STP
Nuclear Operating Company
South Texas Project Electric Generating Station P.O. Box 289 Wadsworth, Texas 77483

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U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555

South Texas Project
Units 1 and 2
Docket Nos. STN 50-498 and STN 50-499
Proposed License Amendment Associated with Revised Calculation Methodology
for Loss Of Coolant Accident Mass and Energy Release Analysis

Reference: 1) Letter from L. E. Martin to U.S. Nuclear Regulatory Commission dated May 7, 1998, (ST-NOC-AE-00159)

In accordance with 10 CFR 50.90, South Texas Project Nuclear Operating Company (STPNOC) proposes to amend Operating Licenses NPF-76 and NPF-80 for the South Texas Project to allow use of a revised methodology to calculate mass and energy release following a postulated large break loss of coolant accident (LBLOCA). Proposed changes to the South Texas Project Units 1 and 2 Updated Final Safety Analysis Report (UFSAR) are attached.

Due to degraded steam generator thermal performance, STPNOC intends to remove the Westinghouse Model E Original Steam Generators (OSG) from Units 1 and 2, and install Westinghouse Delta (Δ) 94 Replacement Steam Generators (RSG). Unit 1 OSGs are currently scheduled for replacement in May of 2000 and Unit 2 OSGs are to be replaced in fall of 2002. To allow use of the Δ94 RSG advanced design, it is necessary to make changes to the existing licensing basis in order to properly model improved performance of the RSG.

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The revised method for calculating mass and energy release following an LBLOCA uses NRC approved methodologies and computer codes, and applies a Nuclear Regulatory Commission (NRC) endorsed correlation, but also includes a minor change. This change is for the purpose of more accurately modeling the transient subsequent to the point at which the steam generators are fully cooled and depressurized. This change to a method of calculation previously described in the UFSAR constitutes an unreviewed safety question (USQ), thus, requires NRC review.

Other steam generator replacement required license change requests have been previously submitted for NRC review, and summary descriptions of them can be found in Reference 1.

This proposal has been reviewed in accordance with 10CFR50.92 and it has been determined that it does not involve significant hazards. It has also been determined that the proposed amendment satisfies the criteria of 10CFR51.22(c)(9) for categorical exclusion from environmental assessment. The South Texas Project Nuclear Safety Review Board has reviewed and approved this proposed amendment.

The required affidavit, a Safety Evaluation, a No Significant Hazards Consideration Determination, and the marked-up UFSAR pages indicating requested changes, are included as attachments to this letter.

STPNOC is providing the State of Texas with a copy of this proposal in accordance with 10CFR50.91(b).

STPNOC requests that the Nuclear Regulatory Commission review and approve this proposed license amendment by November, 1999, to allow implementation of the amendment and a timely return to power from the Unit 1 steam generator replacement outage.

Should you have questions regarding this proposal, please contact either Mr. M. A. McBurnett at (512) 972-7206 or me at (512) 972-8787.

T. H. Cloninger
Vice President,
Engineering and Technical Services

BJS/

Attachments:
1. Affidavit
2. Description of the Proposed Changes
3. Determination of No Significant Hazards Consideration
4. Updated Final Safety Analysis Report Marked-Up Pages

cc:

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U. S. Nuclear Regulatory Commission
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Washington, DC 20555-0001

ATTACHMENT 1

AFFIDAVIT

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the Matter	)	
	)	
STP Nuclear Operating Company	)	Docket Nos. 50-498
	)	50-499
South Texas Project Units 1 & 2	)	

AFFIDAVIT

I, T.H. Cloninger, being duly sworn, hereby depose and say that I am the Vice President, Engineering and Technical Services, of the South Texas Project; that I am duly authorized to sign and file with the Nuclear Regulatory Commission the attached proposed amendment to the STP Operating License Nos. NPF-76 and NPF-80; that I am familiar with the content thereof; and that the matters set forth therein are true and correct to the best of my knowledge and belief.

T.H. Cloninger
Vice President,
Engineering and Technical Services

STATE OF TEXAS	)
	)
COUNTY OF MATAGORDA	)

Subscribed and sworn to before me, a Notary Public in and for the State of Texas, this 29th day of September, 1998.

NOTARY PUBLIC STATE OF TEXAS
LINDA RITTENBERRY
Notary Public, State of Texas
My Commission Expires
OCT. 9, 2001

Linda Rittenberry
Notary Public in and for the
State of Texas

ATTACHMENT 2

DESCRIPTION OF PROPOSED CHANGES FOR PROPOSED LICENSE AMENDMENT ASSOCIATED WITH REVISED CALCULATION METHODOLOGY FOR LOSS OF COOLANT ACCIDENT MASS AND ENERGY RELEASE ANALYSIS

BACKGROUND

South Texas Project Nuclear Operating Company (STPNOC) plans to replace its Westinghouse Model E Original Steam Generators (OSG) with Westinghouse Delta (Δ) 94 Replacement Steam Generators (RSG). Unit 1 steam generator replacement is scheduled to commence at the end of Cycle 9, in the spring of the year 2000. Unit 2 replacement is scheduled to commence at the end of Cycle 9, in the fall of the year 2002. Thus, South Texas Project (STP) units will be operated with different models of steam generator for a limited time.

Performance improvements incorporated within the Δ94 RSG design require evaluations or analyses of design basis accidents that depend on the following considerations:

- Reactor Coolant System (RCS) volume;
- Reactor Coolant System flow resistance;
- Steam Generator (SG) volume;
- Steam Generator metal mass;
- Steam Generator heat transfer surface area; or
- Steam Generator heat transfer coefficient.

The method used to calculate mass and energy releases for Δ94 steam generator analysis, and determine containment pressure and temperature response for the design basis large break loss of coolant accident (LBLOCA), has been improved to more accurately model that effect. Computer codes for calculating mass and energy release rates associated with this event have also been updated. Moreover, the new method addresses concerns raised in Nuclear Regulatory Commission (NRC) Generic Letter 96-06, such as reactor containment-fan-cooler water hammer and isolated pipe over-pressurization.

Δ94 steam generators represent a changed, albeit improved, design, and STPNOC has applied refined, and more recently NRC approved, system response modeling algorithms. Although the resultant response remains within established limits, it differs somewhat from the description in the current licensing basis, and has not been specifically approved in its proposed form by the NRC. Thus, it is an unreviewed safety question (USQ) and requires NRC approval and a license amendment.

Containment pressure and temperature transient analysis requires the calculation of (1) mass and energy releases and (2) containment atmosphere pressure and temperature response. The current licensing basis uses the methodology described in WCAP-8264-P-A to determine the mass and energy releases up to the point of cold leg switchover. After cold leg switchover, mass and energy releases are determined using the reactor vessel model in the COPATTA computer code. Containment pressure and temperature response analysis is calculated using the COPATTA computer code during the entire transient.

The methodology described in WCAP-10325-P-A has been approved by the NRC for use in mass and energy release analysis. The STPNOC proposal uses WCAP-10325-P-A methodology to calculate mass and energy releases up to the point of steam generator depressurization, or for approximately the first 3600 seconds of the transient. After this time, mass and energy release is calculated using the ASB 9-2 decay heat correlation defined by Section 9.2.5 of NUREG-0800. RCS effluent super-heated by decay heat is transformed to steam, using a pressure-flash model, and its mass and energy is added directly to containment atmosphere without mixing with ECCS injection water. Mass and energy of saturated and sub-cooled liquid is added directly to containment sump. Subsequently, containment pressure and temperature response analysis performed , including containment sump temperature calculation, using the CONTEMPT4/MOD5 computer code over the entire transient. CONTEMPT4/MOD5 was developed for the NRC specifically for this application, and has been verified under the STPNOC quality assurance program. Verification included benchmarking against the COPATTA code and showed close agreement.

DESCRIPTION OF PROPOSED CHANGES

South Texas Project Nuclear Operating Company (STPNOC) proposes to revise the Updated Final Safety Analysis Report (UFSAR), as shown in Attachment 4, to more accurately characterize Δ94 steam generator effect on containment mass and energy release rates during a large break loss of coolant accident (LBLOCA). Hence, to determine its effect on containment temperature and pressure response. The revised modeling methodology demonstrates that containment temperature and pressure performance will remain within existing safety margins during the limiting design basis accident.

In the proposed model, STPNOC applies the NRC approved methodologies associated with WCAP-10325-P-A, "Westinghouse LOCA Mass and Energy Release Model for Containment Design, March 1979 Version," until the steam generators are fully cooled and depressurized, or for approximately the first 3600 seconds following initiation of the event. After this point, due to limitations that prevent accurate modeling of sump enthalpy, STPNOC terminates application of the standard WCAP methodology and employs an STPNOC engineered decay heat calculation. The STPNOC calculation more closely models sump enthalpy and prevents introduction of an artificial heat source. In the proposed model, RCS effluent super-heated by decay heat is transformed to steam, using a pressure-flash model, and its mass and energy is added directly to containment atmosphere without mixing with ECCS injection water. Mass and energy of saturated and sub-cooled liquid is added directly to containment sump.

This amendment also references the installed steam generator type, rather than the STP unit in which it is installed. In this manner, the proposed license amendment applies to both STP units, regardless of the steam generator type installed, and no additional license amendment will be needed to support installation of Δ94 steam generators in STP Unit 2.

SAFETY EVALUATION

INTRODUCTION

Analysis of containment pressure and temperature response during a large break LOCA is typically performed in two parts. The first part determines mass and energy release from the reactor coolant system. The second part uses this mass and energy release to determine the resultant pressure and temperature (P/T) response in containment. P/T results from this analysis are then used to determine:

- that systems, structures, and components important to safety are bounded by equipment qualification limits,
- parameters for Integrated Leak Rate Testing, such as peak containment pressure (Pa), anc
- that hydrogen generation rate caused by elevated containment temperatures is less than hydrogen recombiner capacity.

Moreover, Generic Letter 96-06 issues, such as reactor containment-fan-cooler water hammer and isolated pipe over-pressurization, have been addressed by this change proposal.

Using nominal values, Δ94 steam generators increase RCS primary system liquid volume by approximately 9.5%. Additionally, a reduction of upper head temperature to cold leg inlet temperature value, increases primary system (Reactor Coolant System) mass. These effects combine to increase RCS liquid mass by approximately 7.7%. Finally, secondary side initial water mass increases by approximately 11% for each Δ94 steam generator. These factors combine to create an adverse effect on containment pressure and temperature response. To address these issues, STPNOC has incorporated an improved method for determination of LOCA mass and energy releases and the consequent containment pressure and temperature response. Following is a discussion of changes to the current methodology.

MASS AND ENERGY RELEASE

The LOCA analysis calculation model is typically divided into four phases: (1) blowdown, (2) refill, (3) reflood, and (4) froth boiling. Froth boiling is a consideration only on the case of a Double-Ended Pump Suction Guillotine (DEPSG) break, otherwise this last phase is referred to simply as "post reflood." These phases represent periods within the accident:

(1) Blowdown Phase: The period of time commencing with accident initiation with the reactor at full power, steady-state operation, and ending when the RCS and containment reach pressure

equilibrium. Typically, the reactor is drained of coolant during Blowdown Phase, which is usually ≤30 seconds.

(2) Refill Phase: The period of time commencing with the end of Blowdown Phase, and ending when ECCS effluent has filled the lower reactor vessel plenum to the bottom of the reactor core.

(3) Reflood Phase: The period of time commencing with the end of Refill Phase and ending when the reactor core is covered by ECCS effluent, quenching the core.

(4) Post Reflood Phase: The period of time commencing with the end of Reflood Phase and continuing as long as significant energy is being released from the steam generators into containment. In the case of a pump suction break, the initial portion of this phase, commencing with the end of Reflood Phase, and ending when all steam generators are depressurized to Containment design pressure, is referred to as "Froth Phase." Subsequent to Froth Phase, the remainder of the time during which heat continues to be released from the steam generators is referred to as "Post Reflood Phase."

Note: Figure 1, found at the end of this attachment, provides an event related comparison of the following discussion of post accident phases, showing currently approved analysis methodology vs. proposed methodology.

Figures 2 and 3 show comparative Model E and Δ94 steam generator analysis Containment Pressure and Temperature response during the limiting design basis accident, using currently approved methodology and proposed methodology.

MODEL E ORIGINAL STEAM GENERATORS

The methodology described in WCAP-8264-P-A (Ref. 3) is currently used to calculate mass and energy releases for the Model E Original Steam Generator (OSG) during the design basis DEPSG LOCA blowdown, refill, reflood, and froth boiling phases. Usage continues until suction for the safety injection system is switched from the Refueling Water Storage Tank to the containment sump. After ECCS is aligned for containment sump recirculation (cold leg recirculation), mass and energy release from the reactor core is calculated until the end of the transient using the reactor vessel model found in the COPATTA computer code. Energy release associated with cooldown and depressurization of the steam generators continues to 3600 seconds after accident initiation, using the methodology described in WCAP-8264-P-A. These methodologies and results have been reviewed and accepted by the NRC as discussed in Section 6.2.1 of the Safety Evaluation Report (Ref. 4).

Within WCAP-8264-P-A methodology, SATAN-V computer code is used to determine mass and energy releases during blowdown phase. The time to complete Refill Phase is conservatively assumed to be zero, as provided by NUREG 0800, Section 6.2.1.3.II.3.c. WREFLOOD computer code is used to determine mass and energy release during the reflood phase. Mass and energy release associated with post reflood is determined using the POST2 and FROTH computer codes. POST2 computer code calculates the amount of superheat energy transferred from steam generator secondary-system mass to post-blowdown primary-system steam effluent. FROTH calculates the rate of heat release from two-phase liquid and steam mixture in the steam generator tubes. This methodology is used until cold leg switchover. At cold leg switchover, or approximately 1200 seconds after event initiation, the model commences use of the reactor vessel model contained in COPATTA computer code. The COPATTA model provides the advantage of determining sump enthalpy without a separate mass and energy release calculation. It calculates reactor coolant system mass and energy release from decay heat, safety injection flow, and sump temperature.

Δ94 REPLACEMENT STEAM GENERATORS

Mass and energy release calculations associated with the Δ94 steam generators, occurring prior to the point at which the steam generators are cooled and depressurized, use the methodology described in WCAP-10325-P-A (Ref. 2). In this model, the steam generators are cooled and depressurized to atmospheric pressure approximately 1 hour after initiation of the LOCA event. The NRC has reviewed and approved the methodology of WCAP-10325-P-A for such applications.

Using the WCAP-10325-P-A methodology, mass and energy release during blowdown phase is calculated using SATAN-VI computer code. Refill phase is again assumed to take zero time, which results in a conservative mass and energy release calculation. Reflood phase uses an improved version of WREFLOOD computer code to determine mass and energy release. FROTH computer code is used to model the Post-Reflood portion of the transient. FROTH code calculates heat release rates from any two-phase mixture present in the steam generator tubes.

Steam generator equilibration and depressurization are the means by which secondary-side energy is removed in stages from the steam generators. FROTH calculates heat removal from secondary mass until secondary temperature is at saturation temperature (T_{sat}) for containment design pressure. After this point, EPITOME code continues calculations for steam generator cooldown instead of FROTH (EPITOME is the Westinghouse developed computer code version of hand calculations previously used by them for design analysis in this region. EPITOME has been used in similar submittals approved by the NRC). During this period, steam generator secondary energy is removed, based on first-stage and second-stage rates. The first-stage rate is applied until the steam generator reaches T_{sat} at the user-specified intermediate equilibration pressure, at which point secondary pressure is assumed to have reached actual containment pressure. The second-stage rate is then used until final depressurization, when the secondary temperature reaches T_{sat} of 212°F at 14.7 psia. Broken loop and intact loop steam generator heat removals are calculated separately.

To account for sump enthalpy, the FROTH and EPITOME analyses are provided with an estimate of containment sump temperature as a factor to be used in calculation of mass and energy release from the reactor containment system. Containment pressure and temperature analysis is then performed using CONTEMPT4/MOD5. Resultant sump temperature is compared to the estimate of containment sump temperature provided to the FROTH and EPITOME analyses. If calculated sump temperature is lower than the temperature estimated in the first step, then the analysis has produced conservative results. Repeating the analysis, using the newly calculated containment sump temperature as input to the first step, will refine the outcome.

It is possible to use EPITOME analysis through the end of the transient. However, to ensure a conservative calculation during the period prior to steam generators being cooled and depressurized to T_{sat} at 14.7 psia, this method assumes a sump temperature higher than that actually calculated by the CONTEMPT4/MOD5 containment computer code. This introduces an artificial energy source into containment during the remaining time. To eliminate this artificial energy source, the STPNOC Decay Heat Model discontinues use of EPITOME after steam generators are cooled and depressurized to T_{sat} at 14.7 psia, and starts to add core decay heat to containment. The core decay heat value applied in the STPNOC method is calculated using ASB 9-2 decay heat correlation as defined by Section 9.2.5 of NUREG-0800 (Ref. 1). RCS effluent super-heated by decay heat is transformed to steam, using a pressure-flash model, and its mass and energy is added directly to containment atmosphere without mixing with ECCS injection water. Mass and energy of saturated and sub-cooled liquid is added directly to containment sump. Long term containment pressure and temperature performance using this method has been shown to be consistent with COPATTA results.

Analyses of Model E steam generators were performed for the following cases:

1. (LOCA-1) Double Ended Pump Suction Guillotine Break with minimum safety injection
2. (LOCA-2) Double Ended Pump Suction Guillotine Break with maximum safety injection
3. (LOCA-3) Double Ended Hot Leg Break with maximum safety injection
4. (LOCA-4) Double Ended Cold Leg Break with maximum safety injection
5. (LOCA-5) 0.6 FT^2 Pump Suction Break with maximum safety injection
6. (LOCA-6) 3.0 FT^2 Pump Suction Break with maximum safety injection

These analyses determined that a Double Ended Pump Suction Guillotine Break with maximum safety injection (LOCA-2) represents the limiting event for long term containment pressure and temperature response.

WCAP-10325-P-A results for the Δ94 steam generators are consistent with the WCAP-8264-P-A results indicated above for the Model E steam generators. A Double Ended Hot Leg Break is the limiting event for short term containment temperature response, and is used in analysis of reactor containment-fan-cooler water hammer, as discussed in Generic Letter 96-06. Thus, analyses for the Δ94 steam generators were limited to the following three cases:

1. (LOCA-1) (Δ94 equivalent) Double Ended Pump Suction Guillotine Break with minimum safety injection
2. (LOCA-2) (Δ94 equivalent) Double Ended Pump Suction Guillotine Break with maximum safety injection
3. (LOCA-3) (Δ94 equivalent) Double Ended Hot Leg Break

Mass and energy release results for these breaks is provided on Tables 6.2A.1.3-34 to -47 of the attached UFSAR changes.

Figure 1 provides three time lines for the limiting case of a Double Ended Pump Suction Guillotine Break with maximum safety injection (LOCA-2). These time lines compare analyses for:

- the Model E steam generator using WCAP-8264-P-A methodology,
- the Δ94 steam generator analysis using WCAP-10325-P-A, and
- the Δ94 steam generator analysis using WCAP-10325-P-A with STPNOC modification.

Analyses for Δ94 Replacement Steam Generators consider the same single failures as analyses for the current Model E steam generators. Summaries of values used in these analyses are provided in existing UFSAR Tables 6.2.1.3-3, -5, -7, -8 and -9, for Model E, and new, attached, UFSAR Tables 6.2A.1.1-3, -5, -7A, -8 and -9, for Δ94 steam generators.

UFSAR markups for the Δ94 SG analysis in Attachment 4, provide:

(1) mass and energy release values for blowdown (Tables 6.2A.1.3-34 and -35),

(2) reflood (Tables 6.2A.1.3-36 to -39),

(3) post reflood or froth boiling phases(Tables 6.2A.1.3-40 and -41),

(4) mass and energy balances (Table 6.2A 1.3-42 to -47),

(5) decay heat (Tables 6.2A.1.3-48 and -49),

(6) other miscellaneous model details (Tables 6.2A.1.3-29, -50 and -51), and

(7) containment sump temperature assumed in the analysis (Figures 6.2A.1.1-34 and -37).

CONTAINMENT PRESSURE AND TEMPERATURE

Current analyses of containment pressure and temperature response for Model E steam generators use the COPATTA computer code for that portion of Post-Reflood Phase subsequent to steam generators being cooled and depressurized to saturation temperature at standard sea-level pressure. This methodology, and its results, have been reviewed and accepted by the NRC as discussed in Section 6.2.1 of the STP Safety Evaluation Report (Ref. 4).

Analysis of containment pressure and temperature response for Δ94 steam generators proposed in this license amendment uses CONTEMPT4/MOD5 computer code (Ref. 6 & 7). CONTEMPT4/MOD5 computer code was developed for the NRC, to be used in analysis of containment pressure and temperature response during postulated design basis accidents, such as large break LOCA. This computer code, and its associated methodology, have been reviewed and approved by the NRC for use by STPNOC in analysis of steam line break events, as discussed in Section 2.6.1 of the Safety Evaluation Report (SER) for V5H Fuel Upgrade (Ref. 5). It has also been verified under the STPNOC quality assurance program for analysis of large break loss of coolant events. This verification included benchmarks against the COPATTA computer code. Results from benchmarking of the revised mass and energy release methodology proposed in this submittal exhibit good agreement between CONTEMPT4/MOD5 and COPATTA codes.

Both computer models assess effects of heat conductors, containment sprays, and reactor containment-fan-coolers. Both models also remove heat from the sump using a heat exchanger model that represents low head safety injection flow through the Residual Heat Removal heat exchanger. A summary of inputs used in the Δ94 steam generator analyses are provided in Tables 6.2A.1.1-3, -5, -7A, -8 and -9 of the attached UFSAR markups.

DISCUSSION OF RESULTS

Containment pressure and temperature analyses results for Δ94 steam generators are provided in attached UFSAR markups:

- Table 6.2A.1.1-4, summary of design basis LOCA containment pressures and temperatures.
- Figures 6.2A.1.1-30 to –38, pressure, temperature, and heat transfer coefficient profiles,

Δ94 steam generator pressure and temperature analyses have been evaluated for:

1. Effect on equipment qualification
2. Effect on reactor containment-fan-cooler water hammer (Generic Letter 96-06 issue)
3. Effect on isolated pipe over pressurization (Generic Letter 96-06 issue)
4. Hydrogen generation during design basis LOCA
5. Containment structural design pressure and temperature response

CONCLUSION

Thermal characteristics of the advanced Δ94 steam generator were evaluated to determine their mass and energy release effects on containment pressure and temperature response during the limiting design basis large break loss of coolant accident. A double ended pump suction guillotine break with maximum safety injection was determined to be the limiting design basis accident for this purpose. Since the plant was originally constructed, modeling methodology has improved, and an improved methodology was selected to more accurately characterize Δ94 steam generator performance. Additionally, STPNOC designed an improvement to this methodology, that removed an artificial heat source. Results demonstrate that all acceptance limits continue to be satisfied, and peak containment pressure, P_a, remains below the Technical Specification Bases 3/4.6.1.4 value of 41.2 psig. Although these differences do not significantly affect containment pressure and temperature response under conditions of the limiting design basis large break LOCA.

IMPLEMENTATION

STPNOC intends to remove the Westinghouse Model E Original Steam Generators and install Westinghouse Delta (Δ) 94 Replacement Steam Generators for Unit 1, commencing in May, 2000. To allow use of the Δ94 steam generator advanced design, it is necessary to make changes to the existing licensing basis to allow for associated plant changes. This amendment is a required part of those licensing basis changes, and is needed prior to commencement of steam generator replacement.

South Texas Project requests that the Nuclear Regulatory Commission review and approve this proposed license amendment by November, 1999, to provide for implementation of the amendment and a timely return to power from the Unit 1 steam generator replacement outage.

REFERENCES

1. NUREG-0800 US NRC Standard Review Plan, Revision 2, July 1981.

2. WCAP-10325-P-A, Westinghouse LOCA Mass and Energy Release Model For Containment Design March 1979 Version, May 1983.

3. WCAP-8264-P-A, "Westinghouse Mass and Energy Release Data for Containment Design," Rev. 1, 1974.

4. NUREG-0781, Safety Evaluation Report Related to the Operation of South Texas Project, Units 1 and 2, including Supplements 1 through 7.

5. ST-AE-HL-93831, South Texas Project, Units 1 And 2 - Amendment Nos. 61 And 50 to Facility Operating License Nos. NPF-76 and NPF-80, Letter form L.E. Kokajko (NRC) to W.T. Cottle (STP), Dated 5/27/94.

6. Lin, C.C., Economos, C., Lehner, J.R., and Ng, K.K.; CONTEMPT4/MOD4 "A Multicompartment Containment System Analysis Program;" Brookhaven National Laboratory; Prepared for US NRC; March 1984. (NUREG/CR-3716, BNL-NUREG-51754).

7. Lin, C.C.; "CONTEMPT4/MOD5 An Improvement to CONTEMPT4/MOD4 Multicompartment Containment System Analysis Program;" Brookhaven National Laboratory; Prepared for US NRC; September 1984. (NUREG/CR-4001, BNL-NUREG-51824).

FIGURE 1

LOCA MASS & ENERGY RELEASE ANALYSIS COMPARISON (MAXIMUM SAFETY INJECTION CASE)

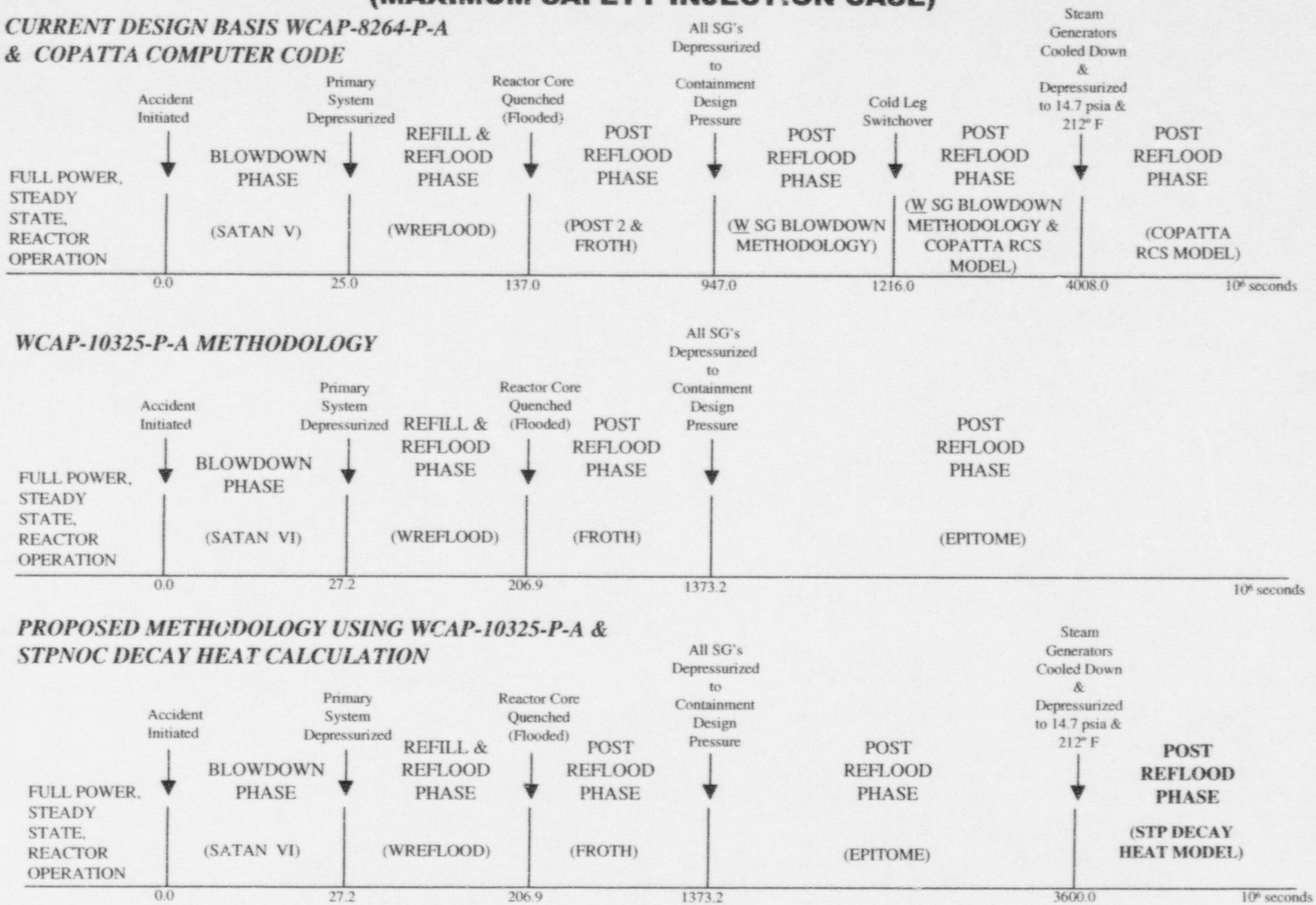
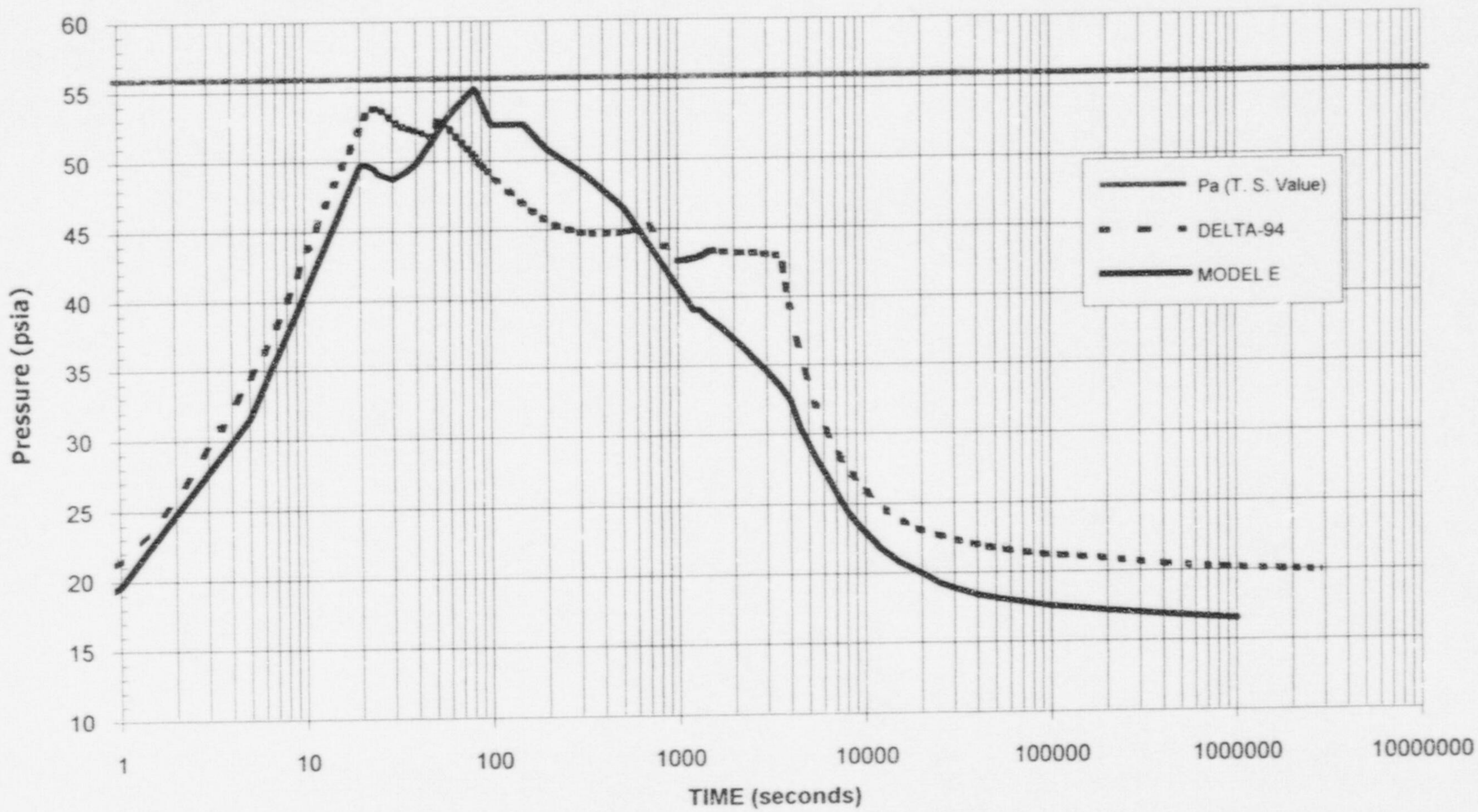
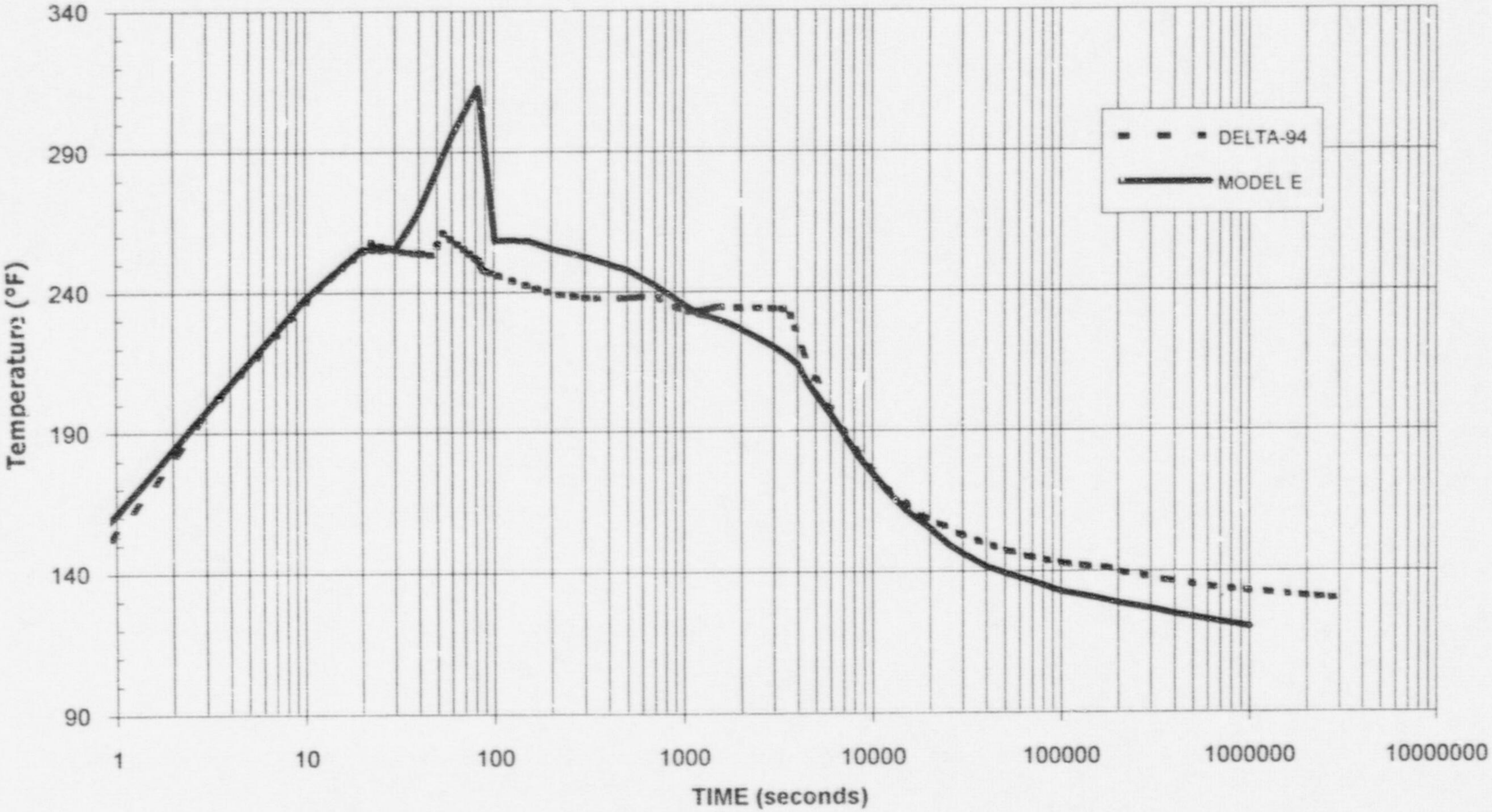


FIGURE 2
COMPARISON OF MODEL E & DELTA-94 SG PRESSURE TRANSIENTS
(DEPSG Breaks with Max SI & Min CHRS)



ALBYFIG.XLS Chart 1

FIGURE 3
COMPARISON: MODEL E & DELTA-94 TEMPERATURE TRANSIENTS
(DEPSG Breaks With Max SI & Min CHRS)



ATTACHMENT 3

NO SIGNIFICANT HAZARDS CONSIDERATION DETERMINATION FOR PROPOSED LICENSE AMENDMENT ASSOCIATED WITH REVISED CALCULATION METHODOLOGY FOR LOSS OF COOLANT ACCIDENT MASS AND ENERGY RELEASE ANALYSIS

DETERMINATION OF NO SIGNIFICANT HAZARDS CONSIDERATION

South Texas Project Nuclear Operating Company has evaluated this amendment proposal and determined that it involves no significant hazards. According to Title 10 Code of Federal Regulations Part 50 Section 92 Paragraph c (10 CFR 50.92(c)), a proposed amendment to an operating license involves no significant hazards if operation of the facility in accordance with the proposed amendment would not:

1. Involve a significant increase in the probability or consequences of an accident previously evaluated; or
2. Create the possibility of a new or different kind of accident from any accident previously evaluated; or
3. Involve a significant reduction in a margin of safety.

INTRODUCTION

South Texas Project Nuclear Operating Company proposes to revise the Update Final Safety Analysis Report (UFSAR), as shown in Attachment 4, to reflect a revised analysis of containment pressure and temperature response from a large break loss of coolant accident with Westinghouse Δ94 steam generators installed. Included in this license amendment is an improved method of calculating mass and energy release rates during this event, which more accurately characterizes the time after steam generator cooldown and depressurization.

NO SIGNIFICANT HAZARDS EVALUATION

1. The proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

This proposal updates the design basis large break loss of coolant accident (LBLOCA) analysis and methodology described in the UFSAR to support replacement of Westinghouse Model F Original Steam Generators (OSG) with Westinghouse Δ94 Replacement Steam Generators (RSG).

A safety analysis has been performed, including evaluation of existing analyses and performance of bounding or confirming calculations, to determine effects of the proposed changes.

Analysis of mass and energy releases and resultant containment pressure and temperature response for the RSG concluded a small reduction in peak pressure and temperature for the

RSG compared to the OSG. Thus, the proposed amendment does not involve a significant increase in the probability of an accident previously evaluated.

Changes to the LBLOCA model caused by installation of the RSGs and associated changes in analysis methodology result in no change in radiological consequence as delineated in 10 CFR 100 and the Standard Review Plan (NUREG-0800). Consequences of this design basis accident have not increased.

Thus, changes in the LBLOCA design basis event analyses associated with replacement of OSGs with RSGs do not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. The proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

This proposal updates the design basis large break loss of coolant accident (LBLOCA) analysis and methodology described in the Updated Final Safety Analysis Report (UFSAR) to support replacement of OSGs with RSGs.

Fit, form, and design function of RSG equipment is not significantly changed from OSG equipment. Analyses of LBLOCA mass and energy releases and resultant containment system response indicates that performance with RSGs remains within the existing design limits. Thus, the proposed change does not create the possibility of a new or different kind of accident from any accident previously evaluated.

3. The proposed change does not involve a significant reduction in a margin of safety.

A safety analysis has been performed, including evaluations of existing analyses and performance of bounding and/or confirming calculations, to determine the effect of the proposed changes. Results of these analyses demonstrate that the proposed license amendment and operation of STP Units with Δ94 steam generators installed will not produce post-accident Containment pressures or temperatures exceeding existing Technical Specification limits. Consequently, there are no effects on dose analyses due to design basis LBLOCA performance of the RSGs. Radiological consequences of the postulated accident did not change, and all results remain within the acceptance criteria of 10 CFR 100 and the Standard Review Plan (NUREG-0800).

Thus, the change in LBLOCA analysis results and methodology descriptions in the UFSAR associated with replacement of Model E steam generators with Δ94 steam generators do not involve a significant reduction in a margin of safety.

Based on the above evaluation, South Texas Project concludes that the changes proposed for the UFSAR involve no significant hazards consideration.

ATTACHMENT 4

UPDATED FINAL SAFETY ANALYSIS REPORT
MARK-UPS
FOR
PROPOSED LICENSE AMENDMENT ASSOCIATED
WITH REVISED CALCULATION METHODOLOGY
FOR
LOSS OF COOLANT ACCIDENT MASS AND ENERGY
RELEASE ANALYSIS

The below listed UFSAR pages are provided in this attachment in support of this amendment. Proposed revisions are indicated as appropriate.

Pages:	Pages:
TC 6-4	TC 6-11
TC 6-18	6.2-1
6.2-57	6.2-74 thru 6.2-78

* Pages with no changes shown are provided to support review of the proposed License Amendment.

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CHAPTER 6

ENGINEERED SAFETY FEATURES

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CHAPTER 6

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6.2 CONTAINMENT SYSTEMS

6.2.1 Containment Functional Design

6.2.1.1 Containment Structure.

6.2.1.1.1 Design Bases: The Containment design basis is to limit the release of radioactive materials, subsequent to postulated accidents, such that resulting calculated offsite doses are less than the guideline values of 10CFR100. In order to meet this requirement, a design (maximum) Containment leakage rate has been defined in conjunction with performance requirements placed on other Engineered Safety Feature (ESF) systems.

The capability of the Containment structure to maintain leak-tight integrity and to provide a predictable environment for operation of ESF systems is ensured by a comprehensive design, analysis, and testing program that includes consideration of:

1. Peak Containment pressure and temperature associated with the most severe postulated accident coincident with the Safe Shutdown Earthquake (SSE).

2. Maximum external pressure to which the Containment may be subjected as a result of inadvertent Containment systems' operations that potentially reduce Containment internal pressure below outside atmospheric pressure.

6.2.1.1.1.1 Postulated Accident Conditions - The spectrum of postulated accidents considered in determining Containment design peak pressure (and temperature), subcompartment peak pressure, and external pressure are summarized in Table 6.2.1.1-1. The spectrum of breaks used in the Emergency Core Cooling System (ECCS) analysis for minimum Containment backpressure is defined in Section 6.2.1.5. For postulated subcompartment pipe break accidents, a discussion of break locations is given in Section 3.6.2. As discussed in Reference 3.6-14 and Section 3.6.2.1.1.1, item a, reactor coolant loop (RCL) ruptures and the associated dynamic effects are not included in the design bases. Subcompartment analyses are based on RCL branch pipe breaks or secondary system pipe breaks. Containment pressure and temperature design is based on nonmechanistic double-ended guillotine breaks.

For Containment structure and subcompartment peak pressure analysis, it is assumed that each accident can occur concurrent with a loss of offsite power (LOOP) and the most limiting single active failure. No two accidents are assumed to occur simultaneously or consecutively.

For each of the categories of Containment peak pressure, subcompartment peak pressure, Containment external pressure, and Containment minimum pressure, the Design Basis Accident (DBA) is defined as the most severe of the spectrum of accidents postulated for each case. The maximum containment peak pressure DBA description, containment design pressure, calculated peak pressure, and margin between the calculated peak and design pressure values are given in Table 6.2.1.1-2. Containment design parameters are given in Table 6.2.1.1-3. The DBA calculated pressures and margins between calculated and design pressure values for various subcompartment analyses are presented in Tables 6.2.1.2-5, 6.2.1.2-9, 6.2.1.2-11, 6.2.1.2-13, 6.2.1.2-15, 6.2.1.2-17 and 6.2.1.2-19.

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Note: Section 6.2 describes reactor Containment analyses for installed Model E Steam Generators. Section 6.2A describes reactor Containment analyses for installed Δ94 Steam Generators. Those analyses & references that apply generically to both models of steam generator remain in Section 6.2, only.

10CFR50, Appendix J, Type C tests. Figure 6.2.4-1 contains a complete list of Containment penetrations and identifies those penetrations that are Type C tested. Table 6.2.6-3 contains a list of Containment isolation valves that are locally (Type C) leak-tested in a direction opposite to that in which the pressure will exist when the valve is required to perform its safety function. The criteria for selecting the Containment isolation valves for Type C tests, as well as the acceptance criteria, are in accordance with 10CFR50, Appendix J. These tests are performed by local pressurization to the maximum calculated pressure. Additional information is supplied in the Technical Specifications.

6.2.6.4 Scheduling and Reporting of Periodic Tests. The schedule for the performance of Type A, B, and C Containment leakage testing is presented in the Technical Specifications. Administrative procedures concerning the reporting of test results that fail to meet acceptance criteria are in conformance with 10CFR50, Appendix J, and are discussed in the Technical Specifications.

6.2.6.5 Special Testing Requirements. Any major modification, replacement of a component that is part of the primary Reactor Containment boundary, or resealing of a seal-welded door that is performed after the preoperational leakage rate test will be followed by either a Type A, Type B, or Type C test, as applicable for the area affected by the modification. If performed directly prior to the conduct of a scheduled Type A test, minor modifications, replacements, or resealing of seal-welded doors do not require a separate test. Administrative procedures concerning the reporting of test results are in conformance with 10CFR50, Appendix J, and are discussed in the Technical Specifications.

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6.2A.1 Containment Functional Design

Note: Section 6.2A describes reactor Containment analyses for installed Δ94 Steam Generators. Section 6.2 describes reactor Containment analyses for installed Model E Steam Generators. Those analyses or references that apply generically to both models of steam generator are found in Section 6.2, only.

6.2A.1.1 Containment Structure.

6.2A.1.1.1 Design Bases:

Containment design basis is the limitation of calculated offsite radiation dose which may be potentially caused by radioactive release from postulated accidents, to levels less than 10CFR100 guideline values. Design maximum Containment leakage rate supports this requirement, and considers performance of other Engineered Safety Feature (ESF) systems.

Containment leak-tight integrity provides a predictable environment for operation of ESF systems, and is ensured through comprehensive analysis, design, and a testing program that considers:

1. Peak Containment pressure and temperature associated with the most severe postulated accident, coincident with the Safe Shutdown Earthquake (SSE), and

2. The maximum external pressure to which the Containment structure may be subjected as a result of inadvertent operations that reduce Containment internal pressure below outside atmospheric pressure.

6.2A.1.1.1.1 Postulated Accident Conditions - The spectrum of accidents postulated in determining Containment design peak pressure and temperature, sub-compartment peak pressure, and external pressure is summarized in Table 6.2A.1.1-1. The breaks used to analyze Emergency Core Cooling System (ECCS) effect on minimum Containment backpressure are discussed in Section 6.2.1.5. Break locations considered in sub-compartment pipe break accident analyses are discussed in Section 3.6.2. As discussed in Reference 3.6-14 and Section 3.6.2.1.1.1, item a, reactor coolant loop (RCL) ruptures and associated dynamic effects, are not included in Containment design bases. However, sub-compartment analyses are based on RCL branch pipe breaks or secondary system pipe breaks. Containment pressure and temperature design is based on non-mechanistic, double-ended guillotine breaks.

For Containment structure and sub-compartment peak pressure analysis, it is assumed that each accident can occur concurrently with a loss of offsite power (LOOP) and the most limiting single active failure. No two Design Basis Accidents (DBA) are assumed to occur simultaneously or consecutively.

For each of the categories of Containment peak pressure, sub-compartment peak pressure, Containment external pressure, and Containment minimum pressure, the DBA is defined as the postulated accident case in each category representing the most severe challenge to Containment design limits. Containment calculated peak maximum and minimum pressures, design pressure, and margin between the calculated peak and design pressures are given in Table 6.2A.1.1-2. Containment design parameters are given in Table 6.2A.1.1-3.

6.2A.1.1.1.2 Mass and Energy Release - Mass and energy release for the most severe accident cases under the categories of Containment peak pressure and sub-compartment peak pressure are given in Sections 6.2.1.2, 6.2A.1.3, and 6.2.1.4. Mass and energy releases used in minimum Containment backpressure analysis for ECCS performance capability studies are discussed in Section 6.2.1.5. The sections on sub-compartment analysis provide design and peak pressures for various sub-compartment pressurization analyses. Computer codes and assumptions used in deriving each of the mass and energy release rates are also discussed in these subsections.

6.2A.1.1.1.3 Effects of ESF Systems on Energy Removal - Energy released to Containment atmosphere from the postulated accidents referenced in Section 6.2A.1.1.1.2 is removed by the Containment Heat Removal Systems (CHRS) (i.e., the Containment Spray System [CSS] and Reactor Containment Fan Cooler System [RCFC]) discussed in Section 6.2.2.

Containment analyses consider operation of either two or three ECCS and CHRS trains with one RCFC unit out for maintenance at time of accident initiation.

Loss-of-Coolant Accidents (LOCA) for the double-ended pump suction break consider both maximum and minimum safety injections (SI) to assure coverage of all failure modes for the DBA. Minimum SI is based on single-failure of a standby diesel generator (SDG). This represents the most substantial loss of ESF equipment. ESF equipment lost with the SDG includes one train of SI, one train of CSS, one train of component cooling water (CCW) to a residual heat removal (RHR) heat exchanger, and one train of RCFC (two RCFC units), in addition to the single RCFC unit assumed to be out of service for maintenance at time of accident initiation.

All possible combinations of ESF failures have been considered in the LOCA analyses by evaluating:

(1) loss of an SDG (minimum SI with two SI trains in operation),

(2) the conservative non-mechanistic case of maximum SI with all six SI pumps running, and

(3) the most substantial failure (loss of an entire train of CHRS resultin[illegible] SDG failure).

Main steam line break (MSLB) analyses consider either a main steam isolation [illegible] failure with maximum CHRS, a main feedwater isolation valve failure with maximum CHRS, or an SDG failure with minimum CHRS.

Further discussion of single failures associated with secondary system pipe ruptures inside Containment is given in Section 6.2.1.4.

6.2A.1.1.1.4 Effects of ESF Systems on Pressure Reduction - Assuming the most limiting single active failure identified in Section 6.2A.1.1.1.3, the CHRS are capable of reducing post-accident pressures to less than 50 percent of the peak calculated pressure for the DBA LOCA within 24 hours following the postulated accident.

6.2A.1.1.1.5 Containment Leakage Rate Bases - The design Containment leakage rate specified in Table 6.2A.1.1-3 was established as the minimum practicable rate based on consideration of reactor power level, site characteristics, type of Containment, iodine removal capability, constructability, and testability. Acceptability of the established design leakage rate is verified by analysis of offsite radiological consequences of the design basis LOCA, as discussed in Section 15.6.

6.2A.1.1.2 Design Features: Design features of the Containment and its internal structures are described in Sections 3.8.1 and 3.8.3, respectively.

6.2A.1.1.2.1 Protection from the Dynamic Effects of Postulated Accidents - The Containment structure, sub-compartments, and ESF systems safety functions are protected from loss due to the dynamic effects of postulated accidents. Containment design provides separation, barriers, or restraints as required to protect essential structures, systems, and components from accident-generated missiles, pipe whip, and jet impingement forces. Detailed criteria, locations, and descriptions of devices used for protection are given in Sections 3 5 and 3.6.

6.2A.1.1.2.2 Codes and Standards - Codes and standards applied to the design, fabrication, and erection of the Containment and internal structures are given in Sections 3.8.1 and 3.8.3. In each case, the codes and standards used are consistent with equipment safety function.

6.2A.1.1.2.3 Protection Against External Pressure Loads - No special provisions are required for protection against loss of Containment integrity under external loading conditions. Inadvertent operation of CHRS, and other possible modes of plant operation (e.g., Containment purging) that could potentially result in significant external structural loading, has resulted in pressure differentials lower than the design Containment pressure differential for external loading. Details of this evaluation are provided in Section 6.2A.1.1.3.6.

6.2A.1.1.2.4 Potential Water Traps Inside the Containment - Drains from potential water traps inside the Containment discharge into Containment sump. All significant water traps are thereby eliminated.

6.2A.1.1.2.5 Containment Cooling and Ventilation Systems - During normal reactor operation, Containment atmosphere is maintained at or below the Technical Specification limit by continuous operation of the RCFC System. This system is described in detail in Section 6.2.2.2.

6.2A.1.1.3 Design Evaluation:

6.2A.1.1.3.1 Containment Peak Pressure and Temperature Analysis - In the event of a postulated LOCA, MSLB, or main feedwater line break (FWLB), mass and energy will be released from the rupture, and high-temperature, high-pressure fluid will flash to steam. This release of mass and energy raises Containment atmosphere temperature and pressure. The magnitude of the resulting temperature and pressure peaks is a function of the nature, location, and size of the postulated rupture.

To establish the controlling rupture for Containment design, a range of primary and secondary breaks, as described in Table 6.2A.1.1-1, was analyzed to determine the effect of each break on Containment.

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Loss of Coolant Accident - Containment Transient

Conditions within Containment assumed at the time of accident initiation are given in Table 6.2A.1.1-3. To minimize heat transfer during the postulated accident, Containment normal operating pressure and temperature is assumed to be at the Technical Specification limit, and outside temperature (consistent with the data of Section 2.3) is assumed to be at design maximum .

For Containment peak pressure and temperature analysis, the Safety Injection System (SIS) and the CHRS (i.e., CSS and RCFC) were assumed to operate in the mode that maximizes Containment peak pressure, as shown in Table 6.2A.1.1-5. Analyses show that, for a DEPSG break with frothing, maximum SI flow results in a slightly higher peak Containment pressure than minimum SI flow

For the CHRS, minimum system capacity is the conservative condition for calculating Containment peak pressures. Thus, CHRS were assumed to be affected by the most restrictive single active failure, which has been determined to be the loss of one SDG train coupled with one RCFC unit being out for maintenance. These analyses show that a sustained loss of one safety-related electrical distribution train (i.e., one SDG) will minimize ESF response and maximize accident Containment pressures.

The Containment heat sink data used in the LOCA accident analyses, except the minimum Containment backpressure analysis, is described in Tables 6.2A.1.1-7A and 6.2A.1.1-8. Table 6.2A.1.1-7A is a detailed list of the geometry of each heat sink. Node spacing used for concrete, steel, and steel-lined concrete heat sinks is fine enough to ensure an accurate representation of the thermal gradient in each slab. A 0.0042 inch air gap is assumed to exist between the Containment steel liner and concrete wall for peak pressure/temperature calculations. It is further assumed that heat is transferred only by conduction across the air gap.

Table 6.2A.1.1-8 lists the thermophysical properties used in LOCA and MSLB P/T analyses. Metal, concrete, and protective coating properties are typical values for the temperature range observed. Surface heat transfer coefficients used in LOCA and MSLB P/T analyses are given in Table 6.2A.1.1-9.

Mass and energy release rates for LOCA cases are discussed in Section 6.2A.1.3. For MSLB analyses, mass and energy releases are discussed in Section 6.2.1.4. The spectrum of hypothetical accidents has been analyzed by the CONTEMPT4/MOD5 computer code (Ref. 6.2.1.1-7) which is designed to predict pressure and temperature transients in Containment following a pipe rupture. CONTEMPT4/MOD5 (References 6.2.1.1-6 and 6.2.1.1-7) describes the thermal-hydraulic response of multicompartment Containment systems subjected to postulated loss of coolant accidents and steam line breaks. This program calculates compartment pressures, temperatures, and mass and energy inventories due to intercompartmental mass and energy exchanges. CONTEMPT4/MOD5 is documented under NUREG/CR-3716 (BNL-NUREG-51754), and NUREG/CR-4001 (BNL-NUREG-51824).

Normally, heat removal by RCFC operation is simulated in the CONTEMPT4/MOD5 code by specifying input values, using a heat removal rate versus Containment atmosphere saturation temperature curve. This performance curve is based on cooling coil thermo-physical design, and is shown in Figure 6.2.1.5-2. Fan cooler start time assumptions for the DEPSG breaks analyzed are

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provided in Table 6 2A.1.1-10. RCFC parameters are given in Table 6.2A.1.1-5. Start times are based on standby diesel start time, loading sequencing time, and startup time for the various ESF systems.

Containment volume is divided into upper and lower regions. The lower region contains water, and the upper region contains a mixture of steam and air. Each region is assumed to be well mixed with a uniform temperature. A heat transfer coefficient is used to describe heat transfer between the two regions, and a value of zero is assumed for this application. Water boiling in the liquid region, and steam condensation in the vapor region, are allowed, according to prevailing conditions.

Containment is represented as heat-conducting sections whose thermal behavior can be described by one-dimensional, multi-region, heat conduction equations. Building internals are also represented as heat-conducting structures. Geometry of the structure may be planar, cylindrical, or spherical. Only planar geometry, with large surface-to-thickness ratios and conservative area approximations, was used for this design evaluation. Heat transfer rate at a boundary is equal to the heat transfer coefficient times the difference between the surface temperature and the bulk temperature. The heat transfer coefficient can be selected for a variety of functions, such as a constant value, a function of time or temperature, or the Tagami and Uchida correlation. Boundary temperature may be Containment vapor temperature (or saturation temperature at partial steam pressure for superheat conditions), Containment liquid temperature, a 24-hour cyclic outside temperature, or a constant.

The structural heat sink is a significant heat removal source. Provision is made in Containment pressure transient analysis for heat transfer througn, and heat storage in, both interior and exterior walls. Each wall is divided into a large 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. Table 6.2A.1.1-7A is a summary of Containment structural heat sinks used in the analysis. Thermophysical properties of these heat sinks are listed in Table 6.2A.1.1-8. Surface heat transfer coefficient for LOCA and MSLB accidents used in the simulation are shown in Table 6.2A.1.1-9.

The coefficient of condensing heat transfer to the Containment structure is calculated by CONTEMPT4/MOD5. The condensing heat transfer correlation used in the MSLB analysis is the Uchida correlation (described in Reference 6.2A.1.1-4). For saturated or superheated conditions in Containment atmosphere, CONTEMPT4/MOD5 uses the temperature difference between vapor region saturation temperature and heat sink surface temperature for condensing heat transfer driving potential. Should heat sink surface temperature exceed vapor region saturation temperature, driving potential used in the calculations is the difference between vapor region temperature and heat sink surface temperature. Since no condensation can occur under these conditions, CONTEMPT4/MOD5 uses a heat transfer coefficient of 2.0 Btu/hr-ft²-°F, which corresponds to a convective heat transfer mechanism.

The CSS is explicitly represented in the model. Spray water is taken from an external source (the refueling water storage tank [RWST]) during the injection phase, or from the liquid region of the Containment (during recirculation phase) and added directly to the Containment vapor space. For two spray trains operating, Containment spray is assumed to be initiated after a calculated delay time following a LOCA concurrent with a LOOP. The delay times account for SDG start, sequencing, instrument delay, and system fill.

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Pipe break locations, break areas, peak pressures and temperatures, and times of peak pressure are summarized in Table 6.2A.1.1-4 for the bounding LOCA cases analyzed. Based upon results presented in this table, the double-ended hot leg (DEHL) break provided the highest peak Containment pressure. The DEPSG break with maximum SI and minimum CHRS in operation was identified as the Containment DBA for long term analysis.

Figures 6.2A.1.1-30 through -38 provide plots of various Containment thermodynamic parameters as a function of time for the analyzed DEHL and DEPSG breaks.

6.2A.1.1.3.2 Long-Term Containment Performance - Long-term results of the most severe cases for primary and secondary side breaks were evaluated to verify the ability of the CHRS to maintain Containment conditions within design limits. These evaluations were based upon conservative performance assumptions for ESF equipment. Minimal CHRS operation was assumed, based on one SDG failure and one RCFC unit out for maintenance. Thus, only two of three CHRS trains, minus one RCFC unit, were functional. Hot leg recirculation does not have an impact on the analysis, and is not assumed.

Containment pressure/temperature responses for a DEPSG LOCA with maximum SI and minimum CHRS, carried to 3×10^6 seconds (~34 days) are shown on Figures 6.2A.1.1-36 and 6.2A.1.1-37. DBA LOCA (DEPSG break) long-term analysis shows that Containment pressure is reduced below 50 percent of the peak calculated pressure within 24 hours. Results of the DBA LOCA are summarized in Table 6.2A.1.1-4.

Containment pressure/temperature response for the most severe MSLB, carried to 2,000 seconds, is shown on Figure 6.2.1.1-25 and -27.

6.2A.1.1.3.3 Accident Chronology - Accident chronology for the most severe RCS breaks are provided in Table 6.2A.1.1-10. It is assumed that time equals zero at the start of each accident.

6.2A.1.1.3.4 Energy Balance - This section not used for Δ94 steam generators.

6.2A.1.1.3.5 Functional Capability of Containment Normal Ventilation Systems - Containment maximum and minimum design pressures are based on conservative assumptions of initial atmospheric pressures and temperatures in Containment. Functional capability of the Containment normal ventilation systems to maintain initial Containment temperature and pressure within the range defined for normal plant operation is discussed in Section 9.4. Technical Specifications stipulate limits for Containment temperature and pressure in normal plant operation, and also describe the actions to be taken if they are exceeded.

6.2A.1.1.3.6 Protection Against Severe External Loading - The DBA for external Containment design pressure has been determined to be inadvertent actuation of the CSS. Improper operation of Containment Normal Purge System was also considered, i.e., operation of the exhaust train with the supply train isolated. But, the maximum feasible internal vacuum for this case is limited to a few inches of water (gauge) provided by exhaust fan operation.

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Table 6.2A.1.1-2 gives the maximum external pressure to which Containment may be subjected by assuming an inadvertent actuation of the CSS. This pressure is based on an initial Containment atmosphere of 113°F, 14.6 psia, and 100 percent relative humidity. Spray water at a minimum temperature of 45°F then cools the Containment atmosphere to 45°F and 100 percent relative humidity. Results are presented in Table 6.2A.1.1-2.

6.2A.1.1.3.7 Post-Accident Containment Monitoring - Containment pressure and sump water level are indicated and recorded in the main control room. Section 7.5 contains a detailed discussion of the Regulatory Guide (RG) 1.97 instrumentation, including equipment qualification requirements.

6.2A.1.1.3.8 Equipment Qualification - Electrical components of safety-related equipment were qualified for their potential normal operational environment and worst case DBA environment. The two general categories of postulated accidents considered in equipment qualification for equipment in the Reactor Containment Building (RCB) are LOCA and MSLB. A spectrum of break sizes was considered for equipment qualification. The MSLB provides the highest RCB atmosphere temperature and LOCA provides the highest RCB atmosphere pressure. Combined MSLB/LOCA pressure and temperature profiles have been used for qualification of the Containment safety related equipment.

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6.2A.1.3 Mass and Energy Release Analyses For Postulated Loss-of-Coolant Accidents. The Containment System receives mass and energy releases following a postulated non-mechanistic double-ended guillotine rupture of a Reactor Coolant System (RCS) piping segment. These releases are assumed to continue throughout blowdown and post-blowdown. Release rates are calculated for piping failure at two locations: (1) hot leg, and (2) pump suction. Because of RCS pressure level prior to the postulated rupture, mass and energy flows rapidly from the RCS to Containment. As primary coolant exits the rupture and enters the lower pressure and temperature of Containment atmosphere, a portion of it flashes to steam.

During Reflood Phase, these breaks compare in the following manner. A cold leg break vents coolant from the core through the associated SG. Heat from the SG flows to this two-phase steam and water mixture, and the steam becomes superheated. However, compared to breaks at other locations, the core reflood rate for cold leg breaks is low because of hydraulic resistance added by the reactor coolant pump. For a hot leg break, vent path resistance is relatively low, with the majority of coolant exiting the core and flowing directly into Containment, bypassing the SGs. This results in a high core flooding rate. The pump suction break combines the effects of high core flooding rate from the hot leg break, and SG heat addition as in the cold leg break. As a result, the pump suction break yields the highest RCS to Containment energy flow rates in the post-blowdown period. Breaks analyzed include a double-ended rupture of the hot leg (Blowdown Phase only), and a double-ended pump suction guillotine break (DEPSG). Because of the reflood phenomenon discussed above, a double-ended pump suction break with maximum safety injection is the limiting Containment design basis accident. This conclusion is supported by Westinghouse Nuclear Energy System studies.

The LOCA mass and energy analysis model is typically divided into four phases:

(1) Blowdown Phase: The period of time from accident initiation, with the reactor at full power, steady-state, operation, until the RCS and Containment reach pressure equilibrium.. The reactor core is typically drained of coolant during this phase, which is completed in under 30 seconds.

(2) Refill Phase: The period of time from the end of Blowdown Phase until the lower reactor vessel plenum is filled with ECCS effluent to the bottom of the reactor core.

(3) Reflood Phase: The period of time from the end of Refill Phase until the reactor core is covered with ECCS effluent.

(4) Post Reflood phase The period of time after completion of Reflood Phase, and during which energy continues to be released from the steam generators into Containment.

For a description of the calculation model used for the mass and energy release analysis, see Reference 6.2A.1.3-1.

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6.2A.1.3.1 LOCA Mass and Energy Release Data:

Blowdown Mass and Energy Release Data

Tables 6.2A.1.3-34 and 6.2A.1.3-35 present the calculated mass and energy releases for the blowdown phase of the various breaks analyzed.

Reflood Mass and Energy Release Data

Tables 6.2A.1.3-36 and 6.2A.1.3-37 present the calculated mass and energy releases for the reflood phase of the two DEPSG cases analyzed. The DEPSG cases model two safety injection (SI) systems in operation (minimum SI/2 trains case) and all six SI pumps in operation (maximum SI/3 trains case). For the mass and energy release calculation, the refill period is conservatively neglected to allow for an uninterrupted release of mass and energy into the Containment. Tables 6.2A.1.3-38 and 6.2A.1.3-39 present the principle parameters during the reflood phase.

Two-Phase Post-Reflood Mass and Energy Release Data

Tables 6.2A.1.3-40 and 6.2A.1.3-41 present the calculated post-reflood mass and energy release data for the two DEPSG cases using minimum and maximum SI assumptions. These releases are calculated using the methodology in Reference 6.2A.1.3-1 from the end of reflood phase to the time when all steam generators are depressurized to saturation temperature of 212 °F at 14.7 psia. This methodology includes the depressurization and equilibrium stages for the steam generator broken and intact loops.

Depressurization Energy Release

The froth mass and energy release rates are based on a reference temperature for heat stored in the SG metal and secondary fluid of saturation at the Containment design pressure. Additional two-phase mass and energy releases become available as the Containment depressurizes to atmospheric conditions.

Depressurization (Two-Phase Mixture)

The steam generator depressurization energy is brought out in two stages. In the first stage, the above mentioned sources are brought into equilibrium with the actual Containment pressure. The froth calculation models set the rate for this phase. In the second stage, the sources give up additional energy as Containment pressure decreases. The rate for this stage is set by the Containment depressurization rate.

The depressurization mass and energy release rates can be determined if the steam generator depressurization time is known. The depressurization time is estimated by choosing a conservatively low value that will maximize the depressurization mass and energy release rates to the Containment (e.g., 3,600 seconds for normal dry Containment). First, a Containment pressure transient analysis is performed, neglecting the pressurization energy release. For this case, the Containment will depressurize faster, and hence a conservative depressurization time is calculated. The second

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Containment pressure calculation is made utilizing a depressurization time and using the procedure for calculating depressurization mass and energy release rates described in this section.

Post-Depressurization

Steam generators are cooled down and depressurized to saturation temperature of 212 °F at 14.7 psia approximately 3600 seconds after accident initiation. The core decay heat value is calculated using ASB 9-2 decay heat correlation as defined by Section 9.2.5 of NUREG-0800 (Ref. 6.2A.1.3-2). This analysis verifies that discharge from the reactor coolant system is sub-cooled. In the event that steaming from the reactor core is indicated, due to high decay heat or sump temperatures, a hand calculation is performed to determine the steaming rate. Steam from decay heat boiling is flashed, using a pressure-flash model, and added directly to containment atmosphere without mixing with ECCS injection water. Saturated and sub-cooled fluid is added directly to containment sump. Long term Containment pressure and temperature performance using this method has been shown to be consistent with COPATTA results.

6.2A.1.3.2 Energy Sources: The sequence of events for each analyzed case are listed in Table 6.2A.1.1-10. The mass and energy balance tables are shown in Tables 6.2A.1.3-42 through 6.2A.1.3-47. The energy sources are:

1. RCS, accumulators, and pumped SI sensible heat

2. Decay heat

3. Core stored energy

4. Thick and thin metal energy

5. SG energy

The energy balance tables show the initial energy distribution, at end of blowdown, end of reflood, at broken loop SG depressurization, at intact loop SG depressurization, and when all SGs depressurize to Containment pressure (i.e., at 3600 seconds.)

The methods and assumptions used in the analysis are given in Reference 6.2A.1.3-1.

The following items ensure that the core energy release is conservatively analyzed for maximum Containment pressure.

1. Average RCS operating temperature (593°F)

2. Allowance in temperature for instrument error and dead band (+5.1°F)

3. Margin in volume (1.4 percent)

4. Allowance in volume for thermal expansion (1.6 percent)

5. Margin in core power associated with the use of engineered safeguards design rating (ESDR = licensed core power = 3800MWt)

6. Allowance for calorimetric error (2 percent of ESDR)

7. Conservatively modified coefficients of heat transfer

8. Allowance in core stored energy for effect of fuel densification

9. Margin in core stored energy (+15 percent)

6.2A.1.3.3 Description of Blowdown Model: A description of the model used to determine the mass and energy released from the RCS during the blowdown phase of a postulated LOCA is provided in Reference 6.2A.1.3-1. All significant correlations are discussed.

6.2A.1.3.4 Description of Core Reflood Model: A description of the model used to determine the mass and energy released from the RCS during the reflood phase of a postulated LOCA is provided in Reference 6.2A.1.3-1. All significant correlations are discussed. Transients of the principal parameters during reflood are given in Tables 6.2A.1.3-38 and 6.2A.1.3-39 for the limiting case pump suction breaks with minimum and maximum safeguards.

6.2A.1.3.5 Description of Long-Term Cooling Model: The calculation procedures used to determine the mass and energy released during the post-reflood phase of a postulated LOCA are described in Reference 6.2A.1.3-1.

6.2A.1.3.6 Single Failure Analysis: The effect of single failures of various ECCS components on the mass and energy releases is included in these data. Two analyses bound this effect.

No single failure is assumed in determining the mass and energy releases for the maximum safeguards case. For the minimum safeguards case, the single failure assumed is the loss of one emergency diesel. This failure results in the loss of one pumped SI train. The maximum SI case considers operation of all six SI pumps. The analysis of both maximum and minimum safeguards cases assures that the effect of all credible single failures is bounded. The SI flows used in the mass and energy release analysis are presented in Tables 6.2A.1.3-50 and –51.

6.2A.1.3.7 Metal/Water Reaction: In the mass and energy release data presented here, no Zr-H_2O reaction heat was considered because the clad temperature did not rise high enough for the rate of the Zr-H_2O reaction to be of any significance. No other metal/water reactions could significantly contribute to energy releases in the Containment following a postulated LOCA.

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6.2A.1.3.8 Energy Inventories: Energy balance for primary and secondary systems are tabulated for DEHL break in Tables 6.2A.1.3-43, and for pump suction breaks in Tables 6.2A.1.3-45 and 6.2A.1.3-47. Table 6.2A.1.3-48 presents the decay heat data from Reference 6.2A.1.3-1 used for mass and energy release rates up to the time the SGs are cooled and depressurized to saturation temperature of 212 °F at 14.7 psia. The SRP ASB 9-2 decay heat curve was used in the post-depressurization phase and is presented in Table 6.2A.1.3-49.

REFERENCES (Continued)

Section 6.2:

6.2.1.3-1 Shepard, R.M., H.W. Massie, R.H. Mark, and P.J. Doherty, "Westinghouse Mass and Energy Release Data for Containment Design", WCAP-8264-P-A, Proprietary (June 1975) and WCAP-8312-A, Revision 1, Nonproprietary (June 1975).

6.2.1.4-1 Burnett, T.W., et. al., "LOFTRAN Code Description," WCAP-7907-P-A (Proprietary Class 2), WCAP-7907-A (Proprietary Class 3), April 1984.

6.2.1.5-1 Bordelon, F.M., Massie, H.W., Jr., Zordon, T.A., "Westinghouse Emergency Core Cooling System Evaluation Model Summary", WCAP-8339, June 1974.

6.2.5-1 Wilson, J. F., "Qualification Testing for Model B Electric Hydrogen Recombiner", WCAP-9346 and WCAP-7709L, Supplements 1 to 7.

6.2.5-2 Cottrell, W. B., "ORNL Nuclear Safety Research and Development Program, Bimonthly Report for July-August 1968", Report No. ORNL-TM-2412, Part 3, Oak Ridge National Laboratory (November 1968).

6.2.5-3 Cottrell, W. B., "ORNL Nuclear Safety Research and Development Program, Bimonthly Report for September-October 1968", Report No. ORNL-TM-2425, Oak Ridge National Laboratory (January 1969), p. 53.

6.2.5-4 Burchell, R. C., and D. D. Whyte, "Corrosion Study for Determining Hydrogen Generation from Aluminum and Zinc during Post Accident Conditions", WCAP-8776, (April 1976).

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6.2A.1.3-1 WCAP-10325-P-A, "Westinghouse LOCA Mass and Energy Release Model For Containment Design March 1979 Version," May 1983.

6.2A.1.3-2 NUREG-0800, Standard Review Plan, Rev. 2, July 1981.

TABLE 6.2A.1.1-1
CONTAINMENT DESIGN ACCIDENTS
(Δ94 Steam Generator)

CONTAINMENT DESIGN PARAMETER	POSTULATED ACCIDENTS ANALYZED
Containment Peak Pressure/ Temperature	**Loss-of-Coolant Accidents (LOCA)** DEPSG, Min. SI, Min. CHRS DEPSG, Max. SI, Min. CHRS DEHL, Max. SI, Min. CHRS (blowdown phase)
Containment Peak Pressure/ Temperature	**Secondary System Breaks (MSLB)** 1.4 ft^2 DER, Min. CHRS, 102% Power 1.4 ft^2 DER, MSIV Fails, 102% Power 1.4 ft^2 DER, MFIV Fails, 102% Power 0.93 ft^2 Split, Min. CHRS, 102% Power 0.93 ft^2 Split, MFIV Fails, 102% Power 0.93 ft^2 Split, MSIV Fails, 102% Power 1.4 ft^2 DER, Min. CHRS, 70% Power 1.4 ft^2 DER, MFIV Fails, 70% Power 1.4 ft^2 DER, MSIV Fails, 70% Power 1.07 ft^2 Split, Min. CHRS, 70% Power 1.07 ft^2 Split, MFIV Fails, 70% Power 1.07 ft^2 Split, MSIV Fails, 70% Power 1.4 ft^2 DER, Min. CHRS, 30% Power 1.4 ft^2 DER, MFIV Fails, 30% Power 1.4 ft^2 DER, MSIV Fails, 30% Power 1.25 ft^2 Split, Min. CHRS, 30% Power 1.25 ft^2 Split, MFIV Fails, 30% Power 1.25 ft^2 Split, MSIV Fails, 30% Power 1.4 ft^2 DER, Min. CHRS, 0% Power 1.4 ft^2 DER, MFIV Fails, 0% Power 1.4 ft^2 DER, MSIV Fails, 0% Power 1.34 ft^2 Split, Min. CHRS, 0% Power 1.34 ft^2 Split, MFIV Fails, 0% Power 1.34 ft^2 Split, MSIV Fails, 0% Power
Sub-compartment Peak Pressure	**SG Loop Compartment** DER - RHR 12"Line DER - FW 16"Line at SG Nozzle
Sub-compartment Peak Pressure	**Pressurizer Sub-compartment** Spray Line Break on Side of Pressurizer
Sub-compartment Peak Pressure	**Surge Line Sub-compartments** Surge Line Break in Pressurizer Skirt Area Surge Line Break in Vestibule
Sub-compartment Peak Pressure	**Steam Line Sub-compartment** Double-ended MS Line Break at Containment Wall

TABLE 6.2A.1.1-1
CONTAINMENT DESIGN ACCIDENTS
(Δ94 Steam Generator)

CONTAINMENT DESIGN PARAMETER	POSTULATED ACCIDENTS ANALYZED
Sub-compartment Peak Pressure	**Feedwater Line Sub-compartment** Double-ended FW Line Break at Containment Wall
Sub-compartment Peak Pressure	**Miscellaneous High Energy Lines** CVCS Line Break in Regenerative HX Compartment CVCS Letdown Line Break in Radioactive Pipe Chase Compartment CVCS Letdown Line Break in RHR Valve Room Sub-compartment
External Pressure	Inadvertent Spray Activation

NOTES:

DER	Double-ended Rupture
CHRS	Containment Heat Removal System
CVCS	Chemical Volume and Control System
DEHL	Double-ended Hot Leg Break
DEPSG	Double-ended Pump Suction Guillotine Break
FWLB	Feedwater Line Break
MFIV	Main Feedwater Line Isolation Valve
MSIV	Main Steam Line Isolation Valve
MSLB	Main Steam Line Break
RHR	Residual Heat Removal
SI	Safety Injection

TABLE 6.2A.1.1 – 2 DBA CALCULATED PRESSURES FOR CONTAINMENT (Δ94 Steam Generator)				
Parameter	**Design Basis Accident**	**Design Pressure**	**Calculated Pressure**	**Margin**
Peak Internal Pressure	Double-Ended Hot Leg Break	56.5 psig	40.5 psig	28.3%
Peak Internal Pressure	Double-Ended Pump Suction Guillotine Break with maximum Safety Injection and minimum Containment Heat Removal	56.5 psig	39.2 psig.	30.6%
External Pressure	Inadvertent Operation of the Containment Spray System	(-)3.5 psig	(-)2.92 psig	16.6%

TABLE 6.2A.1.1 – 3
CONTAINMENT DATA
(Δ94 Steam Generator)

I.	**General Information**		
	A. Internal Design Pressure:	56.5 psig	
	B. External Design Pressure:	(-)3.5 psig	
	C. Structural Design Temperature	286 °F	
	D. Free Volume:	3.41E+06 ft^3	[1]
	E. Design Leak Rate	0.3% per day	
II.	**Initial Conditions for M&E, P/T Analyses**		
	A. Reactor Coolant System (at design overpower of 102% and at normal liquid levels)		
	1. Reactor Power Level	3876 Mwt	
	2. Nominal SG Outlet Coolant Temperature	549.4 to 560.8 °F	
	3. Nominal Reactor Vessel Outlet Temperature	614.8 to 624.8 °F	
	4. Reactor Coolant Mass:	See Tables 6.2A.1.3-42 to –47	
	5. Liquid Plus Steam Energy	See Tables 6.2A.1.3-42 to –47	
	B. Containment		
	1. Pressure:	15.0 psia	[2]
	2. Temperature	110 °F	[3]
	3. Relative Humidity	20 %	
	4. Essential Cooling Water Temperature	110 °F	
	5. Refueling Water Temperature:	120 °F	
	6. Outside Temperature:	95 °F	[4]
	C. Stored water (as applicable)		
	1. Refueling Water Storage Tank:	350,000 gal.	[5]
	2. All Accumulators (safety injection tanks):	3,600 ft^3	

Notes:
1. An error band of +0.1%, -0.85% applies to the calculated free volume.
2. 15.0 psia + 1.5 margin = 16.5 psia (used in P/T analyses).
3. 110 °F + 3.2 °F margin = 113.2 °F (used in P/T analyses).
4. 110 °F used in P/T analysis
5. Includes uncertainties.

TABLE 6.2A.1.1 – 4 SUMMARY OF DBA LOCA CONTAINMENT PRESSURES AND TEMPERATURES (Δ94 Steam Generator)				
Pipe Break Area (ft^2)	**Pipe Break Type**	**Peak Pressure (psia)**	**Peak Temperature (°F)**	**Time of Peak Pressure (seconds)**
10.48	DEPSG, Min. SI, Min. CHRS (analyzed to 3×10^6 seconds)	39.2	260	24.0
10.48	DEPSG, Max. SI, Min. CHRS (analyzed to 3×10^6 seconds)	39.2	262	24.0
9.18	DEHL (analyzed to end of blowdown only)*	40.5	260	20.0

* Note 1: See Section 6.2A.1.3 for discussion of post-blowdown period mass and energy release rates.

TABLE 6.2A.1.1 – 5

ENGINEERED SAFETY FEATURES SYSTEM INFORMATION

(Δ94 Steam Generator)

	Capacity	Value Used for Containment Mass & Energy Release, Pressure & Temperature Analysis (with minimum SI)	Value Used for Containment Mass & Energy Release, Pressure & Temperature Analysis (with maximum SI)
A. Passive Safety Injection System			
1. No. of Accumulators	3	3	3
2. Pressure Setpoint, (psig)	700	590	590
B. Active Safety Injection Systems			
1. High Head Safety Injection System			
a. Number of Lines	3	0	3
b. Number of pumps	3	0	3
c. Flow rate, (gpm)	1,600 (each)	7,634 [1]	12,717 [2]
2. Low Head Safety Injection System			
a. Number of lines	3	2	3
b. Number of Pumps	3	2	3
c. Flow Rate, (gpm)	2,900 (each)	7,634 [1]	12,717 [2]
C. Containment Spray System			
1. Number of Lines	3	2	2
2. Number of Pumps	3	2	2
3. Flow Rate, gpm (each)	2,900	1,832	1,832
D. Reactor Containment Fan Coolers			
1. Number of Units	6	3	3
2. Air Side Flow Rate, cfm	53,500	53,500	53,500
3. Heat Removal rate, BTU/sec, at 235 °F saturated air temp. (See Figure 6.2.1.5-2)	74.8 (at 105°F CCW Temp.)	66.0 (at 125°F CCW Temp.)	66.0 (at 125°F CCW Temp.)

TABLE 6.2A.1.1 – 5
ENGINEERED SAFETY FEATURES SYSTEM INFORMATION
(Δ94 Steam Generator)

	Capacity	Value Used for Containment Mass & Energy Release, Pressure & Temperature Analysis (with minimum SI)	Value Used for Containment Mass & Energy Release, Pressure & Temperature Analysis (with maximum SI)
E. Recirculation Systems			
RHR Heat Exchanger			
a. Type	Vert. U-tube	Vert U-tube	Vert U-tube
b. Number	3	3	3
c. UA, Btu/hr-°F	2.00E+06	2.09E+06	2.09E+06
d. Flow rates/Unit			
1) Recirculation side, gpm (each)	2,900	2,388	2,388
2) Exterior Side, lbm/hr (each)	2.45E+06	2.45E+06	2.45E+06
e. Source of Cooling Water	CCW	CCW	CCW
f. Recirculation Cooling Begins, (sec.)	N.A.	1,465	1,000
F. Others			
Component Cooling Water Heat Exchanger			
a. Type	Counterflow	Counterflow	Counterflow
b. Number	3	2	2
c. UA, Btu/hr-°F/unit	6.99E+06	6.99E+06	6.99E+06
d. Flow rates			
1) CCW Side, lbm/hr	7.035E+06	7.035E+06	7.035E+06
2) ECW Side, lbm/hr	7.500E+06	2.612E+06	2.612E+06
e. Source of Cooling Water	ECW	ECW	ECW

NOTES:

1. Includes 2 LHSI and 2 HHSI flows.
2. Includes 3 LHSI and 3 HHSI flows.

6.2A.1.1-7A

AND LOCA P/T

TABLE ~~6.2.1.1-7A~~

MODELING OF STRUCTURAL HEAT SINKS FOR MSLB ANALYSES

	Passive Heat Sinks	Material	Thickness (ft)	Exposed Surface (ft^2)
No. 1	Containment Dome	Amercote 90 Paint	8 mils	35,343
		Dimetcote 6 Paint	4 mils	
		Carbon-Steel Liner	.03125	
		Air	4.2 mils	
		Concrete	3.0	
No. 2	Containment Wall	Amercote 90 Paint	16 mils	76,836
		Carbon-Steel Liner	.03125	
		Air	4.2 mils	
		Concrete	4.0	
No. 3	Containment Basement	Nutech Paint	50 mils	14,791
		Concrete	2.0	
		Carbon-Steel	.03125	
		Concrete	18.0	
No. 4	Internal Structural Wall (1.28 ft concrete)	Nutech Paint	50 mils	123,479
		Concrete	1.28	
No. 5	Internal Wall (4.39 ft concrete)	Nutech Paint	50 mils	8,820
		Concrete	4.39	
No. 6	Internal Wall	Amercote Paint	8 mils	24,718
		Dimetcote Paint	6 mils	
		Carbon-Steel	.0673	
		Air	4.2 mils	
		Concrete	3.53	
No. 7	Internal Walls	Amercote Paint	8 mils	12,888
		Dimetcote Paint	6 mils	
		Carbon-Steel	.0655	
		Air	4.2 mils	
		Concrete	1.47	
No. 8	Stainless Steel Walls	Stainless Steel	.048	408
No. 9	Carbon Steel Wall	Amercote Paint	8 mils	301,535
		Dimetcote Paint	6 mils	
		Carbon-Steel	.02915	

6.2A.1.1-7A

TABLE ~~6.2.1.1-7A~~ (Continued)

AND LOCA P/T

MODELING OF STRUCTURAL HEAT SINKS FOR MSLB ANALYSES

Passive Heat Sinks	Material	Thickness (ft)	Exposed Surface (ft^2)
No. 10 Carbon Steel Components	Amercote Paint	8 mils	6,867
	Dimetcote Paint	6 mils	
	Carbon-Steel	.0090833	
No. 11 Carbon Steel Components 0.125 in. < t < 0.25 in.	Amercote Paint	8 mils	835
	Dimetcote Paint	6 mils	
	Carbon-Steel	.01300	
No. 12 Carbon Steel Components 0.25 in. < t < 0.5 in.	Amercote Paint	8 mils	8,151
	Dimetcote Paint	6 mils	
	Carbon-Steel	.0341	
No. 13 Carbon Steel Components 0.5 in. < t < 1.0 in.	Amercote Paint	8 mils	10,987
	Dimetcote Paint	6 mils	
	Carbon-Steel	.0689	
No. 14 Carbon Steel Components 1.0 in. < t < 2.5 in.	Amercote Paint	8 mils	9,516.6
	Dimetcote Paint	6 mils	
	Carbon-Steel	.1549	
No. 15 Carbon Steel Components t > 2.5 in.	Amercote Paint	8 mils	2,082
	Dimetcote Paint	6 mils	
	Carbon-Steel	.0308	
No. 16 Stainless Steel Components	Stainless Steel	.0383	1,754
No. 17 Stainless Steel Piping (Combined 20, 21, 22 & 23)	Stainless Steel	.0268	3,987
No. 18 Carbon Steel Piping	Amercote Paint	8 mils	728
	Dimetcote Paint	6 mils	
	Carbon-Steel	.0198	
No. 19 Electrical Components (no paint)	Carbon-Steel (galvanized)	.00913	115,339
No. 20 Electrical Components (painted)	Amercote Paint	16 mils	15,289
	Carbon-Steel	.009746	

6.2A.1.1-7A

TABLE ~~6.2.1.1-7A~~ (Continued)

AND LOCA P/T

MODELING OF STRUCTURAL HEAT SINKS FOR MSLB ANALYSES

	Passive Heat Sinks	Material	Thickness (ft)	Exposed Surface (ft^2)
No. 21	Carbon Steel Components with thickness < .0142 ft.	Carbon Steel	.006262	15,412
No. 22	Carbon Steel Components .01042 < t < .02083 ft.	Carbon Steel	.019163	29,581
No. 23	Steel Components .02083 < t < .04167 ft.	Carbon Steel	.038201	4,497
No. 24	Copper Components	Copper	.0018372	9,206
			TOTAL	833,050

TABLE ~~6.2.1.1-8~~ 6.2A.1.1-8

THERMOPHYSICAL PROPERTIES
OF STRUCTURAL HEAT SINKS
FOR LOCA AND MSLB ANALYSIS

Material	Thermal Conductivity (Btu/hr-ft-°F)	Volumetric Heat Capacity (Btu/ft^3-°F)
Amercote 90 (organic)	.375	49.9
Dimetcote 6 (Inorganic)	0.633	21.67
Nutech Paint	0.1258	28.29
Air	0.0174	0.0103
Carbon Steel	25.0	54.0
Concrete	0.8	30.0
Stainless Steel	9.4	54.0
Copper	200	51.33

TABLE ~~6.2.1.1-9~~ 6.2A.1.1-9

SURFACE HEAT TRANSFER COEFFICIENTS

	Interface	Heat Transfer Coefficient Assumed
1.	Containment Structure to Ambient Air	h_{Amb} = 2.0 Btu/hr-ft^2-°F
2.	Containment Vapor to Liquid	h_{VL} = 0.0
3.	Containment Liquid to Structure	h_{LS} = 0.4 Btu/hr-ft^2-°F
4.	Containment Vapor to Steel and Concrete during LOCA	h_T = Modified Tagami Correlation (see text)
5.	Containment Vapor to Steel and Concrete during MSLB	h_U = Uchida Correlation (see text)

TABLE 6.2A.1.1 – 10 ACCIDENT CHRONOLOGY FOR DBA LOCA (Δ94 Steam Generator)		
Double-Ended Pump Suction Guillotine Break (Minimum Containment Heat Removal Function)		
EVENT	Time (sec) Minimum SI	Time (sec) Maximum SI
Accident Initiation – Pipe Break Coincident with LOOP	0.0	0.0
Pressurizer Low Pressure Trip Setpoint Reached	3.0	3.0
Accumulators begin to Inject	20.7	20.7
End of the Blowdown Phase	27.2	27.2
Pumped SI Begins	33.0	33.0
RCFC starts	45.0	45.0
Accumulator Injection Ends	52.3	52.3
Containment Sprays initiate	84.6	84.6
End of the Reflood Phase	172.9	206.9
Broken Loop SG depressurizes to Containment design pressure	428.0	697.0
Broken Loop SG depressurizes to Containment design pressure minus 10 psi	553.7	859.1
Intact Loop SGs depressurize to Containment design pressure	1341.4	1373.2
Switchover assumed to occur	1465.0	1000.0
Intact Loop SGs depressurize to Containment design pressure minus 20 psi.	1466.7	1499.5
All SGs forced to depressurize to 14.7 psia and 212°F	3600.0	3600.0
Transient Simulation Terminated	3.0×10^6	3.0×10^6

TABLE 6.2A.1.3 – 29

BASIS FOR ANALYSIS

(Δ94 Steam Generator)

Plant Model	4 loop, 14-ft core
Core Power (license application)	3800 MWt
Engineered Safeguards design rating	3800 MWt
Nominal Inlet Temperature	561.2 °F
Nominal Outlet Temperature	624.8 °F
Steam pressure	1066 psia
Rod Array	17 × 17
Total accumulator water mass	3.13×10^5 lbm
Accumulator Temperature	115 °F
Containment design pressure	71.2 psia
Assumed RWST temperature *	120 °F
Pumped Injection (assumed for froth):	
Minimum	See Tables 6.2A.1.3-50 & -51
Maximum	See Tables 6.2A.1.3-50 & -51
Assumed time to initiation of recirculation	See Tables 6.2A.1.3-50 & -51

6.2A.1.3-34

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3.-34~~ Double-Ended Hot Leg Break Blowdown Mass and Energy Releases

Time (Seconds)	Break Path No. 1 Flow*		Break Path No. 2 Flow**	
	(lbm/sec)	Thousand (Btu/sec)	lbm/sec	Thousand (Btu/sec)
.0000	.0	.0	.0	.0
.00110	48176.4	31627.2	48174.5	31624.7
.101	44161.2	29303.5	29202.2	19135.4
.202	38284.0	25430.3	25661.7	16738.2
.301	37050.9	24651.8	22986.5	14861.3
.402	34788.1	23065.6	21550.5	13771.7
.501	35138.3	23263.4	20734.9	13092.0
.602	35016.2	23174.2	20143.7	12574.4
.702	34882.9	23101.9	19721.7	12184.6
.802	34468.4	22874.1	19405.7	11880.9
.902	33758.2	22474.6	19183.5	11650.8
1.00	33087.4	22116.2	18930.1	11415.7
1.10	32695.7	21952.1	18766.1	11248.5
1.20	32591.1	21988.8	18598.4	11088.2
1.30	32368.4	21944.3	18482.5	10965.7
1.40	31913.5	21736.6	18396.7	10867.8
1.50	31307.9	21418.9	18327.0	10784.8
1.60	30709.9	21093.4	18285.1	10721.4
1.70	30316.1	20895.6	18274.0	10679.4
1.80	30078.2	20804.0	18285.1	10651.7
1.90	29805.8	20685.0	18307.1	10632.8
2.00	29354.4	20433.0	18331.2	10616.8
2.10	28766.5	20072.6	18355.7	10603.0
2.20	28210.2	19727.5	18384.2	10593.3
2.30	27797.0	19485.7	18420.5	10589.9
2.40	27466.3	19304.9	18461.4	10590.9
2.50	27105.0	19097.6	18500.1	10592.5
2.60	26670.9	18825.6	18532.2	10592.5

TABLE 6.2A.1.3-34

2.70	26205.3	18520.7	18557.3	10590.3
2.80	25795.9	18252.8	18576.5	10586.6
2.90	25462.2	18040.6	18591.0	10581.9
3.00	25150.2	17840.3	18599.1	10575.4
3.10	24820.9	17617.8	18598.5	10565.5
3.20	24493.6	17387.6	18587.7	10551.3
3.30	24213.9	17188.8	18568.7	10533.9
3.40	23960.5	17004.3	18540.7	10512.7
3.50	23715.9	16818.9	18502.7	10487.0
3.60	23498.4	16647.2	18453.7	10456.2
3.70	23316.5	16498.1	18392.9	10419.8
3.80	23148.5	16353.4	18311.8	10372.7
3.90	22986.5	16205.9	18219.1	10320.0
4.00	22858.1	16079.3	18120.3	10264.7
4.20	22673.6	15868.9	17904.6	10145.8
4.40	22549.7	15685.4	17661.3	10013.6
4.60	22501.9	15548.1	17399.7	9872.7
4.80	22522.8	15449.6	17117.0	9721.2
5.00	22611.8	15392.1	16820.9	9563.0
5.20	22893.3	15452.0	16512.5	9398.6
5.40	23519.7	15598.1	16198.5	9231.3
5.60	24360.0	15883.0	15876.8	9059.8
5.80	15267.6	12116.6	15554.0	8887.7
6.00	16309.0	12354.4	15248.5	8725.9
6.20	16947.9	12617.0	14954.5	8570.2
6.40	17641.4	12885.5	14670.2	8419.7
6.60	18471.4	13255.3	14357.1	8251.6
6.80	19811.5	13909.0	14030.3	8075.6
7.00	26960.2	18451.6	13744.4	7923.1
7.20	28773.5	19380.3	13465.8	7774.5
7.40	28361.9	18727.6	13168.0	7614.1
7.60	29237.3	18954.0	12846.6	7439.7
7.80	30109.6	19274.2	12476.1	7236.7
8.00	30622.5	19450.2	12065.5	7011.6

TABLE 6.2A.1.3-34

8.20	30969.3	19569.7	11670.0	6797.5
8.40	31222.4	19669.1	11280.3	6588.0
8.60	31406.7	19732.7	10877.0	6371.5
8.80	31534.1	19783.5	10482.2	6161.0
9.00	31631.1	19818.3	10097.8	5957.2
9.20	31702.8	19844.6	9722.2	5759.1
9.40	31747.2	19851.3	9364.0	5571.6
9.60	31778.9	19840.2	9022.1	5393.6
9.80	31764.1	19796.7	8694.3	5224.1
10.0	31685.6	19720.6	8385.5	5065.7
10.2	31528.2	19600.0	8091.4	4915.8
10.401	31291.9	19435.1	7810.9	4774.1
10.402	31293.8	19438.3	7809.2	4773.3
10.403	31288.1	19435.3	7808.0	4772.7
10.6	30487.9	18909.2	7546.0	4641.5
10.8	29892.9	18516.8	7292.9	4515.9
11.0	29488.1	18249.8	7054.8	4398.9
11.2	29050.6	17970.3	6828.1	4288.9
11.4	18311.0	11041.1	6611.9	4185.1
11.6	11057.1	7915.2	6407.8	4087.7
11.8	11869.9	8368.2	6220.3	4000.2
12.0	11733.0	8423.5	6071.6	3936.1
12.2	10996.1	8115.8	5944.3	3880.2
12.4	10874.4	8074.3	5836.6	3830.7
12.6	11390.9	8254.0	5749.9	3787.9
12.8	11832.3	8448.5	5681.1	3749.7
13.0	12283.5	8672.1	5627.2	3715.7
13.2	12947.8	9026.3	5583.0	3684.4
13.4	14888.9	10253.9	5542.1	3653.8
13.6	16179.8	11183.4	5494.3	3619.5
13.8	15639.4	10755.1	5440.3	3583.4
14.0	15535.5	10632.3	5368.3	3539.5
14.2	15483.4	10565.6	5277.6	3489.5
14.4	15385.4	10493.6	5174.2	3438.4

TABLE 6.2A.1.3-34

14.6	15213.4	10405.7	5058.2	3385.6
14.8	14980.4	10299.4	4932.4	3332.3
15.0	14690.0	10180.6	4798.6	3278.2
15.2	11674.7	8001.1	4655.6	3221.4
15.4	11360.6	7909.2	4515.4	3168.2
15.6	11780.4	9347.9	4377.9	3116.4
15.8	7057.7	6235.7	4252.1	3071.7
16.0	7239.1	6415.2	4137.0	3029.2
16.2	7242.0	6509.0	4047.0	2996.2
16.4	7206.4	6500.2	3970.9	2961.0
16.6	7187.7	6440.0	3909.3	2925.2
16.8	6932.7	6268.0	3850.4	2885.1
17.0	6272.8	5808.1	3780.6	2840.4
17.2	5487.7	5262.3	3687.4	2791.9
17.4	5024.4	4946.6	3564.7	2741.8
17.6	4721.9	4744.4	3411.9	2692.1
17.8	4484.7	4571.4	3230.2	2642.3
18.0	4248.9	4425.4	3025.6	2590.6
18.2	4024.1	4281.1	2808.1	2535.3
18.4	3833.2	4141.1	2590.0	2478.6
18.6	3623.2	3963.0	2379.2	2419.5
18.8	3366.6	3749.0	2184.7	2355.5
19.0	3073.9	3508.0	2004.9	2281.0
19.2	2783.2	3254.9	1844.4	2187.1
19.4	2526.4	2994.1	1653.6	2015.5
19.6	2343.7	2804.3	1501.6	1850.9
19.8	2275.2	2741.9	1351.3	1674.2
20.0	2133.0	2576.4	1224.4	1522.8
20.2	1972.4	2396.3	1133.8	1414.7
20.4	1856.2	2267.5	1069.3	1336.9
20.6	1756.3	2160.1	997.7	1249.8
20.8	1619.4	1995.6	923.2	1158.3
21.0	1483.6	1834.9	852.5	1071.6
21.2	1342.1	1662.1	798.4	1005.3

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TABLE 6.2A.1.3-34

21.4	1205.6	1493.9	761.8	960.7
21.6	1093.9	1355.1	736.2	929.3
21.8	1008.9	1249.9	713.5	901.4
22.0	881.6	1094.3	690.5	873.0
22.2	731.9	907.8	669.3	846.8
22.4	612.8	760.1	647.3	819.6
22.6	496.4	616.0	619.5	784.8
22.8	376.9	468.6	587.1	744.4
23.0	196.9	241.7	562.8	714.2
23.2	.0	.0	548.4	696.6
23.4	.0	.0	532.8	677.1
23.6	.0	.0	511.7	650.6
23.8	.0	.0	473.0	601.6
24.0	.0	.0	431.2	548.9
24.2	.0	.0	388.0	494.4
24.4	.0	.0	340.6	434.5
24.6	.0	.0	275.9	352.5
24.8	.0	.0	202.4	259.2
25.0	.0	.0	117.2	150.7
25.2	.0	.0	40.1	51.9

*mass and energy exiting from the reactor vessel side of the break

**mass and energy exiting from the SG side of the break

6.2A.1.3-35

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-35~~ Double-Ended Pump Suction Break Blowdown Mass and Energy Releases

Time (Seconds)	Break Path No. 1 Flow*		Break Path No. 2 Flow**	
	(lbm/sec)	Thousand (Btu/sec)	lbm/sec	Thousand (Btu/sec)
.0000	.0	.0	.0	.0
.00114	96078.7	54246.6	43489.3	24483.4
.101	43475.1	24526.3	21663.8	12178.4
.202	48324.0	27373.6	24707.0	13906.5
.302	48151.2	27411.[illegible]	25887.4	14582.7
.402	47864.1	27410.9	25369.3	14300.0
.501	47925.2	27631.2	24469.2	13802.2
.602	47355.9	27509.1	23791.6	13428.2
.701	46392.0	27152.1	23311.6	13162.1
.802	46596.0	27470.8	22815.7	12884.6
.902	46456.0	27575.8	22329.6	12611.1
1.00	46001.7	27487.9	21857.3	12346.1
1.10	45254.8	27220.0	21520.6	12157.8
1.20	44420.0	26899.9	21297.5	12033.7
1.30	43560.5	26570.4	21122.6	11936.7
1.40	42688.8	26236.1	20978.7	11855.7
1.50	41751.7	25869.1	20845.9	11782.6
1.60	40749.5	25462.2	20739.2	11723.1
1.70	39714.2	25027.2	20661.5	11680.1
1.80	38671.3	24580.3	20604.4	11649.1
1.90	37693.4	24156.3	20541.1	11614.2
2.00	36776.3	23751.[illegible]	20468.0	11573.6
2.10	35892.8	23353.1	20402.5	11537.2
2.20	35060.0	22977.8	20349.9	11508.4
2.30	34193.5	22576.0	20285.6	11472.9
2.40	33401.2	22216.4	20188.5	11418.6
2.50	3257[illegible] 3	21826.5	20066.0	11349.8
2.60	31723.1	21413.5	19945.1	11281.9

TABLE 6.2A.1.3-35

2.70	30888.0	21004.0	19730.6	11160.0
2.80	30076.2	20601.9	19521.2	11042.9
2.90	28796.6	19853.4	19328.2	10934.5
3.00	26711.2	18525.3	19116.3	10815.1
3.10	25130.6	17544.2	18901.0	10693.8
3.20	24528.1	17243.0	18696.7	10578.9
3.30	23450.6	16562.6	18499.9	10468.4
3.40	22486.0	15943.9	18290.1	10350.4
3.50	21796.6	15509.9	18074.6	10229.3
3.60	21063.4	15030.7	17859.0	10108.0
3.70	20384.0	14583.4	17664.0	9998.7
3.80	19806.5	14204.0	17480.7	9896.1
3.90	19271.1	13848.2	17294.3	9791.5
4.00	18765.7	13507.4	17105.7	9685.8
4.20	17898.0	12916.1	16761.6	9493.1
4.40	17221.0	12448.5	16433.9	9309.6
4.60	16648.8	12041.9	16119.8	9133.7
4.80	16224.9	11731.1	15789.9	8948.7
5.00	15882.8	11465.0	15468.8	8768.9
5.20	15654.7	11269.8	15107.0	8565.6
5.40	15549.1	11148.5	14751.4	8366.2
5.60	15494.7	11030.2	14649.7	8313.3
5.80	15318.4	10976.4	14355.5	8147.4
6.00	14670.1	10995.3	14075.5	7990.7
6.20	13569.1	10641.0	13829.4	7852.9
6.40	13994.9	10859.7	14480.4	8227.9
6.60	15034.0	11337.1	14327.2	8141.5
6.80	15268.8	11277.7	14201.4	8073.8
7.00	14965.5	10959.9	14120.5	8031.7
7.20	15338.3	11193.9	14002.1	7967.8
7.40	16650.3	12019.1	13882.1	7902.3
7.60	16727.9	11858.9	13623.2	7756.0
7.80	14382.5	10106.8	13542.8	7712.1
8.00	13026.7	9264.8	14148.6	8062.4

x5

TABLE 6.2A.1.3-35

8.20	13275.7	9608.7	13397.5	7624.0
8.40	13485.0	9764.6	13121.8	7467.1
8.60	13318.5	9556.6	13322.2	7583.9
8.80	13856.6	9909.5	13139.6	7480.1
9.00	15530.3	11009.0	12781.9	7275.0
9.20	16823.1	11750.7	12604.0	7173.9
9.40	14908.8	10313.9	12453.4	7089.1
9.60	12434.2	8697.1	12994.1	7404.5
9.80	12300.8	8798.2	12436.9	7074.8
10.0	12239.5	8793.9	12074.8	6867.8
10.2	11395.9	8180.1	12578.7	7160.3
10.2	11390.8	8176.7	12579.8	7160.9
10.4	11355.8	8207.9	12130.3	6900.4
10.6	11542.8	8346.2	11934.3	6789.2
10.8	11065.5	7983.5	12111.8	6892.3
11.0	10908.2	7905.9	11828.7	6729.7
11.2	10871.7	7885.1	11713.1	6663.8
11.4	10379.4	7539.4	11835.3	6735.2
11.6	10193.4	7461.9	11580.4	6586.6
11.8	9983.6	7360.3	11527.3	6556.9
12.0	9733.3	7231.4	11531.4	6559.2
12.2	9615.8	7188.6	11269.5	6408.8
12.4	9473.5	7107.7	11319.4	6438.7
12.6	9385.5	7051.3	11083.2	6302.9
12.8	9285.2	6971.7	11074.2	6299.3
13.0	9121.4	6847.1	10952.3	6229.1
13.2	8938.0	6722.9	10918.5	6210.4
13.4	8769.8	6626.5	10826.5	6156.9
13.6	8630.4	6564.2	10713.8	6092.5
13.8	8464.1	6482.9	10633.4	6047.2
14.0	8316.2	6402.7	10485.5	5963.4
14.2	8204.0	6325.8	10401.1	5916.8
14.4	8109.1	6235.7	10271.0	5843.4
14.6	8027.7	6143.2	10178.0	5791.5

TABLE 6.2A.1.3-35

14.8	7921.4	6032.7	10065.9	5728.5
[illegible].0	7795.1	5922.8	9994.4	5689.0
15.2	7693.7	5844.5	9878.4	5623.7
15.4	7577.1	5758.0	9798.4	5579.6
15.6	7485.9	5688.1	9746.8	5552.7
15.8	7431.4	5636.4	9591.0	5465.0
16.0	7409.7	5596.2	9525.8	5431.4
16.2	7386.2	5540.4	9413.8	5370.7
16.4	7363.0	5480.9	9333.9	5328.8
16.6	7300.6	5402.1	9336.6	5335.6
16.8	7232.4	5342.0	9227.0	5275.8
17.0	7187.4	5323.3	9208.5	5272.1
17.2	7129.9	5321.9	9096.6	5215.2
17.4	7014.1	5293.8	9013.8	5177.3
17.6	6868.9	5232.1	8920.6	5133.9
17.8	6747.8	5160.0	8821.6	5087.1
18.0	6653.8	5092.5	8760.0	5063.0
18.2	6577.1	5042.2	8696.2	5039.6
18.4	6519.3	5024.4	8616.3	5009.6
18.6	6454.8	5026.0	8535.6	4983.3
18.8	6343.9	5013.1	8399.1	4927.1
19.0	6200.3	4974.7	8254.8	4868.4
19.2	6064.0	4923.4	8110.9	4812.3
19.4	5953.4	4874.8	7966.7	4759.1
19.6	5860.8	4836.9	7818.6	4708.4
19.8	5774.2	4813.0	7664.0	4660.7
20.0	5700.6	4814.9	7449.0	4604.4
20.2	5639.0	4842.0	7222.9	4592.7
20.4	5624.5	4949.1	6883.0	4494.0
20.6	5402.7	4991.7	6475.1	4333.3
20.8	4930.6	4910.6	6077.9	4186.8
21.0	4390.4	4755.2	5669.0	4033.0
21.2	3895.1	4545.1	5273.3	3867.3
21.4	3514.8	4277.8	4864.5	3812.4

TABLE 6.2A.1.3-35

21.6	3138.6	3864.0	3708.4	3589.3
21.8	2825.8	3497.9	2508.6	2810.6
22.0	2562.1	3184.8	1620.2	1934.0
22.2	2346.6	2926.4	1374.3	1694.4
22.4	2168.9	2712.5	1220.3	1520.1
22.6	2013.2	2523.1	2855.0	2130.0
22.8	1868.1	2346.1	3108.3	1857.1
23.0	1744.8	2195.9	3079.0	1579.0
23.2	1627.9	2051.7	3147.6	1460.8
23.4	1504.5	1898.9	3188.7	1388.9
23.6	1378.0	1741.7	2949.4	1231.6
23.8	1255.7	1589.5	2537.9	1030.1
24.0	1124.4	1424.6	2257.2	895.5
24.2	975.1	1238.3	2055.2	795.4
24.4	857.7	1090.6	1870.8	703.7
24.6	773.0	983.9	1678.2	615.3
24.8	717.9	914.5	1533.9	551.2
25.0	674.9	860.4	1551.0	545.6
25.2	641.9	818.8	1726.3	584.3
25.4	611.6	780.5	2039.2	656.8
25.6	577.1	736.8	2544.8	782.2
25.8	532.5	680.2	2758.5	815.7
26.0	477.5	610.2	1863.8	538.9
26.2	409.9	524.0	821.8	235.3
26.4	336.8	430.8	.0	.0
26.6	256.5	328.4	.0	.0
26.8	165.4	212.0	.0	.0
27.0	55.5	71.3	.0	.0
27.2	.0	.0	.0	.0

*mass and energy exiting from the reactor vessel side of the break
**mass and energy exiting from the SG side of the break

6.2A.1.3-36

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-37~~ Double-Ended Pump Suction Break Reflood Mass and Energy Releases

(2 TRAINS Case)

Time (seconds)	Break Path No. 1 Flow		Break Path No. 2 Flow	
	(lbm/sec)	Thousand (Btu/sec)	(lbm/sec)	Thousand (Btu/sec)
27.2	.0	.0	.0	.0
27.7	.0	.0	.0	.0
27.9	.0	.0	.0	.0
28.0	.0	.0	.0	.0
28.1	.0	.0	.0	.0
28.1	.0	.0	.0	.0
28.3	53.0	62.6	.0	.0
28.4	43.8	51.7	.0	.0
28.5	49.8	58.9	.0	.0
28.6	57.2	67.5	.0	.0
28.7	64.1	75.7	.0	.0
28.8	70.7	83.5	.0	.0
28.9	76.8	90.7	.0	.0
29.0	82.7	97.6	.0	.0
29.1	88.2	104.2	.0	.0
29.2	93.5	110.5	.0	.0
29.3	98.7	116.6	.0	.0
29.4	103.6	122.4	.0	.0
29.5	108.4	128.0	.0	.0
29.6	112.9	133.4	.0	.0
29.7	117.4	138.7	.0	.0
29.8	121.7	143.8	.0	.0
29.9	125.9	148.7	.0	.0
30.0	130.0	153.5	.0	.0
30.1	134.0	158.2	.0	.0
30.2	137.8	162.8	.0	.0

6.2A.1.3-36

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-37~~ 6.2A.1.3-36 Double-Ended Pump Suction Break Reflood Mass and Energy Releases
(Δ94 STEAM GENERATOR) (2 TRAINS Case)

Time (seconds)	Break Path No. 1 Flow		Break Path No. 2 Flow	
	(lbm/sec)	Thousand (Btu/sec)	(lbm/sec)	Thousand (Btu/sec)
27.2	.0	.0	.0	.0
27.7	.0	.0	.0	.0
27.9	.0	.0	.0	.0
28.0	.0	.0	.0	.0
28.1	.0	.0	.0	.0
28.1	.0	.0	.0	.0
28.3	53.0	62.6	.0	.0
28.4	43.8	51.7	.0	.0
28.5	49.8	58.9	.0	.0
28.6	57.2	67.5	.0	.0
28.7	64.1	75.7	.0	.0
28.8	70.7	83.5	.0	.0
28.9	76.8	90.7	.0	.0
29.0	82.7	97.6	.0	.0
29.1	88.2	104.2	.0	.0
29.2	93.5	110.5	.0	.0
29.3	98.7	116.6	.0	.0
29.4	103.6	122.[illegible]	0	.0
29.5	108.4	128.0	.0	.0
29.6	112.9	133.4	.0	.0
29.7	117.4	138.7	.0	.0
29.8	121.7	143.8	.0	.0
[illegible]	125.9	148.7	.0	.0
30.0	130.0	153.5	.0	.0
30.1	134.0	158.2	.0	.0
30.2	137.8	162.8	.0	.0

6.2A.1.3-36

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-37~~ 6.2A.1.3-36 Double-Ended Pump Suction Break Reflood Mass and Energy Releases (cont.) (2 TRAINS Case) (Δ94 STEAM GENERATOR)

Time (seconds)	Break Path No. 1 Flow		Break Path No. 2 Flow	
	(lbm/sec)	Thousand (Btu/sec)	(lbm/sec)	Thousand (Btu/sec)
30.3	141.6	167.3	.0	.0
31.3	175.5	207.4	.0	.0
32.3	219.3	259.2	797.1	101.1
32.6	567.7	674.3	5031.8	684.7
33.3	764.3	910.4	6707.2	948.8
34.3	757.8	902.8	6671.0	945.4
35.3	748.7	891.9	6602.8	937.5
35.4	747.8	890.7	6595.2	936.7
36.3	738.7	879.8	6524.3	928.2
37.3	728.4	867.4	6442.3	918.2
38.3	718.2	855.2	6359.8	908.2
38.8	713.2	849.1	6318.8	903.2
39.3	708.3	843.2	6278.2	898.3
40.3	698.6	831.6	6198.1	888.6
41.3	689.4	820.5	6120.0	879.1
42.3	680.4	809.7	6043.9	865.9
42.7	676.9	805 [illegible]	6014.1	856.3
43.3	671.8	799.4	5970.0	861.0
44.3	663.5	789.4	5897.8	852.4
45.3	655.5	779.7	5827.5	844.0
46.3	647.7	770.4	5759.3	835.8
46.9	643.2	765.0	5719.3	831.1
47.3	640.3	761.5	5693.0	827.9
48.3	633.1	752.9	5628.7	820.3
49.3	626.2	744.5	5566.2	812.8
50.3	619.4	736.5	5505.5	805.6
51.3	613.0	728.7	5446.5	798.6

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TABLE 6.2A.1.3-36

52.3	606.7	721.1	5389.1	791.7
53.3	398.0	471.6	234.5	194.3
54.3	397.2	470.6	236.1	193.4
55.3	396.8	470.3	237.3	193.0
56.3	396.6	469.9	238.6	192.6
57.0	396.4	469.7	239.5	192.3
57.3	396.3	469.6	239.9	192.2
58.3	396.0	469.3	241.2	191.8
59.3	395.8	469.0	242.4	191.4
60.3	395.5	468.7	243.8	191.0
61.3	395.3	468.3	245.1	190.6
62.3	395.0	468.0	246.5	190.2
63.3	394.7	467.7	247.9	189.9
64.3	394.4	467.4	249.3	189.5
65.3	394.2	467.0	250.7	189.1
66.3	393.9	466.7	252.2	188.7
67.3	393.6	466.4	253.7	188.4
68.3	393.3	466.0	255.2	188.0
69.3	393.0	465.6	256.7	187.6
69.4	392.9	465.6	256.9	187.6
70.3	392.6	465.2	258.3	187.3
71.3	392.3	464.8	259.9	186.9
72.3	391.9	464.4	261.6	186.5
73.3	391.6	464.0	263.2	186.2
74.3	391.2	463.5	264.9	185.8
75.3	390.8	463.1	266.7	185.4
76.3	390.4	462.6	268.5	185.1
77.3	390.0	462.1	270.3	184.7
78.3	389.6	461.6	272.1	184.4
79.3	389.2	461.1	274.0	184.0
80.3	388.7	460.6	275.9	183.7
81.3	388.2	460.0	277.9	183.3
82.3	387.8	459.4	279.8	183.0
82.5	387.[illegible]	459.3	280.2	182.9

TABLE 6.2A.1.3-36

83.3	387.3	458.8	281.9	182.6
84.3	386.8	458.2	283.9	182.3
85.3	386.2	457.6	286.0	182.0
86.3	385.7	457.0	288.1	181.7
87.3	385.1	456.3	290.2	181.3
88.3	384.6	455.6	292.4	181.0
90.3	383.4	454.2	296.9	180.4
92.3	382.1	452.7	301.4	179.8
94.3	380.7	451.0	306.0	179.2
96.3	379.3	449.3	310.7	178.6
96.6	379.0	449.0	311.4	178.5
98.3	377.7	447.5	315.4	178.0
100.3	376.1	445.5	320.3	177.5
102.3	374.4	443.5	325.2	176.9
104.3	372.6	441.3	330.2	176.4
106.3	370.7	439.1	335.3	175.8
108.3	368.7	436.7	340.5	175.3
110.3	366.6	434.2	345.7	174.8
112.0	364.8	432.0	350.3	174.4
112.3	364.4	431.6	351.1	174.3
114.3	362.2	429.0	356.5	173.9
116.3	359.9	426.2	362.0	173.4
118.3	357.5	423.3	367.5	173.0
120.3	355.0	420.4	373.2	172.7
122.3	352.4	417.3	378.9	172.3
124.3	349.8	414.2	384.7	172.0
126.3	347.0	410.9	390.6	171.7
128.3	344.2	407.6	396.6	171.4
129.2	342.9	406.0	399.3	171.[illegible]
130.3	341.3	404.1	402.6	171.2
132.3	338.3	[illegible]0.6	408.8	171.0
134.3	335.3	397.0	415.0	170.8
136.3	332.1	393.2	421.3	170.7
138.3	328.9	389.4	427.7	170.6

TABLE 6.2A.1.3-36

140.3	325.6	385.4	434.3	170.5
142.3	322.1	381.3	440.9	170.5
144.3	318.6	377.2	447.6	170.6
146.3	315.0	372.9	454.5	170.6
148.3	311.3	368.5	461.4	170.7
148.9	310.2	367.1	463.5	170.8
150.3	307.5	363.9	468.5	170.9
152.3	303.5	359.2	475.8	171.1
154.3	299.5	354.4	483.2	171.4
156.3	295.3	349.4	490.8	171.7
158.3	291.0	344.3	498.5	172.1
160.3	286.5	339.0	506.4	172.5
162.3	282.0	333.6	514.4	173.0
164.3	277.3	328.1	522.6	173.6
166.3	272.5	322.3	531.1	174.2
168.3	267.5	316.5	539.7	175.0
170.3	262.4	310.4	548.5	175.7
172.3	257.2	304.2	557.5	176.6
172.9	255.6	302.3	560.3	176.9

6.2A.1.3-37

(Δ94 Steam Generator)

Table ~~6.2.1.3-39~~ Double-Ended Pump Suction Break Reflood Mass and Energy Releases (3 TRAINS Case)

Time (seconds)	Break Path No. 1 Flow*		Break Path No. 2 Flow**	
	(lbm/sec)	Thousand (Btu/sec)	(lbm/sec)	Thousand (Btu/sec)
27.2	.0	.0	.0	.0
27.7	.0	.0	.0	.0
27.9	.0	.0	.0	.0
28.0	.0	.0	.0	.0
28.1	.0	.0	.0	.0
28.3	53.0	62.6	.0	.0
28.4	43.8	51.7	.0	.0
28.5	49.8	58.9	.0	.0
28.6	57.2	67.5	.0	.0
28.7	64.1	75.7	.0	.0
28.8	70.7	83.5	.0	.0
28.9	76.8	90.7	.0	.0
29.0	82.7	97.6	.0	.0
29.1	88.2	104.2	.0	.0
29.2	93.5	110.5	.0	.0
29.3	98.7	116.6	.0	.0
29.4	103.6	122.4	.0	.0
29.5	108.4	128.0	.0	.0
29.6	112.9	133.4	.0	.0
29.7	117.4	138.7	.0	.0
29.8	121.7	143.8	.0	.0
29.9	125.9	148.7	.0	.0
30.0	130.0	153.5	.0	.0
30.1	134.0	158.2	.0	.0
30.2	137.8	162.8	.0	.0
30.3	141.6	167.3	.0	.0
31.3	175.5	207.4	.0	.0
32.3	219.3	259.2	797.1	101.1

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TABLE 6.2A.1.3-37

32.6	567.7	674.3	5031.8	684.7
33.3	814.6	970.9	7103.7	999.9
34.3	803.9	958.4	7062.5	991.3
35.3	796.7	949.7	6996.4	983.4
36.3	786.9	937.9	6920.5	974.1
37.3	776.7	925.6	6840.7	964.3
38.3	766.6	913.5	6760.2	954.4
38.6	763.7	909.9	6736.1	951.5
39.3	756.8	901.6	6680.4	944.6
40.3	747.3	890.1	6602.0	935.1
41.3	738.1	879.1	6525.4	925.7
42.2	730.1	869.5	6458.2	917.6
42.3	729.2	868.4	6450.8	916.7
43.3	720.7	858.2	6378.3	907.9
44.3	712.5	848.3	6307.8	899.5
45.3	704.7	838.9	6239.4	891.3
46.2	697.8	830.7	6179.5	884.1
46.3	697.1	829.8	6173.0	883.3
47.3	689.8	821.0	6108.5	875.6
48.3	682.8	812.5	6045.8	868.1
49.3	675.9	804.3	5985.0	860.9
50.3	669.4	796.4	5925.7	853.8
51.3	663.0	788.7	5868.0	846.9
52.3	656.7	781.3	5811.8	840.1
53.3	495.1	588.3	662.2	254.3
54.3	226.0	267.2	1135.7	307.5
55.3	223.1	263.8	1143.3	306.5
55.6	223.0	263.6	1143.5	306.4
56.3	222.7	263.3	1144.0	306.3
57.3	222.3	262.8	1144.9	306.1
58.3	221.9	262.3	1145.9	306.0
59.3	221.5	261.9	1146.8	305.8
60.3	221.1	261.4	1147.8	305.7

6.2A.1.3-37

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-38~~ Double-Ended Pump Suction Break Reflood Mass and Energy Releases (3 TRAINS Case) (cont)

Time (seconds)	Break Path No. 1 Flow*		Break Path No. 2 Flow**	
	(lbm/sec)	Thousand (Btu/sec)	(lbm/sec)	Thousand (Btu/sec)
61.3	220.7	260.9	1148.8	305.5
62.3	220.3	260.5	1149.8	305.4
63.3	219.9	260.0	1150.9	305.2
64.3	219.5	259.5	1151.9	305.1
65.3	219.1	259.1	1152.9	305.0
66.3	218.7	258.6	1153.9	304.8
67.3	218.4	258.2	1155.0	304.7
68.3	218.0	257.7	1156.0	304.6
69.3	217.6	257.3	1157.0	304.4
70.3	217.2	256.8	1158.1	304.3
71.3	216.9	256.4	1159.1	304.1
71.8	216.7	256.1	1159.7	304.1
72.3	216.5	255.9	1160.2	304.0
73.3	216.1	255.5	1161.2	303.9
74.3	215.7	255.0	1162.3	303.7
75.3	215.4	254.6	1163.4	303.6
76.3	215.0	254.2	1164.4	303.5
77.3	214.6	253.7	1165.5	303.3
78.3	214.3	253.3	1166.6	303.2
79.3	213.9	252.9	1167.7	303.1
80.3	213.5	252.4	1168.8	302.9
81.3	213.2	252.0	1169.9	302.8
82.3	212.8	251.6	1171.0	302.7
83.3	212.4	251.1	1172.1	302.6
84.3	212.1	250.7	1173.2	302.4
85.3	211.7	250.3	1174.3	302.3
86.3	211.3	249.8	1175.4	302.2
87.3	211.0	249.4	1176.6	302.0

TABLE 6.2A.1.3-37

88.3	210.6	249.0	1177.7	301.9
89.0	210.3	248.7	1178.5	301.8
90.3	209.9	248.1	1179.9	301.6
92.3	209.1	247.2	1182.2	301.4
94.3	208.4	246.4	1184.5	301.1
96.3	207.7	245.5	1186.8	300.8
98.3	207.0	244.7	1189.1	300.6
100.3	206.3	243.9	1191.5	300.3
102.3	205.6	243.0	1193.8	300.0
104.3	204.9	242.2	1196.2	299.8
106.3	204.2	241.3	1198.6	299.5
107.6	203.7	240.8	1200.1	299.3
108.3	203.4	240.5	1200.9	299.2
110.3	202.7	239.7	1203.3	298.9
112.3	202.0	238.8	1205.7	298.7
114.3	201.[illegible]	238.0	1208.1	298.4
116.3	200.7	237.2	1210.5	298.1
118.3	200.0	[illegible]	1212.8	297.8
120.3	199.3	235.6	1215.1	297.5
122.3	198.6	234.8	1217.4	297.3
124.3	197.9	234.0	1219.7	296.9
126.3	197.3	233.2	1222.0	296.6
128.0	196.7	232.5	1223.9	296.4
128.3	196.6	232.4	1224.3	296.3
130.3	196.0	231.6	1226.5	296.0
132.3	195.3	230.9	1228.7	295.7
134.3	194.7	230.1	1230.9	295.4
136.3	194.0	229.4	1233.1	295.0
138.3	193.4	228.6	1235.3	294.7
140.3	192.8	227.9	1237.4	294.4
142.3	192.2	227.2	1239.6	294.0
144.3	191.6	226.4	1241.7	293.7
146.3	191.0	225.7	1243.8	293.4
148.3	190.4	225.0	1245.9	293.0

x'.7

TABLE 6.21.1.3-37

150.3	189.8	224.3	1248.0	292.7
150.7	189.7	224.2	1248.4	292.6
152.3	189.2	223.6	1250.0	292.3
154.3	188.6	223.0	1252.1	291.9
156.3	188.1	222.3	1254.2	291.6
158.3	187.5	221.6	1256.2	291.2
160.3	187.0	221.0	1258.3	290.9
162.3	186.4	220.3	1260.3	290.5
164.3	185.9	219.7	1262.3	290.1
166.3	185.3	219.0	1264.3	289.8
168.3	184.8	218.4	1266.3	289.4
170.3	184.3	217.8	1268.3	289.1
172.3	183.8	217.2	1270.3	288.7
174.3	183.3	216.6	1272.3	288.3
176.3	182.8	216.0	1274.2	288.0
176.5	182.7	215.9	1274.4	287.9
178.3	182.3	215.4	1276.2	287.6
180.3	181.8	214.8	1278.2	287.2
182.3	181.3	214.3	1280.1	286.9
184.3	180.8	213.7	1282.1	286.5
186.3	180.4	213.2	1284.1	286.2
188.3	179.9	212.6	1286.0	285.8
190.3	179.5	212.1	1288.0	285.5
192.3	179.0	211.6	1289.9	285.1
194.3	178.6	211.1	1291.9	284.8
196.3	178.2	210.6	1293.9	284.4
198.3	177.8	210.1	1295.9	284.1
200.3	177.4	209.6	1297.9	283.8
202.3	176.9	209.1	1299.9	283.4
204.3	176.5	208.6	1301.9	283.1
206.3	176.2	208.2	1303.9	282.8
206.9	176.0	208.0	1304.5	282.7

Table ~~6.2.1.3-40~~ 6.2A.1.3-38 Double-Ended Pump Suction Break Principle Parameters During Reflood (2 TRAINS Case) (Δ94 STEAM GENERATOR)

Time Seconds	Flooding		Carryover Fraction	Core Height ft	Downcomer Height ft	Flow Frac	Injection			Enthalpy Btu/lbm
	Temp Degree F	Rate in/sec					Total (Pounds Mass Per Second)	Accum	Spill	
17.2	185.0	.000	.000	.00	.00	.250	.0	.0	.0	.00
27.9	181.7	23.401	.000	.54	1.90	.000	9506.6	9506.6	.0	84.53
28.1	178.8	28.805	.000	1.08	1.92	.000	9431.8	9431.8	.0	84.53
29.0	177.3	3.357	.302	1.50	4.94	.316	9197.2	9197.2	.0	84.53
29.9	177.1	3.190	.440	1.65	8.48	.350	8997.3	8997.3	.0	84.53
32.6	177.1	5.988	.632	2.00	18.19	.591	8007.6	8007.6	.0	84.53
33.3	176.8	7.085	.663	2.14	18.31	.629	8373.1	7529.0	.0	84.88
34.3	176.6	6.753	.691	2.33	18.31	.631	8188.5	7346.3	.0	84.89
35.4	176.6	6.507	.708	2.51	18.31	.631	8032.7	7187.2	.0	84.90
38.8	177.2	6.043	.731	3.00	18.31	.628	7621.6	6764.3	.0	84.92
42.7	178.9	5.708	.741	3.50	18.31	.624	7228.5	6358.7	.0	84.95
46.9	181.4	5.439	.745	4.00	18.31	.619	6865.5	5987.2	.0	84.97
52.3	185.1	5.164	.748	4.61	18.31	.612	6467.4	5581.1	.0	85.01
53.3	185.8	3.897	.744	4.70	18.31	.535	924.5	.0	.0	88.00
57.0	189.1	3.866	.745	5.01	18.31	.537	924.7	.0	.0	88.00
63.3	197.1	3.818	.747	5.52	18.31	.540	924.7	.0	.0	88.00
69.4	206.6	3.767	.750	6.00	18.31	.543	924.8	.0	.0	88.00
76.3	218.5	3.703	.753	6.54	18.31	.546	924.9	.0	.0	88.00
82.5	229.6	3.640	.757	7.00	18.31	.549	925.1	.0	.0	88.00
90.3	243.3	3.552	.762	7.57	18.31	.553	925.3	.0	.0	88.00
104.3	262.7	3.380	.770	8.51	18.31	.558	926.1	.0	.0	88.00
112.0	270.8	3.278	.774	9.00	18.31	.560	926.8	.0	.0	88.00
122.3	279.3	3.134	.780	9.61	18.31	.562	928.0	.0	.0	88.00
129.2	284.0	3.034	.784	10.00	18.31	.562	929.0	.0	.0	88.00
140.3	290.0	2.866	.790	10.58	18.31	.561	930.8	.0	.0	88.00

6.2A.1.3-38

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-46~~ (cont) Double-Ended Pump Suction Break Principle Parameters During Reflood (2 TRAINS Case)

Time Seconds	Flooding Temp Degree F	Flooding Rate in/sec	Carryover Fraction	Core Height ft	Downcomer Height ft	Flow Frac	Injection Total (Pounds Mass Per Second)	Injection Accum (Pounds Mass Per Second)	Injection Spill (Pounds Mass Per Second)	Enthalpy Btu/lbm
148.9	293.7	2.728	.794	11.00	18.31	.558	932.5	.0	.0	88.00
160.3	297.7	2.533	.801	11.51	18.31	.551	935.0	.0	.0	88.00
172.9	301.1	2.297	.809	12.00	18.31	.536	938.2	.0	.0	88.00

6.2A.1.3-39

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-41~~ Double-Ended Pump Suction Break Principle Parameters During Reflood (3 TRAINS Case)

Time Seconds	Flooding		Carryover Fraction	Core Height ft	Downcomer Height ft	Flow Frac	Injection			Enthalpy Btu/lbm
	Temp Degree F	Rate in/sec					Total	Accum	Spill	
							(pounds mass per second)			
27.2	185.0	.000	.000	.00	.00	.250	.0	.0	.0	.00
27.9	181.7	23.401	.000	.54	1.90	.000	9506.6	9506.6	.0	84.53
28.1	178.8	28.805	.000	1.08	1.92	.000	9431.8	9431.8	.0	84.53
29.0	177.3	3.357	.302	1.50	4.94	.316	9197.2	9197.2	.0	84.53
29.9	177.1	3.190	.440	1.65	8.48	.350	8997.3	8997.3	.0	84.53
32.6	177.1	5.988	.632	2.00	18.19	.591	8007.6	8007.6	.0	84.53
33.3	176.8	7.414	.665	2.15	18.31	.635	8861.7	7434.7	.0	85.09
34.3	176.6	7.069	.692	2.34	18.31	.639	8660.3	7238.2	.0	85.10
35.3	176.5	6.841	.708	2.51	18.31	.640	8519.2	7093.5	.0	85.11
38.6	177.0	6.372	.732	3.01	18.31	.638	8121.8	6681.8	.0	85.15
42.2	178.4	6.053	.741	3.50	18.31	.634	7759.2	6304.5	.0	85.18
46.2	180.7	5.790	.745	4.01	18.31	.630	7413.6	5944.7	.0	85.22
50.3	183.4	5.572	.748	4.50	18.31	.626	7105.6	5624.5	.0	85.25
53.3	185.4	4.336	.745	4.84	18.31	.544	1522.2	.0	.0	88.00
55.6	187.1	2.855	.734	5.00	18.31	.415	1596.7	.0	.0	88.00
64.3	195.0	2.796	.736	5.55	18.31	.416	1596.6	.0	.0	88.00
71.8	203.5	2.744	.737	6.00	18.31	.418	1596.5	.0	.0	88.00
80.3	214.0	2.685	.740	6.50	18.31	.419	1596.5	.0	.0	88.00
89.0	225.0	2.623	.743	7.00	18.31	.421	1596.4	.0	.0	88.00
98.3	236.5	2.557	.747	7.51	18.31	.422	1596.3	.0	.0	88.00
107.6	247.3	2.490	.751	8.00	18.31	.424	1596.2	.0	.0	88.00
118.3	258.5	2.414	.757	8.54	18.31	.427	1596.1	.0	.0	88.00
128.0	266.8	2.347	.762	9.00	18.31	.429	1596.0	.0	.0	88.00
140.3	275.4	2.265	.768	9.56	18.31	.432	1595.9	.0	.0	88.00

6.2A.1.3-39

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3.41~~ Double-Ended Pump Suction Break Principle Parameters During Reflood
(cont.) (3 TRAINS Case)

Time Seconds	Flooding		Carryover Fraction	Core Height ft	Downcomer Height ft	Flow Frac	Injection			Enthalpy Btu/lbm
	[illegible]mp [illegible]F	Rate in/sec					Total	Accum	Spill	
							(pounds mass per second)			
150.7	281.4	2.199	.774	10.00	18.31	.435	1595.9	.0	.0	88.00
164.3	287.7	2.115	.781	10.55	18.31	.439	1595.7	.0	.0	88.00
176.5	292.3	2.043	.788	11.00	18.31	.442	1595.6	.0	.0	88.00
192.3	297.1	1.952	.799	11.55	18.31	.448	1595.5	.0	.0	88.00
206.9	300.6	1.871	.810	12.00	18.31	.453	1595.4	.0	.0	88.00

6.2A.1.3-40

(Δ94 Steam Generator)

Table ~~6.2.1.3-45~~ 6.2A.1.3-40 Double-Ended Pump Suction Post-Reflood Mass and Energy Releases

(2 TRAINS Case) (Δ94 Steam Generator)

Time (seconds)	Break Path No. 1 Flow		Break Path No. 2 Flow	
	(lbm/sec)	Thousand (Btu/sec)	(lbm/sec)	Thousand (Btu/sec)
173.0	293.6	365.9	656.2	206.2
178.0	291.8	363.7	658.0	206.4
183.0	291.3	363.1	658.5	206.3
188.0	290.7	362.4	659.1	206.1
193.0	288.9	360.1	660.9	206.4
198.0	288.3	359.3	661.5	206.2
203.0	287.8	358.8	662.0	206.1
208.0	286.2	356.7	663.6	206.2
213.0	285.8	356.3	664.0	206.1
218.0	284.2	354.2	665.6	206.3
223.0	283.8	353.7	666.1	206.1
228.0	282.1	351.6	667.8	206.3
233.0	281.6	350.9	668.3	206.1
238.0	281.0	350.2	668.8	206.0
243.0	279.2	348.0	670.6	206.2
248.0	278.6	347.3	671.2	206.1
253.0	278.0	346.4	671.9	206.0
258.0	277.2	345.6	672.6	205.9
263.0	275.4	343.2	674.5	206.2
268.0	274.6	342.2	675.3	206.1
273.0	273.7	341.2	676.1	206.0
278.0	272.9	340.1	677.0	206.0
283.0	271.9	338.9	677.9	206.0
288.0	270.9	337.7	678.9	206.0
293.0	269.9	336.4	680.0	206.0

6.2A.1.3-40

(Δ94 Steam Generator)

Table ~~6.2.1.3-40~~ 6.2A.1.3-40 Double-Ended Pump Suction Post-Reflood Mass and Energy Releases (cont.) (Δ94 Steam Generator) (2 TRAINS Case)

Time (seconds)	Break Path No. 1 Flow		Break Path No. 2 Flow	
	(lbm/sec)	Thousand (Btu/sec)	(lbm/sec)	Thousand (Btu/sec)
298.0	268.8	335.0	681.1	206.0
303.0	267.6	333.5	682.2	206.0
308.0	266.3	332.0	683.5	206.1
313.0	265.1	330.4	684.8	206.2
318.0	264.7	329.9	685.1	206.0
323.0	263.2	328.1	686.6	206.1
328.0	262.7	327.4	687.2	205.9
333.0	261.0	325.3	688.8	206.1
338.0	260.2	324.4	689.6	206.0
343.0	258.4	322.1	691.4	206.2
348.0	257.4	320.8	692.4	206.2
353.0	256.2	319.4	693.6	206.3
358.0	255.8	318.9	694.0	206.1
363.0	254.3	317.0	695.5	206.2
368.0	252.7	314.9	697.1	206.4
373.0	251.7	313.7	698.1	206.3
378.0	250.4	312.1	699.4	206.4
383.0	249.7	311.2	700.1	206.3
388.0	247.9	309.0	701.9	206.5
393.0	247.2	308.2	702.6	206.4
398.0	245.4	305.9	704.4	206.6
403.0	244.6	304.9	705.2	206.5
408.0	243.2	303.2	706.6	206.6
413.0	270.3	336.9	679.6	206.6
418.0	269.1	335.4	680.7	206.6
423.0	267.8	333.8	682.0	206.6
428.0	103.2	128.6	846.7	251.4

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TABLE 6.2A.1.3-40

553.6	103.2	128.6	846.7	251.4
553.7	110.3	130.8	839.5	229.8
558.0	110.1	136.1	839.7	242.2
1464.9	110.1	136.1	839.7	242.2
1465.0	91.8	113.3	564.9	307.1
1466.7	91.8	113.3	564.9	307.1
1466.8	88.4	101.7	568.3	173.8
3600.0	71.0	81.7	585.7	176.9

6.2A.1.3-41

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-44~~ 6.2A.1.3-41 Double-Ended Pump Suction Break Post-Reflood Mass and Energy Releases (3 TRAINS Case) (Δ94 STEAM GENERATOR)

Time (seconds)	Break Path No. 1 Flow		Break Path No. 2 Flow	
	(lbm/sec)	Thousand (Btu/sec)	(lbm/sec)	Thousand (Btu/sec)
207.0	197.2	248.5	1404.2	287.6
212.0	198.3	249.9	1403.1	287.0
217.0	197.7	249.2	1403.7	286.9
222.0	197.1	248.4	1404.2	286.8
227.0	198.2	249.8	1403.2	286.2
232.0	197.6	249.0	1403.8	286.1
237.0	197.0	248.3	1404.4	286.0
242.0	196.4	247.5	1405.0	285.9
247.0	197.5	248.8	1403.9	285.3
252.0	196.9	248.1	1404.5	285.2
257.0	196.2	247.3	1405.1	285.1
262.0	197.3	248.6	1404.1	284.6
267.0	196.6	247.8	1404.7	284.5
272.0	196.0	247.0	1405.4	284.4
277.0	197.0	248.2	1404.4	283.8
282.0	196.4	247.4	1405.0	283.7
287.0	195.7	246.6	1405.6	283.6
292.0	196.7	247.9	1404.7	283.1
297.0	196.1	247.0	1405.3	283.0
302.0	195.4	246.2	1406.0	282.9
307.0	196.3	247.4	1405.0	282.3
312.0	195.7	246.6	1405.7	282.2
317.0	195.0	245.7	1406.4	282.1
322.0	195.9	246.9	1405.5	281.6
327.0	195.3	246.0	1406.1	281.5

Table ~~6.2.1.3-44~~ 6.2A.1.3-41 Energy Releases (cont.)	Double-Ended Pump Suction Break Post-Reflood Mass and (3 TRAINS Case) (Δ94 STEAM GENERATOR)			
Time (seconds)	Break Path No. 1 Flow		Break Path No. 2 Flow	
	(lbm/sec)	Thousand (Btu/sec)	(lbm/sec)	Thousand (Btu/sec)
332.0	196.1	247.1	1405.2	281.0
337.0	195.4	246.3	1405.9	280.8
342.0	194.8	245.4	1406.6	280.8
347.0	195.6	246.5	1405.8	280.3
352.0	194.9	245.6	1406.5	280.2
357.0	195.7	246.6	1405.7	279.7
362.0	195.0	245.7	1406.4	279.6
367.0	194.3	244.8	1407.1	279.5
372.0	195.1	245.8	1406.3	279.0
377.0	194.3	244.9	1407.0	278.9
382.0	195.1	245.8	1406.3	278.4
387.0	194.4	244.9	1407.0	278.4
392.0	193.6	244.0	1407.8	278.3
397.0	194.3	244.9	1407.0	277.8
402.0	193.6	244.0	1407.7	277.7
407.0	194.5	245.1	1406.9	277.2
407.0	194.5	245.1	1406.9	277.2
417.0	193.3	243.5	1408.1	277.0
422.0	194.1	244.5	1407.3	276.4
427.0	193.4	243.7	1407.9	276.3
432.0	194.2	244.7	1407.2	275.8
437.0	193.6	243.9	1407.8	283.3
442.0	192.9	243.1	1408.5	283.2
447.0	193.7	244.0	1407.7	282.7
452.0	193.0	243.2	1408.4	282.6
457.0	193.7	244.1	1407.7	282.1
462.0	193.0	243.2	1408.4	281.9

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TABLE 6.2A.1.3-41

467.0	193.7	244.0	1407.7	281.4
472.0	192.9	243.1	1408.4	281.3
477.0	193.6	243.9	1407.8	280.8
482.0	192.9	243.0	1408.5	280.7
487.0	193.5	243.8	1407.9	280.3
492.0	192.7	242.8	1408.7	280.1
497.0	193.3	243.5	1408.1	279.7
502.0	192.5	242.5	1408.9	279.6
507.0	193.0	243.2	1408.4	279.1
512.0	192.2	242.2	1409.2	279.0
517.0	192.7	242.8	1408.7	278.6
522.0	193.1	243.3	1408.3	278.1
527.0	192.2	242.2	1409.1	278.0
532.0	192.6	242.7	1408.7	277.6
537.0	193.0	243.2	1408.4	277.2
542.0	192.1	242.1	1409.3	277.1
547.0	192.4	242.5	1409.0	276.7
552.0	192.7	242.8	1408.7	276.3
557.0	191.7	241.6	1409.6	276.3
562.0	192.0	241.9	1409.4	275.9
567.0	192.2	242.1	1409.2	275.5
572.0	192.3	242.3	1409.1	275.1
577.0	192.4	242.5	1408.9	274.8
582.0	191.3	241.1	1410.0	274.7
587.0	191.4	241.2	1410.0	274.4
592.0	191.4	241.2	1410.0	274.1
597.0	191.4	241.1	1410.0	273.7
602.0	191.3	241.1	1410.1	273.4
607.0	191.3	241.0	1410.1	273.1
612.0	191.1	240.8	1410.2	272.8
617.0	191.0	240.6	1410.4	272.5
622.0	191.8	241.7	1409.6	272.0
627.0	191.5	241.3	1409.9	271.7
632.0	191.2	240.9	1410.2	271.5

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TABLE G.2A.1.3-41

637.0	191.8	241.6	1409.6	271.0
642.0	191.3	241.0	1410.1	270.8
647.0	190.7	240.3	1410.7	270.6
652.0	191.0	240.7	1410.4	270.2
657.0	191.2	241.0	1410.1	269.8
662.0	191.3	241.1	1410.1	276.5
667.0	191.3	241.0	1410.1	276.1
672.0	191.1	240.8	1410.3	275.8
677.0	190.8	240.4	1410.6	275.5
682.0	191.1	240.8	1410.2	275.0
687.0	190.4	239.9	1411.0	274.9
692.0	190.3	239.9	1411.0	274.5
697.0	93.2	117.4	1508.2	300.8
859.0	93.2	117.4	1508.2	300.8
859.1	102.4	123.5	1498.9	293.3
862.0	102.4	127.5	1499.0	293.0
997.0	99.2	116.7	1502.2	293.3
1000.0	99.1	123.4	1550.7	546.4
1499.5	99.1	123.4	1550.7	546.4
1499.6	89.2	102.6	1560.6	411.5
3600.0	72.4	83.3	1577.4	414.5

6.2A.1.3-42

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-46~~ 6.2A.1.3-42 **Double-Ended Hot Leg Break**
Mass Balance

	Time (seconds)	.00	25.15	25.15
		Mass (thousand lbm)		
Initial	In RCS and ACC	932.85	932.85	932.85
Added Mass	Pumped Injection	.00	.00	.00
	Total Added	.00	.00	.00
*** Total Available ***		932.85	932.85	932.85
Distribution	Reactor Coolant	619.80	78.53	90.21
	Accumulator	313.05	249.68	238.00
	Total Contents	932.85	328.21	328.21
Effluent	Break Flow	.00	604.62	604.62
	ECCS Spill	.00	.00	.00
	Total Effluent	.00	604.62	604.62
*** Total Accountable ***		932.85	932.83	932.83

6.2A.1.3-43

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-46~~ 6.2A.1.3-43 **Double-Ended Hot Leg Break Energy Balance** (Δ94 STEAM GENERATOR)

	Time (seconds)	.00	25.15	25.15
		Energy (million Btu)		
Initial Energy	In RCS, ACC, S GEN	1213.09	1213.09	1213.09
Added Energy	Pumped Injection	.00	.00	.00
	Decay Heat	.00	9.44	9.44
	Heat from Secondary	.00	-11.46	-11.46
	Total Added	.00	-2.02	-2.02
*** Total Available ***		1213.09	1211.07	1211.07
Distribution	Reactor Coolant	372.34	17.15	18.14
	Accumulator	26.46	21.11	20.12
	Core Stored	31.05	13.53	13.53
	Primary Metal	193.74	182.37	182.37
	Secondary Metal	162.92	158.89	158.89
	Steam Generator	426.57	413.29	413.29
	Total Contents	1213.09	806.34	806.34
Effluent	Break Flow	.00	404.03	404.03
	ECCS Spill	.00	.00	.00
	Total Effluent	.00	404.03	404.03
*** Total Accountable ***		1213.09	1210.37	1210.37

6.2A.1.3-44

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-49~~ Double-Ended Pump Suction Break Mass Balance (2 TRAINS Case)

	Time (seconds)	.00	27.20	27.20	172.91	553.72	1466.70	3600.00
		Mass (Thousand lbm)						
Initial	In RCS and ACC	932.85	932.85	932.85	932.85	932.85	932.85	932.85
Added Mass	Pumped Injection	.00	.00	.00	128.69	490.30	1320.76	2757.90
	Total Added	.00	.00	.00	128.69	490.30	1320.76	2757.90
*** Total Available ***		932.85	932.85	932.85	1061.54	1423.15	2253.61	3690.75
Distribution	Reactor Coolant	619.80	48.43	59.02	129.06	129.06	129.06	129.06
	Accumulator	313.05	266.41	255.82	.00	.00	.00	.00
	Total Contents	932.85	314.84	314.84	129.06	129.06	129.06	129.06
Effluent	Break Flow	.00	617.98	617.98	840.39	1202.00	2068.67	3469.59
	ECCS Spill	.00	.00	.00	.00	.00	.00	.00
	Total Effluent	.00	617.98	617.98	840.39	1202.00	2068.67	3469.59
*** Total Accountable ***		932.85	932.82	932.82	969.45	1331.07	2197.73	3598.65

6.2A.1.3-45

(Δ94 Steam Generator)

Table ~~6.2.1.3-50~~ Double-Ended Pump Suction Break Energy Balance (2 TRAINS Case)

	Time (seconds)	.00	27.20	27.20	172.91	553.72	1466.70	3600.00
		Energy (Million Btu)						
Initial Energy	In RCS, ACC, S GEN	1213.09	1213.09	1213.09	1213.09	1213.09	1213.09	1213.09
Added Energy	Pumped Injection	.00	.00	.00	11.32	43.15	128.65	454.40
	Decay Heat	.00	9.61	9.61	29.15	68.51	143.60	279.66
	Heat from Secondary	.00	-9.69	-9.69	-9.69	-.47	7.86	7.86
	Total Added	.00	-.08	-.08	30.79	111.18	280.11	741.92
*** Total Available ***		1213.09	1213.01	1213.01	1243.88	1324.28	1493.20	1955.01
Distribution	Reactor Coolant	372.34	11.04	11.94	37.03	37.03	37.03	37.03
	Accumulator	26.46	22.52	21.62	.00	.00	.00	.00
	Core Stored	31.05	16.27	16.27	5.87	5.65	5.12	3.88
	Primary Metal	193.74	184.37	184.37	154.54	117.64	86.60	65.25
	Secondary Metal	162.92	160.72	160.72	146.81	121.77	84.48	63.49
	Steam Generator	426.57	419.20	419.20	376.61	313.84	221.73	169.87
	Total Contents	1213.09	814.12	814.12	720.85	595.93	434.96	339.52
Effluent	Break Flow	.00	398.21	398.21	504.08	709.41	1035.02	1604.66
	ECCS Spill	.00	.00	.00	.00	.00	.00	.00
	Total Effluent	.00	398.21	398.21	504.08	709.41	1035.02	1604.66
*** Total Accountable ***		1213.09	1212.33	1212.33	1224.94	1305.33	1469.98	1944.17

6.2A.1.3-46

(Δ94 Steam Generator)

Table ~~6.2.1.3-51~~ Double-Ended Pump Suction Break Mass Balance (3 TRAINS Case)

	Time (seconds)	.00	27.20	27.20	206.91	859.11	1499.50	3600.00
		Mass (Thousand lbm)						
Initial	In RCS and ACC	932.85	932.85	932.85	932.85	932.85	932.85	932.85
Added Mass	Pumped Injection	.00	.00	.00	274.70	1318.97	2368.67	5834.07
	Total Added	.00	.00	.00	274.70	1318.97	2368.67	5834.07
*** Total Available ***		932.85	932.85	932.85	1207.55	2251.82	3301.52	6766.92
Distribution	Reactor Coolant	619.80	48.43	59.02	131.38	131.38	131.38	131.38
	Accumulator	313.05	266.41	255.82	.00	.00	.00	.00
	Total Contents	932.85	314.84	314.84	131.38	131.38	131.38	131.38
Effluent	Break Flow	.00	617.98	617.98	984.08	2028.35	3078.12	6543.53
	ECCS Spill	.00	.00	.00	.00	.00	.00	.00
	Total Effluent	.00	617.98	617.98	984.08	2028.35	3078.12	6543.53
*** Total Accountable ***		932.85	932.82	932.82	1115.47	2159.73	3209.51	6674.91

6.2A.1.3-47

(Δ94 Steam Generator)

Table ~~6.2.1.3-59~~ Double Pump Suction Break Energy Balance (3 TRAINS Case)

		Energy Balance						
	Time (seconds)	.00	27.20	27.20	206.91	859.11	1499.50	3600.0
		Energy (Million Btu)						
Initial Energy	In RCS, ACC, S GEN	1213.09	1213.09	1213.09	1213.09	1213.09	1213.09	1213.09
Added Energy	Pumped Injection	.00	.00	.00	24.17	116.07	332.88	1161.11
	Decay Heat	.00	9.61	9.61	33.06	95.63	146.00	279.65
	Heat from Secondary	.00	-9.69	-9.69	-9.69	6.09	7.86	7.86
	Total Added	.00	-.08	-.08	47.55	217.79	486.74	1448.61
*** Total Available ***		1213.09	1213.01	1213.01	1260.64	1430.88	1699.83	2661.71
Distribution	Reactor Coolant	372.34	11.04	11.94	37.48	37.48	37.48	37.48
	Accumulator	26.46	22.52	21.62	.00	.00	.00	.00
	Core Stored	31.05	16.27	16.27	5.87	5.65	5.24	3.88
	Primary Metal	193.74	184.37	184.37	151.61	109.91	87.99	65.81
	Secondary Metal	162.92	160.72	160.72	148.56	111.82	85.68	64.26
	Steam Generator	426.57	419.20	419.20	381.31	291.49	224.67	171.76
	Total Contents	1213.09	814.12	814.12	724.82	556.34	441.05	343.20
Effluent	Break Flow	.00	398.21	398.21	516.89	855.61	1234.15	2296.91
	ECCS Spill	.00	.00	.00	.00	.00	.00	.00
	Total Effluent	.00	398.21	398.21	516.89	855.61	1234.15	2296.91
*** Total Accountable ***		1213.09	1212.33	1212.33	1241.72	1411.96	1675.21	2640.1

Table 6.2A.1.3-49	
Decay Heat Data (Based On Standard Review Plan ASB 9-2 Correlations)	
Time (seconds)	**Decay Heat (Btu/hr)**
1.0E+03	3.06E+08
2.0E+03	2.56E+08
3.0E+03	2.24E+08
3.6E+03	2.11E+08
4.0E+03	2.03E+08
5.0E+03	1.88E+08
6.0E+03	1.78E+08
7.0E+03	1.70E+08
8.0E+03	1.64E+08
9.0E+03	1.59E+08
1.0E+04	1.55E+08
2.0E+04	1.29E+08
3.0E+04	1.13E+08
4.0E+04	1.02E+08
5.0E+04	9.49E+07
6.0E+04	8.96E+07
7.0E+04	8.57E+07
8.0E+04	8.25E+07
9.0E+04	8.00E+07
1.0E+05	7.78E+07
2.0E+05	6.33E+07
3.0E+05	5.42E+07
4.0E+05	4.81E+07
5.0E+05	4.38E+07
6.0E+05	4.06E+07
7.0E+05	3.82E+07
8.0E+05	3.63E+07
9.0E+05	3.48E+07
1.0E+06	3.34E+07
1.1E+06	3.23E+07
1.2E+06	3.13E+07
1.3E+06	3.04E+07
1.4E+06	2.95E+07
1.5E+06	2.87E+07
1.6E+06	2.80E+07
1.7E+06	2.73E+07
1.8E+06	2.67E+07
1.9E+06	2.61E+07
2.0E+06	2.55E+07
2.5E+06	2.30E+07
3.0E+06	2.10E+07
3.5E+06	1.94E+07
4.0E+06	1.81E+07
4.5E+06	1.70E+07
5.0E+06	1.60E+07
6.0E+06	1.46E+07
7.0E+06	1.34E+07
8.0E+06	1.25E+07
9.0E+06	1.17E+07
1.0E+07	1.10E+07
2.0E+07	6.90E+06
3.0E+07	4.99E+06
4.0E+07	3.96E+06
5.0E+07	3.32E+06
6.0E+07	2.90E+06
7.0E+07	2.60E+06
8.0E+07	2.37E+06
9.0E+07	2.21E+06
1.0E+08	2.08E+06

Table ~~6.2.1.3-53~~ 6.2A.1.3-48 Decay Heat Curve BASED ON 1979 ANS Plus 2 Sigma Uncertainty (Δ94 STEAM GENERATOR)

Time (sec)	Decay Heat Generation Rate (Btu/Btu)
1.00E+01	0.053876
1.50E+01	0.050401
2.00E+01	0.048018
4.00E+01	0.042401
6.00E+01	0.039244
8.00E+01	0.037065
1.00E+02	0.035466
1.50E+02	0.032724
2.00E+02	030936
4.00E+02	0.027078
6.00E+02	0.024931
8.00E+02	0.023389
1.00E+03	0.022156
1.50E+03	0.019921
2.00E+03	0.018315
4.00E+03	0.014781
6.00E+03	0.013040
8.00E+03	0.012000
1.00E+04	0.011262
1.50E+04	0.010097
2.00E+04	0.009350
4.00E+04	0.007778
6.00E+04	0.006958
8.00E+04	0.006424
1.00E+05	0.006021
1.50E+05	0.005323
4.00E+05	0.003770
6.00E+05	0.003201
8.00E+05	0.002834
1.00E+06	0.002580

6.2A.1.3-50

(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-56~~ Total Pumped ECCS Flow Rate for 2 Trains of SI Operating

INJECTION MODE (REFLOOD PHASE)	
RCS Pressure (psia)	**Total Flow (lbm/sec)**
14.7	1049.7
114.7	871.9
214.7	601.0

RECIRCULATION MODE		
Time (sec)	**Enthalpy (BTU/lbm)**	**Flow (lbm/sec)**
1465.0	239.0	656.69
3600.1	228.8	659.96
10,000.1	218.6	663.23
100,000.1	188.3	672.36

6.2A.1.3-51

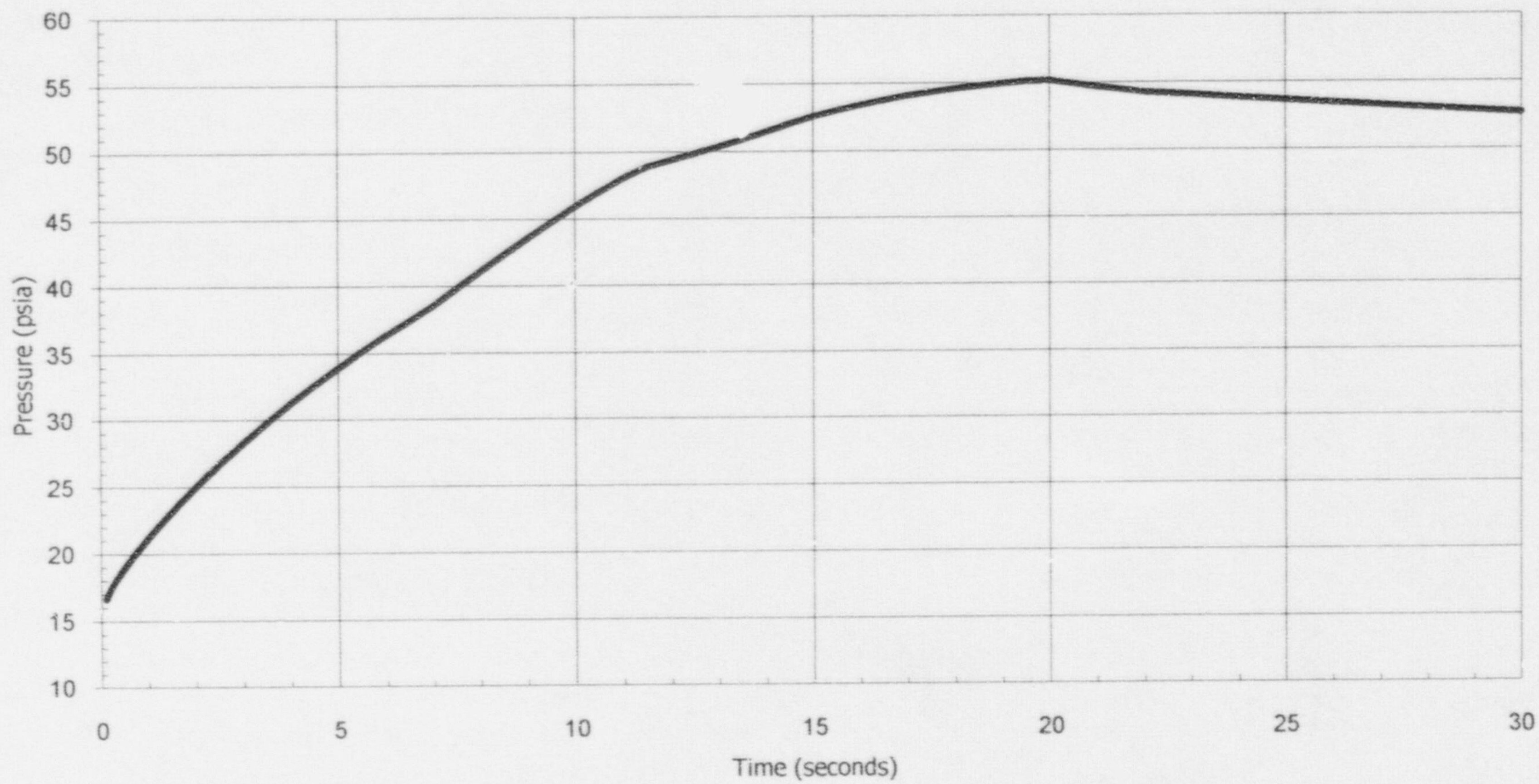
(Δ94 STEAM GENERATOR)

Table ~~6.2.1.3-56~~ Total Pumped ECCS Flow Rate for 3 Trains of SI Operating

INJECTION MODE (REFLOOD PHASE)	
RCS Pressure (psia)	Total Flow (lbm/sec)
14.7	1757.0
114.7	1479.0
214.7	1152.0
314.7	664.0

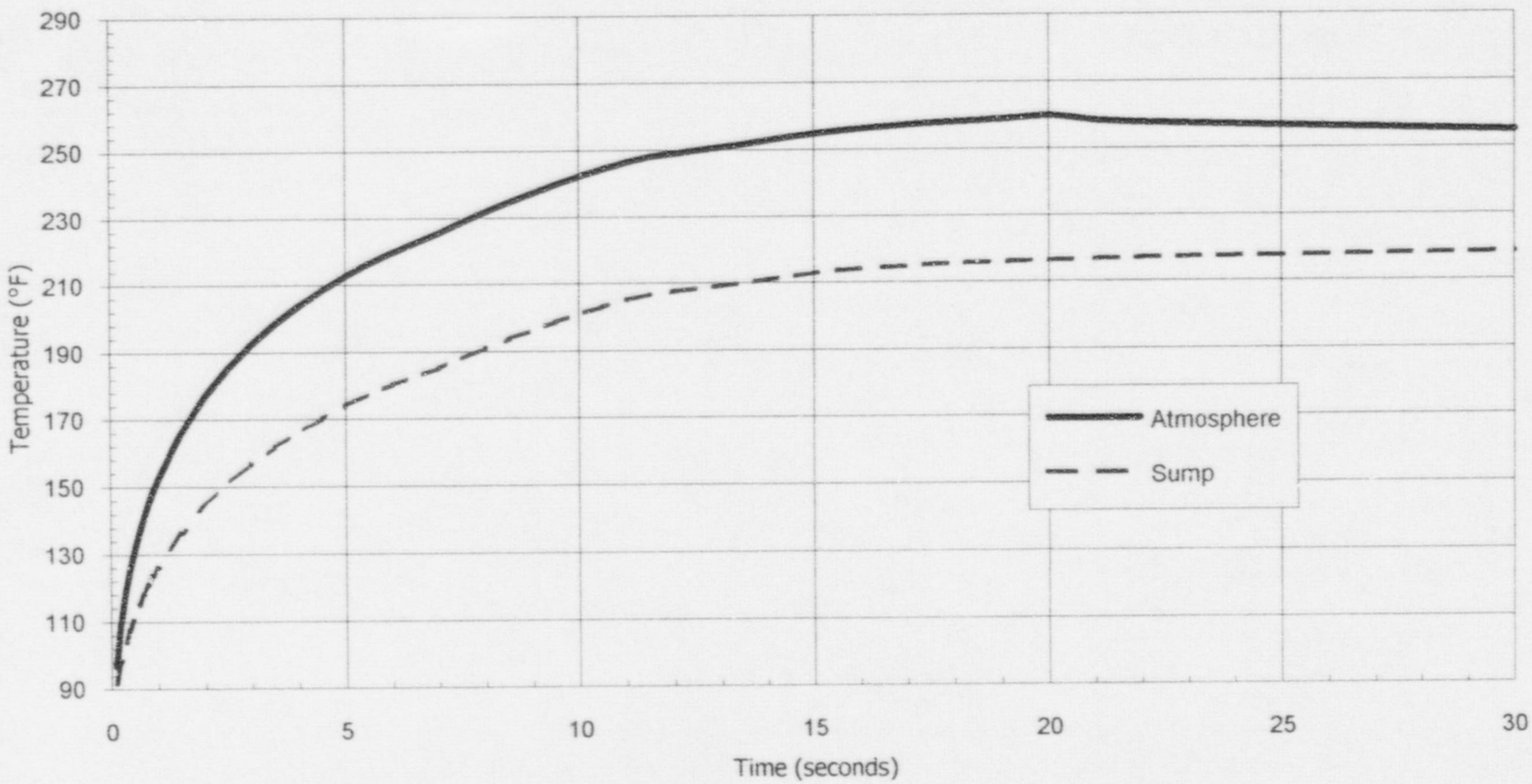
RECIRCULATION MODE		
Time (sec)	Enthalpy (BTU/lbm)	Flow (lbm/sec)
1000.0	239.0	1649.8
3600.1	228.8	1658.0
10,000.1	218.6	1666.2
100,000.1	188.3	1689.1

FIGURE 6.2A.1.1-30
CONTAINMENT PRESSURE
Double-Ended Hot Leg Guillotine Break
(DELTA-94 Steam Generator)



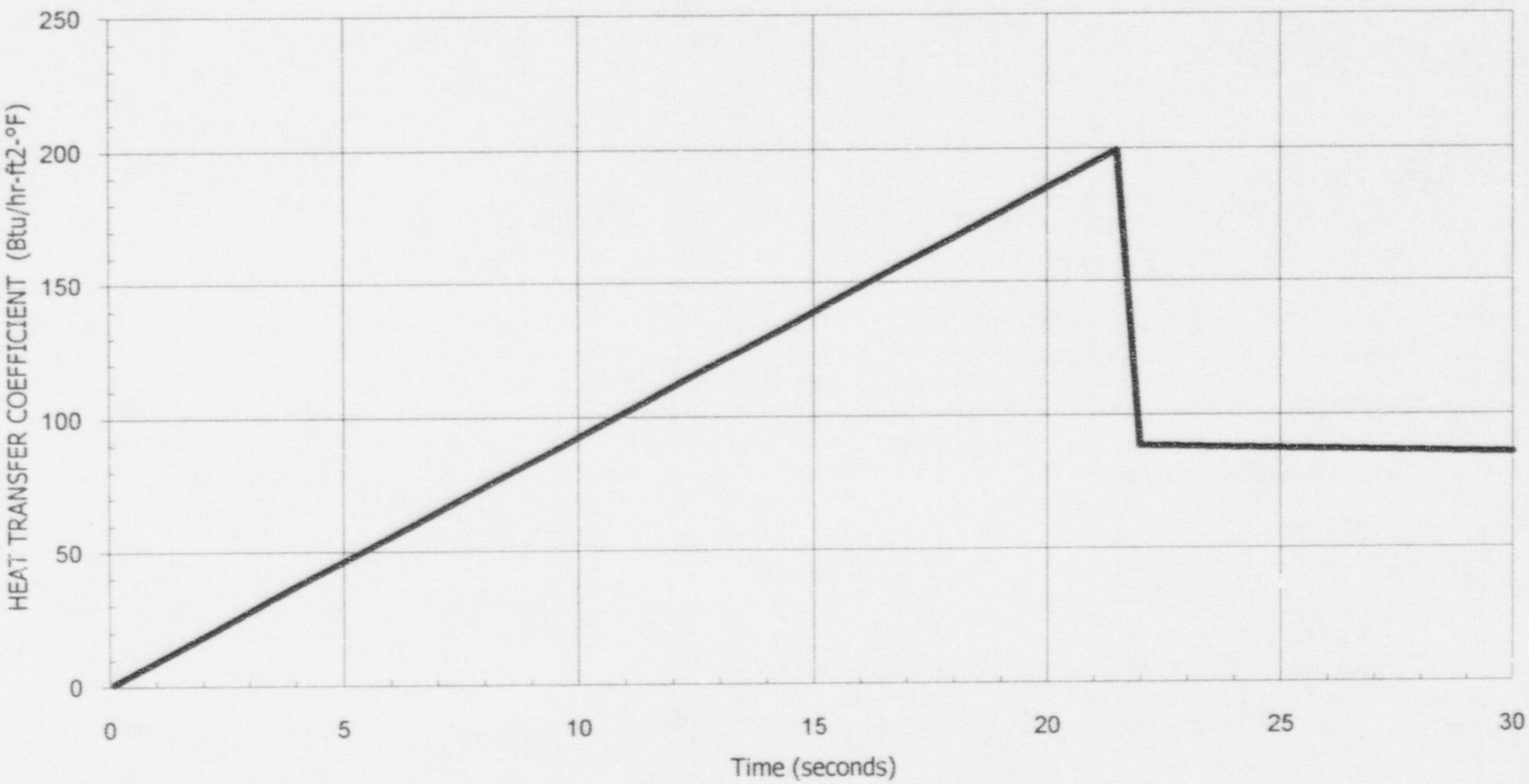
JDEHL3SI.XLS Chart 2

FIGURE 6.2A.1.1-31
CONTAINMENT TEMPERATURES
Double-Ended Hot Leg Guillotine Break
(DELTA-94 Steam Generator)



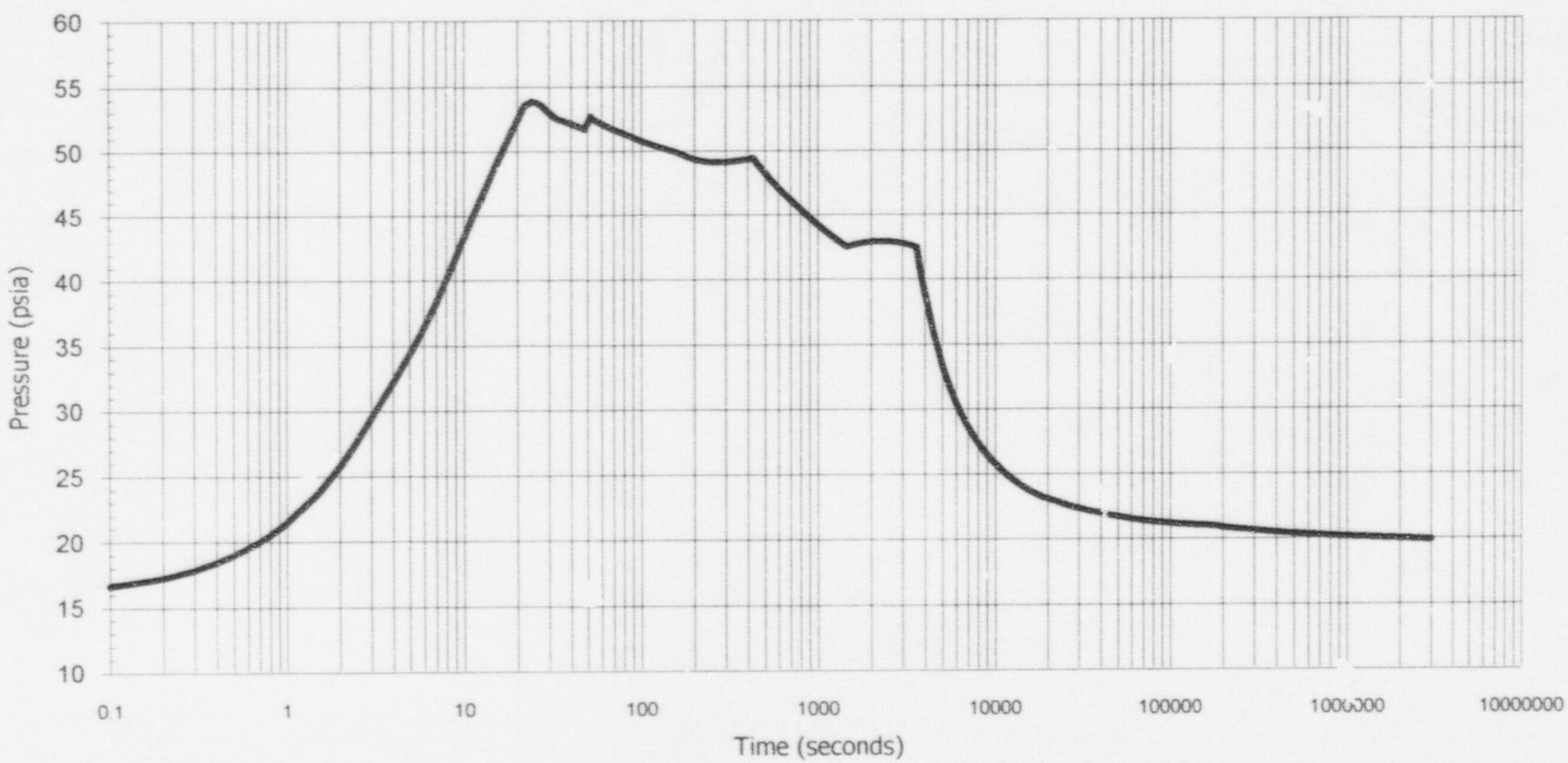
JDEHL3SI.XLS Chart 1

FIGURE 6.2A.1.1-32
HEAT TRANSFER COEFFICIENT
Double-Ended Hot Leg Guillotine Break
(DELTA-94 Steam Generator)



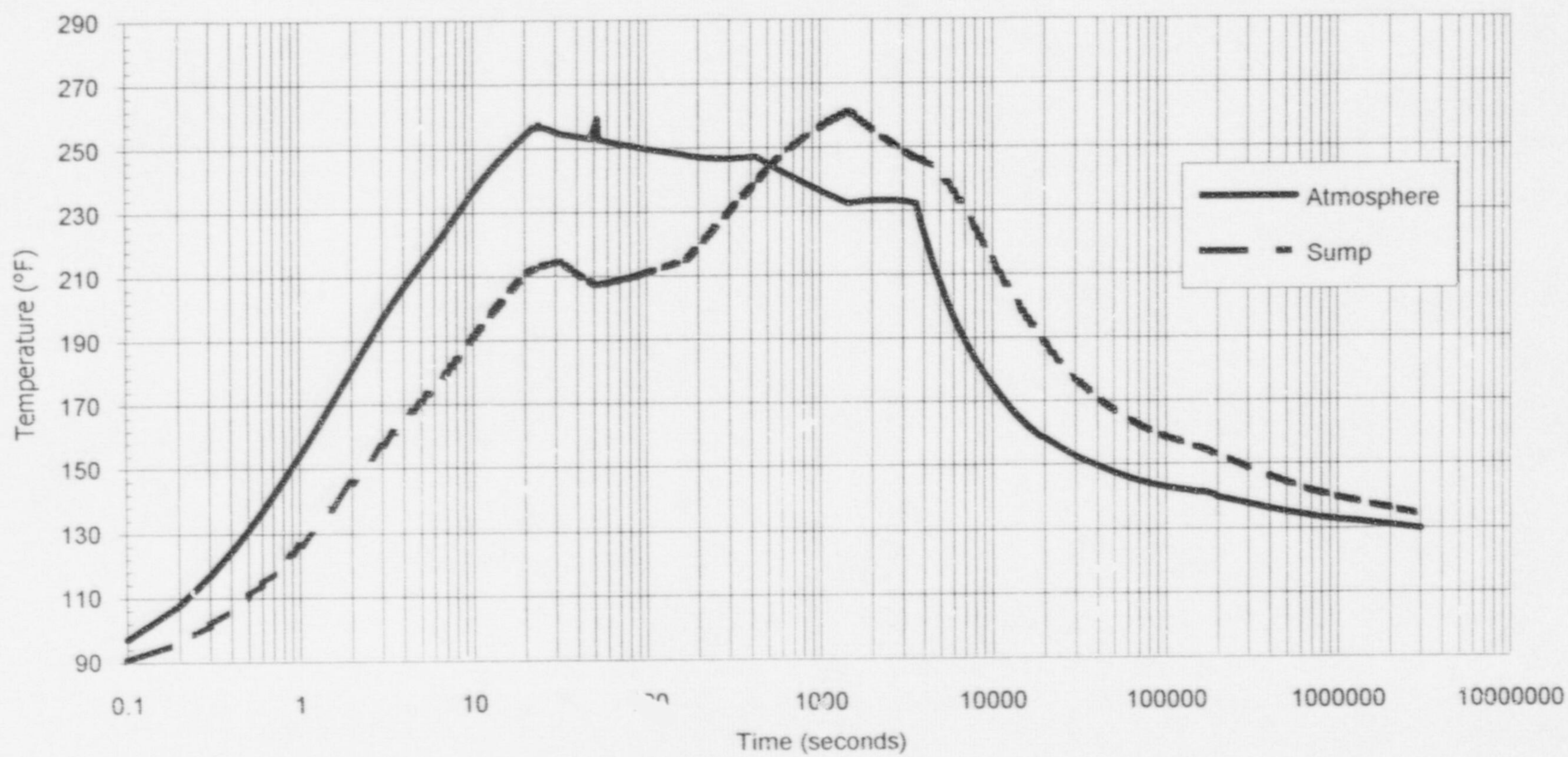
JDEHL3SI.XLS Chart 3

FIGURE 6.2A.1.1-33
CONTAINMENT PRESSURE
Double-Ended Pump Suction Guillotine Break
Minimum SI, Minimum CHRS
(DELTA-94 Steam Generator)



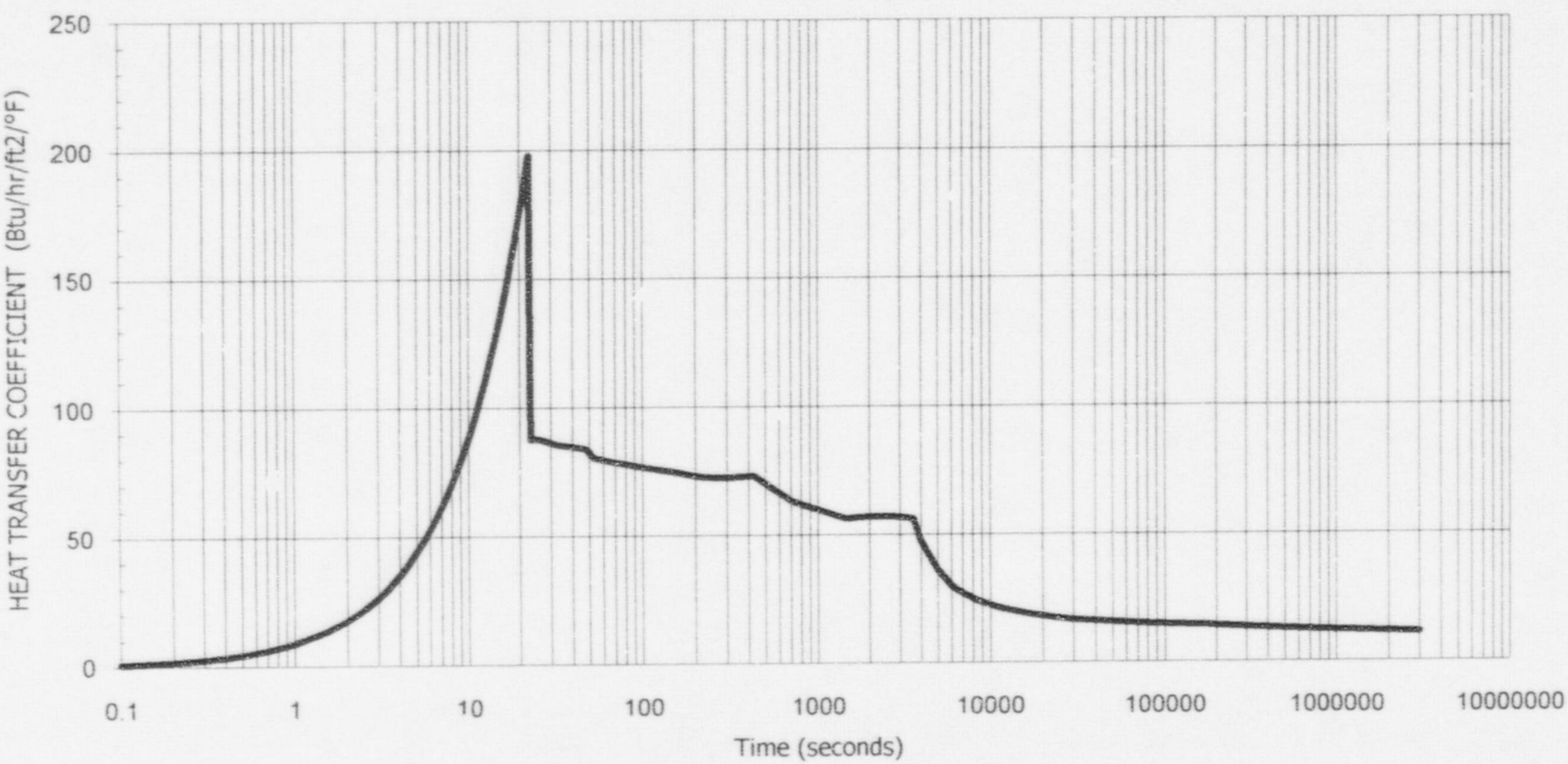
FDELTA11.XLS Chart 4

FIGURE 6.2A.1.1-34
CONTAINMENT TEMPERATURES
Double-Ended Pump Suction Guillotine Break
Minimum SI, Minimum CHRS
(DELTA-94 Steam Generator)



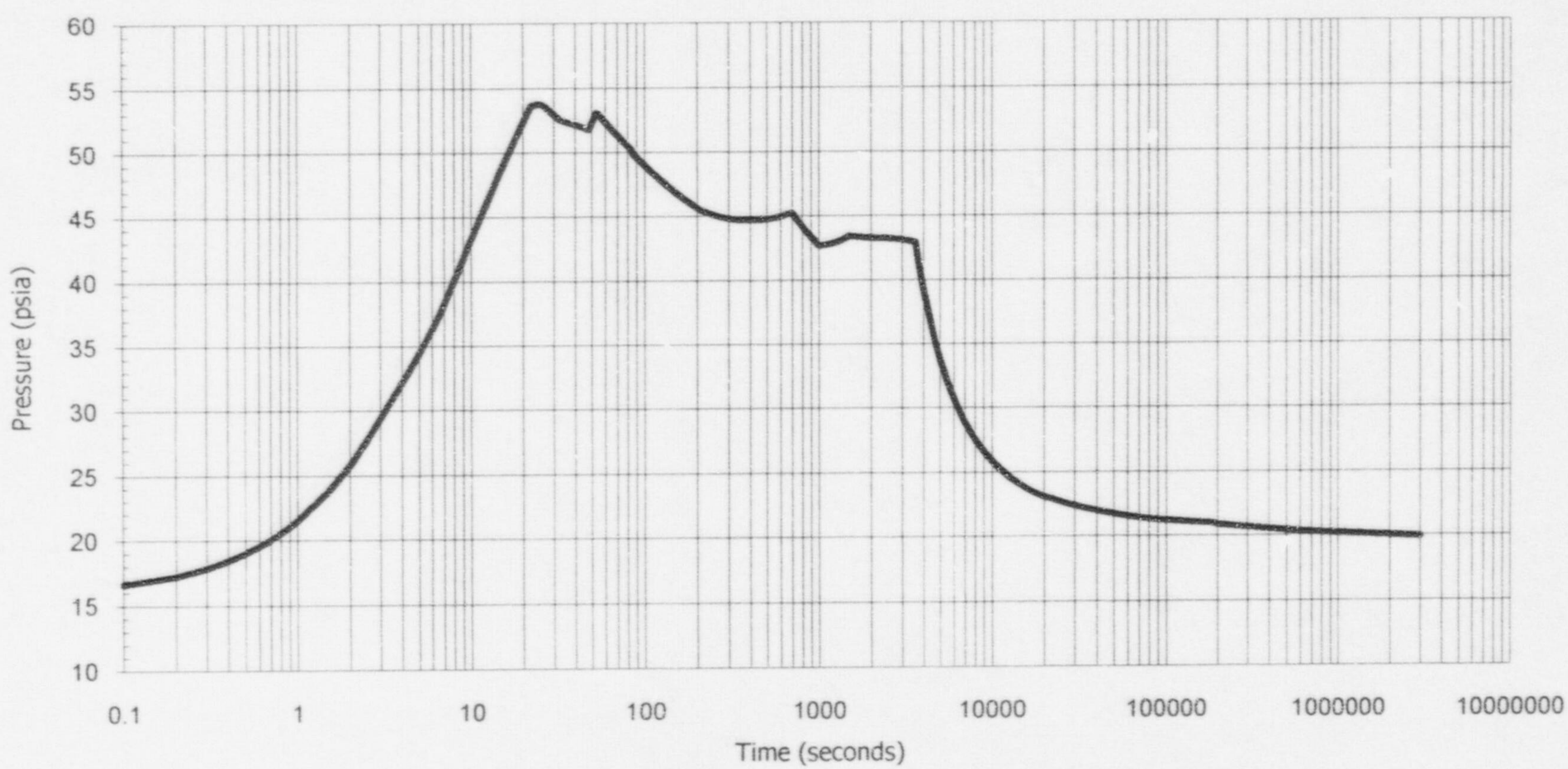
FDELTA11.XLS Chart 1

FIGURE 6.2A.1.1-35
HEAT TRANSFER COEFFICIENT
Double-Ended Pump Suction Guillotine Break
Minimum SI, Minimum CHRS
(DELTA-94 Steam Generator)



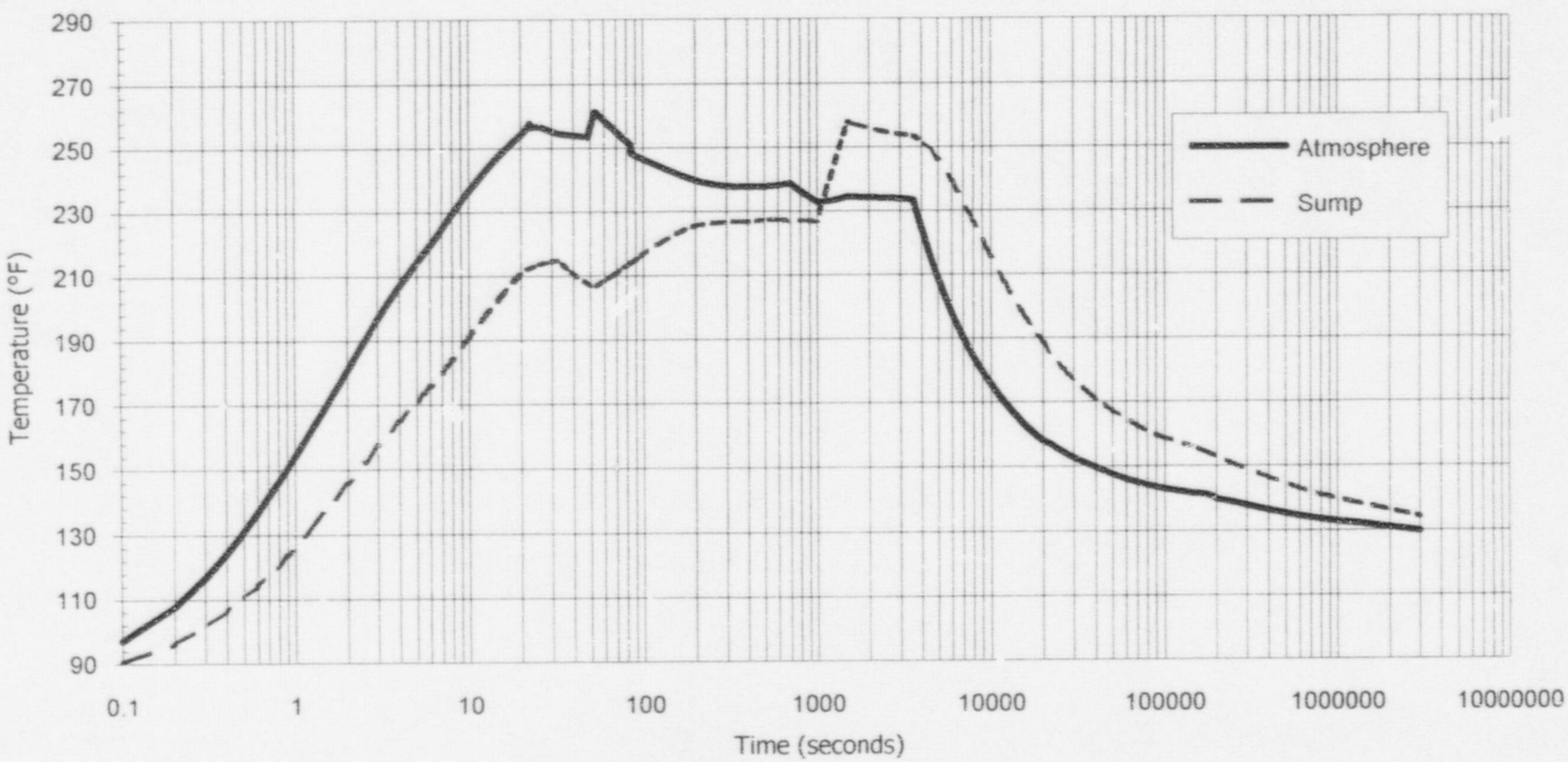
FSIX2SI.XLS Chart 3

FIGURE 6.2A.1.1-36
CONTAINMENT PRESSURE
Double-Ended Pump Suction Guillotine Break
Maximum SI, Minimum CHRS
(DELTA-94 Steam Generator)



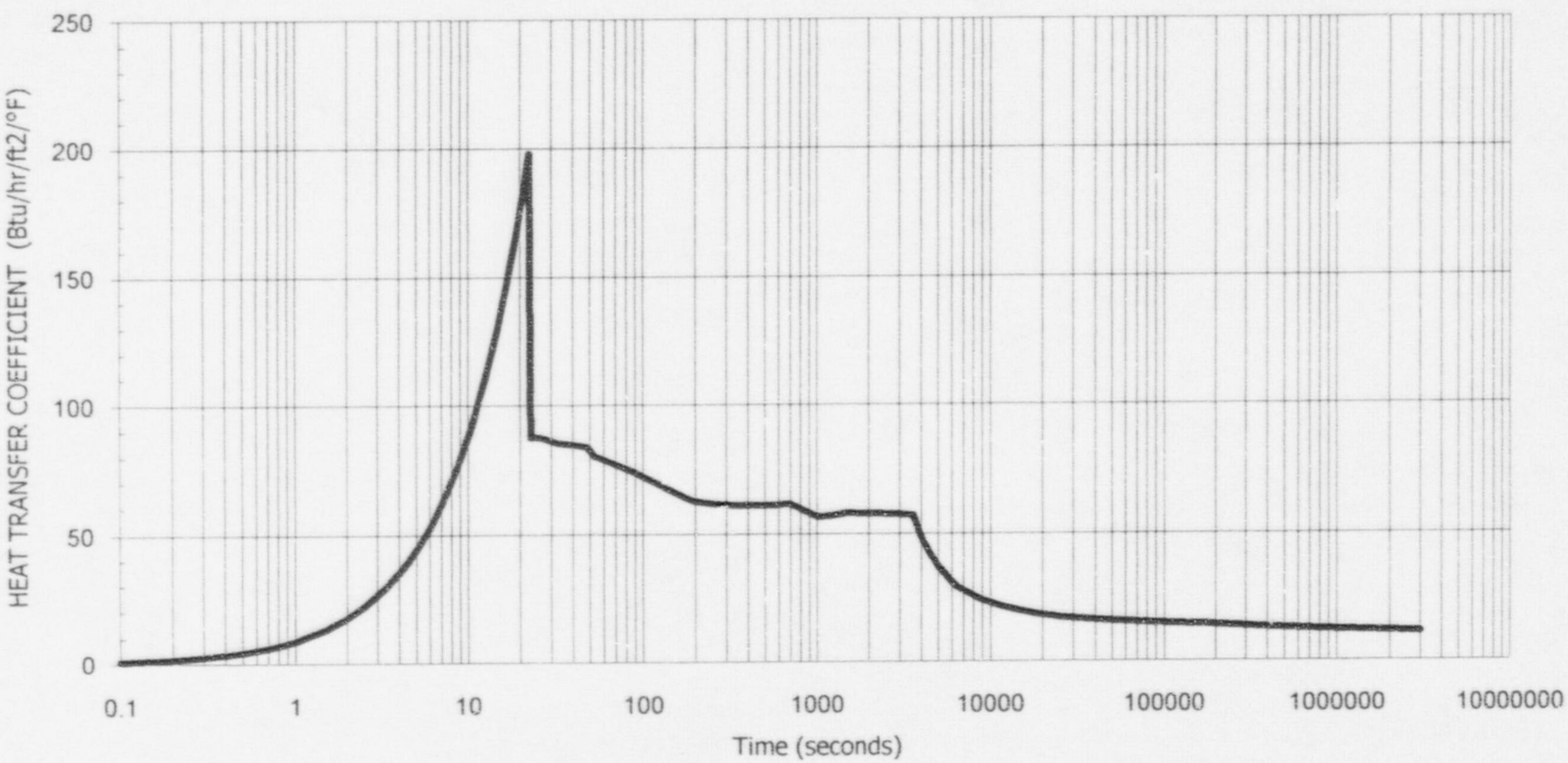
FSIX3SI.XLS Chart 2

FIGURE 6.2A.1.1-37
CONTAINMENT TEMPERATURES
Double-Ended Pump Suction Guillotine Break
Maximum SI, Minimum CHRS
(DELTA-94 Steam Generator)



FSIX3SI.XLS Chart 1

FIGURE 6.2A.1.1-38
HEAT TRANSFER COEFFICIENT
Double-Ended Pump Suction Guillotine Break
Maximum SI, Minimum CHRS
(DELTA-94 Steam Generator)



FSIX3SI.XLS Chart 3