.8739	101.3604	118.4656	100.3380	148.1217
2098392.00	4.8739	101.3537	118.4525	100.3317	148.1109
2101592.00	4.8739	101.3471	118.4395	100.3256	148.1004
2104842.00	4.8739	101.3404	118.4264	100.3193	148.0897
2108042.00	4.8739	101.3338	118.4135	100.3131	148.0791
2111292.00	4.8739	101.3270	118.4004	100.3069	148.0684
2114492.00	4.8739	101.3204	118.3875	100.3007	148.0579
2117742.00	4.8739	101.3137	118.3744	100.2944	148.0472
2120942.00	4.8739	101.3071	118.3615	100.2883	148.0367
2124192.00	4.8739	101.3004	118.3484	100.2820	148.0260

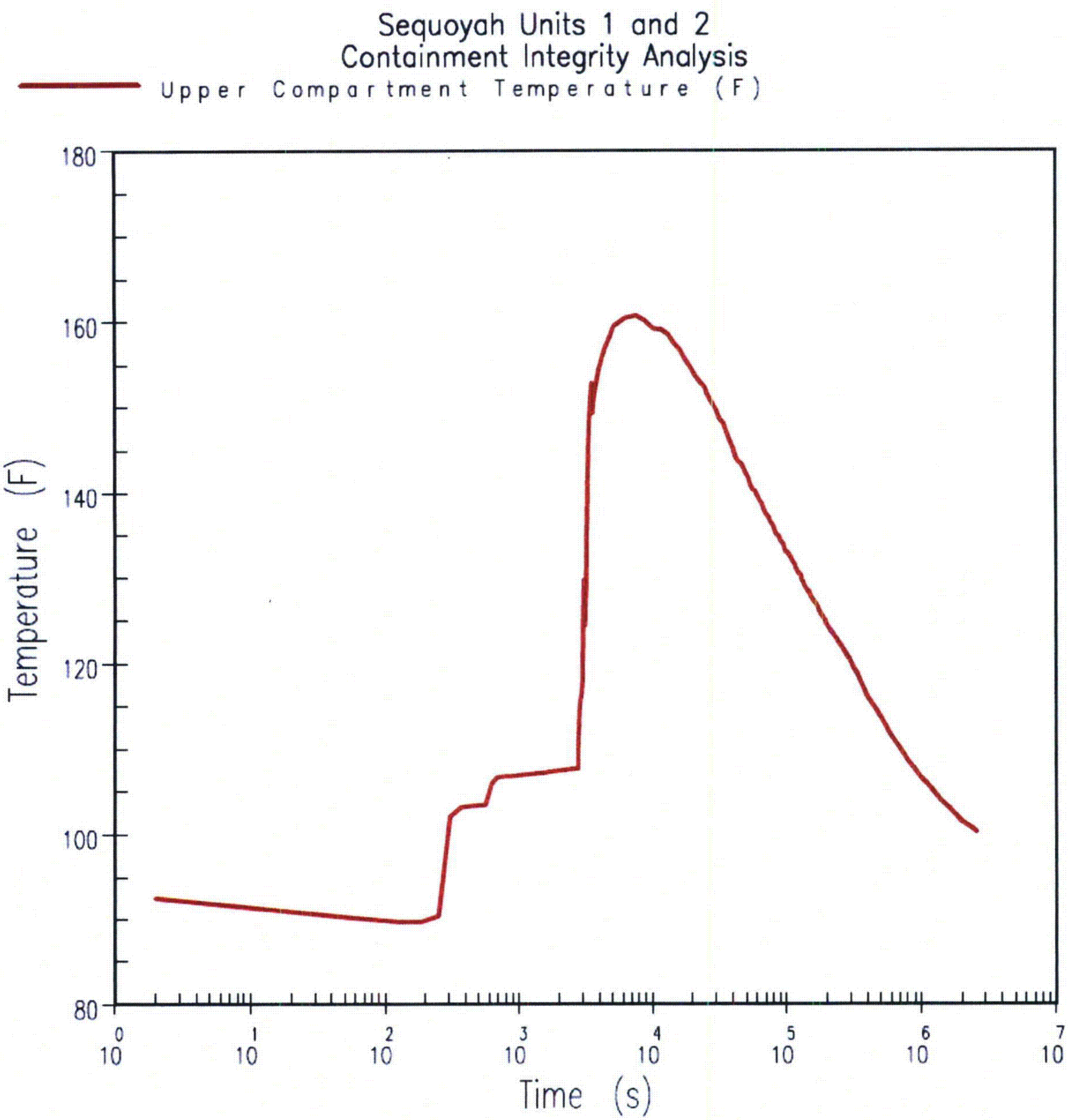
TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
2127392.00	4.8739	101.2938	118.3354	100.2759	148.0155
2130642.00	4.8739	101.2871	118.3223	100.2696	148.0048
2133892.00	4.8739	101.2804	118.3092	100.2634	147.9942
2137092.00	4.8739	101.2738	118.2963	100.2572	147.9837
2140342.00	4.8739	101.2671	118.2832	100.2510	147.9731
2143542.00	4.8739	101.2606	118.2703	100.2448	147.9626
2146792.00	4.8739	101.2539	118.2572	100.2386	147.9520
2149992.00	4.8739	101.2473	118.2443	100.2325	147.9415
2153242.00	4.8739	101.2406	118.2312	100.2262	147.9309
2156442.00	4.8739	101.2340	118.2183	100.2201	147.9205
2159692.00	4.8739	101.2273	118.2052	100.2139	147.9099
2162892.00	4.8739	101.2207	118.1923	100.2077	147.8995
2166142.00	4.8739	101.2141	118.1792	100.2015	147.8889
2169342.00	4.8739	101.2075	118.1663	100.1954	147.8785
2172592.00	4.8739	101.2008	118.1532	100.1891	147.8679
2175792.00	4.8739	101.1943	118.1403	100.1830	147.8575
2179042.00	4.8739	101.1876	118.1271	100.1768	147.8470
2182242.00	4.8739	101.1810	118.1142	100.1707	147.8366
2185492.00	4.8739	101.1743	118.1011	100.1644	147.8261
2188692.00	4.8739	101.1678	118.0882	100.1583	147.8157
2191942.00	4.8739	101.1611	118.0751	100.1521	147.8052
2195142.00	4.8739	101.1545	118.0622	100.1460	147.7949
2198392.00	4.8739	101.1479	118.0491	100.1398	147.7844
2201642.00	4.8739	101.1412	118.0360	100.1336	147.7739
2204842.00	4.8739	101.1347	118.0231	100.1274	147.7635
2208092.00	4.8739	101.1280	118.0100	100.1212	147.7531
2211292.00	4.8739	101.1214	117.9971	100.1151	147.7428
2214542.00	4.8739	101.1148	117.9840	100.1089	147.7323
2217742.00	4.8739	101.1082	117.9711	100.1028	147.7220
2220992.00	4.8739	101.1016	117.9580	100.0966	147.7115
2224192.00	4.8739	101.0950	117.9451	100.0905	147.7012
2227442.00	4.8739	101.0883	117.9319	100.0843	147.6908
2230642.00	4.8739	101.0818	117.9190	100.0782	147.6805
2233892.00	4.8739	101.0751	117.9059	100.0720	147.6701
2237092.00	4.8739	101.0686	117.8930	100.0659	147.6599
2240342.00	4.8739	101.0619	117.8799	100.0597	147.6495
2243542.00	4.8739	101.0554	117.8670	100.0536	147.6392
2246792.00	4.8739	101.0487	117.8539	100.0474	147.6288
2249992.00	4.8739	101.0422	117.8410	100.0413	147.6186
2253242.00	4.8739	101.0356	117.8279	100.0351	147.6082
2256442.00	4.8739	101.0290	117.8149	100.0290	147.5980
2259692.00	4.8739	101.0224	117.8018	100.0228	147.5876
2262892.00	4.8739	101.0158	117.7889	100.0167	147.5774

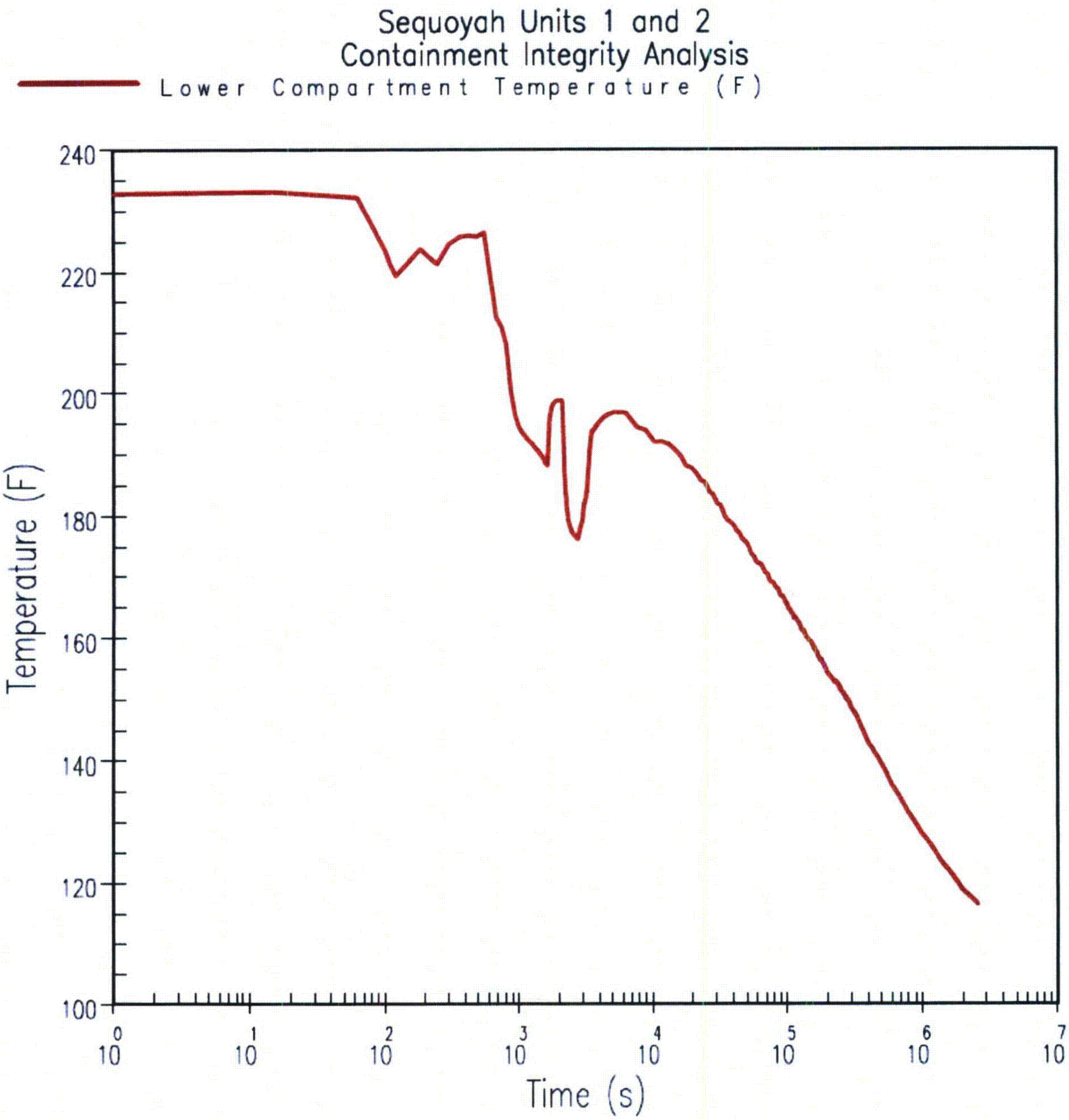
TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
2266142.00	4.8739	101.0092	117.7758	100.0105	147.5671
2269392.00	4.8739	101.0025	117.7627	100.0043	147.5567
2272592.00	4.8739	100.9960	117.7498	99.9982	147.5466
2275842.00	4.8739	100.9893	117.7366	99.9920	147.5362
2279042.00	4.8739	100.9828	117.7237	99.9859	147.5261
2282292.00	4.8739	100.9762	117.7106	99.9797	147.5157
2285492.00	4.8739	100.9696	117.6977	99.9736	147.5056
2288742.00	4.8739	100.9630	117.6846	99.9674	147.4953
2291942.00	4.8739	100.9564	117.6717	99.9613	147.4852
2295192.00	4.8739	100.9498	117.6585	99.9552	147.4749
2298392.00	4.8739	100.9433	117.6456	99.9491	147.4647
2301642.00	4.8739	100.9366	117.6325	99.9429	147.4545
2304842.00	4.8739	100.9301	117.6196	99.9368	147.4444
2308092.00	4.8739	100.9235	117.6064	99.9306	147.4341
2311292.00	4.8739	100.9169	117.5935	99.9245	147.4240
2314542.00	4.8739	100.9103	117.5804	99.9183	147.4137
2317742.00	4.8739	100.9038	117.5675	99.9123	147.4037
2320992.00	4.8739	100.8971	117.5543	99.9061	147.3934
2324192.00	4.8739	100.8906	117.5414	99.9000	147.3834
2327442.00	4.8739	100.8840	117.5283	99.8938	147.3731
2330692.00	4.8739	100.8773	117.5151	99.8876	147.3629
2333892.00	4.8739	100.8708	117.5022	99.8815	147.3529
2337142.00	4.8739	100.8642	117.4891	99.8754	147.3427
2340342.00	4.8739	100.8576	117.4761	99.8693	147.3326
2343592.00	4.8739	100.8510	117.4630	99.8631	147.3225
2346792.00	4.8739	100.8445	117.4501	99.8570	147.3124
2350042.00	4.8739	100.8378	117.4369	99.8508	147.3023
2353242.00	4.8739	100.8313	117.4240	99.8448	147.2923
2356492.00	4.8739	100.8247	117.4109	99.8386	147.2821
2359692.00	4.8739	100.8182	117.3979	99.8325	147.2721
2362942.00	4.8739	100.8115	117.3848	99.8263	147.2620
2366142.00	4.8739	100.8050	117.3718	99.8202	147.2520
2369392.00	4.8739	100.7984	117.3587	99.8141	147.2419
2372592.00	4.8739	100.7919	117.3458	99.8080	147.2319
2375842.00	4.8739	100.7852	117.3326	99.8018	147.2218
2379042.00	4.8739	100.7787	117.3197	99.7957	147.2118
2382292.00	4.8739	100.7721	117.3065	99.7896	147.2017
2385492.00	4.8739	100.7655	117.2936	99.7835	147.1918
2388742.00	4.8739	100.7589	117.2804	99.7773	147.1817
2391942.00	4.8739	100.7524	117.2675	99.7712	147.1718
2395192.00	4.8739	100.7458	117.2543	99.7651	147.1617
2398442.00	4.8739	100.7392	117.2412	99.7589	147.1516
2401642.00	4.8739	100.7326	117.2282	99.7528	147.1417

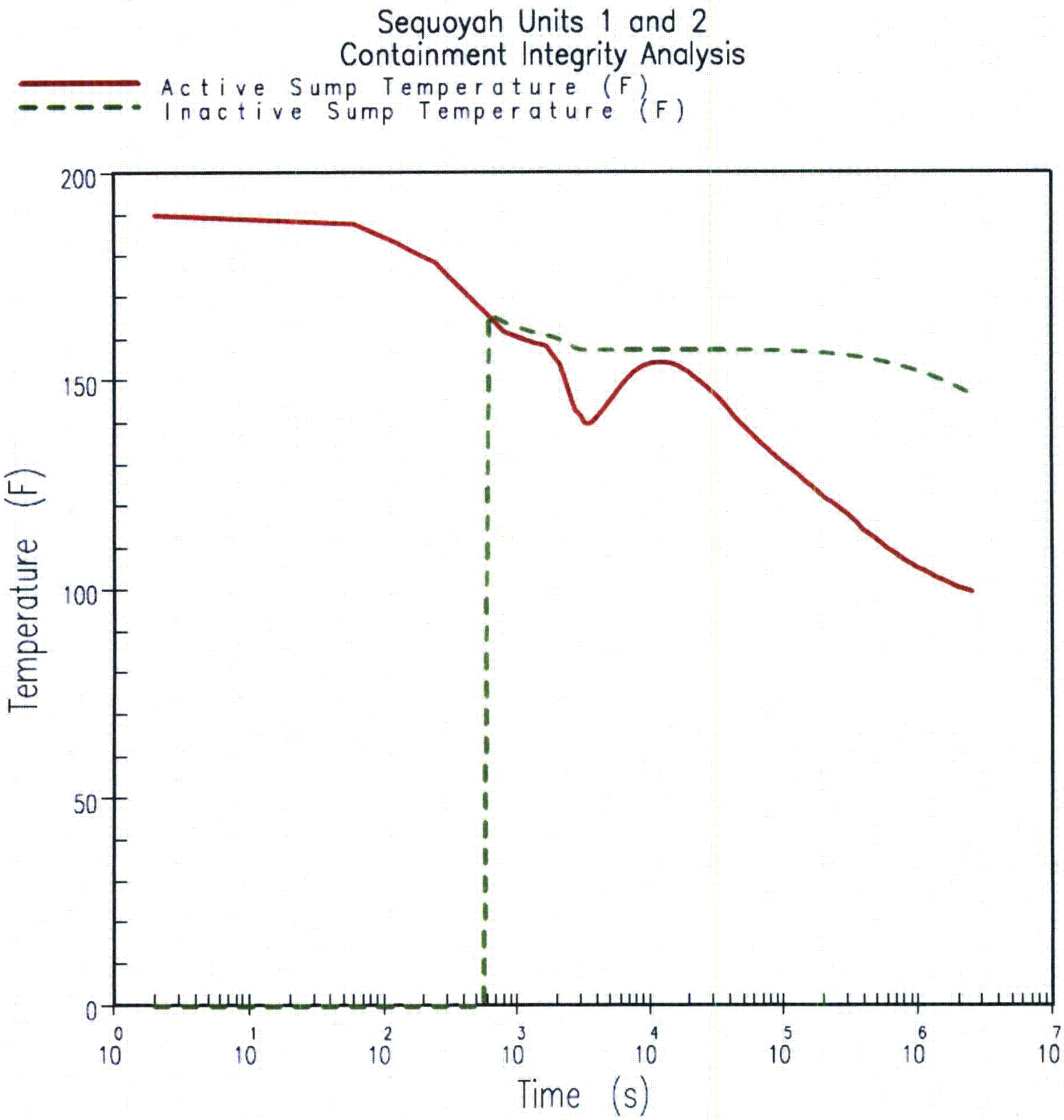
TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
2404892.00	4.8739	100.7260	117.2151	99.7466	147.1317
2408092.00	4.8739	100.7195	117.2021	99.7406	147.1218
2411342.00	4.8739	100.7129	117.1890	99.7344	147.1117
2414542.00	4.8739	100.7063	117.1760	99.7283	147.1018
2417792.00	4.8739	100.6997	117.1628	99.7222	147.0918
2420992.00	4.8739	100.6932	117.1499	99.7161	147.0819
2424242.00	4.8739	100.6866	117.1367	99.7099	147.0719
2427442.00	4.8739	100.6800	117.1238	99.7038	147.0621
2430692.00	4.8739	100.6734	117.1106	99.6977	147.0521
2433892.00	4.8739	100.6669	117.0976	99.6916	147.0422
2437142.00	4.8739	100.6603	117.0845	99.6854	147.0322
2440342.00	4.8739	100.6538	117.0715	99.6793	147.0224
2443592.00	4.8739	100.6471	117.0583	99.6732	147.0124
2446792.00	4.8739	100.6406	117.0454	99.6671	147.0026
2450042.00	4.8739	100.6340	117.0322	99.6609	146.9927
2453242.00	4.8739	100.6275	117.0192	99.6549	146.9829
2456492.00	4.8739	100.6208	117.0061	99.6487	146.9729
2459692.00	4.8739	100.6143	116.9931	99.6426	146.9631
2462942.00	4.8739	100.6077	116.9799	99.6365	146.9532
2466192.00	4.8739	100.6011	116.9667	99.6303	146.9433
2469392.00	4.8739	100.5946	116.9538	99.6242	146.9335
2472642.00	4.8739	100.5880	116.9406	99.6181	146.9236
2475842.00	4.8739	100.5814	116.9276	99.6120	146.9138
2479092.00	4.8739	100.5748	116.9144	99.6058	146.9039
2482292.00	4.8739	100.5683	116.9015	99.5997	146.8942
2485542.00	4.8739	100.5617	116.8883	99.5936	146.8843
2488742.00	4.8739	100.5552	116.8753	99.5875	146.8746
2491992.00	4.8739	100.5485	116.8621	99.5813	146.8647
2495192.00	4.8739	100.5420	116.8491	99.5753	146.8550
2498442.00	4.8739	100.5354	116.8359	99.5691	146.8451
2501642.00	4.8739	100.5289	116.8229	99.5630	146.8354
2504892.00	4.8739	100.5223	116.8098	99.5569	146.8256
2508092.00	4.8739	100.5157	116.7968	99.5508	146.8159
2511342.00	4.8739	100.5091	116.7836	99.5446	146.8060
2514542.00	4.8739	100.5026	116.7706	99.5386	146.7964
2517792.00	4.8739	100.4960	116.7574	99.5324	146.7865
2520992.00	4.8739	100.4895	116.7444	99.5263	146.7769
2524242.00	4.8739	100.4829	116.7312	99.5202	146.7671
2527492.00	4.8739	100.4762	116.7180	99.5140	146.7573
2530692.00	4.8739	100.4697	116.7050	99.5079	146.7476
2533942.00	4.8739	100.4631	116.6918	99.5018	146.7378
2537142.00	4.8739	100.4566	116.6788	99.4957	146.7282
2540392.00	4.8739	100.4500	116.6656	99.4895	146.7184

TIME (SEC)	CONTAINMENT PRESSURE (PSIG)	UPPER COMPARTMENT (DEG-F)	LOWER COMPARTMENT (DEG-F)	ACTIVE SUMP (DEG-F)	INACTIVE SUMP (DEG-F)
2543592.00	4.8739	100.4435	116.6526	99.4835	146.7088
2546842.00	4.8739	100.4368	116.6394	99.4773	146.6990
2550042.00	4.8739	100.4303	116.6264	99.4712	146.6894
2553292.00	4.8739	100.4237	116.6132	99.4651	146.6797
2556492.00	4.8739	100.4172	116.6002	99.4590	146.6701
2559742.00	4.8739	100.4106	116.5870	99.4529	146.6603
2562942.00	4.8739	100.4041	116.5740	99.4468	146.6508
2566192.00	4.8739	100.3974	116.5607	99.4406	146.6410
2569392.00	4.8739	100.3909	116.5477	99.4346	146.6315
2572642.00	4.8739	100.3843	116.5345	99.4284	146.6218
2575842.00	4.8739	100.3778	116.5215	99.4223	146.6122
2579092.00	4.8739	100.3712	116.5083	99.4162	146.6025
2582292.00	4.8739	100.3647	116.4953	99.4101	146.5930
2585542.00	4.8739	100.3580	116.4820	99.4039	146.5833
2588742.00	4.8739	100.3515	116.4690	99.3979	146.5737
2591992.00	4.8739	100.3449	116.4558	99.3917	146.5641


Sequoyah Units 1 and 2
Containment Integrity Analysis
Containment Pressure (psig)
Pressure (psig)
12
11
10
9
8
7
6
5
4
Time (s)
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7


Sequoyah Units 1 and 2
Containment Integrity Analysis
Upper Compartment Temperature (F)
Temperature (F)
180
160
140
120
100
80
Time (s)
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7


Sequoyah Units 1 and 2
Containment Integrity Analysis
Lower Compartment Temperature (F)
Temperature (F)
240
220
200
180
160
140
120
100
Time (s)
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7


Sequoyah Units 1 and 2
Containment Integrity Analysis
Active Sump Temperature (F)
Inactive Sump Temperature (F)
200
150
100
50
0
Temperature (F)
10^0
10^1
10^2
10^3
10^4
10^5
10^6
10^7
Time (s)