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Constellation Energy
Calvert Cliffs Nuclear Power Plant

January 31, 2005

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
License Amendment Request: Appendix K Measurement Uncertainty Recapture – Power Uprate Request

Pursuant to 10 CFR 50.90, the Calvert Cliffs Nuclear Power Plant, Inc. hereby requests an amendment to the Renewed Operating License Nos. DPR-53 and DPR-69 to increase the licensed core power. Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 are currently licensed for a Rated Thermal Power of 2700 MWt. Based on the implementation of more accurate feedwater flow measurement instrumentation, approval is sought to increase the core power by 1.38 percent to 2737 MWt.

The approach used in this amendment request follows that outlined in Nuclear Regulatory Commission (NRC) Regulatory Issue Summary (RIS) 2002-03, "Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications," dated January 31, 2002. Regulatory Issue Summary 2002-03 provides guidance on the scope and detail of the information that should be provided to the NRC for the review of measurement uncertainty recapture power uprate applications.

The significant hazards discussion and the technical basis for this proposed change are provided in Attachment (1). Attachment (2) provides the information delineated in RIS 2002-03. Marked up pages of the affected Operating Licenses and Technical Specifications are provided in Attachment (3). The Technical Specification Bases will be changed as appropriate to support this information.

Based on expected NRC review timeframes as expressed in SECY-04-0104, Status Report on Power Uprates, we request approval of this proposed change by August 1, 2005. Note that this requested approval date does not impact continued operation of the Units. We also request a 180 day implementation period for the approved amendment to allow sufficient time to implement procedure changes and operator training associated with this change.

A001

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

STATE OF MARYLAND :
: **TO WIT:**
COUNTY OF CALVERT :

I, Kevin J. Nietmann, being duly sworn, state that I am Plant General Manager - Calvert Cliffs Nuclear Power Plant, Inc. (CCNPP), and that I am duly authorized to execute and file this License Amendment Request on behalf of CCNPP. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other CCNPP employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of Calvert, this 31st day of January, 2005.

WITNESS my Hand and Notarial Seal:

Notary Public

My Commission Expires: 4-15-06

Date

KJN/DJM/bjd

Attachments: (1) Technical Basis and No Significant Hazards Consideration
(2) Summary of Calvert Cliffs Nuclear Power Plant Measurement Uncertainty Recapture Evaluation
Enclosure (1) CA06494, Revision 0000, Calorimetric Uncertainty Using the AMAG Crossflow Ultrasonic Flowmeter
(3) Marked up Technical Specification Pages

cc: R. V. Guzman, NRC

[Without Enclosure (1)]
S. L. Miller, Esquire
J. E. Silberg, Esquire
S. J. Collins, NRC
Resident Inspector, NRC
R. I. McLean, DNR

ATTACHMENT (1)

TECHNICAL BASIS AND

NO SIGNIFICANT HAZARDS CONSIDERATION

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1. DESCRIPTION

This letter requests an amendment to Renewed Operating License DPR-53 and DPR-69 for Calvert Cliffs Unit Nos. 1 and 2, including Appendix A, Technical Specifications (TS), to increase the licensed core power. Calvert Cliffs Units 1 and 2 are currently licensed for a Rated Thermal Power (RTP) of 2700 MWt. Through the use of more accurate feedwater flow measurement equipment, approval is sought to increase this core power by 1.38 percent to 2737 MWt. The power uprate is based on the use of the CROSSFLOW™ system for determination of main feedwater flow and the associated determination of reactor power through the performance of the power calorimetric calculation currently required by Calvert Cliffs Technical Specifications.

2. PROPOSED CHANGE

This proposed license amendment would revise the Calvert Cliffs Nuclear Power Plant Operating Licenses and Technical Specifications to increase the licensed power level to 2737 MWt, or 1.38 percent greater than the current level of 2700 MWt. The proposed changes, which are indicated on the marked up pages in Attachment (3), are described below:

1. Paragraph 2.C.(1) in Renewed Operating License Nos. DPR-53 and DPR-69 is revised to authorize operation at a steady-state reactor core power level not in excess of 2737 megawatts-thermal (100 percent power).
2. The definition of RATED THERMAL POWER (RTP) in Technical Specification 1.1 is revised to reflect the increase from 2700 MWt to 2737 MWt.

3. BACKGROUND

Calvert Cliffs Units 1 and 2 are presently licensed for an RTP of 2700 MWt. Through the use of more accurate feedwater flow measurement equipment, approval is sought to increase this core power by 1.38 percent to 2737 MWt.

The approach used in this amendment request follows that outlined in Nuclear Regulatory Commission (NRC) Regulatory Issue Summary (RIS) 2002-03, "Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications," dated January 31, 2002. Regulatory Issue Summary 2002-03 provides guidance on the scope and detail of the information that should be provided to the NRC for the review of measurement uncertainty recapture (MUR) power uprate applications.

The 1.38 percent core power MUR uprate for Calvert Cliffs is based on eliminating unnecessary analytical margin originally required for Emergency Core Cooling System (ECCS) evaluation models performed in accordance with the requirements set forth in the Title 10 Code of Federal Regulations (CFR) Part 50, Appendix K (ECCS). The NRC has approved a change to the requirements of 10 CFR Part 50, Appendix K (Federal Register 65 FR 34913, June 1, 2000). The change provides licensees with the option of maintaining the 2-percent power margin between the licensed power level and the assumed power level for the ECCS evaluation, or applying a reduced margin for ECCS evaluation. For the reduced margin for ECCS evaluation case, the proposed alternative reduced margin must account for uncertainties due to power level instrumentation error. Based on the proposed use of the CROSSFLOW™ instrumentation with a power measurement uncertainty of less than 0.6 percent, it is proposed to reduce the licensed power uncertainty required by 10 CFR Part 50, Appendix K. This results in the proposed increase of 1.38 percent in the Calvert Cliffs licensed power level using the current NRC approved methodologies. The CROSSFLOW™ instrumentation provides a more accurate indication of feedwater flow (and correspondingly reactor thermal power) than assumed during the original development of Appendix K requirements. The improved thermal power measurement accuracy

eliminates the need for the full 2 percent power margin assumed in Appendix K, thereby increasing the thermal power available for electrical generation.

4. TECHNICAL ANALYSIS

The impact of the proposed power uprate on applicable systems, components, and safety analyses has been evaluated. Attachment (2) summarizes the results of the comprehensive engineering review performed to evaluate the increase in the licensed core power from 2700 MWt to 2737 MWt. The results of this evaluation are provided in a format consistent with regulatory guidance provided in RIS 2002-03.

As discussed in Attachment (2), the evaluations and analyses have been completed to support an increase in RTP from 2700 MWt to 2737 MWt. In many cases an RTP of 2746 MWt (or a target power uprate of 1.7 percent) was used in order to provide bounding input for these evaluations. Currently, with the RTP of 2700 MWt, an analytical power level of 2754 MWt (102% of 2700 MWt) is used in the safety analysis. With a revised RTP of 2737 MWt and a revised uncertainty, the analytical power level is unchanged at 2754 MWt.

5. NO SIGNIFICANT HAZARDS CONSIDERATION

Calvert Cliffs Nuclear Power Plant is proposing an amendment to the Facility Operating License and Technical Specifications that will increase the licensed power level from 2700 MWt to 2737 MWt. The proposed changes have been evaluated against the standards in 10 CFR 50.92 and have been determined to not involve a significant hazards consideration in the operation of the facility in accordance with the proposed amendment.

1. *Operation of the facility in accordance with the proposed amendment would not involve a significant increase in the probability or consequences of an accident previously evaluated.*

   In support of this measurement uncertainty recapture (MUR) power uprate, a comprehensive evaluation was performed for Nuclear Steam Supply System (NSSS), balance of plant systems and components, and analyses that could be affected by this change. A power calorimetric uncertainty calculation was performed, and the impact of increasing plant power by 1.38 percent on the plant's design and licensing basis was evaluated. The result of these evaluations is that structures, systems, and components required to mitigate transients will continue to be capable of performing their design function at an uprated core power of 2737 MWt. In addition, an evaluation of the accident analyses demonstrates that applicable analysis acceptance criteria continue to be met. No accident initiators are affected by this uprate and no challenges to any plant safety barriers are created by this change. Therefore, operation of the facility in accordance with the proposed change will not involve a significant increase in the probability of an accident previously evaluated.

   The proposed change does not affect the radiological release paths, the frequency of release, or the source-term for release for any accidents previously evaluated in the Updated Final Safety Analysis Report. Structures, systems, and components required to mitigate transients remain capable of performing their design functions, and thus were found acceptable. The reduced uncertainty in the feedwater flow input to the power calorimetric measurement ensures that applicable accident analyses acceptance criteria continue to be met in support of operation at a core power of 2737 MWt. Analyses performed to assess the effects of mass and energy remain valid. The source-terms used to assess radiological consequences have been reviewed and determined to bound operation at the uprated condition. Therefore, operation of the facility in accordance with the proposed change will not involve a significant increase in the consequences of an accident previously evaluated.

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

2. *Operation of the facility in accordance with the proposed amendment would not create the possibility of a new or different kind of accident from any accident previously evaluated.*

   No new accident scenarios, failure mechanisms, or single-failures are introduced as a result of the proposed changes. The installation of the CROSSFLOW™ system has been analyzed, and failures of this system will have no adverse effect on any safety-related system or any structures, systems, and components required for transient mitigation. All structures, systems and components previously required for the mitigation of a transient remain capable of fulfilling their intended design functions. The proposed changes have no adverse effects on any safety-related system or component and do not challenge the performance or integrity of any safety-related system.

   This change does not adversely affect any current system interfaces or create any new interfaces that could result in an accident or malfunction of a different kind than was previously evaluated. Operating at a core power level of 2737 MWt does not create any new accident initiators or precursors. The reduced uncertainty in the feedwater flow input to the power calorimetric measurement ensures that applicable accident analyses acceptance criteria continue to be met to support operation at a core power of 2737 MWt. Credible malfunctions continue to be bounded by the current accident analysis of record or evaluations that demonstrate that applicable acceptance criteria continue to be met.

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

3. *Operation of the facility in accordance with the proposed amendment would not involve a significant reduction in a margin of safety.*

   The margins of safety associated with the MUR power uprate are those pertaining to core power. This includes those associated with the fuel cladding, Reactor Coolant System pressure boundary, and containment barriers. A comprehensive engineering review was performed to evaluate the 1.38 percent increase in the licensed core power from 2700 MWt to 2737 MWt. The 1.38 percent increase required that revised NSSS design thermal and hydraulic parameters be established, which then served as the basis for all of the NSSS analyses and evaluations. This engineering review concluded that no design modifications are required to accommodate the revised NSSS design conditions. The NSSS and components were evaluated and it was concluded that the NSSS equipment has sufficient margin to accommodate the 1.38 percent power uprate. The NSSS accident analyses were evaluated for the 1.38 percent power uprate. In all cases, the evaluations demonstrate that the applicable analyses acceptance criteria continue to be met. As a result, the margins of safety continue to be bounded by the current analyses of record for this change.

   Therefore, the proposed change does not involve a significant reduction in the margin of safety.

In summary, based upon the above evaluation, Calvert Cliffs has concluded that the proposed amendment involves no significant hazards consideration under the standards set forth in 10 CFR 50.92(c), and, accordingly, a finding of "no significant hazards consideration " is justified.

6. ENVIRONMENTAL CONSIDERATION

We have determined that operation with the proposed amendment would not result in any significant change in the types, or significant increases in the amounts, of any effluents that may be released offsite, nor would it result in any significant increase in individual or cumulative occupational radiation exposure. Therefore, the proposed amendment is eligible for categorical exclusion as set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment is needed in connection with the approval of the proposed amendment.

7. PRECEDENCE

Similar amendment requests have been approved for:

Facility	Amendment #(s)	Approval Date
Donald C. Cook Nuclear Plant, Unit 2	259	May 2, 2003
Kewaunee Nuclear Power Plant	168	July 8, 2003
Waterford 3	183	March 29, 2002

ATTACHMENT (2)

SUMMARY OF CALVERT CLIFFS NUCLEAR POWER PLANT MEASUREMENT UNCERTAINTY RECAPTURE EVALUATION

Calvert Cliffs Nuclear Power Plant, Inc.
January 31, 2005

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LIST OF ACRONYMS

ABB	Asea Brown Boveri, Inc.
AC	Alternating Current
AFAS	Auxiliary Feedwater Actuation System
AFW	Auxiliary Feedwater
ALARA	As Low As Reasonably Achievable
ANSI	American National Standards Institute
AOR	Analysis of Record / Analyses of Record
AOV	Air-Operated Valve
ASME	American Society of Mechanical Engineers
ATWS	Anticipated Transients Without SCRAM
BLPB	Branch Line Pipe Break
BOP	Balance of Plant
Calvert Cliffs	Calvert Cliffs Nuclear Power Plant, Inc.
CCW	Component Cooling Water
CE	Combustion Engineering
CEA	Control Element Assembly
CEDM	Control Element Drive Mechanism
CEOG	Combustion Engineering Owners Group
CFR	Code of Federal Regulations
COLR	Core Operating Limits Report
CUF	Cumulative Usage Factor
CVCS	Chemical and Volume Control System
DBA	Design Basis Accident
DBE	Design Basis Event
DC	Direct Current
DNBR	Departure from Nucleate Boiling Ratio
D/P	Differential Pressure
ECCS	Emergency Core Cooling System
EM	Evaluation Model
EQ	Environmental Qualification
FAC	Flow Accelerated Corrosion
gpm	gallons per minute
HELB	High Energy Line Break
HVAC	Heating, Ventilation, and Air Conditioning
ICI	Incore Instrumentation
ISI	Inservice Inspection
IST	Inservice Testing
K_e	plastic strain correction factor
LBB	Leak Before Break
LBLOCA	Large Break Loss-of-Coolant Accident
LCO	Limiting Conditions for Operation
LHR	Linear Heat Rate
LOCA	Loss-of-Coolant Accident
LOSP	Loss of Secondary Pressure
LPSI	Low Pressure Safety Injection
MCLB	Main Coolant Loop Break

LIST OF ACRONYMS

MNSA	Mechanical Nozzle Seal Assembly
MOV	Motor-Operated Valve
MSIV	Main Steam Isolation Valve
MSLB	Main Steam Line Break
MSS	Main Steam System
MSSV	Main Steam Safety Valve
MUR	Measurement Uncertainty Recapture
MVA	MegaVolt Ampere
MVAR	MegaVolt Ampere Reactive
MWt	Megawatt Thermal
NRC	Nuclear Regulatory Commission
NSSS	Nuclear Steam Supply System
OBE	Operating Basis Earthquake
ODCM	Offsite Dose Calculation Manual
PLCEDM	Part Length Control Element Drive Mechanism
PWR	Pressurized Water Reactor
RCP	Reactor Coolant Pump
RCS	Reactor Coolant System
RIS	Regulatory Issue Summary
RPS	Reactor Protective System
RTD	Resistance Temperature Detector
RTP	Rated Thermal Power
RV	Reactor Vessel
RVI	Reactor Vessel Internals
S2M	Supplement 2 to CENPD-137 Evaluation Model
SBLOCA	Small Break Loss-of-Coolant Accident
SDC	Shutdown Cooling
SER	Safety Evaluation Report
SFPC	Spent Fuel Pool Cooling
SG	Steam Generator
SI	Safety Injection
SIT	Safety Injection Tank
SRW	Service Water
T_{avg}, T_{ave}	Vessel Average Coolant Temperature
T_{cold}	Vessel/Core/Inlet Temperature
T_{hot}	Vessel Outlet Temperature
TM/LP	Thermal Margin/Low Pressure
UF	Usage Factor
UFM	Ultrasonic Flow Measurement
UFSAR	Updated Final Safety Analysis Report
USE	Upper Shelf Energy

INTRODUCTION

BACKGROUND AND REASON FOR PROPOSED CHANGE

Calvert Cliffs Nuclear Power Plant (Calvert Cliffs) Units 1 and 2 are presently licensed for a Rated Thermal Power (RTP) of 2700 MWt. Through the use of more accurate feedwater flow measurement equipment, approval is sought to increase this core power by 1.38% to 2737 MWt. The impact of a 1.38% core power uprate for applicable systems, components, and safety analyses has been evaluated.

The analyses and evaluations were performed for both Calvert Cliffs Units 1 and 2. In some cases where cycle specific data is needed, the analyses/evaluations targeted Unit 1 as the lead unit for the Measurement Uncertainty Recapture (MUR) power uprate. Confirmation of the applicability of the analyses and evaluations on future cycles of Unit 2, and subsequent cycles of Unit 1, are performed as part of the normal reload design process.

The approach used in this amendment request follows that outlined in Nuclear Regulatory Commission (NRC) Regulatory Issue Summary (RIS) 2002-03, "Guidance on the Content of Measurement Uncertainty Recapture Power Uprate Applications" dated January 31, 2002. Regulatory Issue Summary 2002-03 provided guidance on the scope and detail of the information that should be provided to the NRC for the review of MUR power uprate applications.

The 1.38% MUR power uprate for Calvert Cliffs is based on eliminating unnecessary analytical margin originally required for Emergency Core Cooling System (ECCS) evaluation models (EMs) performed in accordance with the requirements set forth in the Code of Federal Regulations (CFR), 10 CFR Part 50, Appendix K (ECCS).

As discussed in Section II, the evaluations and analyses described herein have been completed to support an increase in RTP from 2700 MWt to 2737 MWt. In many cases an RTP of 2746 MWt (or a target power uprate of 1.7%) was used in order to provide bounding input for these evaluations. Currently, with the RTP of 2700 MWt, the analytical power level of 2754 MWt (102% of 2700 MWt) is used in the safety analysis. With a revised RTP of 2737 MWt and a revised uncertainty, the analytical power level is unchanged at 2754 MWt.

The NRC has approved a change to the requirements of 10 CFR Part 50, Appendix K [as revised by the Federal Register 65 FR 34913, June 1, 2000]. The change provides licensees with the option of maintaining the 2-percent power margin between the licensed power level and the assumed power level for the ECCS evaluation, or applying a reduced margin for ECCS evaluation. For the reduced margin for ECCS evaluation case, the proposed alternative reduced margin must account for uncertainties due to power level instrumentation error. Based on the proposed use of the CROSSFLOW™ instrumentation with a power measurement uncertainty of less than 0.6%, it is proposed to reduce the licensed power uncertainty required by 10 CFR Part 50, Appendix K. This results in the proposed increase of 1.38% in the Calvert Cliffs licensed power level using current NRC approved methodologies.

The CROSSFLOW™ instrumentation provides a more accurate indication of feedwater flow (and correspondingly reactor thermal power) than assumed during the development of Appendix K requirements. Complete technical support for this conclusion is discussed in detail in the CROSSFLOW™ Topical Report (Reference I-1). The improved thermal power measurement

accuracy eliminates the need for the full 2% power margin assumed in Appendix K, thereby increasing the thermal power available for electrical generation.

The desired power increase of 1.38% will be accomplished by increasing the electrical demand on the turbine-generator. As a result of this demand increase, steam flow will increase and the resultant steam pressure will decrease. The Reactor Coolant System (RCS) nominal cold leg temperature will remain constant and the hot leg temperature will increase in response to the increased steam flow demand. The RCS average temperature will increase slightly.

Procedures for maintenance and calibration of the CROSSFLOW™ system will be enhanced per the design control process based on the vendor's recommendations. Should the CROSSFLOW™ system be unavailable, the main steam or feedwater flow venturis can be used to sense flow rate in the feedwater system, as was done prior to the installation of the CROSSFLOW™ system. If the CROSSFLOW™ system is not operable, the power limit will be administratively controlled at a level consistent with the accuracy of the available instrumentation as described in this amendment request. The power limit reduction requirement for the CROSSFLOW™ out-of-service will be incorporated into the Calvert Cliffs Technical Requirements Manual.

DESCRIPTION OF PROPOSED CHANGE

The proposed license amendment would revise the Calvert Cliffs Nuclear Power Plant, Inc. (Calvert Cliffs) Operating Licenses and Technical Specifications to reflect an increase in core power level by 1.38% to 2737 MWt. The power uprate is based on the use of the CROSSFLOW™ system for determination of main feedwater flow and the associated determination of reactor power through the performance of the power calorimetric calculation currently required by Calvert Cliffs Technical Specifications. The proposed changes are identified on the markups of the current Calvert Cliffs Operating Licenses and Technical Specification pages.

Calvert Cliffs notes that various Combustion Engineering (CE) topical reports that are part of the Calvert Cliffs licensing basis (Technical Specification 5.6.5), consistent with 10 CFR Part 50, Appendix K may have included explicit references to their use of "102% of licensed core power levels." These topical reports describe the NRC approved methodologies which support the Calvert Cliffs safety analyses, including the small break and large break loss-of-coolant accident (LOCA) analyses. Along with the proposal to increase the reactor thermal power to 2737 MWt, Calvert Cliffs requests continued use of these topical reports. Calvert Cliffs does not consider that these topical reports require revision to reflect this requested power uprate. Rather, it will be understood that those statements refer to the Appendix K margin and the original licensed power level. Calvert Cliffs proposes that these topical reports be approved for use consistent with this license amendment request, and further, the NRC acknowledge that the change in the power uncertainty does not constitute a significant change, as defined in 10 CFR 50.46 and 10 CFR Part 50, Appendix K, to these topical reports.

GENERAL LICENSING APPROACH FOR PLANT ANALYSIS USING PLANT POWER LEVEL

The MUR power uprate program for Calvert Cliffs as described herein addresses Nuclear Steam Supply System (NSSS) performance parameters, design transients, systems, components, accidents, and nuclear fuel as well as interfaces between the NSSS and Balance-of-Plant systems. No new analytical techniques have been used to support the MUR power uprate project. The key points include the use of:

- Well-defined analysis input assumptions/parameter values
- Currently approved analytical techniques
- Applicable licensing criteria and standards

The evaluations and analyses described herein have been completed in order to bound an increase in RTP from 2700 MWt to 2737 MWt, or a 1.38% increase. The RTP used for many evaluations targeted a bounding power uprate of 1.7% with MUR power uprate, or 2746 MWt. Currently, with the RTP of 2700 MWt, the analytical power level of 2754 MWt (102% of 2700 MWt) is used in the safety analysis. With a revised RTP of 2737 MWt and a revised uncertainty, the analytical power level is unchanged at 2754 MWt.

Section II provides the results of the accident analyses and evaluations performed for the LOCA and non-LOCA transients. Section II also summarizes the containment accident analyses and evaluations and the radiological consequence evaluations.

Section III provides results for accidents and transients for which the existing analyses of record (AOR) do not bound plant operation at the proposed uprated power level.

Section IV of this report discusses the revised NSSS design thermal and hydraulic parameters that were modified as a result of the MUR power uprate and that serve as the basis for all of the NSSS analyses and evaluations. Section IV also contains the results of the fuel-related analyses.

Section V provides an analysis of the effects of the power uprate on the Calvert Cliffs electrical power systems.

Section VI presents information on the impact of the proposed power uprate on the system design [e.g., safety injection (SI), shutdown cooling (SDC), and control systems] and components [e.g., reactor vessel (RV), pressurizer, Reactor Coolant Pumps (RCPs), steam generator (SG), and NSSS auxiliary equipment] and the evaluations completed for the revised design conditions. Section VI also summarizes the effects of the uprate on the Balance-of-Plant (secondary) systems based upon a heat balance evaluation.

Section VII evaluates the impact of the power uprate on other areas [e.g., Flow Accelerated Corrosion (FAC)].

Section VIII presents information on changes to Technical Specifications, protection system settings, and emergency system settings as a result of the proposed power uprate.

The results of all of the analyses and evaluations performed demonstrate that all acceptance criteria continue to be met.

I. FEEDWATER FLOW MEASUREMENT TECHNIQUE AND POWER MEASUREMENT UNCERTAINTY

INSTRUMENTATION

The feedwater flow measurement system installed at Calvert Cliffs is the CROSSFLOW™ ultrasonic flow measurement (UFM) system. The installation of this system conforms to the requirements of the NRC approved topical report (see Reference I-1).

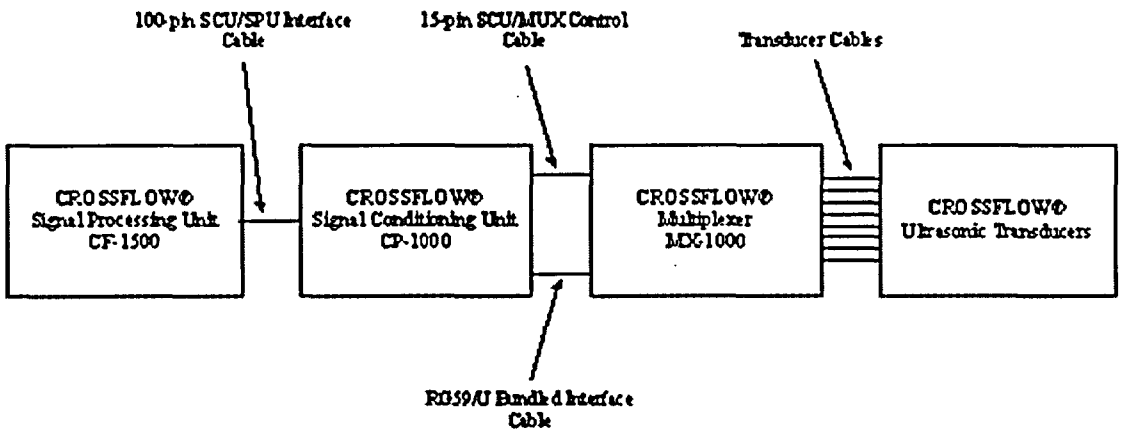
I.1 CROSSFLOW™ SYSTEM

The Westinghouse CROSSFLOW™ UFM system is used in conjunction with the plant process computer, to support the increase in reactor power. Reactor power is calculated using plant supplied inputs for feedwater temperature, SG pressure, SG moisture carryover, blowdown flow, and feedwater venturi flow that has been corrected to improve its accuracy using the CROSSFLOW™ system. The components and information flow paths are shown in Figure I-1, "Block Diagram of the Calvert Cliffs CROSSFLOW™ System."

Figure I-1

Block Diagram of the Calvert Cliffs CROSSFLOW™ System

Basic Signal Conditioning Unit Connection Layout



The CROSSFLOW™ system consists of a set of ultrasonic sensors that are permanently mounted on each of the two feedwater lines, cables, signal conditioning unit, multiplexer and a data processing computer. The ultrasonic sensors for each meter are mounted on a metal support frame that attaches externally to the feedwater pipe.

Signals are passed from the ultrasonic flow sensors through the multiplexer to the signal conditioning unit and data processing computer located in a non-harsh environment area. The functions of the signal conditioning unit and data processing computer are described in Reference I-1. The multiplexer simply alternates the ultrasonic signal to the signal-conditioning unit between the two loop CROSSFLOW™ meters to provide the flow measurements for each loop.

The data processing computer receives values of feedwater flow, temperature, and pressure for each loop from the plant process computer. The data processing computer then calculates a feedwater density and compensates for any thermal growth of the feedwater pipe and frame

due to a change in feedwater temperature. It also calculates an instantaneous flow, flow uncertainty and venturi correction factor for the venturi by dividing the feedwater flow measured using CROSSFLOW™ by the feedwater flow measured by the plant venturi for the same time period. The instantaneous correction factor is next added to a moving average buffer of venturi correction factors in order to smooth the data. The data processing computer then verifies that the venturi correction factor uncertainty is within the time delay uncertainty specified in the plant specific quality assured uncertainty calculation and passes flow with the smoothed venturi correction factor back to the plant computer along with a quality flag indicating that the correction factor meets the required accuracy for the MUR power uprate.

I.2 COMPLIANCE WITH NUCLEAR REGULATORY COMMISSION SAFETY EVALUATION REPORT

The installation of the CROSSFLOW™ flow measurement system at Calvert Cliffs is consistent with the Topical Report (Reference I-1). In addition to the installation requirements, the NRC identified the following four criteria that must be addressed by licensees requesting a license amendment based on the Topical Report. Calvert Cliffs meets the four criteria as described below.

Criterion 1

Discuss maintenance and calibration procedures that will be implemented with the incorporation of the CROSSFLOW™ system, including processes and contingencies for inoperable CROSSFLOW™ instrumentation and the effect on thermal power measurements and plant operation.

Response to Criterion 1

Installation of the CROSSFLOW™ system was performed by vendor and Calvert Cliffs personnel in accordance with vendor documentation and the Calvert Cliffs maintenance and engineering procedures. Maintenance and calibration are performed using Calvert Cliffs' maintenance and calibration procedures, which will be enhanced using vendor information and Calvert Cliffs specific experience, or will be performed by a combination of vendor and Calvert Cliffs procedure.

Verification of proper CROSSFLOW™ system operation is provided by onboard system diagnostics. CROSSFLOW™ operation will be monitored on a periodic basis using an internal time delay check. The onboard system diagnostics enable verification that the signal conditioning unit, computer, and software remain within the stated accuracy.

A plant specific uncertainty calculation has been performed by Westinghouse for the feedwater mass flow for Calvert Cliffs Units 1 and 2. The mass flow uncertainties based on these calculations is less than 0.45% of full power total feed flow. The uncertainty values will be confirmed after final system set up and prior to an increase in plant power.

The accuracies of all other process input parameters to the core thermal power calculation reflect either vendor or operating data uncertainties for one full fuel cycle. Hence, there is only one condition that requires an explanation for the proposed actions - an inoperable CROSSFLOW™ system. Contingency plans for operation of the plant with CROSSFLOW™ out-of-service are described in Section I.5.

Condition	Measurement Uncertainty	Power Level
With CROSSFLOW™	0.56%	2737 MW(th)
Without CROSSFLOW™	0.85%	2700 MW(th)

As part of the approved amendment implementation process, Calvert Cliffs Nuclear Power Plant will revise the appropriate operating procedures to reflect the above responses to the unavailability of the CROSSFLOW™ system, and will include this information in the operator training program.

Criterion 2

For a plant that currently has a CROSSFLOW™ UFM installed, provide an evaluation of the operational and maintenance history of the installed instrumentation and confirmation that the installed instrumentation is representative of the CROSSFLOW™ UFM system and bound the analysis and assumptions set forth in Topical Report (Reference I-1).

Response to Criterion 2

The CROSSFLOW™ systems at Calvert Cliffs have been in operation since July, 2003.

Reference I-1 indicates that once the CROSSFLOW™ system is installed, properly set up and its functionality confirmed, CROSSFLOW™ has proven that it is not prone to system or component failures that force the system off-line. To date, no equipment failures which adversely impact the meters' ability to provide its venturi recalibration function have been experienced at Calvert Cliffs.

The quality of the baseline functionality of the initial CROSSFLOW™ installation at Calvert Cliffs was established through a combination of laboratory tests and in-situ calibration. As a result of recent industry experience, a baseline frequency spectrum analysis was performed to determine if acoustic noise could have an adverse affect of the CROSSFLOW™ ultrasonic signal. Analyses of the results show no effect of noise on flow measurement.

At approximately 100% RTP, the venturi correction factor is relatively stable, varying less than 0.3% from a baseline value. However, correction factor has been observed to increase as power increases on three of the four CROSSFLOW™ meter locations based on correction factor trends obtained at steady state power levels between 85% and 100% RTP, indicating that the flow profile may not be stable at all locations. Although bound by the current uncertainty calculations and restrictions imposed on the allowable values for venturi correction factor, this issue must be corrected prior to power uprate to ensure flow meter performance is bound by the more restrictive uncertainty requirements (summarized in the response to Criterion 1), and the analysis and assumptions of the Topical Report (Reference I-1).

Planned corrective actions and expected impact on uncertainty are further evaluated in the response to Criterion 4.

Criterion 3

Confirm that the methodology used to calculate the uncertainty of the CROSSFLOW™ UFM in comparison to current feedwater instrumentation is based on accepted plant setpoint methodology (with regard to the development of instrument uncertainty). If an alternative approach is used, the application should be justified and applied to both venturi and UFM instrumentation installations for comparison.

Response to Criterion 3

The methodology used to calculate the uncertainty of the CROSSFLOW™ UFM in comparison to the current feedwater flow instrumentation is based on accepted plant setpoint methodology, consistent with Regulatory Guide 1.105 and Instrument Society of America (ISA) S67.04, as described in the Topical Report. An alternative methodology is not used. The Calvert Cliffs CROSSFLOW™ uncertainty calculations are consistent with the methodology described in the Topical Report.

Criterion 4

For plants where the ultrasonic meter was not installed and flow elements calibrated to a site-specific piping configuration (flow profiles and meter factors not representative of the plant specific installation), additional justification should be provided for its use. The justification should show that the meter installation is either independent of the plant specific flow profile for the stated accuracy, or that the installation can be shown to be equivalent to known calibrations and plant configurations for the specific installation including the propagation of flow profile effects at higher Reynolds numbers. Additionally, for previously installed calibrated elements, confirm that the piping configuration remains bounding for the original UFM installation and calibration assumptions.

Response to Criterion 4

At Calvert Cliffs, only one of the four feedwater loops, Loop 12 on Unit 1, had a sufficiently long run of straight pipe which satisfied the installation requirements of and were bounded by Topical Report CENPD-357-P-A. The CROSSFLOW™ UFM on Loop 12 is installed sufficiently downstream of the nearest elbow where the flow is fully developed. Because of this situation, CROSSFLOW™ meters were installed in identical locations on all four feed flow loops downstream of a flow straightener and upstream of the feed flow venturi; Loop 11 and Loop 12 for Unit 1 and Loop 21 and Loop 22 for Unit 2. The CROSSFLOW™ meter installed on Loop 12, which satisfies the Reference I-1 installation requirements, was used to establish a flow profile correction factor and its associated uncertainty for the flow as measured by the meter located downstream of the flow straightener. The flow profile correction factor was determined by taking the ratio of the flow measurement at this location with the flow measurement of the meter downstream of the flow straightener. Laboratory tests were performed to determine the effect of upstream piping geometry on flow measurement. The results of the laboratory tests indicated that the flow straightener removed any upstream geometry effects which justified use of this flow profile correction factor for the Loop 11, Loop 21, and Loop 22 CROSSFLOW™ meters.

As part of the evaluation, Calvert Cliffs reviewed the operating experience available for this type of system. Frequency spectrum analysis confirmed that acoustic interference from the Calvert Cliffs feedwater system does not effect the CROSSFLOW™ ultrasonic signal. Further, Calvert Cliffs is aware of recent industry experience of CROSSFLOW™ sensitivity to changes in

feedwater system configuration following initial installation and setup. Although Calvert Cliffs has no plans to alter the feedwater system configuration during periods in which CROSSFLOW™ is in use, CROSSFLOW™ performance will be closely monitored should any such evolutions be required. Calvert Cliffs Nuclear Power Plant procedures will also describe appropriate actions should the CROSSFLOW™ system identify any problem with the generated venturi correction factor.

However, as noted above, venturi correction factor has been observed to increase as power increases on these three locations based on correction factor trends obtained at steady state power levels between 85% and 100% RTP, indicating that the flow profile may not be stable. The venturi correction factor for the fourth feedwater loop, Loop 12, does not vary with power, confirming that the flow profile is fully developed at this location.

To address this concern, new X-BEAM ultrasonic transducers will be installed farther downstream from the flow straightener. The X-BEAM ultrasonic transducers are similar to the standard CROSSFLOW™ transducers with the exception that two diametrically offset, independent sets of transducers are located at each site. At the proposed locations, the flow profile is expected to be fully developed. Flow will be confirmed to be fully developed by comparing venturi correction factors obtained at different power levels. In addition to elimination of the power dependency, the trending of flows obtained from the two sets of transducers at each location provides an additional method to identify potential equipment concerns.

The X-BEAM ultrasonic transducers will be initially installed and tested on both Unit 1 headers. The installation and testing of the X-BEAM ultrasonic transducers on the Unit 1 headers is currently scheduled to be completed by June 1, 2005. Calvert Cliffs will provide the results of this testing to the NRC staff by July 1, 2005. If successful, the X-BEAM ultrasonic transducers will be installed on Unit 2. Necessary actions to understand and resolve the flow depending issue for each unit must be complete prior to implementation of the power uprate for that unit.

I.3 THERMAL POWER MEASUREMENT UNCERTAINTY

The impact of the CROSSFLOW™ system on the overall thermal power measurement uncertainty was assessed. Table I-1 summarizes the core thermal power measurement uncertainty for Calvert Cliffs:

Table I-1

Calvert Cliffs Process Parameter Inputs to Secondary Calorimetric Calculation

Parameter	Random Component		Bias Component
	Unit 1	Unit 2	
Feedwater Flow	0.32%	0.39%	
Blowdown Flow	0.05%		
Steam Enthalpy	0.05%		0.02%
Feedwater Enthalpy	0.16%		0%
Calorimetric Constants[1]			0.07%
	Unit 1	Unit 2	0.08%
Net Uncertainty	0.41%	0.46%	

[1] Adjustments for miscellaneous heat addition and heat removal terms from the RCS, such as input from pressurizer heaters.

The parameter uncertainties in Table I-1 are based upon the instrumentation uncertainties listed in Table I-2.

Table I-2

Uncertainties of Instrumentation Used For Secondary Calorimetric Calculation

Instrumentation		Random Component		Bias Component
Feedwater Flow	Path	Unit 1	Unit 2	
	1*	34832 lbm/hr (0.56% flow)	34210 lbm/hr (0.55% flow)	
	2**	29234 lbm/hr (0.47% flow)	35454 lbm/hr (0.57% flow)	
Blowdown Flow		8094 lbm/hr		
Feedwater Pressure		27.57 psi		0.16 psi
Feedwater Temperature		1.88°F		
Steam Pressure		19.8 psi		3.4 psi
Plant Computer Calculation of Enthalpy		0.1 Btu/lbm		

* Unit 1 Loop 11, Unit 2 Loop 21
** Unit 1 Loop 12, Unit 2, Loop 22

Enclosure (1) provides the detailed calorimetric uncertainty calculation performed for Calvert Cliffs.

I.4 CALIBRATION AND MAINTENANCE

The following information addresses specific aspects of calibration and maintenance procedures for the CROSSFLOW™ system.

Calibration and maintenance is performed by Calvert Cliffs maintenance personnel using site procedures. The site procedures will be enhanced using the CROSSFLOW™ technical manuals and work instructions. All work is performed in accordance with site work control procedures.

Routine preventive maintenance activities include physical inspections, power supply checks, and internal self tests.

Personnel are trained in the operation of the equipment prior to performing any system calibration.

The CROSSFLOW™ system is designed and manufactured in accordance with Westinghouse's quality assurance program (class 4, considered important to safety) and in accordance with Reference I-1.

Any needed corrective maintenance is performed by qualified Calvert Cliffs maintenance personnel.

Reliability of the CROSSFLOW™ system is monitored by Calvert Cliffs Systems Engineering personnel. Equipment deficiencies are documented under the site's corrective action process,

which includes requirements for the resolution of identified deficiencies. Equipment manufacturers are contacted as required to correct the deficiency.

The CROSSFLOW™ system vendor has established processes for informing utilities of equipment deficiencies. Additionally, Calvert Cliffs has procedures for reviewing incoming Institute of Nuclear Power Operations Operating Experience for applicability. Those deficiencies applicable to Calvert Cliffs are documented under the site's corrective action process.

I.5 OUTAGE TIME

The proposed outage time for operation at the increased power level with the CROSSFLOW™ system out-of-service is 72 hours, provided steady-state conditions exist and the plant computer is available to perform the reactor thermal power calculation. Review of correction factor trends since CROSSFLOW™ has been in use at Calvert Cliffs, indicate that correction factors are relatively constant. Over the course of 72 hours, the actual variation of the correction factor has an uncertainty (two standard deviations from the average) of less than 0.0532%. The net contribution to calorimetric uncertainty is negligible. Furthermore, since only an increase in thermal power above RTP needs to be considered, the random component of uncertainty could be substantially reduced permitting an even greater (~0.24%) variation in correction factor over the 72 hour interval.

If the plant computer is unavailable for greater than 24 hours, power level shall be reduced to the pre-uprate power level of 2700 MWt (approximately 98.65%). The 24-hour period is based on the minimum frequency for the calibration of the power range nuclear instrumentation in accordance with Technical Specification Surveillance Requirement 3.3.1.2. Per Technical Specification Surveillance Requirement 3.3.1.2, the power range nuclear instruments are adjusted every 24 hours based on the reactor thermal power calculation. The precision of the plant computer calculation is required to support the increased power level. If CROSSFLOW™ and the plant computer cannot be returned to service within 24 hours, Calvert Cliffs proposes that the power level be reduced.

II. ACCIDENTS AND TRANSIENTS FOR WHICH THE EXISTING ANALYSES OF RECORD BOUND PLANT OPERATION AT THE PROPOSED INCREASED POWER LEVEL

INTRODUCTION

The reactor core and/or NSSS thermal power are used as inputs to most plant safety, component, and system analyses. These analyses generally model the core and/or NSSS thermal power in one of three ways.

First, some analyses apply an explicit 2% increase to the initial condition power level to account solely for the power measurement uncertainty. These analyses have not been re-performed for the requested MUR power uprate conditions because the sum of increased core power level and the decreased power measurement uncertainty falls within the previously analyzed conditions.

The power calorimetric uncertainty calculation described in Section I indicates that with the UFM devices installed, the power measurement uncertainty (based on a 95% probability at a 95% confidence interval) is less than 0.6%. Therefore, these analyses only need to reflect a 0.6% power measurement uncertainty. Currently with the RTP of 2700 MWt, the analytical power level of 2754 MWt (102% of 2700 MWt) is used in the safety analysis. With a revised RTP of 2737 MWt and a revised uncertainty, the analytical power level is unchanged at 2754 MWt.

Second, some analyses employ a nominal initial condition power level. These analyses have been evaluated for the increased power level with the MUR power uprate. The results demonstrate that the applicable analysis acceptance criteria continue to be met at the MUR power uprate conditions.

Third, some of the analyses are performed at zero power initial conditions or do not actually model the core power level. Consequently, these analyses have not been reperformed since they are unaffected by the core power-level.

II.1 NUCLEAR STEAM SUPPLY SYSTEM ACCIDENT EVALUATION

The analyses referenced in Table II-1 are the AOR for Calvert Cliffs Units 1 and 2. These analyses do not change, that is they continue to remain valid for the MUR power uprate.

The information in the table is organized to comply with Section II of RIS 2002-03. The first column contains the applicable Updated Final Safety Analysis Report (UFSAR) section. The second column identifies the transient, and columns three through six contain power and uncertainty information from the AOR, as well as confirmation that the AOR remains bounding with the MUR power uprate. Column seven provides the reference for the NRC's previous approval of the AOR, as well as an indication of type of approval. Approval types are either NRC Safety Evaluation Report (SER) or performed under 10 CFR 50.59. The final column elaborates briefly on the impact of the power uprate on the AOR.

The sections that follow provide details of the safety analyses.

TABLE II-1 – Impact of Power Uprate on the UFSAR Chapter 14 Accident Analyses

UFSAR SECTION/EVENT		ANALYSIS OF RECORD ASSUMPTIONS					NOTES
		RTP (MWt)	Uncert. (%)	Total Core Power (MWt)	Bounds MUR?	Reference/ Method (50.59, etc.)	
RIS 2002-03 Rqmnt→	A	B,C	B,C	B,C	B,C	D	
14.2	Control Element Assembly Withdrawal Event	2700	±2	2754	Yes	II-1/50.59	Re-analyzed for thermal margin credits seen with TURBO fuel. MUR has no impact.
14.3	Boron Dilution Event	{_}	{_}	{_}	{_}	{_}	Not effected by an increase RTP. Analysis based on boron concentrations and RCS volumes which are unchanged for power uprate.
14.4	Excess Load Event	2700	±2	2754	Yes	II-2/50.59	Re-analyzed for thermal margin credits seen with TURBO fuel. MUR has no impact.
14.5	Loss of Load Event	2700	±2	2754	Yes	II-1/50.59	Evaluated for impact of MUR. Existing AOR plus uncertainty bounds the MUR total core power.
14.6	Loss of Feedwater Flow Event	2700	±2	2754	Yes	II-3/50.59	Evaluated for impact of MUR. Existing AOR plus uncertainty bounds the MUR total core power.
14.7	Excess Feedwater Heat Removal Event	2700	±2	2754	Yes	II-2/50.59	Re-analyzed as a sub-set of the Excess Load event. MUR has no impact.
14.8	Reactor Coolant System Depressurization	2700	±2	2754	Yes	II-2/50.59	Evaluated for impact of MUR. Existing AOR plus uncertainty bounds the MUR total core power.
14.9	Loss-of-Coolant Flow Event	2700	±2	2754	Yes	II-1/50.59	Re-analyzed for thermal margin credits seen with TURBO fuel. MUR has no impact.
14.10	Loss-of-Non-Emergency AC Power	2700	±2	2754	Yes	II-2/50.59	Evaluated for impact of MUR. Existing AOR plus uncertainty bounds the MUR total core power.
14.11	Control Element Assembly Drop Event	2700	±2	2754	Yes	II-2/50.59	Re-analyzed for thermal margin credits seen with TURBO fuel. MUR has no impact.
14.12	Asymmetric Steam Generator Event	2700	±2	2754	Yes	II-2/50.59	Re-analyzed for thermal margin credits seen with TURBO fuel. MUR has no impact.

TABLE II-1 – Impact of Power Uprate on the UFSAR Chapter 14 Accident Analyses

UFSAR SECTION/EVENT		ANALYSIS OF RECORD ASSUMPTIONS					NOTES
		RTP (MWt)	Uncert. (%)	Total Core Power (MWt)	Bounds MUR?	Reference/ Method (50.59, etc.)	
RIS 2002-03 Rqmnt→	A	B,C	B,C	B,C	B,C	D	
14.13	Control Element Assembly Ejection	2700	±2	2754	Yes	II-2/50.59	Evaluated for impact of MUR. Existing AOR plus uncertainty bounds the MUR total core power.
14.14	Steam Line Break Event	2700	±2	2754	Yes	II-1/50.59	Pre-trip portion re-analyzed for thermal margin credits seen with TURBO fuel. Post-trip re-analyzed for cycle specific credits. MUR has no impact on either portion of the event.
14.15	Steam Generator Tube Rupture Event	2700	±2	2754	Yes	II-1/50.59	Evaluated for impact of MUR. Existing AOR plus uncertainty bounds the MUR total core power.
14.16	Seized Rotor Event	2700	±2	2754	Yes	II-2/50.59	Re-analyzed for thermal margin credits seen with TURBO fuel. MUR has no impact.
14.17	Loss-of-Coolant Accident	2700	±2	2754	Yes	II-4/II-5	Evaluated for impact of MUR. Existing AOR plus uncertainty bounds the MUR total core power.
14.18	Fuel Handling Incident	2700	±2	2754	Yes	{_}	Evaluated for impact of MUR. Radionuclide inventories based upon 2754 MWt. Existing AOR plus uncertainty bounds the MUR total core power.
14.19	Turbine-Generator Overspeed Incident	{_}	{_}	{_}	{_}	{_}	Not effected by power increase. Analysis based on pitching turbine blades.
14.20	Containment Response	2700	±2	2754	Yes	{_}	Evaluated for impact of MUR. Existing AOR plus uncertainty bounds the MUR total core power.
14.21	Hydrogen Accumulation in Containment	{_}	{_}	{_}	{_}	{_}	A change to the Calvert Cliffs Technical Specifications recently removed this incident.

TABLE II-1 – Impact of Power Uprate on the UFSAR Chapter 14 Accident Analyses

UFSAR SECTION/EVENT		ANALYSIS OF RECORD ASSUMPTIONS					NOTES
		RTP (MWt)	Uncert. (%)	Total Core Power (MWt)	Bounds MUR?	Reference/ Method (50.59, etc.)	
RIS 2002-03 Rqmnt→	A	B,C	B,C	B,C	B,C	D	
14.22	Waste Gas Incident	2700	±2	2754	Yes	{_}	Evaluated for impact of MUR. Radionuclide inventories based upon 2754 MWt. Existing AOR plus uncertainty bounds the MUR total core power.
14.23	Waste Processing System Incident	2700	±2	2754	Yes	{_}	Evaluated for impact of MUR. Radionuclide inventories based upon 2754 MWt. Existing AOR plus uncertainty bounds the MUR total core power.
14.24	Maximum Hypothetical Accident	2700	±2	2754	Yes	{_}	Evaluated for impact of MUR. Radionuclide inventories based upon 2754 MWt. Existing AOR plus uncertainty bounds the MUR total core power.
14.25	Excessive Charging Event	{_}	{_}	{_}	{_}	{_}	Not effected by power increase. Evaluated to assure that the operator has at least 15 minutes from initiation of high pressure level alarm to take corrective action and terminate the event prior to filling the pressurizer solid.
14.26	Feedline Break Event	2700	±2	2754	Yes	II-1/50.59	Evaluated for impact of MUR. Existing AOR plus uncertainty bounds the MUR total core power.

II.2 NON-LOSS-OF-COOLANT ACCIDENT/TRANSIENT ANALYSES

All of the UFSAR Chapter 14 non-LOCA transient analyses were evaluated for increase in RTP due to the MUR power uprate. While many of the events were reanalyzed for thermal margin credit associated with TURBO fuel, no explicit reanalysis was conducted for the uprated power. In cases where an evaluation was performed, a target power uprate of 2746 MWt (1.7%) was used, which bounds the proposed change in RTP to 2737 MWt. The uprated RTP with uncertainty is equivalent to the pre-uprate total core power, which is 2754 MWt.

In the evaluation of the remaining events, the existing assumption on core power plus uncertainty bounds the MUR power uprate. No changes to the Reactor Protective System (RPS) or Engineering Safety Features were assumed or necessary.

Table II-1 summarizes the transient analyses that were determined to bound plant operation at a conservative 1.7% power level increase.

The evaluation of the UFSAR Chapter 14 non-LOCA transient analyses concludes that the current analyses are applicable for Calvert Cliffs with the MUR power uprate.

II.3 EMERGENCY CORE COOLING SYSTEM PERFORMANCE

The Calvert Cliffs Units 1 and 2 ECCS performance analysis consists of a large break loss-of-coolant accident (LBLOCA) and a small break loss-of-coolant accident (SBLOCA) analysis. Both analyses were performed at a core power level of 2754 MWt. Consistent with the original requirement of Paragraph I.A of Appendix K to 10 CFR Part 50, 2754 MWt is equal to 102% of the current licensed core power level, i.e., RTP of 2700 MWt.

The Calvert Cliffs Units 1 and 2 LBLOCA and SBLOCA analyses were performed with the 1999 Evaluation Model (EM) (Reference II-6) and Supplement 2 to CENPD-137 Evaluation Model (S2M) (Reference II-7) versions of the Westinghouse ECCS EMs for CE pressurized water reactors (PWRs). The SERs for the 1999 EM (Reference II-8) and the S2M (Reference II-9) generically approved the EMs for referencing in licensing applications for CE designed PWRs. The two EMs were specifically accepted for Calvert Cliffs Units 1 and 2 as allowed analytical methods for use in determining core operating limits in Reference II-10. A summary of the Calvert Cliffs LBLOCA and SBLOCA analyses using the 1999 EM and the S2M was provided to the NRC in Reference II-4. Detailed descriptions of the analyses are contained in Calvert Cliffs UFSAR Section 14.17.

As allowed by Paragraph I.A of Appendix K, Calvert Cliffs Nuclear Power Plant proposes to increase the licensed core power level and decrease the power measurement uncertainty such that the analytical core power level, after accounting for the new power measurement uncertainty, remains equal to 2754 MWt. Since the Calvert Cliffs Units 1 and 2 ECCS performance analysis was performed at an analytical core power level of 2754 MWt, it complies with Paragraph I.A of Appendix K for the proposed values for the licensed core power level and power measurement uncertainty.

A review of the impact that the proposed increase in licensed core power level (2737 MWt) has on the Calvert Cliffs Unit 1 values for plant data used in the Calvert Cliffs Units 1 and 2 ECCS performance analyses concluded that the increase in power does not affect the applicability of the analysis to Calvert Cliffs Unit 1 under the MUR power uprate conditions.

The analyses and evaluations were performed for Calvert Cliffs Units 1 and 2. In some cases where cycle specific data is needed the analyses/evaluations targeted Unit 1 as the lead unit for the MUR power uprate. Consequently, for Calvert Cliffs Unit 1, there are no changes to the peak cladding temperature or any other result of the Calvert Cliffs Units 1 and 2 ECCS performance analyses as a consequence of the proposed changes to the licensed core power level and power measurement uncertainty. Confirmation of the applicability of the analyses and evaluations on future cycles of Unit 2, and subsequent cycles of Unit 1, will be performed as part of the normal reload design process.

The 1999 EM and the S2M EMs consist, in part, of topical reports that were written prior to the revision to Paragraph I.A of Appendix K. Some of those earlier topical reports contain statements that the analyses will use 102% of the licensed core power level. For example, Section III.A of CENPD-132P (Reference II-11) states that *"The reactor will be assumed to be operating at a power level of 102% of the maximum licensed power."* Subsequent to the revision to Paragraph I.A of Appendix K, the topical reports that comprise the LBLOCA and SBLOCA EMs were not amended to reflect the revision to Appendix K; i.e., sentences like the above were not revised. As identified in the Introduction Section, Calvert Cliffs requests that approval of this license amendment request constitutes approval to apply the EMs at the proposed core power level and power measurement uncertainty.

II.4 ANTICIPATED TRANSIENTS WITHOUT SCRAM

As noted in Reference II-12, Calvert Cliffs has installed a diverse scram system. The NRC concluded that the Diverse Scram System met the requirements of 10 CFR 50.62 in Reference II-13. Reference II-14 stated that the installation of the diverse scram system, diverse turbine trip, diverse Auxiliary Feedwater Actuation System (AFAS), maintain the probability and consequences of an Anticipated Transients Without Scram (ATWS) as low, and eliminate the need to consider an ATWS as a Design Basis Event (DBE). Therefore, the proposed MUR power uprate does not adversely impact ATWS.

II.5 CONTAINMENT RESPONSE

The mass and energy transfer data for the limiting LOCA Design Basis Accident (DBA) is based on three types of LOCA DBAs; hot leg LOCA with minimum SI, cold leg LOCA with minimum SI, and cold leg LOCA with maximum SI. The limiting LOCA DBA is the cold leg LOCA with maximum SI. The limiting LOCA DBA assumes a reactor power of 102% (2754 MWt).

The mass and energy for the Main Steam Line Break (MSLB) DBA includes a spectrum of core power levels to determine the most limiting mass and energy transfer for containment peak pressure and temperature including 0%, 50%, 75%, and 102% power levels. The most limiting for MSLB DBA corresponds to a 75% power level.

Note that all other events that challenge the containment integrity and are mentioned in other UFSAR sections are bounded by the limiting LOCA and MSLB DBA analyzed in Section 14.20 and discussed above.

In conclusion, the proposed MUR power uprate of 1.38% falls within the conservative set of inputs and assumptions used in the Calvert Cliffs containment response analysis.

II.6 STATION BLACKOUT EVENT

The proposed changes to the licensed core power level and power measurement uncertainty have no impact on the station blackout analysis. The initial portion of the station blackout transient [i.e., loss of alternating current (AC) power] was determined to be unaffected by the proposed MUR power uprate (see Table II-1). The small increase in decay heat as a result of the proposed MUR power uprate has a negligible impact on post-trip equipment [e.g., opening of main steam safety valves (MSSVs)] or operator response.

III. ACCIDENTS AND TRANSIENTS FOR WHICH THE EXISTING ANALYSES OF RECORD DO NOT BOUND PLANT OPERATION AT THE PROPOSED INCREASED POWER LEVEL

There are no accidents or transients that are not bounded by the existing AOR (see Table II-1). However, other related personnel and equipment concerns need to be addressed. Therefore, the potential effects of the MUR power uprate were evaluated for the following issues:

- Normal Operational Shielding and Personnel Exposure
- Radiological Environmental Qualification (EQ)
- Post-LOCA Access to Vital Areas

As discussed in the previous section, no Chapter 14 accidents or transients required additional analysis because the existing AOR remained bounding for plant operation at the proposed increased power level. Discussion on the impact of the proposed MUR power uprate on plant radioactive waste effluents is provided in Section VI under Radioactive Waste Systems.

Normal Operational Shielding and Personnel Exposure

The MUR power uprate will cause a 1.38% increase in expected radiation levels. However, these increases will not affect radiation zoning or shielding requirements in the various areas of the plant. Individual worker exposures will be maintained within acceptable limits by the site as low as reasonably achievable (ALARA) program that controls access to radiation areas. In addition, procedural controls may be used to compensate for increased radiation levels.

Radiological Environmental Qualification

In accordance with 10 CFR 50.49, safety-related electrical equipment must be qualified to survive the radiation environment at their specific location during normal operation and during an accident.

The Containment and Auxiliary Buildings are divided into various rooms for environmental zoning purposes. The radiological environmental conditions noted for these rooms are the maximum conditions expected to occur. The current normal operation values represent 40 years of operation, while the AOR post-accident radiation exposure levels are determined for a one-year period following an accident using Regulatory Guide 1.89 source term assumptions and a core power level of 2700 MWt.

For the MUR power uprate, the EQ accident source term was reanalyzed for a core power level that bounds the proposed MUR power uprate with the same release assumptions as before. The increased source term was compared to the AOR to develop integrated energy ratios that were used to adjust the doses from various sources (airborne, sump, iodine filters, etc.) for each Containment and Auxiliary Building room. The normal operation contribution to the EQ dose is based on survey data. It was increased by 1.38% (MUR power uprate), as well as by a factor of 1.5 to account for the extended operation period of 60 years.

Post-LOCA Access to Vital Areas

Vital access dose considerations are described in NUREG-0737, Item II.B.2. Specifically, the design dose for personnel in a vital area should not exceed 5 rem whole body, or its equivalent to any part of the body, for the duration of DBAs. Updates of the dose analyses were performed to confirm that this requirement was met for a LOCA using Regulatory Guide 1.4 source term

assumptions and a core power level of 2737 MWt. The UFSAR time-dependent radiation dose rate maps that cover plant areas and access paths which may require occupancy during post-LOCA recovery operations will be updated to reflect the proposed MUR power uprate. The MUR power uprate will not have an impact on vital area access requirements.

IV. MECHANICAL/STRUCTURAL/MATERIAL COMPONENT INTEGRITY AND DESIGN

INTRODUCTION

The RCS component specifications define the frequency and severity of the design transients that must be considered in the fatigue evaluations of the components in accordance with the American Society of Mechanical Engineers (ASME) code. The design transients in the individual component specifications represent events that are expected to occur, or may occur, during the life of the plant. The design transients are characterized in terms of the type of transients, the frequency of occurrence, the initial design conditions, and the associated thermal-hydraulic conditions experienced by various systems and components as a result of the transients. This information is then used in fatigue evaluations for those systems and components. The design transients defined in the current component specifications were reviewed to determine the effect of the MUR power uprate.

With respect to the type of transients and frequency of occurrence, the implementation of the MUR power uprate will not create new types of transients nor change the original event frequencies for the design transients.

With respect to the initial conditions and the thermal-hydraulic response during the transients, some were found to be affected by the uprate and some were not. The transients which occur in the lower operating modes remain valid because the hot zero power (no load) plant conditions are unaffected by the MUR power uprate. Many of the transient responses remain valid because the original design hot and cold leg temperatures are higher than the increased operating point.

Where necessary, the design transients were re-analyzed quantitatively to assess the impact of the changes on existing design conditions due to the MUR power uprate. In these cases, the analyses simulated the transients under the increased conditions and produced thermal-hydraulic responses (pressures, temperatures, and flow rates) for use in the component-by-component fatigue evaluations described in this section.

This section also provides the results of the structural integrity evaluations for RCS components and supports at MUR power uprate conditions. Section IV.1 discusses RCS LOCA loads in general terms and with respect to the MUR power uprate. Section IV.2 follows with individual discussions of the structural integrity assessments performed for the RCS major components. Section IV.3 contains a discussion of the effects of small variations in the MUR power uprate operating point data. Section IV.4 discusses RV integrity. Finally, Section IV.5 discusses the impact of the MUR power uprate on nuclear fuel and core thermal hydraulics.

Table IV-1

Current NSSS Design and MUR Power Uprate Nominal Operating Parameters for Calvert Cliffs

Parameter	Current Normal Operating Conditions	MUR Power Uprate Normal Operating Conditions	Percent Change
Core Power MWt (input)	2700	2746 (6)	1.70% (6)
No. of Plugged Tubes per SG	≤ 10%	≤ 10%	-
Primary Bulk T_h, °F	595.1	595.9 (7)	0.13%
Primary T_c, °F	548	548	-
Primary ΔT, °F	48.4 (3)	49.2 (3)	1.65%
Primary Flow Rate, gpm (input)	370,000 - 422,250	370,000 - 422,250	-
Core Bypass Flow Rate, %	3.7	3.7	-
Primary Pressure, psia	2250	2250	-
Feedwater Temperature, °F	431.5 (5)	433.6 (5)	0.70%
Feedwater Enthalpy, Btu/lbm (input)	409.2 (1,5)	410.8 (1,5)	0.39%
Feedwater Flow Rate per SG, lbm/sec (input)	Same as Steam Flow	Same as Steam Flow	-
SG Blowdown Flow per SG, lbm/sec (input)	41.7 (max)(6)	41.7 (max)(6)	-
SG Steam Flow per SG, Mlbm/hr	5.900 (1)	5.999 (1,5,6)	1.68%
Steam Pressure, psia	888 (1,2) 863 (1,3)	886.5 (1,2) 860.3 (1,3)	-0.17% -0.31%
SG Total Mass, lbm	138,524 (1,4)	138,024 (1,4)	-0.36%
SG Liquid Mass (lbm)	128,130 (1,4)	127,636 (1,4)	-0.39%

(1) At 100% Power
(2) No Plugged Tubes
(3) 10% Plugged Tubes
(4) SG Level at 35.95 ft
(5) Based on Best Available Data
(6) Bounding Value selected for the evaluation
(7) A large portion of the MUR power uprate evaluation was completed using an estimated temperature increase for T_{hot} of 1.1°F, conservatively. Further evaluations have since been finalized, predicting an 0.8°F increase for T_{hot}. Therefore, the original evaluation performed for MUR power uprate remains bounding.

IV.1 REACTOR COOLANT SYSTEM LOSS-OF-COOLANT ACCIDENT FORCES EVALUATION

The purpose of a LOCA hydraulic forces analysis is to generate the hydraulic forcing functions and blowdown loads that occur on RCS components as a result of a postulated LOCA. These forcing functions and loads act on the component's shell and internal structures.

The full set of RCS loadings considered in the structural analysis of a LOCA event consists of the internal forcing functions generated from the hydraulic forces analysis, the pipe tension release, and jet impingement forces acting at the break locations, and, where applicable, the external loads due to subcompartment pressurization effects that act on the components and their supports.

Except for the Thimble Support Plate and selected RV internals components, the faulted loads and stresses in the current AORs are based on Main Coolant Loop Breaks (MCLBs) where thrust loadings were based on simplified (pressure x area) terms and where asymmetric

blowdown loadings were calculated using design setpoint parameters for 2700 MWt, where T_{hot}=604°F and T_{cold}=548°F. Since the MCLBs have been eliminated by leak before break (LBB) and replaced by Branch Line Pipe Breaks (BLPBs), loads and motions on NSSS components due to pipe breaks are greatly reduced. Furthermore, since the RV blowdown loads are primarily affected by changes in T_{cold}, and T_{cold} remains the same for the MUR power uprate, the effects of BLPBs at the MUR power uprate would not be significantly different from the effects of BLPBs under pre-MUR power uprate conditions. Therefore, the effects on NSSS components of BLPBs at the MUR power uprate are less severe than the effects of pipe breaks currently documented in the AORs.

Based on this conclusion, the DBA for blowdown loads at the MUR power uprate conditions remains the original design basis LOCA analyzed. Except where noted, the following structural evaluation discussions are based on the original DBA, and do not make direct use of the mitigating effects of LBB.

IV.2 REACTOR COOLANT SYSTEM MAJOR COMPONENT ASSESSMENTS

As noted in the introduction to this section, the majority of the NSSS design transients are demonstrated to be unaffected by the MUR power uprate. Transients with the potential to adversely affect the AOR results for particular RCS components were evaluated for their effects on the critical stress margins identified for the RCS components. The transients involved are listed below, on a component by component basis:

<u>RV (including original RV Head), RCPs, RCS Piping and Fittings (except Surge Line), and Original Control Rod Drive Mechanism & Part Length Control Rod Drive Mechanisms</u>

- Reactor Trip – The rate of change in temperature for the MUR power uprate for this transient is slightly greater than that for the design basis.

<u>Surge Line and Fittings</u>

- Reactor Trip, Loss of Flow, Step Load Increase/Decrease, Plant Loading/Unloading – The change in temperature for the MUR power uprate for these transients is slightly greater than that for the design basis.

<u>Pressurizer</u>

- Step Load Increase - The rate of change in temperature for the MUR power uprate is greater than that for the design basis for this transient.

The above observations were used to help determine which MUR power uprate transients needed to be evaluated with respect to their effects on fatigue for limiting RCS components. Evaluations of these limiting components are discussed in the remainder of this section.

In another assessment, the Calvert Cliffs RCS loads and displacements due to normal operating thermal expansion effects under the MUR power uprate conditions were reconciled with the loads and displacements from the pre-uprate RCS thermal expansion analysis, where T_{hot} was set to 604°F and T_{cold} was set to 550°F. It was concluded that MUR power uprate does not cause any significant changes in thermal anchor motions, and that all previously documented thermal anchor motions for Calvert Cliffs remain valid. All RCS loads due to normal operating thermal expansion either decrease or change insignificantly due to the decrease in delta-T between T_{cold} and T_{hot} of the initial power rating design setpoint temperature and the MUR power

uprate conditions stated in Table IV-1. The SG inlet nozzle moment (the moment around the horizontal axis perpendicular to the hot leg axis) increases, but this moment is not a limiting load with respect to stress margins on either the hot leg or the SG inlet nozzle.

Based on the results of this normal operating thermal expansion evaluation, specified normal operating loads on NSSS component supports and nozzles, and the main loop piping, and normal operating displacements on RCS tributary nozzles do not need to be revised for the MUR power uprate. This conclusion is utilized in the AOR stress evaluations discussed in the remainder of this section.

IV.2.1 Reactor Vessel Structural Evaluation

This evaluation assesses the effects that the MUR power uprate has on the most limiting locations with regard to ranges of stress intensity and fatigue usage factors (UFs) in each of the vessel regions, as identified in the RV stress reports and addenda.

The nominal vessel outlet temperature increases to 595.9°F, and the nominal vessel inlet temperature remains at the current value of 548.0°F as a result of the MUR power uprate (see Table IV-1 for a comparison of operating parameters). Therefore, the T_{hot} variation during normal plant loading and plant unloading increases while the T_{cold} variation remains unchanged.

As noted above, the nominal vessel inlet temperature associated with the MUR power uprate is the same as the nominal temperature for the current fuel cycle. The nominal vessel outlet temperature has increased slightly but is still less than the normal design vessel outlet temperature of 604°F that was originally used in the analysis of the RV outlet nozzles. Therefore, the effects of the plant loading and unloading transients on the inlet and outlet nozzles remain bounded by the stress AOR.

The RV main closure flange region and control element drive mechanism (CEDM) housings were originally evaluated for the effects of a higher vessel outlet temperature. Therefore, the effects of the MUR power uprate vessel outlet temperature on these regions are also bounded by the current design basis.

The remaining RV regions, including the inlet nozzles, vessel wall transition, core support guides, bottom head-to-shell juncture, and instrumentation nozzles are affected by the vessel inlet temperature, which is unchanged for the MUR power uprate. Therefore, the previously determined maximum stress intensity ranges and maximum cumulative fatigue UFs for these regions are valid.

The critical stress margin at the closure head studs remains unchanged because it is based on compression due to the bolt-up procedure, which is unchanged by the MUR power uprate. The critical margins at the vessel wall at the core stabilizer lugs remain unchanged because they are based on normal operating pressure and Operating Basis Earthquake (OBE), none of which are changed by the MUR power uprate. The margins on the load capability of the RV cold leg and hot leg horizontal supports due to MCLBs are significantly increased to non-critical margins due to the elimination of the MCLBs by LBB and their replacement with BLPBs.

None of the margins on the Incore Instrumentation (ICI) Flange Assembly for either unit are critical. The lowest margin on stress is 7.7%, which is a margin on the bearing stress at the nut-to-compression collar surface for the Quickloc on Unit 2. This margin is unchanged because

the bearing stress is due to design pressure and OBE, neither of which are changed by the MUR power uprate.

None of the margins on the RV vent line are considered to be critical. The lowest margin on stress is for the primary-plus-secondary stress at the J-weld on the RV closure head. The controlling stress range is generated from the loss of secondary pressure (LOSP) and the normal heat-up transients. These specified design transients are not changed by the MUR power uprate. Therefore, the critical stress margins for this component remain valid for MUR power uprate conditions.

The critical stress margins for other RV components are discussed below.

RV Closure Head Instrument Nozzle Bimetallic Weld

The critical margin of 5.39% on the stress intensity is due to a design pressure of 2500 psia, and the allowable S_m is based on a design temperature of 650°F. The design pressure and temperature are not changed due to the MUR power uprate. Therefore, the stress margin for this component is unchanged and remains acceptable for the MUR power uprate.

Vessel Wall at RV Outlet Nozzle

The critical stress margin of 2.5% is for primary-membrane-plus-local stress. Per the AOR, the calculated stress is a function of design moments and forces on the pipe, and of a design pressure of 2500 psia. The design moments and forces are unchanged due to the MUR power uprate. In addition, the design pressure of 2500 psia is unchanged by the MUR power uprate. Therefore, this stress margin remains acceptable for the MUR power uprate.

RV Outlet Nozzle

As above, the critical stress margin for primary-membrane-plus-local stress is a function of design moments and forces on the pipe, and of a design pressure of 2500 psia. Therefore, the stress margin of 0.79% for this component is unchanged and remains acceptable for the MUR power uprate.

Vessel Wall Transition Part of Vessel Support

The critical stress margin of 0.64% is for the primary-membrane stress. Per the AOR, the calculated primary-membrane stress is based on a design pressure of 2500 psia. The design pressure of 2500 psia is not changed by the MUR power uprate. Therefore, the stress margin of 0.64% for this component is unchanged and remains acceptable for the MUR power uprate.

Taper between RV Dome and Closure Flange

The critical stress margin of 3.07% is for primary-membrane-plus-local stress. Per the AOR, the calculated stress is due to design pressure, flange bolt-up loads and core (i.e., vessel internals) loads. The specified flange bolt-up loads and core loads are unchanged due to the MUR power uprate. In addition, the design pressure of 2500 psia is not changed by the MUR power uprate. Therefore, this stress margin is unchanged and remains acceptable for the MUR power uprate.

Surveillance Holder and Brackets

The critical margin on the alternating stresses (S_{alt}) from peak stresses is 2.33%. Per the AOR, the calculated stress is based on design moments and forces and stress concentration factors. None of these parameters are changed as a result of the MUR power uprate. Therefore, the stress margin for this component is unchanged and remains acceptable for the MUR power uprate.

Vessel Wall at Core Stabilizer Lugs

The critical margin on the maximum stress (S_{max}) due to the lateral load on the shell at the lug attachment is 5.25%. Per the AOR, the calculated stress is a function of the lateral moment and the design pressure. The specified design moments and forces are unchanged due to the MUR power uprate. In addition, the design pressure of 2500 psia is not changed by the MUR power uprate. Therefore, this stress margin is unchanged and remains acceptable for the MUR power uprate.

Vessel Shell and Bottom Head

The critical margin on primary-membrane stress is 0.64%. It is noted that the critical location coincides with the vessel wall transition part of vessel support location discussed above. Therefore, the stress margin for this component is unchanged and remains acceptable for the MUR power uprate.

Vessel Head at Core Stop Lugs

The critical margin on the maximum stress intensity is 0.24%. Per the AOR, the calculated stress is based on design moments of the retainer (i.e., core stop) lugs. These design moments are not affected by the MUR power uprate. Therefore, this stress margin is unchanged and remains acceptable for the MUR power uprate.

Head Lift Rig

This evaluation pertains to the currently installed head lift rigs at Calvert Cliffs Units 1 and 2. Evaluation of the planned replacement lift rig will be performed prior to its installation after the MUR power uprate.

The vertical link in the head lift rig has a critical margin on stress of 2.3%. This small margin is due to tension stress during closure stud handling, which is not affected by the MUR power uprate. Therefore, this head lift rig subcomponent remains acceptable for the MUR power uprate.

The cooling duct cover plate has a critical margin on stress intensity of 0.9%, which is due to a combination of dead weight, seismic excitation, and flow loads. These flow loads are hot air flow loads across the cover plate for which the operating temperature under the MUR power uprate conditions remains lower than the design temperature. In addition, the dead weight and seismic loads are not affected by the MUR power uprate. Therefore, this critical head lift rig subcomponent also remains acceptable.

The Code version used in the evaluation for the Calvert Cliffs Unit 1 and 2 RVs is the 1965 Edition of Section III of the ASME Boiler & Pressure Vessel Code through the Winter 1967 Addendum. The Code is the same as the current Code of Record for these components.

Conclusion

The RV evaluation for the MUR power uprate demonstrates that the maximum ranges of stress intensity remain within their applicable acceptance criteria, and the maximum cumulative fatigue UFs remain below the acceptance criterion of 1.0.

In addition, the faulted condition stress analyses for the Calvert Cliffs RV do not change as a result of the MUR power uprate, because the seismic loads are unchanged from the AOR, and the pipe break load input remains based on the original MCLBs. Therefore, no changes in the faulted condition RV/reactor internals interface loads or other faulted condition parameters are identified as a result of the MUR power uprate.

IV.2.2 Reactor Vessel Internals Evaluation

The reactor internals support the fuel and control rod assemblies, experience control rod assembly dynamic loads, and transmit these and other loads (e.g., deadweight, seismic vibration) to the RV. The internals also direct flow through the fuel assemblies, provide adequate cooling to various internals structures, and support ICI. The changes in the RCS design parameters identified previously in Table IV-1 produce insignificant changes in the boundary conditions experienced by the reactor internals components. This section describes the evaluation performed to demonstrate that the reactor internals can perform their intended design functions at the MUR power uprate conditions.

IV.2.2.1 Thermal-Hydraulic Systems Evaluations

The MUR power uprate can potentially affect such parameters as reactor vessel internal (RVI) component heating rates, coolant temperature levels, and their downstream impacts. A key area in evaluation of core performance is the determination of the hydraulic behavior of coolant flow and its effect within the reactor internals system. The core bypass flows are required to ensure reactor performance and adequate RV head cooling. The hydraulic forces are critical in the assessment of the structural integrity of the reactor internals. The results of the thermal-hydraulic evaluations are provided below.

RVI Component Temperatures

The AOR on RVI component temperatures were reviewed to determine the component most affected by the MUR power uprate. The component selected from this review process is the core shroud. Component metal temperatures, and therefore, thermal stresses, are dependent on the core power level and coolant temperatures. Calvert Cliffs Nuclear Power Plant core shroud metal temperatures were re-evaluated for the MUR power uprate level. The resulting core shroud component temperatures were used to calculate thermal stresses, in order to evaluate the structural margins for the shroud. The structural evaluation demonstrated that there is adequate structural margin for the core shroud for the MUR power uprate; see Section IV.2.2.3.

RVI Component Hydraulic Loads

A review of the AOR design hydraulic loads on the RVI components indicated that the current design loads are bounding for the MUR power uprate operation. Small increases in power level, such as the MUR power uprate, have minimal impact on the design hydraulic loads.

Core Bypass Flow Calculation

Bypass flow is the total amount of reactor coolant flow bypassing the core region and is, therefore, not considered effective in the core heat transfer process. The design core bypass flow limit is 3.70% of the total RV flow. This value is used in the thermal margin calculations. A lower bound value of 1.6% is used in the calculation of hydraulic loads since the higher core flow results in higher core pressure drops and, therefore, higher uplift and differential pressure (D/P) loads. The best-estimate core bypass flow is 3.43% of the RV flow.

Core bypass flow is negligibly affected by the MUR power uprate. The core pressure drop will tend to increase very slightly, due to the higher power level. This will have the effect of diverting very slightly more bypass flow through the various leakage flow paths. But the margin between the best estimate and design values of core bypass flow will readily accommodate the negligible increase in core bypass flow due to the uprate.

Therefore, the core bypass flow limit of 3.7% remains valid for the MUR power uprate.

Control Element Assembly (CEA) Drop Time Analyses

Calvert Cliffs Technical Specification Surveillance Requirement 3.1.4.6 requires that the drop times of all full-length CEAs from a fully withdrawn position, must be verified to be less than or equal to 3.1 seconds prior to the startup of each cycle.

Control element assembly drop times are explicitly confirmed to meet the times assumed in the accident analyses. An evaluation was performed for all CE fleet plants to demonstrate continued compliance with the current Technical Specification requirements based on CE fleet's robust five finger silver tip design, which has not shown any failure to insert at any time in life through the end-of-life core burnup. The MUR power uprate conditions will slightly increase the power level in leading rodded fuel assemblies; however the projected burnup levels and fluences are substantially less than the values assumed in the design calculations. The assembly burnups and fluences are confirmed on a cycle specific bases to be within the values assumed in the CEA design analysis. In addition, the CEA drop time is measured prior to the startup of each reload cycle.

Finally, the fluid density has not increased for the MUR power uprate since T_{cold} has not changed and T_{hot} has increased slightly. Therefore, CEA drop times are not adversely affected by the MUR power uprate.

Based on the above, the current limiting rod drop time requirements remain valid for the MUR power uprate conditions.

CEA and ICI Cooling Assessment

Cooling analyses for CEAs and incore instruments were performed for the MUR power uprate. These analyses indicate that the following design criteria are met:

- No coolant bulk boiling will prevail inside the CEA and ICI guide tubes.
- B_4C and AgInCd maximum temperatures will stay within the design limits of 2000°F and 1400°F, respectively.

IV.2.2.2 Mechanical Evaluations

As discussed previously, the MUR power uprate conditions do not affect the current design bases for seismic and LOCA loads. Therefore, it was not necessary to re-evaluate the structural effects from seismic OBE and Safe Shutdown Earthquake loads, or from the LOCA hydraulic and dynamic loads. Furthermore, it is noted that the LOCA hydraulic and dynamic loads would be less severe if BLPBs were analyzed instead of the original design basis MCLBs.

With regard to flow and pump induced vibration, the current analysis uses a mechanical design flow that does not change for the revised design conditions (see Table IV-1). The revised design conditions alter the T_{hot} fluid density. However, this very small change in the T_{hot} fluid density has a negligible effect on the forces induced by flow. In addition, the MUR power uprate results in a negligible change in T_{avg}. Therefore, the mechanical loads are not affected by the MUR power uprate conditions.

IV.2.2.3 Structural Evaluations

As described in Section IV.2.2.1, the normal operating hydraulic loads used in the AOR for the structural evaluation of the RVI components are bounding for the MUR power uprate. Seismic and LOCA loads on the RVI components are unaffected by the MUR power uprate operation, and the primary stresses calculated in the AOR therefore remain applicable. The MUR power uprate can potentially increase thermal loadings and the resulting thermal stresses in the RVI components. Because this MUR power uprate is relatively small (~1.38%), it was concluded that potential adverse effects on the RVI structures would be confined to the core shroud, which is more sensitive than the other RVI components to minor variations in thermal loading.

To quantify these potential effects, the AOR for the calculation of thermal stresses in the core shroud was reviewed. Because of limitations in this AOR, the applicability of a more recent analysis, performed for a similar core shroud design, was investigated. The applicability of this analysis was confirmed, and the thermal stresses calculated therein were combined with the appropriate primary stress and evaluated against acceptance criteria. Elevated (> 800°F) temperature effects (reflecting the core shroud maximum temperature of 885°F) were considered in the determination of these acceptance criteria, and a fatigue evaluation was performed.

Under thermal loadings that encompass the MUR power uprate, the core shroud analysis determined that the maximum primary-plus-secondary stress intensity exceeded the allowable value. Therefore, a simplified elastic-plastic analysis with attendant re-evaluation of fatigue usage was performed in accordance with the acceptance criteria.

The resulting maximum primary-plus-secondary stress intensity (excluding thermal bending stresses) was 37,927 psi, which is less than the 43,800 psi allowable. Furthermore, the cumulative usage factor (CUF) for the MUR power uprate conditions was determined to be 0.375, which is significantly less than the 1.00 allowable. Thus, the core shroud satisfies the acceptance criteria.

Increases in core thermal power will slightly increase nuclear heating rates in the RVIs, such as lower core support plate, fuel alignment plate, and core shroud. Evaluations have been performed verifying that the existing thermal-hydraulic AOR will support the MUR power uprate. Therefore, the calculated component lifetimes will envelop the component lifetimes associated with the MUR power uprate related increases in nuclear heating.

The allowable stress formulae defining the primary stress limits for the core shroud, as specified in the Calvert Cliffs UFSAR, were adopted prior to the establishment, by the ASME Boiler & Pressure Vessel Code, of specific design criteria for core support structures. Core support structure-specific design criteria were formally introduced as Subsection NG in the Winter 1973 Addendum to Section III of the ASME Boiler & Pressure Vessel Code. Therefore, the core shroud evaluation described above, used allowable stress values defined in Subsection NG of the Winter 1973 Addendum. Rules for the evaluation of core support structures at elevated temperatures have not yet been approved. Subsection NH in the 1998 Edition of Section III of the ASME Code, which provides rules for the design of Class 1 components in elevated temperature service, was therefore used to adjust the allowable stress values defined in Subsection NG of the Winter 1973 Addendum.

IV.2.3 Control Element Drive Mechanisms

The CEDMs and part length control element drive mechanisms (PLCEDMs) are mounted on top of the Calvert Cliffs reactor head. These components are affected by the reactor coolant pressure, vessel outlet temperature, and hot leg NSSS design transients. The following evaluation pertains to the currently installed CEDMs and PLCEDMs at Calvert Cliffs Units 1 and 2. Evaluation of the planned replacement CEDMs will be performed prior to their installation following approval of the MUR power uprate.

According to Table IV-1, the vessel outlet temperature for the MUR power uprate has increased slightly to 595.5°F. However, this temperature remains well below the design operating temperature of 604°F. Therefore, no additional assessments of the impact of thermal loads on the CEDMs and CEDM nozzles are required. The reactor coolant operating pressure (2250 psia) for the MUR power uprate conditions remains the same as originally specified for the CEDMs/PLCEDMs.

The coil stack fasteners on the CEDMs/PLCEDMs were found to be the critical components for Safe Shutdown Earthquake, but seismic loads are not affected by the MUR power uprate. The critical CEDM component for LOCA was the CEDM nozzle, for which the maximum calculated bending load is 170 in-kips vs. an allowable bending moment of 0.7 of the instability load (203 in-kips), for a margin on load of 16.26%. Margins on CEDM components for BLPBs are larger than margins due to LBLOCA.

Since all critical margins on the CEDMs/PLCEDMs are maintained for the MUR power uprate, these components remain acceptable.

IV.2.4 Pressurizer Surge Line Piping

Parameters associated with the MUR power uprate were reviewed for their impact on the design basis analysis for the pressurizer surge line piping including the effects of thermal stratification. Nuclear Steam Supply System design parameters, NSSS design transients, and changes at the reactor coolant loop Auxiliary Class 1 branch nozzle connections due to deadweight, thermal, seismic, and LOCA loading conditions were considered.

Thermal stratification takes place during plant transients (e.g., during plant heatup), and the temperature ranges defined in the stratification AOR were conservatively based on plant operating data. T_{hot} has increased slightly for the MUR power uprate (see Table IV-1). This change has a negligible effect on the stratification AOR, since it only results in a slight reduction

in the delta-T between the pressurizer and the hot leg during steady-state normal operation. Therefore, the stratification temperature ranges developed in the AOR will bound the new operating conditions.

There is no impact on the deadweight analysis due to the MUR power uprate because there is no discernable change in the weight of the Auxiliary Class 1 pressurizer surge line piping systems. Fluid weight changes due to the change in T_{hot} are very small, and their effect on the overall piping weight is insignificant. The seismic response spectra remain unchanged. Therefore, there is no impact on the seismic analysis. Although BLPBs could be invoked through LBB implementation, continuing to base the RCS structural analyses on the original design basis LOCA events is conservative and valid. Therefore, no change to the LOCA hydraulic forcing functions is required. In conclusion, the MUR power uprate has no impact on Auxiliary Class 1 branch nozzle connection loads resulting from the deadweight, thermal, seismic, or LOCA input loading conditions.

It is noted in the introduction to this section, however, that some of the NSSS calculated thermal transients are affected by the MUR power uprate. The calculated transients refer to thermal transients re-calculated for the MUR power uprate conditions. Reconciliation between the design transients and re-calculated transients for the MUR power uprate was performed for critical locations on the Calvert Cliffs Units 1 and 2 RCS surge lines and fittings. These reconciliations are summarized below.

Surge Line Piping

The critical margin on the maximum primary-plus-secondary stress is 1.78%. Per the AOR, the maximum calculated stress intensity range is based on design pressure, dead weight, seismic loads, and specified normal operating transients for surge line piping.

The design pressure, dead weight, and seismic loads are not affected by the MUR power uprate. Per the AOR, the dominant stresses are from the plant loading transient and the plant unloading transient. The effect of the MUR power uprate on these transients was evaluated. Based on this evaluation, these transients as originally specified for design remain applicable for the MUR power uprate. Therefore, the stresses on the surge nozzle are also unchanged.

The critical CUF of 0.937 in the surge line occurs at the elbow under the pressurizer. This CUF is primarily due to stratified flow and striping, was developed for the Combustion Engineering Owners' Group (CEOG), and represents a bounding case for the combined effects of stratified flow and striping on the maximum CUF of any CE plant surge line.

The report to the CEOG (Reference IV-1) stated the following with respect to the calculated generic CUF of 0.937:

> *The actual usage factor for each specific plant is expected to be lower because 1) the loadings are generic and very conservative, 2) the assumptions made for material properties are conservative, and 3) the most highly stressed line (elastically) was used as the line for shakedown. The highest contribution to fatigue results from a load set which ranges between a non-stratified load state and a 340°F stratified flow load state. Virtually all of the cumulative usage includes load sets with a stratified flow load state. This indicates that the OBE and full flow thermal stresses contribute very little to the overall fatigue conclusions.*

Therefore, there is a much greater margin on the allowable CUF for the Calvert Cliffs surge lines, and the actual margin for the Calvert Cliffs surge lines is not considered critical. As documented in the piping specification, all transients affecting the RCS piping, including the surge line, are unchanged by the MUR power uprate. Consequently, the Calvert Cliffs surge line piping remains acceptable for the MUR power uprate.

Surge Line Temperature Measurement Nozzle

The surge line temperature measuring nozzle is a resistance temperature detector (RTD) nozzle that has a pre-uprate CUF of 0.732, and the transient contributing the largest UF (0.333) is the LOSP transient in combination with heatup, neither of which is affected by the MUR power uprate conditions. The design transients contributing to the RTD nozzle fatigue usage that are also affected by the MUR power uprate are reactor trip, loss of flow, step load increase/decrease, and plant unloading. The step load increase/decrease transients under the MUR power uprate conditions will not increase the alternating stresses or UF on the RTD nozzle. Therefore, the delta UF calculation for the MUR power uprate includes only the effects from the reactor trip, loss of flow, and plant unloading transients. Using a conservative 35 years of additional operation to end-of-life in order to envelop plant operation under the MUR power uprate conditions, the CUF is increased by 0.109, from 0.732 to 0.841. This CUF continues to meet the acceptance criterion. The surge line temperature measuring RTD nozzle is therefore considered acceptable for the MUR power uprate.

Surge Line Sampling Nozzle

The surge line sampling nozzle has a pre-uprate CUF of 0.996, and the transient contributing the largest UF (0.263) is the LOSP transient in combination with heatup, neither of which is affected by the MUR power uprate conditions. In addition, this UF was very conservatively generated originally using the simplified elastic-plastic analysis (i.e., application of the K_e factor as defined in Paragraph NB-3228.5 of the ASME Code). A full elastic-plastic analysis reduces this UF from 0.263 to 0.044, thereby reducing the pre-uprate CUF to 0.777 (0.996 - 0.263 + 0.044).

The design transients that contribute to the sampling nozzle fatigue usage and that are also affected by the MUR power uprate conditions are reactor trip, loss of flow, step load increase/decrease and plant unloading. The step load increase/decrease transients under the MUR power uprate conditions will not increase the alternating stresses or UF on the sampling nozzle. Therefore, the delta UF calculation for the MUR power uprate includes only the effects from the reactor trip, loss of flow, and plant unloading transients. Using a conservative 35 years of additional operation to end-of-life in order to envelop plant operation under the MUR power uprate conditions, the CUF is increased by 0.207, from 0.777 to 0.984. This CUF continues to meet the acceptance criterion. The surge line sampling nozzle is, therefore, considered acceptable for the MUR power uprate.

Based on the above, the existing pressurizer surge line piping analysis remains valid.

IV.2.5 Reactor Coolant Pumps and Motors

IV.2.5.1 Reactor Coolant Pump Structural Analysis

The four RCPs are installed in the cold legs of the reactor coolant loops. The RCPs are affected by the reactor coolant pressure, SG outlet temperature, and primary side cold leg NSSS design transients. The SG outlet temperature affects both the thermal expansion and thermal transient loads on the RCPs.

The nominal SG primary outlet temperature for the MUR power uprate (i.e., T_{cold} = 548.0°F) is the same as the current nominal and design basis temperature for the SG outlet, RCP suction and discharge and RV inlet. Consequently, RCP thermal expansion loadings for the MUR power uprate are bounded by the design condition.

The Calvert Cliffs RCP supports are designed to carry loads due to normal operating conditions and seismic excitations, neither of which is changed by the MUR power uprate. Under LBLOCA, the RCP nozzles were shown to be capable of carrying the faulted condition loads that the RCP supports were not designed to carry. When LBLOCAs are replaced by BLPBs via LBB considerations, the faulted loads on the RCP supports and nozzles are significantly reduced, and the margin on the nozzle loads is increased.

The AOR also identified a critical margin on the horizontal strut load due to OBE. Since seismic excitations are unaffected by the MUR power uprate, this margin remains unchanged and acceptable.

In addition to the support system, other critical RCP components stress margins were addressed in the MUR power uprate assessments, as follows.

Casing Diffuser Vanes

Design Conditions - Critical margins exist for the primary-membrane and the primary-membrane-plus-local stress intensities at Vane 8. These margins are 2.74% and 4.81%, respectively. Per the AOR, the calculated membrane stress intensity is the average stress in the vane, and the calculated membrane plus local stress intensity represents the largest surface stress intensity, adjusted by removing the discontinuity bending stress. These stresses are a function of design moments and forces on the structure and the design pressure of 2500 psia. The specified design moments and forces are unchanged due to the MUR power uprate. In addition, the design pressure of 2500 psia is unchanged by the MUR power uprate. Therefore, these diffuser vane stress margins are unchanged and remain acceptable for the MUR power uprate.

Suction Nozzle

Design Conditions – The critical margin on the primary-membrane stress of the suction nozzle due to the design conditions is 2.0% and is only due to the design pressure 2500 psia. The design pressure, and therefore, primary-membrane stress, is not affected by the MUR power uprate.

Emergency Conditions - The critical margin in the suction nozzle due to emergency conditions involves primary-local stress, which is negative (-11.20%) when compared to the more restrictive limit of 1.2 S_m cited in the AOR. When compared to the less restrictive AOR limit of 1.8 S_m, a large positive margin exists. The AOR noted that although the more restrictive allowable was exceeded by the primary-local membrane stress, the

corresponding primary-general-membrane stress, which did not contain local effects, was less than the same allowable. Consequently, the AOR concluded that the conservatism inherent in the more restrictive primary-local stress allowable was unwarranted. This reasoning also applies to stresses for the MUR power uprate conditions.

Furthermore, since the specified external moments and forces, and the operating pressure loads are unchanged for the MUR power uprate conditions, the stress margins are unaffected and the suction nozzle design remains acceptable.

Discharge Nozzle

Design Conditions - Critical margins exist for the primary-membrane and the primary-membrane-plus-bending stress intensities in the crotch region of the discharge nozzle. These margins are 2.20% and 2.67%, respectively. Per the AOR, the acceptable primary-membrane stress margin of 2.20% was obtained after correcting the as-calculated stress analysis results for the as-cast thickness of the discharge nozzle and shell. Regarding the primary-membrane-plus-bending stress, the acceptable margin of 2.67% was obtained by removing the secondary bending stress from the greatest surface stress intensity in the crotch. The specified design moments and forces are unchanged due to the MUR power uprate. In addition, the design pressure of 2500 psia is unchanged by the MUR power uprate. Therefore, the stress margins of 2.20% and 2.67% for the discharge nozzle remain acceptable for the MUR power uprate.

Emergency Conditions - Critical margins exist for the primary-membrane and the primary-local-plus-bending stress intensities in the crotch region of the discharge nozzle. Primary-local-plus-bending results apply to the top half of the nozzle. These margins are 0.10% and 0.87%, respectively. Since the external moments and forces, and the operating pressure loads are unchanged for the MUR power uprate conditions, the stress margins remain acceptable for the MUR power uprate.

Hanger Bracket

Design Conditions - The critical margin for this location, 2.67%, is associated with the primary-membrane-plus-bending stress intensity. The membrane stress, which is 1.046 S_m, is classified as primary-local stress, and therefore is well below the limit of 1.5 S_m. The specified design moments and forces are unchanged due to the MUR power uprate. In addition, the design pressure of 2500 psia is unchanged by the MUR power uprate. Therefore the stress margin of 2.67% for the hanger bracket remains acceptable for the MUR power uprate.

Volute, Lower Flange

Design Conditions - The critical margin for this location, 4.70%, is associated with the primary-membrane stress intensity. The AOR also states that no surface stress exceeds the 1.5 S_m limit. Consequently, the primary-membrane-plus-bending limits are also satisfied for this region of the structure. The specified design moments and forces are unchanged due to the MUR power uprate. In addition, the design pressure of 2500 psia is unchanged by the MUR power uprate. Therefore, the stress margin of 4.70% for the volute/lower flange region remains acceptable for the MUR power uprate.

Cover, Region 4

According to the AOR, the critical stress margin for this region of the cover (the inside corner of the cover between cooling holes) occurs under operating conditions (i.e., for operation between steady-state hot and steady-state cold conditions). In this case, the highest stress intensity range was determined from linearized surface stresses and compared to 3 S_m at operating temperature, resulting in the critical margin of 4.96%. Since the heat-up and cooldown transients are not affected for the MUR power uprate, the critical margin of 4.96% is unchanged for the MUR power uprate conditions.

Based on the above discussions, it can be concluded that the existing RCP stress analyses are bounding and remain applicable for the pressure boundary components.

IV.2.5.2 Reactor Coolant Pump Motor Evaluation

Previous analyses determined that the RCP motors are acceptable for continuous operation with limiting hot loop and cold loop conditions under 2700 MWt. The RCP motors were determined to remain acceptable for operation at the MUR power uprate parameters based on the following:

- No-load T_{avg} is unchanged by the MUR power uprate. Therefore, the RCP hot start is not affected.
- Limiting RCP motor starting conditions occur during RCS cold loop conditions that are unchanged, and therefore not impacted by the MUR power uprate (i.e., T_{cold} remains at the design value of 548°F).
- The mechanical loads controlling RCP motor thrust bearing design are associated with seismic and LOCA conditions (i.e., RCP motor peak accelerations). Seismic loads are not affected by the MUR power uprate, and LOCA condition loads are reduced when BLPBs are invoked as the limiting design basis pipe breaks.
- The thermal transients on the drive motor are not affected by the MUR power uprate.

IV.2.6 Steam Generators

The thermal-hydraulic performance of the SGs was analyzed for the MUR power uprate conditions. Given the new RCS input of 595.9°F for T_{hot}, with flow, and T_{cold} remaining the same as at 2700 MWt, the secondary side of the SG experiences a 1.7% flow rate increase with pressure and temperature decreasing 1.5 psi and 0.1°F. There will also be a slight 0.36% decrease in SG inventory at 100% power. The new conditions were checked against the design, test and Level A, B, C and D stress levels specified in the ASME Code and found to be acceptable. The internals and flow induced vibration effects were found to be negligible. Structurally there is negligible effect. Therefore, the SGs remain fully qualified to operate at the MUR power uprate.

IV.2.6.1 Steam Generator Upper and Lower Supports Structural Integrity

The Calvert Cliffs SG support system consists of the following components at each SG:

- Lower SG supports - a sliding base, with four vertical pad supports and two lower keys.
- Upper SG supports - two upper shear key supports and eight directing-acting hydraulic snubbers.

Even though the operating setpoint temperatures (T_{hot} and T_{cold}) for the MUR power uprate conditions are enveloped by the design setpoint temperatures used in the original design basis structural analyses of the RCS, an assessment was performed to determine the effects of the MUR power uprate condition operating temperatures on the RCS components and supports. This analysis concluded that the loads on the RCS supports, including the supports on the SGs, either decreased or changed insignificantly due to the decrease in delta-T between T_{cold} and T_{hot}, relative to the original design basis analyses. Therefore, the effect of RCS thermal expansion on SG support loads due to the MUR power uprate is insignificant.

Since the original seismic and LOCA loads are also unchanged for the MUR power uprate, the SG upper, and lower supports continue to be acceptable under the MUR power uprate conditions.

IV.2.7 Pressurizer

The conditions that could affect the primary-plus-secondary stresses, and the primary-plus-secondary-plus-peak stresses, are the changes in the RCS hot leg temperature (T_{hot}), the RCS cold leg temperature (T_{cold}), and the pressurizer transients. Table IV-1 indicates that T_{cold} is unchanged, and that the increase in T_{hot} is very small. A T_{hot} change of this magnitude is enveloped by the current stress analysis. Some of the calculated thermal transients, however, were affected by the MUR power uprate. Therefore, critical locations in the pressurizer were re-examined, as discussed below.

Pressurizer Upper, Bottom and Side RTD Nozzles, and Heater Sleeves

The maximum CUF for these pressurizer locations, after mechanical nozzle seal assembly (MNSA) repairs, is 0.863. In all cases, the CUFs were entirely due to fatigue usage from plant heatup/cooldown and leak test transients. None of these transients are affected by the MUR power uprate; therefore the CUFs for these components are unchanged, and the components remain acceptable for the MUR power uprate.

Surge Nozzle at the Pressurizer End

The surge nozzle at the pressurizer end has a CUF of 0.764. Per the AOR, a UF of 0.716 (or greater than 94% of the CUF) is due to contributions from the normal plant variations at steady-state transient and from the step load increase transient.

The normal plant variations at steady-state transient (defined as ±100 psi and ±6°F) is unchanged by the MUR power uprate. The effect of the MUR power uprate on the step load increase transient was evaluated by calculating stress factors based on a comparison of the calculated transient based on the MUR power uprate setpoints vs. the originally specified transient. The evaluation showed that while the effect of the MUR power uprate on the step load transient increased the alternating stress significantly (by a factor of 2.5) at the nozzle, the original UF was calculated too conservatively. The number of occurrences used in the AOR to calculate the UF for this transient was 34,470 (which is the number of occurrences for heatup/cooldown) instead of the 2,000 occurrences specified for design for step load increases or decreases. By removing that conservatism and adding the MUR power uprate effect, the UF was reduced from 0.716 (pre-uprate conditions) to 0.333 (the MUR power uprate conditions), and the new CUF was reduced to 0.381.

As a result, this component remains acceptable for the MUR power uprate.

It is, therefore, concluded that all pressurizer components meet the stress and fatigue analysis requirement of Section III of the ASME Code 1965 Edition, up to and including the Winter 1967 Addenda for plant operation at the MUR power uprate conditions.

IV.2.8 Fuel Assembly

The Calvert Cliffs Unit 1, Cycle 17, 14x14 fuel design was evaluated to determine the impact of the MUR power uprate on the fuel assembly design criteria. The evaluation concluded that the Calvert Cliffs fuel design remains acceptable and will continue to satisfy the required design criteria under the operating temperature, operating pressure, and flow rates resulting from the MUR power uprate conditions.

The evaluation methodology compared significant operating parameter values, used in the AOR, with the values of those same parameters proposed for the MUR power uprate. The significant parameters evaluated included inlet temperature, system pressure, core average linear heat rates (LHRs), maximum fuel rod axial average fluence, minimum coolant flow rate, fuel residence time, and peak fuel rod burnup. These parameters affect such important design criteria issues as the fuel rod stress, strain, fatigue, and clad collapse, as well as the fuel assembly hold-down margin and shoulder gap. The evaluation of the comparison of these significant parameter values showed that the proposed MUR power uprate operating and transient values are the same as or bounded by the existing AOR values except for the core average LHR. Sufficient margins exist, however, to allow for the power uprate increase in that parameter. Since the core plate motions for the seismic and LOCA evaluations are not affected by the uprated conditions, there is no impact on the fuel assembly seismic/LOCA structural evaluation.

Therefore, the fuel mechanical performance design criteria will continue to be satisfied under the proposed MUR power uprate conditions.

IV.2.9 Nuclear Steam Supply System Piping and Pipe Whip

The reactor coolant main coolant loop piping system (including primary loop piping and pipe whip restraints, and tributary piping nozzles) was assessed for the MUR power uprate effects. It was concluded that these equipment designs remain acceptable and will continue to satisfy design basis requirements in accordance with applicable design basis criteria, which include the criteria associated with the original design basis mechanistic LOCA breaks, when considering the operating temperature, operating pressure, and flow rate effects resulting from the MUR power uprate conditions. The primary piping and tributary nozzles remain within allowable stress limits in accordance with ASME Section III, 1965 Edition, up to and including the Winter 1967 Addendum (and in accordance with ASME Section III, 1986 Edition for components with MNSA).

Reconciliation of a number of critical locations on the Calvert Cliffs Units 1 and 2 RCS piping and fittings under the MUR power uprate conditions is summarized below.

<u>Hot and Cold Leg Piping</u>

The critical margins on the maximum primary-local-plus-bending stress intensity at the hot leg and cold leg elbows are 5.80% and 3.26%, respectively. The calculated stresses are based on the design moments from dead weight and seismic excitation, and the design pressure of 2500 psia. The specified design loads do not change for the MUR power

uprate. Therefore, the stress margins of 5.80% and 3.26% are unchanged and remain acceptable for the MUR power uprate.

Pump/Pipe Junction at the Discharge Nozzle

The critical margin on the maximum primary-bending stress at the pipe-pump discharge nozzle juncture is 4.82%. The stress is a function of the design loads (including loads due to OBE) and the design pressure of 2500 psia. The specified design moments are not changed by the MUR power uprate. In addition, the design pressure is not changed by the MUR power uprate. Therefore the stress margin of 4.82% for the pipe/pump juncture is unchanged and remains acceptable for the MUR power uprate.

Pump/Pipe Junction at the Suction Nozzle

The CUF at this location is 0.836 (i.e., a 16.4% margin). Most of the fatigue usage (0.833 of 0.836) is due to the seismic transients. The rest of the fatigue usage (0.003) comes from the heatup transient. The specified normal operating loads and design seismic loads are unaffected by the MUR power uprate. Therefore, the effect of seismic on stress and fatigue is unchanged. The fatigue usage due to the heatup transient is also unchanged because this transient occurs at zero power and is not affected by the MUR power uprate. Therefore, this component remains acceptable for the MUR power uprate.

Safety Injection Nozzle

The critical margin on the maximum primary-plus-secondary stress, (Local Primary Membrane Stress (PL) plus Primary Bending Stress (PB) Secondary Stress (Q)) or the primary plus secondary stress intensity (PL+PB+Q), is 2.24%, and is due to the seismic load and heatup transient and the cooldown transient when combined with the effects of design pressure, dead weight, and seismic loads. The design pressure, dead weight, and seismic loads are not affected by the MUR power uprate. The heatup/cooldown transients occur at zero power and therefore are not affected by the MUR power uprate. Therefore, this critical margin on stress is unchanged for the MUR power uprate.

The highest CUF in the SI nozzle is only 0.1892, and is primarily due to an alternating stress from combinations of plant cooldown/seismic and plant heatup/cooldown transients. The plant heatup/cooldown transients and seismic excitations are not affected by the MUR power uprate. Therefore, the CUF for the SI nozzle is unchanged, and the nozzle remains acceptable for the MUR power uprate.

Hot Leg RTD and Pressure Differential Transmitter Nozzles with a MNSA

The critical margin on the maximum primary-plus-secondary stress, PL+PB+Q, is 1.68% for either the hot leg RTD or pressure differential transmitter nozzle with a MNSA installed. This limiting stress is based on the hydrostatic test and LOSP transients. These transients are not altered by the MUR power uprate. Therefore, this component remains acceptable for the MUR power uprate.

Hot Leg Drain Nozzle

The critical margin on primary-local-plus-bending stress is 1.25%. The calculated stress range is based on design moments from design pressure, dead weight, thermal and design seismic effects. These effects are changed by the MUR power uprate. Therefore the stress

margin of 1.25% for this nozzle is unchanged and the nozzle remains acceptable for the MUR power uprate.

In conclusion, the Calvert Cliffs Units 1 and 2 primary piping and tributary nozzles remain within allowable stress limits in accordance with ASME Section III, 1965 edition, up to and including the Winter 1967 Addendum (and in accordance with ASME Section III, 1986 Edition for components with MNSA). Furthermore, no piping or pipe restraint modifications are required as a result of the increased power level, because conservatively determined LOCA loads due to MCLBs were used to design the pipe restraint systems.

IV.3 EFFECTS OF OPERATING POINT DATA VARIATIONS

The MUR power uprate operating point values shown in Table IV-1 represent a best estimate. In all probability, the MUR power uprate operating point will move slightly over time, resulting in small changes in the operating point parameters.

Regardless of these small anticipated changes, particularly in the operating temperatures and the resulting delta-T, the structural AOR performed for the Calvert Cliffs Units 1 and 2 RCS components will remain bounding. The following discussion is based on the fact that the AOR considered T_{hot} and T_{cold} design values of 604°F and 548°F, respectively, with a resulting delta-T of 56°F.

IV.3.1 Reactor Coolant System Thermal Movements

The maximum thermal movements of various locations on the RCS (e.g., tributary nozzle ends) result from the change in RCS temperature from ambient conditions to operating conditions. The MUR power uprate thermal movements will be enveloped by the AOR results, since AOR results are based on ambient to operating condition nominal temperature ranges that bound the temperature ranges associated with the MUR power uprate conditions. This was demonstrated in an analysis comparing RCS thermal movements due to design operating setpoint temperatures to similar results determined at the MUR power uprate nominal setpoint temperatures. The MUR power uprate condition thermal movements either remained the same or decreased slightly, relative to the movements due to design operating setpoint temperatures. In general the decreases were on the order of 1 to 2%. Maximum decreases were 4 to 5%.

Furthermore, this conclusion will remain valid if the nominal values of T_{hot} and T_{cold} vary slightly after the MUR power uprate, because 1) there is sufficient margin between the MUR power uprate nominal T_{hot} value of 595.9°F and the design T_{hot} of 604°F, and 2) the T_{cold} value is anticipated to remain at the design value of 548°F, which has been the case for previous plant operation.

IV.3.2 Reactor Coolant System Loads

Reactor Coolant System component nozzle and primary piping thermal expansion loads are directly affected by delta-T, the temperature difference between T_{hot} and T_{cold}. Given the same RCS configuration and operating temperatures that are generally the same, lower delta-T values will result in lower piping and nozzle loads, which in turn will result in proportionally lower loads at intermediate component locations and at the component supports. This conclusion can be drawn because the general RCS characteristics of stiffness, mass and connectivity will not change for the MUR power uprate, thus resulting in an overall RCS load distribution for the

MUR power uprate conditions that will be very similar to the load distribution analyzed in the AOR.

The delta-T values associated with current and the MUR power uprate conditions are both less than the delta-T value used in the AOR. Therefore, even though delta-T will increase slightly when going from the current to the MUR power uprate conditions (by ~1°F), the AOR piping, component and component support thermal expansion loads will remain bounding, because they are associated with a higher value of delta-T.

Per Section IV.2, the majority of the AOR design thermal transients remain bounding for the MUR power uprate. Even those that do not remain bounding were demonstrated to have little effect on the AOR stress calculations (see detailed discussions in Section IV.3.3).

Original design basis RCS seismic analysis results are negligibly affected by the MUR power uprate, because small changes in temperature have virtually no effect on the material properties of the structure, and therefore, on the manner in which the structure responds to a given set of input loads. Furthermore, Section IV.1 concludes that it is valid to base the MUR power uprate LOCA evaluations on the original DBEs. Furthermore, since LBB can be implemented to mitigate any adverse effects from the MCLB load contributions, basing the MUR power uprate LOCA evaluations on the original DBEs is both valid and conservative.

Finally, since the RCS structure will respond to the same design input loadings in essentially the same manner under the MUR power uprate conditions, the original design basis structural analysis results will remain valid.

IV.3.3 Reactor Coolant System Stresses and Usage Factors

Since the AOR normal operating conditions, seismic, and LOCA structural analysis results remain bounding for the MUR power uprate, the only changes to the AOR design, emergency, and faulted condition load combinations used to calculate the stresses and fatigue UFs of record are related to the design thermal transients. As discussed above and throughout Section IV.2, the CUFs determined in the AOR were insensitive to the effects of the transient input changes associated with the MUR power uprate. It is safe to conclude that any further, even smaller, changes resulting from operating point drift will also be acceptable.

It is also noted that the ASME Code stress allowables used in the AOR are unaffected by small changes in operating temperatures, leading to the conclusion that the bounding stresses determined in the AOR will continue to remain below their corresponding ASME Code allowables. Consequently, the structural integrity of the RCS components is further confirmed for small variations in the MUR power uprate conditions, and the stress margins identified in the AOR calculations remain applicable.

IV.4 REACTOR VESSEL INTEGRITY

The factors influencing RV integrity are the initial properties of the materials and the neutron fluence incident on the materials. The MUR power uprate does not affect the initial material properties, but the neutron fluence can change. The effect of neutron fluence changes on vessel integrity are assessed below using 10 CFR Part 50, Appendices G and H, and 10 CFR 50.61.

Pressurized Thermal Shock- The screening criteria in 10 CFR 50.61 are 270°F for an assumed axial flaw and 300°F for an assumed circumferential flaw. The highest RT_{PTS} value for Calvert Cliffs Unit 1 at the end of the extended license was determined to be 261°F which is associated with the RV lower shell course axial weld seams. This is based on a projected fluence of 5.13×10^{19} n/cm^2, E>1MeV. The highest RT_{PTS} value for Calvert Cliffs Unit 2 at the end of the extended license was determined to be 199°F which is associated with the RV lower shell course plate D8907-2. This is based on a projected fluence of 5.78×10^{19} n/cm^2, E>1MeV. In both cases the projected value of RT_{PTS} is less than the pressurized thermal shock screening criterion of 270°F such that the planned uprate does not result in exceeding the screening criterion.

Vessel Fluence Evaluation- The vessel fluence is predicted to increase approximately 0.04×10^{19} n/cm^2, E>1MeV, as a result of the planned uprate. This is based on the conservative assumption that a 1.7% uprate in power corresponds to a 1.7% increase in neutron fluence for the time period following the initiation of the uprate.

Heat-up and Cool-down Pressure Temperature Limit Curves and Low Temperature Overpressure Protection– 10 CFR Part 50 Appendix G addresses the limits on pressure and temperature that are placed on heat-up and cool-down during normal operation. There are no significant changes to the values used to establish the Appendix G normal operating limits. The 0.04×10^{19} n/cm^2 increase in fluence results in less than 0.5°F change to the adjusted reference temperature at the one-quarter thickness location. The low temperature overpressure protection limits for power uprate conditions are unchanged for those same reasons.

Upper Shelf Energy- 10 CFR Part 50 Appendix G requires that the upper shelf energy (USE) throughout the life of the vessel be no less than 50 ft-lb. Projections were done in accordance with Regulatory Guide 1.99, Revision 2, and were based on the neutron fluence values through the end of the extended license adjusted to represent conditions for power uprate. For Calvert Cliffs Units 1 and 2, the USE values at the end of the current license were determined to range from 52 ft-lb to 85 ft-lb for the RV beltline plates and welds. This demonstrates that all the beltline materials will exceed the USE screening criteria.

Surveillance Capsule Withdrawal Schedule- 10 CFR Part 50 Appendix H defines the RV surveillance program that is to be used by the licensee to monitor the neutron radiation induced changes in fracture toughness of the vessel during the life of the plant. It includes requirements to establish a surveillance capsule withdrawal schedule. The schedule for Calvert Cliffs Units 1 and 2 has been updated based on the fluence projected for the extended license. The vessel fluence is predicted to increase only 0.04×10^{19} n/cm^2, E>1MeV, as a result of the planned uprate. Therefore, the updated surveillance capsule withdrawal schedule is also applicable under conditions including the MUR power uprate.

IV.5 NUCLEAR FUEL

This section summarizes the evaluations performed to determine the effect of the MUR power uprate on the nuclear fuel. The core design for Calvert Cliffs is performed on a fuel cycle specific basis and varies according to the needs and specifications for each fuel cycle. However, some fuel-related analyses are not cycle specific. The nuclear fuel review for the MUR power uprate evaluated the fuel core design, thermal-hydraulic design, and fuel rod performance.

IV.5.1 Fuel Core Design

The impact of a bounding 1.7% uprate condition on the fuel core design was evaluated against the data used in the current Calvert Cliffs safety AOR. Since the MUR power uprate is relatively small, the range of parameters used in the current safety AOR are adequate to accommodate the range of parameters expected for future cores that have implemented the MUR power uprate. The core analyses for specific uprate cycles has shown that the implementation of the MUR power uprate does not result in significant changes to the current nuclear design basis for the safety analysis documented in the UFSAR. The impact of the MUR power uprate on peaking factors, rod worths, reactivity coefficients, shutdown margin, and kinetics parameters is either well within normal cycle-to-cycle variation of these values or controlled by the core design and will be addressed on a cycle-specific basis consistent with reload methodology.

The methods and core models used in the MUR power uprate analyses are consistent with those presented in the Calvert Cliffs UFSAR. No changes to the nuclear design philosophy, methods, or models are necessary due to the MUR power uprate. The current range of required cycle specific analysis will be sufficient to verify the applicability of these parameters for future cycles.

IV.5.2 Core Thermal-Hydraulic Design

The core thermal-hydraulic design and methodology were evaluated for the MUR power uprate. The thermal hydraulic design is based on the TORC computer code described in Reference IV-2, the ABB-TV [Asea Brown Boveri, Inc.-Turbo vane] and ABB-NV [non-mixing vane] critical heat flux correlations described in Reference IV-3, the simplified TORC modeling methods described in Reference IV-4, and the CETOP-D code described in Reference IV-5. In addition, the departure from nucleate boiling ratio (DNBR) analysis uses the methodology for determining the limiting fuel assembly or assemblies.

The Extended Statistical Combination of Uncertainties presented in Reference IV-6 and approved in Reference IV-7 was applied to validate the design limit of 1.24 on the ABB-TV and ABB-NV minimum DNBR. This DNBR limit includes the following allowances:

1. NRC specified allowances for TORC code uncertainty.
2. Rod bow penalty equivalent to 0.6% on minimum DNBR as discussed in Reference IV-8.

The core thermal-hydraulic design and methodology remain applicable for Calvert Cliffs with the MUR power uprate.

IV.5.3 Fuel Rod Design

The thermal performance of erbia and UO_2 fuel rods for Calvert Cliffs Unit 1 Cycle 17 core with the MUR power uprate were evaluated using the FATES3B version of the fuel EM (References IV-8, IV-9, and IV-10), the erbia burnable absorber methodology described in Reference IV-11, the maximum pressure methodology described in Reference IV-12, and the ZIRLO™ fuel rod cladding methodology described in Reference IV-13. This evaluation included a power history that enveloped the power and burnup levels expected for the peak fuel rod at each burnup interval, from beginning-of-cycle to end-of-cycle burnups, including a reduction in maximum permitted F_r, consistent with implementation of the power uprate. The maximum predicted fuel rod internal pressure for the uprated core remains below the critical pressure for No-Clad-Lift-Off (Reference IV-14).

The thermal performance of erbia and UO_2 fuel rods for Calvert Cliffs Unit 1 (subsequent to Cycle 17) and Unit 2 (subsequent to Cycle 15) cores with the MUR power uprate is evaluated using the FATES3B version of the fuel EM (References IV-8, IV-9, and IV-10), the erbia burnable absorber methodology described in Reference IV-11, the maximum pressure methodology described in Reference IV-12, and the ZIRLO™ fuel rod cladding methodology described in Reference IV-13. These evaluations include a power history that envelopes the power and burnup levels expected for the peak fuel rod at each burnup interval, from beginning-of-cycle to end-of-cycle burnups. The maximum predicted fuel rod internal pressure for the uprated conditions will be shown to remain below the critical pressure for No-Clad-Lift-Off (Reference IV-14).

The expected fuel rod corrosion performance for Calvert Cliffs Units 1 and 2 cores with MUR power uprate was evaluated and found acceptable. This evaluation was conducted consistent with requirements of the NRC SER on the high burnup topical report for 14x14 CE design fuel of Reference IV-15. This evaluation also considered the impact of recent high duty corrosion observations for OPTIN™ clad fuel that may be resident in Calvert Cliffs Units 1 and 2 (see also Reference IV-16). The fuel rod corrosion performance of OPTIN™ and ZIRLO™ clad fuel specifically for the MUR power uprated Calvert Cliffs Unit 1 Cycle 17 core were evaluated (References IV-14, IV-15, and IV-16) and found to be acceptable. The fuel rod corrosion performance for MUR power uprated Calvert Cliffs Unit 1 (subsequent to Cycle 17) and Unit 2 (subsequent to Cycle 15) cores is evaluated using this same methodology.

As noted in previous sections (e.g., II.3) Calvert Cliffs Unit 1 Cycle 17 was targeted as the lead unit for implementation of the MUR power uprate. Application of the MUR power uprate analyses and evaluations to Unit 2 would be made as part of the normal reload process. Subsequent to performance of these Unit 1 analyses and evaluations, a fuel design change that implements the use of Zirconium Diboride (ZrB_2) integral burnable absorbers was submitted to the NRC (Reference IV-17). Unit 2 Cycle 16 is the lead unit for the fuel design change. The analyses that are being performed to support the transition to ZrB_2 have already included the MUR power uprate as an initial condition. No additional analyses to support both ZrB_2 and the MUR power uprate are required.

IV.6 BALANCE OF PLANT PIPING

The balance of plant (BOP) piping systems impacted by the uprate (main steam, feedwater, extraction steam, moisture separator drains, reheater drains, condensate, and heater drain piping) have been evaluated by comparing the conditions for the proposed power uprate with the current operating conditions. The design temperatures and pressures used in the analyses continue to bound the uprate conditions. The maximum operating temperatures with the MUR power uprate are within 1% of the existing maximum operating temperatures.

The BOP piping systems remain acceptable for operation at the MUR power uprate conditions, and the proposed 1.38% power uprate will not have adverse effects on the BOP piping.

V. ELECTRICAL EQUIPMENT DESIGN

This section summarizes the evaluations performed to determine the effect of the MUR power uprate on the electrical equipment. The electrical equipment included in the evaluation is presented within each subsection.

V.1 MAIN GENERATOR AND ASSOCIATED SYSTEMS

The Unit 1 Main Generator has a design rating of 1,020 MVA at 25 kV 60 Hz when operated at 0.9 lagging power factor (918 MW) and hydrogen pressure of 60 psig. Unit 2 Main Generator is rated at 1,012 MVA at 22 kV 60 Hz when operated at 0.9 lagging power factor (910.8 MW) and hydrogen pressure of 75 psig. The new operating point corresponding to the MUR power uprate is within the design rating of both machines. The generators are operated to produce power output within the limits of their associated reactive capability curves. If required, the MVAR output of the generator can be adjusted such that the total MVA rating is not exceeded. No modification to auxiliary or support equipment is required.

Applicable calculations were reviewed and determined no changes are required for generator voltage regulator and associated protective relay settings.

Two unit transformers are connected via an isolated phase bus to the output of each main generator and are designed to carry the maximum generator output and transform generator output voltage to transmission system voltage. Each of the paralleled transformers is rated for 810 MVA at 65°C rise. The maximum MVA rating of the Unit 1 and Unit 2 generators remain at 1020 and 1012 MVA which is well within the rating of the paralleled transformers.

The associated isolated phase bus and switchyard equipment are also rated for maximum current flow from the generator, thus no modification to this equipment is required. However, the existing unit limitations for conditions when the unit's isophase bus duct cooling is not available or operating at rated capability, or when one of the unit's generator step-up transformers is not available still remain.

V.2 ONSITE DISTRIBUTION SYSTEMS

The onsite electrical distribution systems include non-Class 1E plant service transformers and associated busses. The 4.16 kV, 480 volt, and 120/208 volt systems include both Class 1E and non-Class 1E equipment. The onsite direct current (DC) distribution system includes both Class 1E and non-Class 1E equipment.

The non-Class 1E AC distribution systems provide power for non-safety-related systems during normal plant conditions. The large non-safety loads powered from these busses include condensate pumps, condensate booster pumps, and heater drain pumps. The MUR power uprate does not result in an increase in mechanical load beyond the design rating of any non-Class 1E equipment. The motors and associated support and protective equipment are sized based on design ratings, thus they are adequately sized for the small load increase resulting from the MUR power uprate.

The Class 1E AC distribution system includes two Class 1E 4.16 kV busses per operating unit, each capable of being powered by an associated Class 1E standby emergency diesel generator in the event of a loss of offsite power. A station blackout diesel generator is designed to provide sufficient power to any of the four Class 1E 4.16 kV busses in order to safely shutdown one unit and maintain it in a safe shutdown condition during a station blackout event. Downstream

480 Volt and 120 Volt busses also feed two trains of redundant safety equipment. As referenced in Section II.1, there is no change to the existing accident analyses and they continue to be valid for the MUR power uprate. The electrical motors and supporting equipment are sized for maximum accident load requirements. Thus, there is no need to upgrade any existing equipment.

The onsite DC distribution system will see minor load variations due to the power uprate; however the resulting electrical loads remain within the ratings of the existing distribution system and no changes are required.

V.3 ENVIRONMENTAL QUALIFICATION OF ELECTRICAL EQUIPMENT

In accordance with 10 CFR 50.49, certain electrical equipment must be qualified to operate when exposed to the postulated harsh accident environments of DBAs [i.e., LOCA, MSLB, High Energy Line Breaks (HELBs)]. The qualification includes aging considerations of normal plant operating ambient environments. The effects of the proposed MUR power uprate on the 10 CFR 50.49 Environmental Qualification (EQ) Program is as follows:

V.3.1 Environmental Qualification Accident (Temperature/Pressure) Environments

As discussed in Section II.5, the current UFSAR Chapter 14 Containment LOCA and MSLB temperature/pressure analyses will not be affected (i.e., remain bounding) considering the MUR power uprate. The current EQ accident (temperature/pressure) environments utilize these UFSAR Chapter 14 analyses. Therefore, the current inside-Containment EQ equipment LOCA/MSLB temperature/pressure qualification is unaffected by the MUR power uprate.

As discussed in Section VII.5, the current UFSAR Chapter 10A outside-Containment HELB temperature/pressure analyses will not be affected (i.e., remain bounding) considering the MUR power uprate. The current EQ accident (temperature/pressure) environments utilize these UFSAR Chapter 10A analyses. Therefore, the current outside Containment EQ Equipment HELB temperature/pressure qualification is unaffected by the MUR power uprate.

V.3.2 Environmental Qualification Accident (Radiation) Environments

As discussed in Section III, the current accident radiation doses, utilized in the EQ Program, required re-evaluation as a result of the proposed MUR power uprate. Environmental qualification equipment was re-evaluated against these revised accident radiation doses and confirmed to remain environmentally qualified to these revised accident doses.

V.3.3 Environmental Qualification Normal Plant Operating Ambient (Temperature/Humidity) Environments

As discussed in Section VI.22, the heating, ventilation, and air conditioning (HVAC) systems, control normal plant operating ambient environments in Containment and Auxiliary Building. Environmental qualification equipment is located in both the Containment and the Auxiliary Building. These HVAC Systems were reviewed considering the MUR power uprate. The review determined that these existing HVAC systems will continue to maintain the Containment and Auxiliary Buildings within their UFSAR Chapter 9 design ranges. Therefore, the current normal plant operating aging considerations, utilized in the EQ Program, will not be impacted and are bounded by the current design.

V.3.4 Environmental Qualification Normal Plant Operating Ambient (Radiation) Environments

As discussed in Section III, the current normal operating radiation doses, utilized in the EQ Program, required re-evaluation as a result of the proposed MUR power uprate. Equipment was re-evaluated against these revised normal operating radiation doses and confirmed to remain environmentally qualified to these revised normal operating doses.

V.4 GRID STABILITY

The Pennsylvania, New Jersey, Maryland (PJM) Interconnection has preliminarily reviewed the power uprate for impact on grid stability. The proposed increase in plant electrical output will not affect the stability of the grid. No switchyard modifications are required as a result of the MUR power uprate.

VI. SYSTEM DESIGN

This section presents the results of the evaluations and analyses performed in the NSSS area to support the revised conditions provided previously in Table IV-1. The systems addressed in this section include fluid systems and control systems. The results and conclusions of each evaluation and analysis are presented within each subsection.

VI.1 REACTOR COOLANT SYSTEM

The purpose of the RCS is to remove heat from the core and transfer it to the secondary side of the SGs. The RCS consists of the reactor pressure vessel, two hot leg pipes, two SGs, four RCPs, four cold leg pipes, and one pressurizer with attendant interfacing piping, valves and instrumentation.

Evaluations were performed to ensure that the RCS design basis functions could still be met at the revised operating conditions. The principal effects of the MUR power uprate on the RCS are a slight increase in T_{hot} and the increase in decay heat. The normal operating pressure of 2250 psia remains unchanged. The results of the evaluation of uprated conditions on the RCS functions are described below.

a. The increase in T_{hot} will increase the total amount of heat transferred to the Main Steam System (MSS). Verification that the major components of the NSSS can support this increase in the normal heat removal function is addressed in this section.

b. The increased thermal power can change the transient response of the RCS to normal and postulated DBEs. The acceptability of the RCS with respect to protection functions is addressed in Section II. The acceptability of the RCS with respect to fatigue evaluations is addressed in Section IV. The setpoints for various control systems will be evaluated for recommended changes prior to plant startup.

c. The cold leg temperature remains unchanged at 548°F. As a result, the RCS mass flow is not affected by the MUR power uprate.

d. Reactor coolant system design temperature and pressure of 650°F and 2500 psia continue to remain applicable for the uprate conditions.

e. The pressurizer design temperature and pressure of 700°F and 2500 psia continue to remain applicable for the uprate conditions.

f. The pressurizer relief requirements increased slightly due to an increase in RCS stored energy and decay heat. However, the change is well within the relieving capacity of the pressurizer safety valves for the design transient condition (Section II.2).

VI.2 SAFETY INJECTION SYSTEM

The function of the SI System is to remove the stored energy and fission product decay heat from the reactor core following a LOCA. The system is designed such that fuel rod damage is minimized, facilitating the long-term removal of decay heat. The system also provides injection of negative reactivity (boron) in the RCS cooldown events such as a MSLB.

The active part of the SI System consists of high pressure SI pumps, the refueling water tank, low pressure safety injection (LPSI) pumps, and the associated valves, instrumentation, and piping.

The passive portion of the SI System is the safety injection tanks (SITs) that are connected to each of the RCS cold leg pipes. Each SIT contains borated water under nitrogen pressure and automatically injects into the RCS when the RCS pressure drops below the operating pressure of the SITs. The active portion of the SI System (injection pumps) injects borated water from the refueling water tank into the reactor following a break in either the RCS or steam system piping to cool the core and prevent an uncontrolled return to criticality.

Safety Injection System operation is described in two phases; the injection phase and the recirculation phase. The injection phase provides emergency core cooling and additional negative reactivity immediately following a spectrum of accidents including a LOCA by prompt delivery of borated water to the RV. The recirculation phase provides long-term post-accident cooling by recirculating water from the containment sump.

During normal operation the SI System does not operate and has no design function. Thus, during normal operation, there is no impact on the system due to the MUR power uprate. However, the slight increase in RCS stored energy and decay heat resulting from the power uprate are well within the capabilities of the SI System to respond to DBAs. The results of the evaluation of a LOCA are presented in Section II.3. For non-LOCA RCS depressurization events, the SI System is acceptable for power uprate as demonstrated in Section II.2.

VI.3 CHEMICAL AND VOLUME CONTROL SYSTEM

The Chemical and Volume Control System (CVCS) provides for boric acid addition and removal, chemical additions for corrosion control, reactor coolant cleanup and degasification, reactor coolant makeup, and processing of reactor coolant letdown.

During plant operation, reactor coolant letdown is taken from the cold leg on the suction side of the RCP, through the tube side of the regenerative heat exchanger and then through letdown control valves. The regenerative heat exchanger reduces the temperature of the reactor coolant and the control valves reduce the pressure. The letdown is cooled further in the tube side of the letdown heat exchanger and subsequently passes through the purification filter. Flow continues through the purification ion exchangers, where ionic impurities are removed, and enters the volume control tank. The charging pumps take suction from the volume control tank and return the coolant through the shell side of the regenerative heat exchanger to the RCS in the cold leg, downstream of the RCP.

The nominal T_{cold} for the power uprate remains unchanged at 548°F. As a result, the temperature of the letdown flow is not changed. Consequently, there is no impact on the thermal performance of the CVCS.

The CVCS provides a source of borated water for post-accident injection. Evaluation of required ECCS water volumes and boric acid concentrations will be performed as part of the normal reload safety evaluation process. The slight increase of N-16 activity at the MUR power uprate conditions has a negligible effect on letdown line decay time requirements. There will be no change to the letdown and makeup requirements as a result of the MUR power uprate.

As previously noted, T_{cold} and the reactor coolant mass flow rate remain unchanged. Increased power is due to a slight increase in T_{hot} and associated increase in T_{ave}. The increase in T_{ave} will cause a small increase in the makeup requirements for coolant shrinkage during cooldown. However, this effect is considered negligible.

VI.4 SHUTDOWN COOLING SYSTEM

The SDC System is designed to remove sensible and decay heat from the core and to reduce the temperature of the RCS during the second phase of plant cooldown.

The SDC System consists of two electrically aligned trains. Each train consists of one heat exchanger, one LPSI pump, associated valves, and instrumentation. Both trains take suction from a common suction line off one reactor coolant hot leg, and then flow is divided through the LPSI pumps, the tube side of the SDC heat exchangers, and back to the RCS cold legs through a four leg header.

The proposed power uprate will affect the SDC System due to an increased heat load from higher decay heat input. Since decay heat is proportional to plant operating power, any increase in RTP will result in an increase in decay heat load.

The SDC System was previously evaluated to be capable of supporting the decay heat that would be present based on 102% of 2700 MWt, which is 2754 MWt including uncertainty. The analytical power level including revised uncertainty with the MUR power uprate remains 2754 MWt. Therefore the system is capable of supporting the MUR power uprate.

VI.5 AUXILIARY FEEDWATER SYSTEM

The purpose of the Auxiliary Feedwater (AFW) System is to provide sufficient feedwater to the SGs for the removal of sensible and decay heat, and to cool the primary system to 300°F in case the condensate or the main feedwater systems are inoperable. An evaluation was performed to determine whether the current design of the AFW System will satisfy its safety functions and support an MUR power uprate.

The AFW and condensate storage tank analyses are based on 102% of 2700 MWt (2754 MWt). The analytical power level, including revised uncertainty, with the MUR power uprate remains 2754 MWt. Therefore, the evaluation concluded that the AFW System and condensate storage tank system will support Calvert Cliffs Unit 1 and Unit 2 with the MUR power uprate.

VI.6 MAIN STEAM SYSTEM

The MSS is designed to transfer steam from the SGs to the turbine throttle stop valves, the reheaters, and the turbine-driven pumps. The MSS also controls SG pressure by means of steam bypass, dump, or safety valves (high pressure) and main steam isolation valves (MSIVs) (low pressure).

The system is designed to accommodate electrical load changes from 15 to 100% power at a rate of 5% per minute and at greater rates over smaller load change increments, up to a step change of 10%. This is normally accomplished by manual CEA movement and adjustment of RCS soluble boron concentration. The primary impact of the MUR power uprate on the MSS is an increase in main steam flow of about 2%. There is no change in the main steam operating pressure and temperature. Steam flow to the high pressure turbine will increase by 2.07% for Unit 1 and 2.23% for Unit 2. The MSS and associated components were evaluated for the increased steam flow and found to be acceptable.

However, for Unit 2 there is an economic issue concerning the turbine throttle valves. The Unit 2 turbine throttle valves are currently operating at the valve wide open position, which will be a limiting factor for taking full advantage of the full MUR power uprate. This limitation does

not effect the safe operation of the plant and the necessary hardware changes to eliminate this limitation will be addressed as an economic concern.

VI.7 MAIN STEAM SAFETY VALVES

Overpressure protection for the shell side of the SGs and the main steam line piping up to the inlet of the turbine stop valve is provided by 16 spring-loaded ASME Code MSSVs which discharge to the atmosphere. Eight of these safety valves are mounted on each of the main steam lines upstream of the steam line isolation valves, but outside the Containment. The MSSVs are designed for full flow relief pressure of 1085 psig, thereby ensuring that the secondary system pressure will be limited to within 110% of its design pressure of 1015 psia during the most severe anticipated system operational transient. The opening pressure of the valves is set in accordance with ASME Code allowances, with the minimum set pressure at 935 psig, and the maximum set pressure at 1050 psig. The total relieving capacity for all valves on both of the steam lines in either unit is 12.26×10^6 lbs/hr of saturated steam (6.13×10^6 lbs/hr per SG). This relief capacity is larger than the steam flow at the MUR power uprate conditions. The accident analysis shows there is adequate MSSV capability at 102% power.

Startup and/or power operation is allowable with MSSVs inoperable within the limitations of the Technical Specifications. The number of inoperable MSSVs will determine the necessary level of reduction in secondary system steam flow and thermal power required by the reduced reactor trip settings of the Power Level-High channels. The current Technical Specifications were confirmed to remain applicable for the proposed change in RTP.

VI.8 MAIN STEAM ISOLATION VALVES

One MSIV assembly is provided on each main steam line header. The MSIV is a "y"-type, bi-directional, balanced disk globe valve with an American National Standards Institute (ANSI) 600 primary pressure rating; the bonnet closure is of a pressure seal design body and disk seating surfaces, disk guides, and backseat are integrally hardfaced with Stellite 21; limit switches are mounted on the yoke to provide full open, full closed, and intermediate position indication. The valve is capable of shutting against pressure from either side. A motor-operated bypass valve is provided to equalize pressure across the valve before opening. The MSIVs and their actuator systems are designed to Seismic Category I requirements.

Closure of the MSIV, within a maximum of six seconds after a trip signal is initiated, prevents rapid flashing and blowdown of water stored in the shell side of the SG, thus avoiding a rapid uncontrolled cooldown of the RCS. Also, the isolation valves prevent release of the contents of the secondary side of both SGs to the Containment in the event of the rupture of one main steam line inside the Containment Structure.

The MSIVs are not impacted by the MUR power uprate because SG and the MSS operational pressure are not increased. Therefore, the ability of the MSIV to close within the Technical Specification limited closure time following a postulated steam line break event is not affected.

VI.9 STEAM DUMP AND BYPASS SYSTEM

The Steam Dump and Bypass System is used to rapidly remove RCS stored energy and to limit secondary steam pressure following a turbine-reactor trip. The atmospheric steam dump system consists of two automatically actuated atmospheric dump valves which exhaust to the atmosphere. The turbine bypass system consists of four turbine bypass valves which exhaust

to the main condenser. The power-operated steam dump valves and steam bypass valves obviate opening of the MSSVs following turbine and reactor trips from full power.

The system also provides a means of heat removal during hot standby, startup, and during plant cooldown. The atmospheric steam dump valves are capable of removing reactor decay heat when the condenser is not available.

The total respective capacities of the atmospheric steam dump and turbine bypass valves are nominally 5% and 40% of steam flow with the reactor at full power. This flow is sufficient to control the secondary steam pressure on a turbine trip at the MUR power uprate without necessitating operation of the spring-loaded safety valves.

The system controls are arranged for either automatic operation or remote manual control.

The Steam Dump and Bypass System was confirmed to provide adequate pressure relief and decay heat removal for the proposed MUR power uprate.

VI.10 STEAM GENERATOR BLOWDOWN SYSTEM

Each SG has an upper and lower blowdown line which can be used to control the build-up of soluble and particulate concentrations within the SG. The blowdown system will continue to operate normally with no change at a continuous rate of up to 200 gpm per SG. No changes to SG blowdown are required to support the proposed MUR power uprate.

VI.11 FEEDWATER AND CONDENSATE SYSTEMS

The Feedwater and Condensate Systems are designed to provide a means for transferring the condensate from the condenser hotwell to the SGs (while at the same time raising the temperature and pressure) and providing a means for controlling the quantity of feedwater into the SGs.

The MUR power uprate results in approximately a 2% increase in condensate flow, due to an increase in extraction steam flow through the feedwater heaters and an increase in the condensate temperature. A hydraulic calculation was performed verifying the condensate systems ability to perform its design function of delivering condensate from the condenser hotwells to the feedwater system at the required flow, pressure, temperature, and quality at the MUR power uprate conditions.

The feedwater flow will increase approximately 2% under the MUR power uprate conditions. A hydraulic calculation was performed to evaluate the feedwater systems ability to provide sufficient flow to the SGs at the MUR power uprate conditions. Results of the calculation found the feedwater system capable of providing sufficient flow to the SGs.

However, one level of the feedwater heaters on Unit 1 and two levels of feedwater heaters on Unit 2 have been identified as having possible limitations for full MUR power uprate conditions. The feedwater heaters are not a safety critical component and will be further evaluated with the potential for replacement/modification as an economic concern.

VI.12 EXTRACTION STEAM SYSTEM/HEATER DRAINS SYSTEM

The extraction steam and heater drain systems provide a means of heating condensate and feedwater, and for returning condensed steam to the condensate system.

The MUR power uprate results in approximately a 2% increase in heater drain flow and a corresponding increase in heater drain temperature, due to the increase in heat load in the feedwater heaters. The system evaluation demonstrated that the equipment can operate at the MUR power uprate conditions, with further action needed to upgrade or evaluate the capability of the Unit 2 heater drain pumps and Unit 2 heater drain tank emergency dump valves. These actions will be treated as economic issues as they are not safety significant.

The MUR power uprate results in an increase in extraction steam flows and pressures. The temperature and pressure ratings for the Unit 1 and Unit 2 bleeder trip valves bound the MUR power uprate service conditions based on the maximum working pressures contained in ANSI B16.34. The design temperature and pressure ratings for Units 1 and 2 extraction steam drain trip air-operated (AOVs) and motor-operated valves (MOVs) bound the MUR power uprate service conditions based on the maximum working pressure contained in ANSI B16.34 and the pressure rating listed on the MOV drawings.

VI.13 CIRCULATING WATER SYSTEM

The condensers for both of the electrical generating units have been designed such that the increase in temperature of the Chesapeake Bay water passing through them is not more than 10°F at maximum expected, not guaranteed, operating conditions. Under the MUR power uprate conditions, the temperature rise across the condensers will be no more than 11.3°F. A test program allowing a temperature increase up to 12°F has been completed by the State of Maryland. Current limits allow use of a 12°F increase on a permanent basis. The only change in circulating water system operation will be a small increase in temperature rise across the condenser. For Unit 1, the calculated temperature rise will increase from 11.03°F to 11.23°F. For Unit 2, it will increase from 11.00°F to 11.20°F. Currently, the actual measured temperature rise is approximately 11.6°F which would be approximately 11.8°F after the MUR power uprate. The licensing basis limit for the temperature rise is 12°F, which is met. Condenser vacuum in-balance is not adversely affected by the MUR power uprate. The circulating water system is acceptable for the MUR power uprate.

VI.14 CONDENSER

Each unit has one three-shell, single-pass, deaerating-type condenser with divided water boxes. The condenser is capable of condensing the exhaust steam from the main turbine and the SG feed pump turbines under the MUR power uprate plant load. Two of the three condenser shells are connected to discharge lines from the steam dump and bypass system. The condenser is internally equipped to receive the full flow from this system. The condenser is adequately sized to support the proposed MUR power uprate.

The condenser will operate with approximately 1.9% higher backpressure under the MUR power uprate during summer conditions (< 3.8 in-HgA). This is still well below the backpressure limit (5.5 in-HgA).

VI.15 HEAT BALANCE

A plant specific model was developed for each unit for both summer and winter bay temperature limits at both the current and the MUR power uprate conditions. This detailed model was benchmarked to existing plant operating conditions and used to simulate the estimated impact

of the proposed uprate. Output from these simulations (pressure, flows, temperatures) were used as an aid in evaluating the impact the MUR power uprate will have on the plant equipment.

VI.16 SERVICE WATER SYSTEM

The Service Water (SRW) System is designed to remove heat from the plant's various auxiliary systems. The Saltwater System provides the cooling medium for the SRW heat exchangers. System components are rated for maximum duty requirements during normal operation and SDC operation, and are also capable of providing heat removal during a LOCA. The SRW System serves as an intermediate barrier between the various auxiliary systems and the Saltwater System.

The SRW System is a closed system and uses plant demineralized water with a corrosion inhibitor added. The system removes heat from turbine plant components, blowdown recovery heat exchangers, containment cooling units, spent fuel pool cooling (SFPC) heat exchangers, and Fairbanks Morse Emergency Diesel Generator heat exchangers.

The turbine plant components cooled by SRW include:

a. Generator isolated 3 phase bus duct coolers
b. Exciter air coolers
c. Generator hydrogen coolers
d. Stator liquid coolers (Unit 1 only)
e. Circulating Water System priming pump seal water coolers
f. Condenser vacuum pump seal water coolers
g. Feed pump turbine lube oil coolers
h. Condensate booster pump lube oil and seal water coolers
i. Instrument and plant air compressors and aftercoolers
j. Turbine lube oil cooler
k. Electro-hydraulic oil coolers
l. Turbine Building sample cooling system
m. Seal oil system coolers (Unit 2 only)
n. Auxiliary feed pump room air cooler

The SRW Systems do not see significant impact with the MUR power uprate. The increased decay heat and turbine auxiliary cooling loads will cause a small increase in the cooling water temperature. The heat loads increase slightly for the SFPC in the Auxiliary Building; however, this increase is due to the SDC function, not the MUR power uprate. The impact on the SRW System with the MUR power uprate on the component heat loads has been addressed, some system adjustments may be necessary to ensure proper cooling to the affected heat loads. The SRW System was evaluated to have adequate margin to perform its design functions within its design parameters.

VI.17 SALTWATER SYSTEM

The Saltwater System has three pumps for each unit. The pumps provide the driving head to move saltwater from the intake structure, through the system, and back to the circulating water discharge conduits. The system is designed such that each pump has sufficient head and capacity to provide cooling water for the SRW and Component Cooling Water (CCW) Systems. The system also cools the ECCS pump room air coolers. The maximum recommended pump flow for each pump is 25,000 gpm. Although under most conditions this is not a limiting feature, when storm conditions consisting of the lowest expected tide of 4.0 ft below mean sea level and

the lowest expected barometric pressure of 26.9 of mercury are considered, sufficient net positive suction head may not be available at flows above 25,000 gpm.

The Saltwater System consists of two subsystems in each unit. Each subsystem provides saltwater to two SRW heat exchangers, a CCW heat exchanger, and the ECCS pump room air cooler in order to transfer heat from those systems to the Chesapeake Bay. Seal water for the circulating water pumps is supplied by both subsystems. A self-cleaning strainer is installed upstream of each SRW heat exchanger.

Operation of the Saltwater System following a LOCA has two phases: before the recirculation actuation signal and after the recirculation actuation signal. Since the LOCA analysis has been performed at 102% of 2700 MWt (2754 MWt) it remains applicable at the MUR power uprate. Therefore, the cooling requirements for both phases are unchanged.

The MUR power uprate will result in small increases to the heat loads for the CCW and SRW heat exchangers to be transferred to the Saltwater System, corresponding to a slight increase of the saltwater discharge piping temperature. These impacts are negligible on the Saltwater System and component operation. The margins in the system remain essentially the same as for current operating power levels.

VI.18 COMPONENT COOLING WATER SYSTEM

The CCW System is designed to remove heat from the plant's various auxiliary systems. The Saltwater System provides the cooling medium for the CCW heat exchangers. System components are rated for maximum duty requirements during normal and SDC, and are also capable of providing heat removal during a LOCA. The CCW System serves as an intermediate barrier between the various auxiliary systems and the Saltwater System.

The CCW heat exchangers are designed for a CCW supply temperature of 95°F, with a saltwater cooling supply temperature of 90°F, at normal operating conditions. Component cooling water may reach as high as 120°F during a LOCA, and during plant cooldown and cold shutdowns.

The MUR power uprate will result in a change to the CCW System heat loads. The change has a negligible impact on the CCW System. The increased decay heat will have a small impact on the cooling water temperature increase. Calvert Cliffs has evaluated the most limiting mode of operation, the SDC, to the analytical power level of 2754 MWt, therefore, the MUR power uprate has no impact on the CCW System.

VI.19 TURBINE-GENERATOR

The turbine-generator is designed to receive steam from the SGs and convert it into electric energy. The condenser transfers unusable heat to the condenser cooling water and deaerates the condensate. The closed regenerative turbine cycle heats the condensate and returns it to the SGs.

The turbines are 1800 rpm tandem compound, six-flow exhaust, indoor units. Saturated steam is supplied to the turbine throttle from the SGs through four stop valves and four governor control valves. The steam flows through a dual-flow, high-pressure turbine and then through combination moisture separator-reheaters (two in parallel for Unit 1, four in parallel for Unit 2) to three double-flow, low-pressure turbines which exhaust to the main condenser system.

Unit 1 is a General Electric turbine and Unit 2 is a Westinghouse turbine. The two units are similar in construction and type, and have similar performance characteristics and generating capacity.

Each generator has the capability to accept the gross rated output of the turbine at rated steam conditions. The generator shafts are oil-sealed to prevent hydrogen leakage. Each generator has its own shaft-driven excitation equipment.

The turbine-generator and its associated components were reviewed for the MUR power uprate conditions. The turbines were discussed earlier under MSS, (see Section VI.6). Also note that generator rotor rewinds are recommended as purely an economic decision.

VI.20 RADIOACTIVE WASTE SYSTEMS

The waste processing systems are designed to provide controlled handling and disposal of radioactive liquid, gaseous, and solid wastes from both units. Design criteria were established to maintain the release of radioactive material from the plant to the environment at levels which are ALARA.

The design of the waste processing systems was based upon processing reactor coolant and miscellaneous waste during operation with 1% failed fuel. The proposed MUR power update is for a small power increase and since the radioactive waste processing system is designed to handle 1% failed fuel, the MUR power uprate does not represent a significant challenge to the liquid or gaseous radwaste processing system.

All releases meet the Offsite Dose Calculation Manual (ODCM) limits. By meeting the ODCM limits, the guidelines of 10 CFR Part 50, Appendix I are met. This is confirmed by the effluent data and doses reported to the NRC in the Radioactive Effluent Release Reports required by the Technical Specifications and 10 CFR 50.36a.

The ODCM is a program governed by requirements described in Technical Specifications. It provides limits for offsite radioactive waste releases, calculational methods to determine those releases, and alternative methods of accounting for and controlling release of radioactive materials. In the event that the radiation monitors used in the release of liquid and gaseous radioactive material are not available, the alternative methods described in the ODCM may be used.

VI.21 HEATING, VENTILATION, AND AIR CONDITIONING SYSTEMS

The plant ventilating systems are designed to provide a suitable environment for equipment and personnel with a maximum amount of safety and operating convenience. Potentially contaminated areas are separated from clean areas. Airflow patterns originate in areas of potentially low contamination and progress toward areas of higher activity. Generally, negative pressures are maintained in potentially contaminated areas and positive pressures in clean areas. The ventilating systems in the Containment, waste processing and fuel-handling areas are designed for containment of radioactive particles. The path of the discharge from potentially contaminated areas is directed into the respective plant vent where the radioactivity level is monitored. The equipment in most critical systems is redundant in character.

The heat load from the primary systems increases only marginally as a result of the minor change in T_{hot}. The heat load from the feedwater piping in the Containment, Auxiliary Building (steam tunnel), and Turbine Building were evaluated to account for a < 2°F increase in feedwater process fluid temperature to ensure UFSAR Chapter 9 design basis are not impacted. The remaining BOP piping temperatures do not change appreciably.

VI.21.1 Containment

The Containment is cooled by the containment air coolers. During the summer the air temperature is expected to remain below the 120°F design limit. The total heat load in the Containment during normal operation is calculated to be ~7.44 x 10^6 Btu/hr. The increase of <2.0°F in feedwater temperature could potentially increase the heat load on the cooling system by ~400 Btu/hr, clearly inconsequential given the order of magnitude difference considering the original heat load in the building. This assessment is applicable and valid for both Units.

VI.21.2 Main Steam Penetration Rooms

Heat load from the main steam and feedwater piping traversing through these rooms was evaluated previously. The inputs and assumptions used in this calculation are very conservative and the small increase in anticipated feedwater process fluid operating temperature (<2°F) will not have any effect on the calculated or actual overall room temperature. The calculated heat load in the room is already based on 460°F feedwater design in lieu of lower operating feedwater temperature. This assessment is applicable and valid for both Units.

VI.21.3 Turbine Building

Heat load from the main steam and feedwater piping in the Turbine Building was evaluated to account for a < 2°F increase in feedwater process fluid temperature. This evaluation indicates that general Turbine Building area air temperatures may increase by less than a fraction of (0.05°F) a degree. This is reasonable since the minimal increase in the feedwater temperature as compared to all of the other large heat loads in the Turbine Building has minimal effect on the Turbine Building air temperature rise. This assessment is applicable and valid for both Units.

Based on the above, none of the design, operational or performance requirements of area heat removal capabilities will be affected by the slight increase in feedwater fluid temperature.

VI.21.4 Auxiliary Feedwater Pump Room and 5' Fan Room

Heat load from process piping traversing through these two rooms were previously established. The less than 2°F increase in feedwater fluid temperature has no effect on the results of the calculation. A feedwater design temperature of 460°F was used in the analysis; therefore the calculation predicted room temperatures already bound the room conditions expected as a result of the power uprate. This assessment is applicable and valid for both Units.

VI.21.5 Auxiliary Building

There is a minimal amount of piping traversing through the Auxiliary Building to and from the main steam penetration room and the 5' fan room. There is no specific calculation evaluating the heat input from the feedwater piping into this area, given the short run of piping and the minimal increase of feedwater temperature, the effect of air temperature increase in that area is expected to be negligible. This assessment is applicable and valid for both Units.

Based on the above, none of the design, operational, or performance requirements of area heat removal capability will be affected by the slight increase in feedwater fluid temperature.

VI.21.6 *Control Room Heating, Ventilation, and Air Conditioning System*

The Control Room (Elevation 45'0") and the Cable Spreading Room (Elevation 27'0") are incorporated into a single year-round air-conditioning system serving the common Control Room for Units 1 and 2. Therefore, the ambient temperature in the Control Room is expected to be the same as the ambient temperature in the Cable Spreading Room. Air handling and refrigeration equipment are redundant. The Control Room and Cable Spreading Room areas have a third source of cooling, which is not safety-related, in the form of a water chiller supplying a second set of coils in the safety-related air handling systems.

Based on the above, none of the design, operational or performance requirements of area heat removal capabilities will be affected by the slight increase in feedwater fluid temperature.

VI.21.7 Auxiliary Building Ventilation System (Auxiliary Building Charcoal Filters)

Key parameters for the Auxiliary Building Ventilation System charcoal filters are total flow rates, and total charcoal weights. The charcoal is Barnebey-Cheney #727 (or equivalent) impregnated with 5 weight% iodine compounds. The flow velocity through the charcoal bed is 40 fpm in all cases and the corresponding residence time is 0.25 seconds. A typical charcoal filter module is 24-1/4"x25-3/4"x6-1/4". Each module is designed for an air flow of 333 cfm. Each filter housing contains sufficient modules for the total flow rates. Testing is performed to demonstrate that the installed charcoal absorbers will perform satisfactorily in removing both elemental and organic iodides for design conditions of flow, temperature, and relative humidity. Periodic testing is conducted to ensure filter efficiencies credited in the accident analysis are maintained.

These key parameters remain unaffected by the MUR power uprate and, as such, the MUR power uprate has negligible impact on the Auxiliary Building charcoal filters.

VI.22 SPENT FUEL POOL COOLING

The SFPC system is common to both Units. The pool contains water with the proper dissolved concentration of boron and has the capacity to store 1830 fuel assemblies.

The SFPC system is designed to remove the maximum decay heat expected from 1613 fuel assemblies, not including a full core off-load. The maximum pool temperature in this case is 127°F. The system is also capable of being used in conjunction with the SDC system to remove the maximum expected decay heat load from 1830 fuel assemblies, including a full core discharge. The maximum spent fuel pool temperature in this case is 130°F.

The maximum decay heat load expected from 1613 fuel assemblies, not including a full core off-load, is 19.9×10^6 Btu/hr. The SAS2H/ORIGEN-S sequence of the SCALE code system was utilized to determine decay heat for discharged fuel. The discharged VAP fuel is assumed to have undergone steady-state burnup as a MUR power uprate MWt low leakage core for an average of 1562 days and decay of 5.5 days. The spent fuel pool heat exchangers have the combined capacity to remove 20.2×10^6 Btu/hr while maintaining the pool at a temperature of 127°F. In the event that one SFPC loop is lost, the remaining loop can remove this heat load while maintaining the pool temperature at 155°F.

The decay heat source-term used in the evaluation of the SFPC system was determined to be conservative for the proposed MUR power uprate conditions.

VII. OTHER

VII.1 OPERATOR ACTIONS

Operator actions that are part of the Abnormal Operating Procedures and Emergency Operating Procedures have been reviewed, and it was concluded that the proposed MUR power uprate will not adversely impact the available time for operator actions. The small change in decay heat will have a negligible impact on operator response times.

Any plant hardware modifications potentially required to support the proposed MUR power uprate have been identified. Also, a review of plant systems has indicated that minor modifications are necessary (e.g., software modification that redefines the new 100% RTP, rescaling of plant indications to reflect the new 100% RTP). Established engineering procedures are used to install the necessary minor modifications prior to implementing the proposed power uprate.

A review of the plant simulator will be conducted, and necessary changes made, prior to implementing the proposed MUR power uprate. Prior to actual implementation of the proposed MUR power uprate, training will be conducted to instruct the operations staff on impact of the uprate on plant operations (e.g., revised scaling for instrumentation, required actions for CROSSFLOW™ out-of-service).

Currently Calvert Cliffs uses a rolling 8-hour average of secondary calorimetric power in the surveillance of maximum core power under full-power, steady-state conditions. Currently, the maximum deviation of the indicated power does not exceed 2754 MWt (102% of 2700 MWt). After the proposed MUR power uprate is implemented, the maximum deviation will remain at an upper limit of 2754 MWt.

VII.2 AFFECTED PLANT PROGRAMS

VII.2.1 Flow Accelerated Corrosion

The impact of the proposed the MUR power uprate on the FAC program was evaluated. The evaluation resulted in long-term FAC program impacts and no short-term impacts were identified. The MUR power uprate will result in a slight increase in inspection scope for some specific systems and possibly some additional replacement scope prior to the end-of-plant life expectancy. The corrective action implementation for the long-term impact will be incorporated into the FAC program during the revision of the FAC programs susceptibility analysis.

VII.2.2 Inservice Inspection Program

The Inservice Inspection (ISI) program defines the scope and method of examination of Class 1, 2, and 3 components, and also supports the procedures and examination schedule of these components at Calvert Cliffs.

The MUR power uprate does not impact the scope, method of examination, schedule and requirements, or criteria of the ISI program. Additionally, the operating condition changes associated with the MUR power uprate are bounded by the design of the ISI components and supports and do not affect the program scope, selection criteria, or acceptance standards. Therefore, the ISI program is not affected by the MUR power uprate.

VII.2.3 Inservice Testing Program

The Inservice Testing (IST) program at Calvert Cliffs defines the scope or Class 1, 2, and 3 pumps and valves to be tested, the test method and test schedule.

The MUR power uprate does not impact the scope, test methods, schedule and requirements, or criteria of the IST program. Additionally, the operating condition changes associated with the MUR power uprate are bounded by the design of the IST pumps and valves and do not affect the valve scope, selection criteria, or acceptance standards. Therefore, the IST program is not affected by the MUR power uprate.

VII.2.4 Alloy 600 Program

Industry experience in PWRs has shown that Alloy 600 (Inconel 600) components and Alloy 82/182 weld filler metals are susceptible to primary water stress corrosion cracking. The program includes all Alloy 600 components and Alloy 82/182 welds that are part of the RCS pressure boundary, integral attachments to the RCS pressure boundary, or can have a direct or indirect effect on the integrity of the RCS pressure boundary. These components include: partial penetration welded nozzles and penetrations in the RCS fabricated from Alloy 600 material, welds made with Alloy 82 or 182 filler metal, full-penetration welds made with Alloy 82 and 182 filler metal, and Alloy 600 piping components, non-pressure boundary Alloy 600 components such as welded internal attachments to vessels, and thermal sleeves. Steam generator tubes, and the associated tube-to-tube sheet seal welds, are specifically excluded from this program.

This program has assessed the Alloy 600 components and for each of them has documented the risks of failure. As part of the program, system reliability is evaluated with respect to potential for equipment degradation. The system reliability is in part based on Calvert Cliffs susceptibility modeling of Alloy 600 components. Primary water stress corrosion cracking has been shown to be predominantly temperature and environment dependent. As such, with an increase in RCS temperature, Alloy 600 susceptibility could potentially be challenged. Therefore, a review was performed on the impact of a temperature increase as a result of a power uprate with regards to Alloy 600 susceptibility.

As part of the MUR power uprate it was determined that the RCS temperature would only increase by 0.8°F on the hot leg. The RCS pressure, flow, and cold leg temperatures would remain the same. Thus, it is anticipated for the worst case scenario that the overall increase experienced by Alloy 600 materials is a 0.8°F increase. The review of this increase on the Alloy 600 components concluded that this increase in temperature affects the Alloy 600 component aging but has an insignificant impact on the components' risk of failure.

VII.2.5 Coatings

Coatings used within the Containment were specified based on their ability to withstand accident conditions. The Containment is designed to withstand an internal pressure of 50 psig at 276°F including all thermal loads resulting from the temperature associated with this pressure (UFSAR Section 14.20.2). The coatings within the Containment will not be impacted by the MUR power uprate since as the mass and energy values are not changed from previously analyzed conditions.

VII.2.6 Environmental Protection

The Environmental Report, the Final Environmental Statement, and supplements to the Environmental Report were reviewed. The only non-radiological discharge parameter that will be affected by the MUR power uprate is the delta-T across the condenser. The maximum predicted increase in the delta-T across the condensers after the MUR power uprate is described in Section VI.13. It is within the 12°F (max) limit in our discharge permit.

The Calvert Cliffs discharge permit contains the following requirement:

> *"All discharges authorized herein shall be consistent with the terms and conditions of this permit. The discharge of any pollutant identified in this permit at a level in excess of that authorized shall constitute a violation of the terms and condition of this permit. Anticipated facility expansions, production increases or decreases, or process modifications, which will result in new, different, or an increased discharge of pollutants, shall be reported by the permittee by submission of a new application or, if such changes will not violate the effluent limitations specified in this permit, by notice to the Department. Following such notice, the permit may be modified by the Department to specify and limit any pollutants not previously limited".*

The MUR power uprate does constitute a production increase that will result in an increased discharge of pollutants, thus Calvert Cliffs will need to send a letter to Maryland Department of the Environment describing the change that is made and the impact on the effluents.

The delta-T across the condenser will be closely monitored during implementation of the MUR power uprate to verify accuracy of the predicted temperature increase.

VII.2.7 Steam Generator Program

The purpose of the SG program is to ensure tube structural and leakage integrity through the implementation of the following program elements:

- Assessment of existing degradation mechanisms in the reactor coolant pressure boundary within the SG
- Steam generator inspection in accordance with the Electric Power Research Institute PWR SG examination guidelines
- Assessment of tube integrity after each SG inspection to ensure that the performance criteria for the operating period have been met and will continue to be met for the next period
- Maintenance, plugging, and repairs of SG tubes
- Primary-to-secondary leakage monitoring
- Maintenance of SG secondary side integrity
- Primary Side and Secondary Side Water Chemistry
- Foreign Material exclusion
- Self-assessment of the SG program
- Preparation of NRC and industry reports

A review of the SG program elements has concluded that the program elements are symptom based, augmented by regular inspections, maintenance and chemistry activities, and industry

experiences. At the MUR power uprate conditions, the SG tubes will be exposed to a 0.8°F increase in temperature. This temperature increase will marginally increase the stress corrosion cracking rate in the SG tubes. The existing plugging margin and inspection program elements are sufficient to ensure tube integrity. The SG program elements are independent of the reactor thermal power and therefore, the SG program elements will not be affected by the MUR power uprate.

VII.2.8 Containment Leak Rate Program

The Calvert Cliffs Containment Leak Rate Testing program performs the Type A, B, and C containment leakage testing to verify the integrity of the Containment and those systems and components which penetrate the containment walls.

The MUR power uprate does not impact the scope, requirements or criteria of the Containment Leak Rate Testing program. Additionally, the operating condition changes associated with the MUR power uprate do not affect the Containment or the systems and components which penetrate the containment walls. The containment pressure following a DBA from the MUR power uprate conditions is bounded by the AOR performed at 102% thermal power. Therefore, the Containment Leak Rate Testing program is not affected by the MUR power uprate.

VII.2.9 Radiation Protection

The source-terms used in the Radiation Protection program were reviewed and determined to remain applicable for the proposed power uprate.

VII.3 VALVES

VII.3.1 Motor-Operated Valves

The proposed MUR power uprate will not impact the Generic Letter 89-10 Motor-Operated Valve (MOV) program. There are 44 program valves per unit.

1. One valve in the instrument air system,
2. Twenty five valves in the SI system,
3. Two valves in plant drain system,
4. Three valves in primary containment heating and ventilation,
5. Two valves in the containment spray system,
6. Six valves in the CVCS,
7. Three valves in the RCS, and
8. Two valves in the feedwater system.

The variables that could affect MOV performance are increased D/P across the valve, increased effects of pressure locking/thermal binding, and increased temperature experienced by the actuator motor.

Systems 1 through 5 above are not impacted by the MUR power uprate. The 11 valves in groups 6 through 8 could potentially be impacted by the uprate. The D/P calculations for these valves were reviewed and all of them use system design pressures for calculating maximum D/P. Since the system design pressures are not changing there is no effect on the calculated D/Ps across the valves.

The valves susceptible to pressure locking or thermal binding (Generic Letter 95-07) are the power-operated relief block valves and the SDC return line valves. These valves possess engineered features that preclude pressure locking or thermal binding.

The maximum design temperature of the room in which the motor is located is used to calculate the torque reduction effect of increased temperature. Since the design temperatures are not changing there will be no effect on the MOV motors.

The real impact of this uprate will be increased D/Ps. Although the changes will be small, the overall effect will be a reduction of performance margin. This margin is the difference between the calculated required thrust and the actual thrust developed. There are no program valves that have margins less than 10%. Therefore, there will be no impact on the MOV program due to this power increase.

As identified in Section II.1, there are no changes to the safety analysis (i.e., existing analysis of the MSLB and LOCA remain bounding). Consequently, there is no impact on our response to Generic Letter 96-06.

VII.3.2 Air-Operated Valves

The Air-Operated Valve (AOV) program was evaluated for impact due to the proposed MUR power uprate.

A review considered valves in the main steam, feedwater, and other secondary side systems. Valves in primary side systems such as SI and CVCS should not be affected since RCS pressure is not changing. From an AOV Program standpoint, the main concern is D/P across the valve and flow through the valve. Thrust calculations to determine required outputs from the air-operators conservatively assume worst case D/P across a valve. The following valves are addressed in the review:

1. Atmospheric Dump Valves
2. Feedwater Regulating Valves
3. Feedwater Regulating Bypass Valves
4. Main Steam to AFW Pumps

There is no impact from a thrust standpoint because the calculations assume the highest SG pressure based on pressure limits, MSSV settings and SG feed pumps running at shutoff head. These are conservatively higher pressures or D/Ps than the MUR power uprate will implement, so there is no impact on actuator capability.

Based on the information that was provided through the heat balance calculation generated using the plant specific model, there is no impact to AOV program valves from an actuator thrust standpoint.

VII.3.3 Non Program Valves

Since increases in D/P are minimal and flow rates will only increase about 2% or less, it was determined that the control valves will be able to handle the increased flow due to the MUR power uprate.

VII.4 FIRE PROTECTION

This evaluation has been conducted in order to evaluate the effects of the MUR power uprate on the plant's Fire Protection program.

The plant Fire Protection program is the integrated effort involving systems, structures, components, procedures, and personnel used to carry out all activities of fire protection, fire prevention, and to ensure safe shutdown following a fire event. The Fire Protection program uses a defense in depth concept to prevent fires from starting, to detect, control, and suppress those fires that do occur; and to ensure that fire will not prevent essential plant safety functions from being performed.

Both units are served by a Fire Protection System that provides a reliable fire protection water supply delivering fire protection water in quantities sufficient to satisfy the maximum probable demand; and, automatic and manual Fire Protection Systems and equipment that provide fire suppression capabilities.

The Fire Protection program and fire protection features are described in Calvert Cliffs UFSAR Section 9.9. Fire protection features include the fire water supply; fire pumps and distribution piping; fixed water suppression systems; fixed gaseous suppression systems; manual fire suppression systems; and fire detection and alarm systems. Passive fire protection features include fire barriers and fire rated penetration seals. Fire and emergency response activities are performed by the on site fire brigade.

The changes that will occur as a result of the MUR power uprate which will increase the thermal and electrical power of the plant have been evaluated with respect to their impact on plant fire protection. The results of the evaluation are that the MUR power uprate has no affect on the plant's Fire Protection program.

VII.4.1 Appendix R

The goal of 10 CFR Part 50, Appendix R, is to ensure safe shutdown of the reactor following a fire in any plant area, thereby preventing core damage and protecting the public. Appendix R applies to plants licensed prior to January 1, 1979.

Appendix R compliance can be affected by adding heat to plant areas that could affect Appendix R safe shutdown because the higher temperatures could affect Appendix R equipment and plant operators. However, the overall temperature changes in the primary and secondary systems are very small such that the issue of added heat load to the plant is not a concern.

Appendix R can be affected by additional decay heat due to the higher power levels. This additional decay heat associated with the changes from the MUR power uprate was evaluated and found to be negligible.

VII.5 HIGH ENERGY LINE BREAK

The Calvert Cliffs HELB analysis was reviewed in support of the MUR power uprate. The activities, elements, and philosophy that currently constitute the HELB analysis are not affected by the MUR power uprate. In accordance with Calvert Cliffs design change process, the design change package for installing the CROSSFLOW™ system was evaluated against the HELB analysis requirements. No new piping was added, no postulated break locations changed, and

no changes were made to the assumed blowdown from any currently-postulated breaks; therefore, there is no impact on the current Calvert Cliffs HELB analysis.

VIII. CHANGES TO TECHNICAL SPECIFICATIONS, PROTECTION SYSTEM SETTINGS, AND EMERGENCY SYSTEM SETTINGS

INTRODUCTION

This section addresses the impact of the proposed change in RTP on Technical Specifications, Protection System Settings, and Emergency System Settings.

VIII.1 TECHNICAL SPECIFICATIONS

Other than the proposed change to the RTP, there are no other changes required to support the increase in RTP.

VIII.2 REACTOR PROTECTIVE SYSTEM

The RPS at Calvert Cliffs Units 1 and 2 includes three trip functions whose settings could be impacted by the increase in the RTP. The three trip functions, as listed in the Technical Specifications Table 3.3.1-1 are:

- Power Level – High,
- Axial Power Distribution – High, and
- Thermal Margin/Low Pressure (TM/LP).

The setpoints/allowable values for the Power Level – High trip are specified in Technical Specifications Table 3.3.1-1. The setpoints/allowable values for the Axial Power Distribution – High trip and the TM/LP trip are specified in the Core Operating Limits Report (COLR).

The setpoints/allowable values and coefficients for these three trip functions are calculated and/or verified every cycle using the methodology described in References VIII-1, VIII-2, and VIII-3. No changes will be required to the methodology as a result of the increase in the RTP. Therefore, the cycle specific calculation and/or verification of the setpoints/allowable values and coefficients for these trip functions will appropriately reflect the increase in the RTP. No changes to the Variable High Power Trip setpoints/allowable values in Technical Specifications Table 3.3.1-1 or to the Axial Power Distribution or TM/LP trip settings/allowable values in the COLR are expected due to the increase in the RTP.

VIII.3 LIMITING CONDITIONS FOR OPERATION

Four of the Limiting Conditions for Operation (LCOs) in Technical Specifications Section 3.2 could be impacted by the increase in the RTP. These Technical Specification LCOs are:

- 3.2.1, Linear Heat Rate (LHR),
- 3.2.2, Total Planar Radial Peaking Factor (F_{xy}^T),
- 3.2.3, Total Integrated Radial Peaking Factor (F_r^T), and
- 3.2.5, Axial Shape Index (ASI).

The limits for these LCOs are specified in the COLR and are calculated and/or verified every cycle using the methodology described in References VIII-1, VIII-3 and VIII-4. No changes will be required to the methodology as a result of the increase in the RTP. Therefore, the cycle specific calculation and/or verification of the limits for these LCOs will appropriately reflect the increase in the RTP and the COLR will be modified as necessary. In addition, coefficients for

the Better Axial Shape Selection System, which is used to establish the limits for the Axial Shape Index LCO, are updated as necessary each cycle. The cycle specific updates will reflect the increase in the RTP.

VIII.4 EMERGENCY SAFETY FEATURES ACTUATION SYSTEM AND AUXILIARY FEEDWATER ACTUATION SYSTEM

The existing Emergency Safety Features Actuation System and AFAS setpoints and response times were used in the justification of the continued applicability of the safety analysis (see Section II). No changes were required or necessary to support the proposed change in RTP.

IX. REFERENCES

Section I

I-1 CENPD-397-P, Revision-01-P-A "Improved Flow Measurement Accuracy Using CROSSFLOW™ Ultrasonic Flow Measurement Technology" for referencing in power uprate license applications in a safety evaluation dated March 20, 2000 (TAC No. MA6452)

Section II

II-1 Letter from A. W. Dromerick (NRC) to C. H. Cruse (BGE), dated May 23, 1998, Docket Nos. 50-317 and 50-318, "Issuance of Amendments for Calvert Cliffs Nuclear Power Plant Unit No. 1 (TAC No. M97855) and Unit No. 2 (TAC No. M97856)"

II-2 Letter from D. H. Jaffe (Signed by R. A. Clark) (NRC) to A. E. Lundvall, Jr. (BG&E), dated June 24, 1982, Amendment No. 71 to Facility Operating License No. DPR-53 for Calvert Cliffs Nuclear Power Plant, Unit No. 1

Letter from D. H. Jaffe (NRC) to A. E. Lundvall, Jr. (BG&E), dated January 10, 1983, Amendment No. 61 to Facility Operating License No. DPR-69 for Calvert Cliffs Nuclear Power Plant, Unit No. 2

II-3 Letter from D. M. Skay (NRC) to C. H. Cruse (Calvert Cliffs), dated February 26, 2002, Docket Nos. 50-317 and 50-318, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 - Amendment RE: Reanalysis of Loss of Feedwater Event (TAC Nos. MB3442 and MB3443)"

II-4 Letter from C. H. Cruse (Calvert Cliffs) to Document Control Desk (NRC), dated May 9, 2002, "Calvert Cliffs Nuclear Power Plant Unit Nos. 1 & 2, Docket Nos. 50-317 & 50-318, 10 CFR 50.46 30-Day Report for Changes to the Calvert Cliffs Nuclear Power Plant Emergency Core Cooling System Performance Analysis"

II-5 Letter from D. M. Skay (NRC) to C. H. Cruse (Calvert Cliffs), dated April 8, 2002, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 – Amendment Re: Implementation of ZIRLO Clad Fuel Rods (TAC Nos. MB2540 and MB2541)"

II-6 CENPD-132, Supplement 4-P-A, "Calculative Methods for the CE Nuclear Power Large Break LOCA Evaluation Model," March 2001

II-7 CENPD-137, Supplement 2-P-A, "Calculative Methods for the ABB CE Small Break LOCA Evaluation Model," April 1998

II-8 Letter from S. A. Richards (NRC) to P. W. Richardson (Westinghouse), dated December 15, 2000, "Safety Evaluation of Topical Report CENPD-132, Supplement 4, Revision 1, 'Calculative Methods for the CE Nuclear Power Large Break LOCA Evaluation Model' (TAC No. MA5660)"

II-9 Letter from T. H. Essig (NRC) to I. C. Rickard (ABB CENP), dated December 16, 1997, "Acceptance for Referencing of the Topical Report CENPD-137(P), Supplement 2, 'Calculative Methods for the C-E Small Break LOCA Evaluation Model' (TAC No. M95687)"

II-10 Letter from D. M. Skay (NRC) to C. H. Cruse (Calvert Cliffs), dated April 8, 2002, "Calvert Cliffs Nuclear Power Plant, Unit Nos. 1 and 2 – Amendment Re: Implementation of ZIRLO Clad Fuel Rods (TAC Nos. MB2540 and MB2541)"

II-11 CENPD-132P, "Calculative Methods for the C-E Large Break LOCA Evaluation Model," August 1974

II-12 Letter from A. W. Dromerick (NRC) to C. H. Cruse (BGE), dated October 2, 1997, "Issuance of Amendments for Calvert Cliffs Nuclear Power Plant Unit 1 (TAC No. M95181) and Unit No. 2 (TAC No. M95182)"

II-13 Letter from S. A. McNeil (NRC) to J. A. Tiernan (BGE), dated November 2, 1988, "Safety Evaluation Concerning Conformance to the ATWS Rule (TACs 59079 and 59080)"

II-14 Letter from C. H. Cruse (BGE) to Document Control Desk (NRC), dated July 31, 1997, "Response to Request for Additional Information Regarding the Technical Specification Change to the Moderator Temperature Coefficient (TAC Nos. M95181 and M95182)"

Section III

None.

Section IV

IV-1 CENPD-387-P-A, "ABB Critical Heat Flux Correlations for PWR Fuel," May 2000

IV-2 CENPD-206-P-A, "TORC Code: Verification and Simplified Modeling Methods," June 1981

IV-3 CEN-191(B)-P, "CETOP-D Code Structure and Modeling Methods for Calvert Cliffs Units 1 and 2," December 1981

IV-4 CEN-348(B)-P-A, Supplement 1-P-A, "Extended Statistical Combination of Uncertainties," January 1997

IV-5 Letter from G. M. Holahan (NRC) to S. A. Toelle (ABB), dated August 31, 1994, "Generic Approval of CEN-348(B)-P-A, 'Extended Statistical Combination of Uncertainties' (TAC No. M90019)"

IV-6 CENPD-225-P-A, "Fuel and Poison Rod Bowing," June 1983

IV-7 CEN-161(B)-P Supplement 1-P-A, "Improvements to Fuel Evaluation Model," January 1992

IV-8 CENPD-139-P-A, "Fuel Evaluation Model," July 1974

IV-9 CEN-161(B)-P-A, "Improvements to Fuel Evaluation Model," August 1989

IV-10 CENPD-382-P-A, "Methodology for Core Designs Containing Erbium Burnable Absorbers," August 1993

IV-11 CEN-372-P-A, "Fuel Rod Maximum Allowable Gas Pressure," May 1990

IV-12 CENPD-404-P-A, Revision 0, "Implementation of ZIRLO™ Cladding Material in CE Nuclear Power Fuel Assembly Designs," November 2001

IV-13 CEN-382(B)-P-A, "Verification of the Acceptability of a 1-Pin Burnup Limit of 60 MWD/kgU for Combustion Engineering 14x14 PWR Fuel," August 1993

IV-14 CENPD-384-P, "Report on the Continued Applicability of 60 MWD/kgU for ABB Combustion Engineering PWR Fuel," September 1995

IV-15 Letter from B. S. Montgomery (CCNPP) to document Control Desk (NRC), dated July 15, 2004, "License Amendment Request: Incorporate Methodology References for the Implementation of PHOENIX-P, ANC, PARAGON, and Zirconium Diboride into the Technical Specifications"

IV-16 CEN-387-P, Revision 1-P-A, "Pressurizer Surge Line Flow Stratification Evaluation," May 1994

IV-17 CENPD-161-P-A, "TORC Code, A Computer Code for Determining the Thermal Margin of a Reactor Core," April 1986

Section V

None.

Section VI

None.

Section VII

None.

Section VIII

VIII-1 CENPD-199-P, Revision 1-P-A, "C-E Local Power Density and DNB LSSS and LCO Setpoint Methodology for Analog Protection Systems," January 1986

VIII-2 CEN-124(B)-P, Statistical Combination of Uncertainties, Part 1," December 1979

VIII-3 CEN-348(B)-P-A Supplement 1-P-A, "Extended Statistical Combination of Uncertainties," January 1997

VIII-4 CEN-124(B)-P, Statistical Combination of Uncertainties Methodology Part 3, December 1979

ATTACHMENT (2)

SUMMARY OF CALVERT CLIFFS NUCLEAR POWER PLANT MEASUREMENT UNCERTAINTY RECAPTURE EVALUATION

Enclosure (1)

CA06494, Revision 0000, Calorimetric Uncertainty Using the AMAG Crossflow Ultrasonic Flowmeter

INITIATION (Control Doc Type - DCALC)

DCALC No.: CA06494 Revision No.: 0000

Vendor Calculation (Check one): ☐ Yes ☒ No

Responsible Group: 4A-11-08

Responsible Engineer: D. A. Dvorak

CALCULATION

ENGINEERING DISCIPLINE: ☐ Civil ☒ Instr & Controls ☐ Nuc Engrg ☐ Electrical ☐ Mechanical ☐ Diesel Gen Project ☐ Life Cycle Mngmt ☐ Reliability Engrg ☐ Nuc Fuel Mngmt ☐ Other:

Title: CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

Unit ☒ UNIT 1 ☒ UNIT 2 ☐ COMMON

Proprietary or Safeguards Calculation ☐ YES ☒ NO

Comments:

Vendor Calc No.: NA REVISION NO.:

Vendor Name:

Safety Class (Check one): ☐ SR ☐ AQ ☒ NSR

There are assumptions that require Verification during walkdown: AIT #: ES200300421, MILESTONE 083 (ASSUMPTIONS 5.1, 5.2, 5.3)

This calculation SUPERSEDES: NA

REVIEW AND APPROVAL:

Responsible Engineer: DAD Dvorak Date: 12-10-04

Independent Reviewer: JOSEPH R. SUAREZ-MURIAS Joseph R. Suarez-Murias Date: 12-15-2004

Approval: 12/22/04 Date:

OR (for Vendor Calcs)

Owner's Acceptance Reviewer: D.E. LENKER DE Lenker Date: 12/21/04

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CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

1.0 PURPOSE

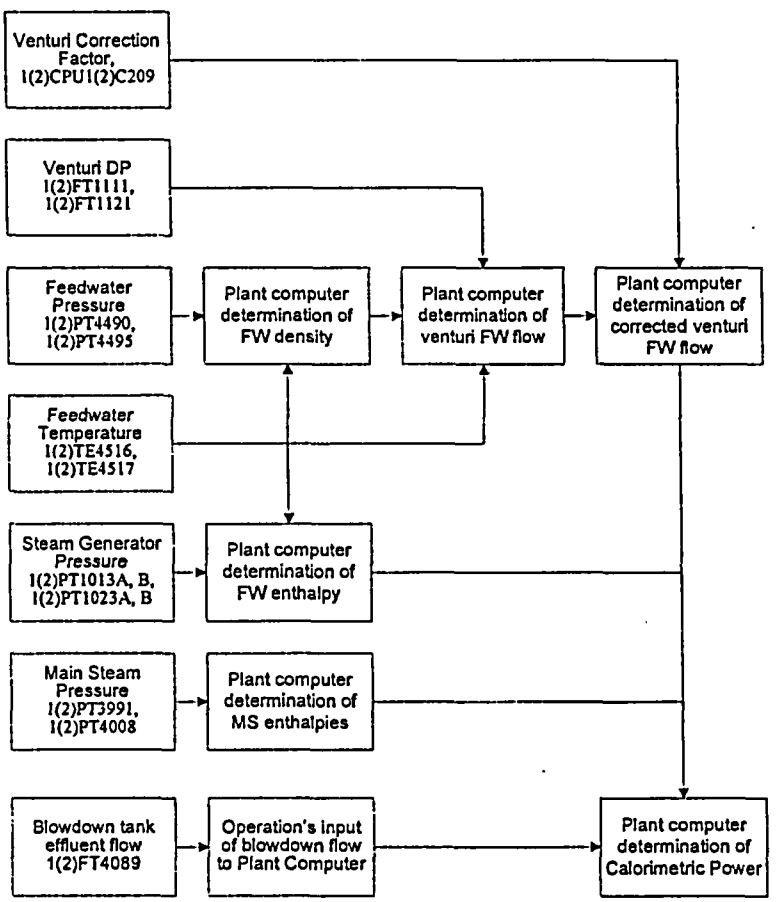
The purpose of this evaluation is to estimate the calorimetric uncertainty using the AMAG CROSSFLOW ultrasonic flowmeters to measure feedwater flow.

2.0 COMPONENT LISTING

2.1. Inputs from the following instrument loops are used by the plant computer to calculate calorimetric power.

EQP ID	Description
1(2)CPU1(2)C209	Unit 1(2) Crossflow Measurement Cabinet Computer
1(2)FT1111	11(21) Feedwater Flow
1(2)FT1121	12(22) Feedwater Flow
1(2)FT4089	Unit 1(2) BD Tank Effluent Flow
1(2)PT4490	11(21) SGFP Discharge Pressure
1(2)PT4495	12(22) SGFP Discharge Pressure
1(2)PT1013A, B	11(21) SG Pressure
1(2)PT1023A, B	12(22) SG Pressure
1(2)TE4516	11(21) SG Feedwater Inlet Temperature
1(2)TE4517	12(22) SG Feedwater Inlet Temperature
1(2)PT3991	11(21) Main Steam Header Pressure
1(2)PT4008	12(22) Main Steam Header Pressure

2.2. The following diagram is a simplified representation of the calorimetric calculation.



3.0 METHOD OF ANALYSIS

3.1. This calculation uses the methodology established in ES-028, "Instrument Loop Uncertainty and Setpoint Methodology" (Reference 6.1).

3.2. Sign Convention:

3.2.1. Uncertainties are applied to actual values, as opposed to calculated or indicated values.

3.2.2. Uncertainty is positive when indicated value is greater than actual value.

3.2.3. Uncertainty is negative when indicated value is less than actual value.

3.2.4. If indicated power is less than actual power and the plant is being operated with indicated power near the rated thermal power limit, the rated thermal power limit may be exceeded.

3.2.5. Therefore, only the negative component of calorimetric uncertainty needs to be evaluated.

3.3. Uncertainties will be determined using parametric analysis as follows:

3.3.1. Uncertainty will be evaluated over a range of values for each input using the ASME 1967 steam tables.

3.3.1.1. The results are tabulated in Attachment A.

3.3.1.2. The ASME 1967 steam tables are the current basis for the plant computer determination of thermodynamic properties.

3.3.2. Each input is varied by its uncertainty. The contribution to calorimetric uncertainty is the difference between calorimetric power calculated at the varied input to calorimetric power calculated at the nominal value for the input.

3.3.3. Overall calorimetric uncertainty is determined by statistically combining the contributions to calorimetric uncertainty from each input.

3.4. The computations performed were calculated to several significant digits. Hand verification utilizing the rounded values may result in slightly different results due to round off errors.

3.5. No computer codes were utilized in the performance of this calculation.

4.0 DESIGN INPUTS

4.1. VENTURI FEEDWATER FLOW CORRECTION

4.1.1. The feedwater flow measured by the CROSSFLOW system is used to determine a correction factor to the venturi flow calculated by the plant computer.

4.1.2. The correction factor is determined by the CROSSFLOW system as the ratio of average CROSSFLOW measured feedwater flow to average venturi flow.

4.1.3. When the correction factor is applied, the net result is setting the flow used in the plant calorimetric calculation equal to the CROSSFLOW measured feedwater flow. Therefore, the application of the CROSSFLOW ultrasonic flowmeter to venturi flow is essentially an in-situ calibration of the venturi flow loop.

4.1.4. Thus, the uncertainty of feedwater flow used for the calorimetric calculation is the same as the uncertainty of the CROSSFLOW measured feedwater flow. Uncertainty of the instrumentation used to determine venturi flow does not need to be considered.

4.2. BOUNDING CONDITIONS FOR CALORIMETRIC UNCERTAINTY

4.2.1. Calorimetric uncertainty is maximized at 100% power.

4.2.1.1. The uncertainty for the CROSSFLOW system's determination of feedwater flow increases as flow and power increases.

4.2.1.2. Feedwater flow is the largest contributor to calorimetric uncertainty, as shown in Attachment A.

4.2.2. Calorimetric uncertainty is maximized with total blowdown flow at maximum allowable with maximum allowable flow through one Steam Generator per References 6.9.1 and 6.9.2.

4.2.2.1. From References 6.9.1 and 6.9.2, total blowdown flow through both steam generators is limited to 180 gpm. Maximum blowdown flow through a single steam generator is limited to 125 gpm. Using the tables of References 6.9.1 and 6.9.2, these volumetric flowrates equate to mass flowrates of 107000 lbm/hr for total flow with 91000 lbm/hr through one steam generator and 16000 lbm/hr through the second steam generator.

4.2.2.2. Attachment B provides a demonstration that calorimetric uncertainty is maximized at the selected blowdown flows.

4.2.3. Per Reference 6.10, the setpoints for steam quality, 1(2)PAK0001 and 1(2)PAK0002 are set at a value of 1. Therefore, calorimetric uncertainty is only evaluated for no moisture carryover.

4.2.4. The specific values for feedwater flow, feedwater temperature, feedwater pressure and main steam pressure are established in Assumption 5.2.

4.3. EQUATIONS FOR CALORIMETRIC POWER

4.3.1. Per Reference 6.2, the gross thermal output of one steam generator is computed from the expression

$$Q_{SG} = (M_{FW} - M_{BD})[(1-X)h_{FS} + Xh_{GS} - h_{FW}] + M_{BD}(h_{FS} - h_{FW})$$

which simplifies to:

$$Q_{SG} = (M_{FW})[(1-X)h_{FS} + Xh_{GS} - h_{FW}] + (XM_{BD})(h_{FS} - h_{GS})$$

where,

M_{FW} is feedwater flow,
M_{BD} is blowdown flow,
h_{FS} is the fluid component of steam enthalpy,
h_{GS} is the vapor component of steam enthalpy,
h_{FW} is the feedwater enthalpy (compressed liquid),
X is the steam quality.

4.3.2. For a steam quality of 1 (no moisture carryover), the above expression is further simplified to

$$Q_{SG} = (M_{FW})(h_{GS} - h_{FW}) + (M_{BD})(h_{FS} - h_{GS})$$

4.3.3. Calorimetric Constant

4.3.3.1. To determine reactor power from steam generator thermal output, adjustments are made to account for heat additions to the Reactor Coolant System, such as the heat added by the pressurizer heaters, and heat losses from the Reactor Coolant System, such as losses through pipe insulation.

4.3.3.2. These corrections are input as constants to the calorimetric calculation.

4.3.3.3. For convenience, this calculation represents the net adjustment as a single constant.

4.3.4. Calorimetric power is the sum of the gross thermal output of both steam generators and the calorimetric constant.

$$Q = Q_{SG1} + Q_{SG2} + C$$

4.4. INPUT UNCERTAINTIES:

4.4.1. Feedwater Flow

4.4.1.1. The uncertainties of the CROSSFLOW ultrasonic flowmeters were determined in References 6.3.1 and 6.3.2.

4.4.1.2. The total uncertainties in Reference 6.3.1 and 6.3.2 are rounded up to the nearest 0.01%. Also, as stated in Reference 6.3.2, the total uncertainty for the Unit 2 flowmeters consists of a dependent term resulting from the method used to evaluate the piping configuration correction factor.

4.4.1.3. Temperature dependency between feedwater flow measurement and calorimetric uncertainty

a. The temperature instrumentation used to determine feedwater enthalpy is also used by CROSSFLOW in the calculation of feedwater flowrate. CROSSFLOW calculates mass flowrate using the following expression:

$$M_{FW} = C\rho\left(\frac{\pi d^2}{4}\right)\left(\frac{L}{t}\right)$$

where

C is a dimensionless correction factor that correlates measured velocity of the flow eddies to bulk velocity of the fluid based on Reynolds number,
ρ is the feedwater density,
d is the internal diameter of the feedwater piping
L is the spacing between transducers,
t is the transit time between the CROSSFLOW transducers.

b. Temperature instrumentation is used by CROSSFLOW to correct for all variables with the exception of time. Therefore, there is a dependency between the uncertainty of the flow measurement and the uncertainty of feedwater enthalpy.

c. A decrease in feedwater temperature affects the CROSSFLOW calculation as follows:

- Feedwater density increases, which tends to increase flow,
- Pipe diameter decreases due to thermal contraction of the pipe, which tends to decrease flow,
- Transducer spacing decreases due to thermal contraction of the pipe, which tends to decrease flow,
- Reynolds number decreases which tends to decrease flow. A decrease in feedwater temperature results in a increase of both density and viscosity. Reynolds number is proportional to the ratio of density to viscosity, which decreases as feedwater temperature increases. There is also a small contribution to Reynolds number from pipe diameter changes; however, this effect is negligible.
- Since transducer spacing is decreases, the time measurement used by CROSSFLOW to calculate velocity also decreases. However, this is a decrease in the actual time measurement used to calculate velocity and does not affect measurement uncertainty. CROSSFLOW uses the correct time to calculate velocity.

d. From inspection of the CROSSFLOW uncertainty calculations, References 6.3.1 and 6.3.2, the change in feedwater density resulting from a change in temperature is substantially greater than the changes in the other terms. Therefore, if actual temperature is less than indicated temperature, actual mass flow rate is greater than indicated mass flow rate, resulting in a negative contribution to calorimetric uncertainty.

e. For conservatism, the contribution to CROSSFLOW uncertainty from feedwater density will be used as the basis for the temperature dependent feedwater flow uncertainty. This is conservative since the contribution to CROSSFLOW uncertainty from feedwater density consists of both temperature instrumentation and pressure instrumentation uncertainty.

4.4.1.4. The value of the independent component of uncertainty can be determined from

$$U_{MFW-IND\%} = \sqrt{U^2_{MFW\%} - U^2_{MFW-MDEP\%} - U^2_{MFW-TDEP\%}}$$

where

$U_{MFW-IND\%}$ is the fully independent component of feedwater flow uncertainty,
$U_{MFW-MDEP\%}$ is the dependent component of feedwater flow uncertainty resulting from the piping configuration correction factor,
$U_{MFW-TDEP\%}$ is the dependent component of feedwater flow uncertainty resulting from the temperature instrumentation dependency.

4.4.1.5. Dependent and independent uncertainties will be rounded to the nearest 0.0001%.

4.4.1.6. Therefore, the uncertainties of the CROSSFLOW ultrasonic flowmeters are

Header	Location	Total Uncertainty, % Flow, $U_{MFW\%}$	Uncertainty, Piping Configuration Dependent Component, % Flow, $U_{MFW-MDEP\%}$	Uncertainty, Temperature Dependent Component, % Flow, $U_{MFW-TDEP\%}$	Uncertainty, Independent Component, % Flow, $U_{MFW-IND\%}$
11	Venturi	+/- 0.56%	0%	+/- 0.1604%	+/- 0.5365%
12	Pipe	+/- 0.47%	0%	+/- 0.1602%	+/- 0.4419%
21	Venturi	+/- 0.55%	+/- 0.2672%	+/- 0.1649%	+/- 0.4516%
22	Venturi	+/- 0.57%	+/- 0.2672%	+/- 0.1652%	+/- 0.4756%

4.4.2. Main Steam Pressure

4.4.2.1. Steam enthalpy is a function of main steam pressure measured downstream of the steam generator by the 1(2) PT3991 and 1(2) PT4008 instrument loops.

4.4.2.2. From Reference 6.4, the uncertainty of the main steam pressure measurement is

U_{PSTM} = ± 19.8 psi (Random Component of Uncertainty) and

B_{PSTM} = + 3.4 psi (Bias Component of Uncertainty).

4.4.3. Feedwater Temperature

4.4.3.1. Feedwater enthalpy is a function of feedwater temperature as measured by the 1(2)TE4516, 4517 instrument loops.

4.4.3.2. From Reference 6.6, the uncertainty of the feedwater temperature input is

U_{TFW} = ± 1.88 deg. F.

4.4.4. Feedwater Pressure

4.4.4.1. Feedwater enthalpy is also a function of feedwater pressure as measured by 1(2)PT1013A, B and 1(2)PT1023A, B.

4.4.4.2. From Reference 6.7, the uncertainty of the plant computer datapoints is

U_{PFW} = ± 27.57 psi (Random Component of Uncertainty) and

B_{PFW} = + 0.04 / -0.16 psi (Bias Component of Uncertainty)

4.4.4.3. Although the feedwater pressure used by the plant computer in the calorimetric calculation is the average of two instruments, which reduces the uncertainty, calorimetric uncertainty is based upon the uncertainty of a single instrument.

4.4.5. Plant Computer Calculation of Enthalpy

From Reference 6.2, the uncertainty of the plant computer calculation of enthalpy is

$U_{PC\text{-}ENTH}$ = ± 0.1 BTU/lbm.

4.4.6. Blowdown Flow

4.4.6.1. Total blowdown flow uncertainty is evaluated in Reference 6.5 as a function of indicated blowdown flow and power.

4.4.6.2. From a review of Reference 6.5, blowdown flow at 50 gpm indicated flow bounds the uncertainty at higher blowdown flow rates and will be used for this evaluation.

4.4.6.3. Since the sign convention for uncertainties in this reference is not clear, the largest magnitude of uncertainty (positive or negative) for 50 gpm total indicated flow will be used and applied in both the positive and negative directions.

4.4.6.4. For conservatism, the uncertainty of the total blowdown flow will be applied to each steam generator.

4.4.6.5. Therefore, the uncertainty of blowdown flow is

U_{MBDT} = ± 8094 lbm/hr.

4.4.7. Steam Quality

From Design Input 4.2.3, steam quality is set at 1. Therefore, uncertainty is not considered, since higher values for steam quality are not possible and a steam quality of 1 results in a conservative calculation of calorimetric power as shown in Attachment C.

4.4.8. Calorimetric Constant Biases:

4.4.8.1. Uncertainties of the calorimetric constants Reference 6.8 were reviewed by Reference 6.12. As part of the review, sign conventions of the uncertainties were verified to consistent with Section 3.2. Therefore, only the negative value of uncertainty needs to be considered. As a result of the review, corrections to uncertainties were made by Reference 6.8.1.

4.4.8.2. If the values for the uncertainties of the constants are different between the units, the most conservative value is used to evaluate calorimetric uncertainty.

4.4.8.3. Summary of calorimetric constant uncertainty from References 6.8 as modified by Reference 6.8.1.

a. PAK0021, pressurizer heater input

$B_{PAK0021} = 0$ MW

b. PAK0022, RCS heat loss

$B_{PAK0022} = -0.35$ MW.

c. PAK0024, Letdown flow heat loss.

$B_{PAK0024} = -3.19$ MBTU/hr

d. Reactor Coolant Pump Heat Addition

$B_{PAK0026} = -0.61$ MW

4.4.8.4. Using a conversion of 3.412141 BTU/hr/W, the total bias of the calorimetric constant is given by

$$B_{CAL-CONST} = \left[B_{PAK0024} + (3.412141 \text{ BTU/hr/W})(B_{PAK0021} + B_{PAK0022} + B_{PAK0026})\right](10^6 \text{ BTU/MBTU})$$

$$B_{CAL-CONST} = -6465656 \text{ BTU/hr}$$

5.0 ASSUMPTIONS

5.1. Feedwater Flow Uncertainty

Performance of the ultrasonic flowmeters at the uprated conditions, including re-evaluation of uncertainty, will be verified at the uprated power of 2737 MW. This evaluation assumes that uncertainty of the ultrasonic flowmeters will be at or below the values established by in Design Input 4.4.1. {THIS ASSUMPTION REQUIRES VERIFICATION}

5.2. Assumed Plant Parameters at 2737 MW {VALUES ASSUMED FOR PLANT PARAMETERS REQUIRE VERIFICATION)

5.2.1. Feed flow:

From an inspection of operating data for Unit 1 and Unit 2, maximum indicated feedwater flow at 2700 MW is less than 6075 klbm/hr with average values of approximately 5910 klbm/hr (Unit 1) and 5975 klbm/hr (Unit 2). Following a 1.40% uprate to 2737 MW the maximum feedwater flow should increase by approximately 1.40%. From Design Input 4.4.1, the maximum uncertainty of feedwater flow is +/- 0.57%.

For conservatism, an additional 20 klbm/hr will be included.

A value of M_{FW} = (6075 klbm/hr)(1+1.40%)(1+0.57%) + 20 klbm/hr= 6220 klbm/hr (rounded up to nearest 10 klbm/hr) is assumed for this evaluation.

5.2.2. Main Steam Pressure:

Main steam pressure is evaluated in 10 psia increments from 770 PSIA to 870 PSIA.

5.2.3. Feedwater Temperature:

Feedwater Temperature is evaluated in 2 degree increments between 428 deg. F and 452 deg. F.

5.2.4. Feedwater Pressure:

Feedwater pressure is evaluated in 10 psia increments from 770 PSIA to 870 PSIA.

5.3. Feedwater Pressure Input

This evaluation is based upon the use of steam generator pressure to determine feedwater enthalpy. The current input to feedwater enthalpy is average feedpump discharge pressure. {THIS ASSUMPTION REQUIRES VERIFICATION}

6.0 REFERENCES

6.1. ES-028, Instrument Loop Uncertainty And Setpoint Methodology, Revision 1

6.2. VTM 12138-249, Control Spec, Plant Computer, Revision 25

6.3. AMAG Uncertainty Calculations

6.3.1. DCALC CA06004, Feedwater Flow Measurement Using The CROSSFLOW Ultrasonic Flowmeter At Constellation Nuclear Calvert Cliffs Unit 1, Revision 0

6.3.2. DCALC CA06102, Feedwater Flow Measurement Using The CROSSFLOW Ultrasonic Flowmeter At Constellation Nuclear Calvert Cliffs Unit 2, Revision 0

6.4. DCALC I-93-037, Uncertainty Calculation For The Plant Computer Indication Of Main Steam Pressure, Revision 1

6.5. DCALC CA04564, Uncertainty Calculation for the Blowdown Flow Input to the Secondary Heat Balance, Revision 0.

6.6. DCALC CA00470, Loop Uncertainty For Feedwater RTDS, Revision 0

6.7. DCALC CA02092, Uncertainty Calculation For Steam Generator Pressure Instrumentation For Loops AFAS, Remote Shutdown Indication And PAM Indication, Revision 2

6.8. DCALC I-93-072, Uncertainties Of The Secondary Calorimetric Constants For Unit 1 & 2, Revision 0

6.8.1. CCN I-93-072-0001, Revision 0

6.9. Operating Procedures

6.9.1. OI-08A-1, Blowdown System, Revision 35 (Unit 1)

6.9.2. OI-08A-2, Blowdown System, Revision 33 (Unit 2)

6.10. SP 094, System 094 Setpoint File, Revision 9

6.11. ASME Steam Tables, Fifth Edition (1967 ASME Steam Tables)

6.12. ESP ES200400492-000, Review/Revise Calorimetric Constants, Revision 0

6.13. ISA-RP67.04.02-2000, Methodologies for the Determination of Setpoints for Nuclear Safety Related Instrumentation, 1/1/2000

7.0 CALCULATION

7.1. Calorimetric uncertainty is determined by varying each input parameter individually by its uncertainty, determining the resultant calorimetric power, then subtracting the nominal calorimetric power from the resultant power. The difference in calorimetric power resulting from the variation of each parameter represents that parameter's contribution to calorimetric uncertainty.

$$U_{CAL-INPUT} = \Delta Q_{CAL} = (Q_{SG1} + Q_{SG2} + C)_{\varepsilon} - (Q_{SG1} + Q_{SG2} + C)_0$$

where the subscript INPUT represents the parameter being evaluated, the subscript ε represents indicated values, and the subscript 0 represents actual values.

7.2. Net calorimetric uncertainty is the statistical combination of each parameters contribution to uncertainty.

7.3. Feedwater temperature, feedwater pressure, and main steam pressure are evaluated over a range of values. For simplicity, the subsequent calculation is shown for the following conditions:

Feedwater Temperature, T_{FW} = 428 deg. F

Feedwater Pressure, P_{FW} = 770 PSIA

Main Steam Pressure, P_{STM} = 860 PSIA

Refer to Attachment 1 for the calorimetric uncertainty calculation at other values using the methodology developed in Step 7.1.

7.4. From Reference 6.11, the feedwater enthalpy at 428 deg. F and 770 PSIA is h_{FW} = 406.0780 BTU/lbm. [Attachment A, Table 1A]

7.5. From Reference 6.11, at 860 PSIA, the saturated vapor component of main steam enthalpy is h_{GS} = 1197.7 BTU/lbm, the saturated liquid component of main steam enthalpy is h_{FS} = 520.1 BTU/lbm, and the difference between the saturated vapor and liquid components is h_{FG} = 677.6 BTU/lbm. [Attachment A, Table 2A]

7.6. FEEDWATER FLOW UNCERTAINTY CONTRIBUTION

7.6.1. From Assumption 5.1, the uncertainty of the corrected feedwater flow calculation is bound by the uncertainty of CROSSFLOW measured flow.

7.6.2. General equations:

$$U_{CAL-MFW} = (Q_{SG1} + Q_{SG2} + C)_{\varepsilon MFW} - (Q_{SG1} + Q_{SG2} + C)_0$$

An error in feedwater flow to one steam generator affects only the thermal output of that steam generator. Therefore, for steam generator 11 (21),

$$U_{CAL-MFW1} = (Q_{SG1})_{\varepsilon MFW} - (Q_{SG1})_0$$

$$U_{CAL-MFW1} = \left\{ \begin{matrix} [(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_{\varepsilon MFW} \\ -[(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_0 \end{matrix} \right\}$$

$$U_{CAL-MFW1} = [(M_{FW1-\varepsilon MFW})(h_{GS1} - h_{FW1})] - [(M_{FW1-0})(h_{GS1} - h_{FW1})]$$

$$U_{CAL-MFW1} = U_{MFW1}(h_{GS1} - h_{FW1})$$

Similarly, for steam generator 12 (22)

$$U_{CAL-MFW2} = U_{MFW2}(h_{GS2} - h_{FW2})$$

7.6.3. From inspection of the above equations, a negative calorimetric uncertainty results from a negative feedwater flow uncertainty. (Indicated flow < Actual flow)

7.6.4. From Design Input 4.4.1, feedwater uncertainty consists of random uncertainties with a dependent and independent component. The uncertainty, expressed in lbm/hr, is the product of the uncertainty, expressed in % flow, and the nominal flow, 6220 klbm/hr.

7.6.4.1. The piping configuration dependent component is

Header	Uncertainty, Flow Dependent Component, % Flow, $U_{MFW\text{-}MDEP\%}$	Uncertainty, Piping Configuration Dependent Componentt, lbm/hr, $U_{MFW\text{-}MDEP}$
11	0%	+/- 0
12	0%	+/- 0
21	+/- 0.2672%	+/- 16620
22	+/- 0.2672%	+/- 16620

7.6.4.2. The temperature dependent component is

Header	Uncertainty, Temperature Dependent Component, % Flow, $U_{MFW\text{-}TDEP\%}$	Uncertainty, Temperature Dependent Component, lbm/hr, $U_{MFW\text{-}TDEP}$
11	+/- 0.1604%	+/- 9977
12	+/- 0.1602%	+/- 9964
21	+/- 0.1649%	+/- 10257
22	+/- 0.1652%	+/- 10275

7.6.4.3. The independent component is

Header	Uncertainty, Independent Component, % Flow, $U_{MFW\text{-}IND\%}$	Uncertainty, Independent Component, lbm/hr, $U_{MFW\text{-}IND}$
11	+/- 0.5365%	+/- 33370
12	+/- 0.4419%	+/- 27486
21	+/- 0.4516%	+/- 28090
22	+/- 0.4756%	+/- 29582

7.6.5. The contributions to calorimetric uncertainty are

7.6.5.1. The independent component is

Unit 1 [Attachment A, Table 3A1]

SG	U_{MFW}, lbm/hr	h_{GS}, BTU/lbm	h_{FW}, BTU/lbm	$U_{CAL\text{-}MFW\text{-}IND}$, BTU/hr
1	-33370	1197.7000	406.0780	-26416664
2	-27486	1197.7000	406.0780	-21758665

Unit 2 [Attachment A, Table 3A2]

SG	U_{MFW}, lbm/hr	h_{GS}, BTU/lbm	h_{FW}, BTU/lbm	$U_{CAL\text{-}MFW\text{-}IND}$, BTU/hr
1	-28090	1197.7000	406.0780	-22236282
2	-29582	1197.7000	406.0780	-23418015

7.6.5.2. The piping configuration dependent component is

Unit 1 [Attachment A, Table 3B1]

SG	U_{MFW}, lbm/hr	h_{GS}, BTU/lbm	h_{FW}, BTU/lbm	$U_{CAL\text{-}MFW\text{-}MDEP}$, BTU/hr
1	0	1197.7000	406.0780	0
2	0	1197.7000	406.0780	0

Unit 2 [Attachment A, Table 3B2]

SG	U_{MFW}, lbm/hr	h_{GS}, BTU/lbm	h_{FW}, BTU/lbm	$U_{CAL\text{-}MFW\text{-}MDEP}$, BTU/hr
1	-16620	1197.7000	406.0780	-13156631
2	-16620	1197.7000	406.0780	-13156631

7.6.5.3. The temperature dependent component is

Unit 1 [Attachment A, Table 3C1]

SG	U_{MFW}, lbm/hr	h_{GS}, BTU/lbm	h_{FW}, BTU/lbm	$U_{CAL\text{-}MFW\text{-}TDEP}$, BTU/hr
1	-9977	1197.7000	406.0780	-7897918
2	-9964	1197.7000	406.0780	-7888070

Unit 2 [Attachment A, Table 3C2]

SG	U_{MFW}, lbm/hr	h_{GS}, BTU/lbm	h_{FW}, BTU/lbm	$U_{CAL\text{-}MFW\text{-}TDEP}$, BTU/hr
1	-10257	1197.7000	406.0780	-8119493
2	-10275	1197.7000	406.0780	-8134264

7.7. BLOWDOWN FLOW UNCERTAINTY CONTRIBUTION

7.7.1. General equations:

Since the same bounding conditions are established for feedwater flow, main steam pressure, feedwater temperature and feedwater pressure, the net thermal output of both steam generators, $Q_{SG1} + Q_{SG2}$, can be re-written as

$$Q_{SG1} + Q_{SG2} = (2M_{FW})(h_{GS} - h_{FW}) + (M_{BDT})(h_{FS} - h_{GS})$$

where M_{BDT} is the total blowdown flow.

The contribution to calorimetric uncertainty from total blowdown flow is

$$U_{CAL\text{-}MBDT} = (Q_{SG1} + Q_{SG2} + C)_{\varepsilon MBDT} - (Q_{SG1} + Q_{SG2} + C)_0$$

$$U_{CAL\text{-}MBDT} = \left\{ \begin{array}{l} [(2M_{FW})(h_{GS} - h_{FW}) + (M_{BDT})(h_{FS} - h_{GS}) + C]_{\varepsilon MBDT} \\ -[(2M_{FW})(h_{GS} - h_{FW}) + (M_{BDT})(h_{FS} - h_{GS}) + C]_0 \end{array} \right\}$$

$$U_{CAL\text{-}MBDT} = (M_{BDT\text{-}\varepsilon MBDT})(h_{FS} - h_{GS}) - (M_{BDT\text{-}0})(h_{FS} - h_{GS})$$

$$U_{CAL\text{-}MBDT} = U_{MBDT}(h_{FS} - h_{GS})$$

$$U_{CAL\text{-}MBDT} = -U_{MBDT}(h_{FG})$$

7.7.2. From inspection of the above equations, a negative calorimetric uncertainty results from a positive total blowdown flow uncertainty since $h_{FS} < h_{GS}$. (Indicated flow > Actual flow)

7.7.3. The contribution of total blowdown flow uncertainty to calorimetric uncertainty is [Attachment A, Table 4]

U_{MBDT}, lbm/hr	h_{FG}, BTU/lbm	$U_{CAL-MBDT}$, BTU/hr
8094	677.60	-5484494

7.8. FEEDWATER ENTHALPY UNCERTAINTY CONTRIBUTION FROM TEMPERATURE MEASUREMENT

7.8.1. General equations:

$$U_{CAL-TFW} = (Q_{SG1} + Q_{SG2} + C)_{\varepsilon TFW} - (Q_{SG1} + Q_{SG2} + C)_0$$

An error in feedwater temperature to one steam generator affects only the thermal output of that steam generator. Therefore, for steam generator 11 (21),

$$U_{CAL-TFW1} = (Q_{SG1})_{\varepsilon TFW} - (Q_{SG1})_0$$

$$U_{CAL-TFW1} = \left\{ \begin{matrix} [(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_{\varepsilon TFW} \\ -[(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_0 \end{matrix} \right\}$$

$$U_{CAL-TFW1} = [(M_{FW1})(h_{GS1} - h_{FW1})]_{\varepsilon TFW} - [(M_{FW1})(h_{GS1} - h_{FW1})]_0$$

$$U_{CAL-TFW1} = M_{FW1}(h_{FW1-0} - h_{FW1-\varepsilon TFW})$$

Similarly, for steam generator 12 (22).

$$U_{CAL-TFW2} = M_{FW2}(h_{FW2-0} - h_{FW2-\varepsilon TFW})$$

7.8.2. As feedwater temperature increases, feedwater enthalpy increases. Thus, a negative calorimetric uncertainty results from a positive feedwater temperature uncertainty. (Indicated temperature > Actual temperature).

Therefore, the temperature is varied by adding the uncertainty, 1.88 deg. F.

7.8.3. Since the same feedwater flow, feedwater temperature, and feedwater pressure are applied to both steam generators, the contribution of feedwater enthalpy uncertainty resulting from feedwater temperature measurement is the same for both steam generators.

7.8.4. The contribution of feedwater temperature per steam generator to calorimetric uncertainty is [Attachment A, Table 5]

SG	M_{FW}, klbm/hr	T_{FW-0}, DEG F	$T_{FW-\varepsilon}$, DEG F	h_{FW-0}, BTU/LBM	$h_{FW-\varepsilon TFW}$, BTU/LBM	$U_{CAL-TFW}$, BTU/hr
1	6220	428	429.88	406.0780	408.1347	-12792798
2						

7.8.5. This uncertainty will be combined with the temperature dependent component of feedwater uncertainty when evaluating calorimetric uncertainty.

7.9. FEEDWATER ENTHALPY UNCERTAINTY CONTRIBUTION FROM PRESSURE MEASUREMENT

7.9.1. General equations

7.9.1.1. Random Contribution

a. The expression for the contribution of a feedwater pressure error to negative calorimetric uncertainty is similar to the expression for the contribution of a feedwater temperature error.

$$U_{CAL-PFW1} = M_{FW1}(h_{FW1-0} - h_{FW1-\varepsilon PFW})$$

$$U_{CAL-PFW2} = M_{FW2}(h_{FW2-0} - h_{FW2-\varepsilon PFW})$$

b. The same feedwater flow, feedwater temperature, and feedwater pressure are applied to both steam generators. Therefore, the net contribution to calorimetric uncertainty is given by

$$U_{CAL-PFWNET} = -\left\{(U_{CAL-PFW})^2_{SG1} + (U_{CAL-PFW})^2_{SG2}\right\}^{1/2}$$

$$U_{CAL-PFWNET} = -\sqrt{2}\left\{(U_{CAL-PFW})^2_{SG}\right\}^{1/2} = \sqrt{2}[M_{FW}(h_{FW-0} - h_{FW-\varepsilon PFW})]$$

7.9.1.2. Bias Contribution

Similarly,

$$B_{CAL-PFWNET} = B_{CAL-PFW}|_{SG1} + B_{CAL-PFW}|_{SG2}$$

$$B_{CAL-PFWNET} = 2B_{CAL-PFW} = 2M_{FW}(h_{FW-0} - h_{FW-\varepsilon PFW})$$

7.9.2. As feedwater pressure increases, feedwater enthalpy increases. Thus, a negative calorimetric uncertainty results from a positive feedwater pressure uncertainty. (Indicated pressure > Actual pressure)

Therefore, the pressure is varied by adding the random and positive bias components of uncertainty, 27.57 PSI and 0.04 PSI respectively.

7.9.3. The random contribution of feedwater pressure to calorimetric negative uncertainty is [Attachment A, Table 6A]

M_{FW}, klbm/hr	P_{FW-0}, PSIA	$P_{FW-\varepsilon}$, PSIA	h_{FW-0}, BTU/lbm	$h_{FW-\varepsilon PFW}$, BTU/lbm	$U_{CAL-PFWNET}$, BTU/hr
6220	770	797.57	406.0780	406.1001	-194014

7.9.4. The bias contribution of feedwater pressure to calorimetric uncertainty is [Attachment A, Table 6B]

M_{FW}, klbm/hr	P_{FW-0}, DEG F	$P_{FW\varepsilon}$, DEG F	h_{FW-0}, BTU/LBM	$h_{FW-\varepsilon PFW}$, BTU/LBM	$U_{CAL-PFWNET}$, BTU/hr
6220	770	770.04	406.0780	406.0780	0

7.10. MAIN STEAM ENTHALPY UNCERTAINTY CONTRIBUTION FROM PRESSURE MEASUREMENT

7.10.1. General equations:

7.10.1.1. Random Contribution:

$$U_{CAL-PSTM} = (Q_{SG1} + Q_{SG2} + C)_{\varepsilon PSTM} - (Q_{SG1} + Q_{SG2} + C)_0$$

An error in the steam pressure measurement for one steam generator affects only the thermal output of that steam generator. Therefore, for steam generator 11 (21),

$$U_{CAL-PSTM1} = (Q_{SG1})_{\varepsilon PSTM} - (Q_{SG1})_0$$

$$U_{CAL-PSTM1} = \begin{Bmatrix} [(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_{\varepsilon PSTM} \\ -[(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_0 \end{Bmatrix}$$

$$U_{CAL-PSTM1} = \begin{Bmatrix} [(M_{FW1})(h_{GS1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_{\varepsilon PSTM} \\ -[(M_{FW1})(h_{GS1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_0 \end{Bmatrix}$$

$$U_{CAL-PSTM1} = (M_{FW1} - M_{BD1})(h_{GS1-\varepsilon PSTM} - h_{GS1-0}) + (M_{BD1})(h_{FS1-\varepsilon PSTM} - h_{FS1-0})$$

Similarly, for steam generator 12 (22)

$$U_{CAL-PSTM2} = (M_{FW2} - M_{BD2})(h_{GS2-\varepsilon PSTM} - h_{GS2-0}) + (M_{BD2})(h_{FS2-\varepsilon PSTM} - h_{FS2-0})$$

7.10.1.2. Bias contribution

$$B_{CAL-PSTM1} = (M_{FW1} - M_{BD1})(h_{GS1-\varepsilon PSTM} - h_{GS1-0}) + (M_{BD1})(h_{FS1-\varepsilon PSTM} - h_{FS1-0})$$

$$B_{CAL-PSTM2} = (M_{FW2} - M_{BD2})(h_{GS2-\varepsilon PSTM} - h_{GS2-0}) + (M_{BD2})(h_{FS2-\varepsilon PSTM} - h_{FS2-0})$$

7.10.2.

From the above expression, the direction of change in steam pressure resulting in a negative calorimetric uncertainty is not apparent and must be evaluated by applying instrument uncertainty in both directions.

7.10.3. Random Contribution

Indicated Steam Pressure > Actual Pressure by U_{PSTM} (+19.8 PSI) [Attachment A, Table 7A]

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS-0}, BTU/lbm	$h_{GS-\varepsilon PSTM}$, BTU/lbm	h_{FS-0}, BTU/lbm	$h_{FS-\varepsilon PSTM}$, BTU/lbm	$U_{CAL-PSTM+}$, BTU/hr
1	6220000	91000	1197.7000	1197.0070	520.1000	523.3670	-3950100
2	6220000	16000	1197.7000	1197.0070	520.1000	523.3670	-4247100

Indicated Steam Pressure < Actual Pressure by U_{PSTM} (-19.8 PSI) [Attachment A, Table 7B]

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS-0}, BTU/lbm	$h_{GS-\varepsilon PSTM}$, BTU/lbm	h_{FS-0}, BTU/lbm	$h_{FS-\varepsilon PSTM}$, BTU/lbm	$U_{CAL-PSTM-}$, BTU/hr
1	6220000	91000	1197.7000	1198.1950	520.1000	516.7340	2727549
2	6220000	16000	1197.7000	1198.1950	520.1000	516.7340	3017124

Therefore, indicated power is less than actual power when indicated steam pressure is greater than actual pressure.

The net contribution of steam pressure measurement uncertainty to calorimetric uncertainty is given by

$$U_{CAL-PSTMNET} = -\{(U_{CAL-PSTM1})^2 + (U_{CAL-PSTM2})^2\}^{1/2} = -5800099 \text{ BTU/hr.}$$

7.10.4. Bias Contribution

The positive bias component (+3.4 PSI) must also be considered. [Attachment A, Table 7C]

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS-0}, BTU/lbm	$h_{GS-\varepsilon PSTM}$, BTU/lbm	h_{FS-0}, BTU/lbm	$h_{FS-\varepsilon PSTM}$, BTU/lbm	$B_{CAL-PSTM+}$, BTU/hr
1	6220000	91000	1197.7000	1197.5640	520.1000	520.6780	-780946
2	6220000	16000	1197.7000	1197.5640	520.1000	520.6780	-834496

The net bias is given by

$$B_{CAL-PSTMNET} = B_{CAL-PSTM1} + B_{CAL-PSTM2} = -1615442 \text{ BTU/hr.}$$

7.11. PLANT COMPUTER UNCERTAINTY CONTRIBUTION

7.11.1. Feedwater Enthalpy

7.11.1.1. General equations:

$$U_{CAL-CMP(hFW)} = (Q_{SG1} + Q_{SG2} + C)_{\varepsilon CMP(hFW)} - (Q_{SG1} + Q_{SG2} + C)_0$$

An error in the enthalpy of steam enthalpy for one steam generator affects only the thermal output of that steam generator.

$$U_{CAL-CMP(hFW)1} = (Q_{SG1})_{\varepsilon CMP(hFW)} - (Q_{SG1})_0$$

$$U_{CAL-CMP(hFW)1} = \left\{ \begin{array}{l} [(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_{\varepsilon CMP(hFW)} \\ -[(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_0 \end{array} \right\}$$

$$U_{CAL-CMP(hFW)1} = M_{FW1}(h_{FW1-0} - h_{FW1-\varepsilon CMP(hFW)})$$

$$U_{CAL-CMP(hFW)1} = M_{FW1}(U_{PC-ENTH})$$

Similarly,

$$U_{CAL-CMP(hFW)2} = M_{FW2}(U_{PC-ENTH})$$

7.11.1.2. Since the same feedwater flow is applied to both steam generators, the net contribution to calorimetric uncertainty is given by:

$$U_{CAL-CMP(hFW)NET} = \sqrt{2}[M_{FW}(U_{PC-ENTH})]$$

7.11.1.3. From inspection of the above equations, a negative calorimetric uncertainty results from a positive plant computer enthalpy uncertainty.

7.11.1.4. The contribution to calorimetric uncertainty is summarized below.

SG	M_{FW}, lbm/hr	$U_{PC-ENTH}$, BTU/lbm	$U_{CAL-CMP(hFW)}$, BTU/hr	$U_{CAL-CMP(hFW)NET}$, BTU/hr
1	6220000	-0.10	622000	-879641
2	6220000	-0.10	622000	

7.11.2. Steam Enthalpy, Saturated Vapor

7.11.2.1. General equations:

$$U_{CAL-CMP(hGS)} = (Q_{SG1} + Q_{SG2} + C)_{\varepsilon hGS} - (Q_{SG1} + Q_{SG2} + C)_0$$

An error in the enthalpy of steam enthalpy for one steam generator affects only the thermal output of that steam generator. Therefore, for steam generator 11 (21),

$$U_{CAL-CMP(hGS)1} = (Q_{SG1})_{\varepsilon hGS} - (Q_{SG1})_0$$

$$U_{CAL-CMP(hGS)1} = \left\{ \begin{array}{l} [(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_{\varepsilon CMP(hGS)} \\ -[(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_0 \end{array} \right\}$$

$$U_{CAL-CMP(hGS)1} = \left\{ \begin{array}{l} [(M_{FW1})(h_{GS1}) + (M_{BD1})(-h_{GS1})]_{\varepsilon CMP(hGS)} \\ -[(M_{FW1})(h_{GS1}) + (M_{BD1})(-h_{GS1})]_0 \end{array} \right\}$$

$$U_{CAL-CMP(hGS)1} = (M_{FW1} - M_{BD1})(h_{GS1-\varepsilon CMP(hGS)} - h_{GS1-0})$$

$$U_{CAL-CMP(hGS)1} = (M_{FW1} - M_{BD1})(U_{PC-ENTH})$$

Similarly, for steam generator 12 (22)

$$U_{CAL-CMP(hGS)2} = (M_{FW2} - M_{BD2})(U_{PC-ENTH})$$

7.11.2.2. From inspection of the above equations, a negative calorimetric uncertainty results from a negative plant computer enthalpy uncertainty.

7.11.2.3. The net contribution to calorimetric uncertainty is given by:

$$U_{CAL-CMP(hGS)NET} = -\left[(U_{CAL-CMP(hGS)1})^2 + (U_{CAL-CMP(hGS)2})^2\right]^{1/2}$$

7.11.2.4. The contribution to calorimetric uncertainty is summarized below.

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	$U_{PC-ENTH}$, BTU/lbm	$U_{CAL-CMP(hGS)}$, BTU/hr	$U_{CAL-CMP(hGS)NET}$, BTU/hr
1	6220000	91000	-0.10	-612900	-872091
2	6220000	16000	-0.10	-620400	

7.11.3. Steam Enthalpy, Saturated Liquid

7.11.3.1. General equations:

$$U_{CAL-CMP(hFS)} = (Q_{SG1} + Q_{SG2} + C)_{\varepsilon hFS} - (Q_{SG1} + Q_{SG2} + C)_0$$

An error in the enthalpy of steam enthalpy for one steam generator affects only the thermal output of that steam generator. Therefore, for steam generator 11 (21),

$$U_{CAL-CMP(hFS)1} = (Q_{SG1})_{\varepsilon CMP(hFS)} - (Q_{SG1})_0$$

$$U_{CAL-CMP(hFS)1} = \left\{ \begin{array}{l} [(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_{\varepsilon CMP(hFS)} \\ -[(M_{FW1})(h_{GS1} - h_{FW1}) + (M_{BD1})(h_{FS1} - h_{GS1})]_0 \end{array} \right\}$$

$$U_{CAL-CMP(hFS)1} = \{(M_{BD1})(h_{FS1-\varepsilon CMP(hFS)}) - (M_{BD1})(h_{FS1-0})\}$$

$$U_{CAL-CMP(hFS)1} = (M_{BD1})(U_{PC-ENTH})$$

Similarly, for steam generator 12 (22)

$$U_{CAL-CMP(hFS)2} = (M_{BD2})(U_{PC-ENTH})$$

7.11.3.2. From inspection of the above equations, a negative calorimetric uncertainty results from a negative plant computer enthalpy uncertainty.

7.11.3.3. The net contribution to calorimetric uncertainty is given by:

$$U_{CAL-CMP(hFS)NET} = -\left[(U_{CAL-CMP(hFS)1})^2 + (U_{CAL-CMP(hFS)2})^2\right]^{1/2}$$

7.11.3.4. The contribution to calorimetric uncertainty is summarized below.

SG	M_{BD}, lbm/hr	$U_{PC-ENTH}$, BTU/lbm	$U_{CAL-CMP(hFS)}$, BTU/hr	$U_{CAL-CMP(hFS)NET}$, BTU/hr
1	91000	-0.10	-9100	-9240
2	16000	-0.10	-1600	

7.11.4. The net contribution of the plant computer's determination of enthalpy to calorimetric uncertainty is given by [Attachment A, Table 8]

$$U_{CAL-CMPNET} = -\left\{(U_{CAL-CMP(hFW)NET})^2 + (U_{CAL-CMP(hGS)NET})^2 + (U_{CAL-CMP(hFS)NET})^2\right\}^{1/2}$$

$U_{CAL-CMPNET}$ = -1238707 BTU/hr

7.12. TOTAL CALORIMETRIC UNCERTAINTY

7.12.1. This section summarizes the total calorimetric uncertainty for the parameters selected in 7.3

Feedwater Temperature, T_{FW} = 428 deg. F

Feedwater Pressure, P_{FW} = 770 PSIA

Main Steam Pressure, P_{STM} = 860 PSIA

The calorimetric uncertainty for other parameters is summarized in the tables of Attachment A.

7.12.2. Random Component

7.12.2.1. The random component of calorimetric uncertainty is the determined from

$$U_{CAL-RAND} = -\left\{\begin{array}{l}(U_{CAL-MFW-IND1})^2 + (U_{CAL-MFW-IND2})^2 + (U_{CAL-MFW-MDEP1} + U_{CAL-MFW-MDEP2})^2 \\ + (U_{CAL-MFW-TDEP1} + U_{CAL-TFW1})^2 + (U_{CAL-MFW-TDEP2} + U_{CAL-TFW2})^2 \\ + (U_{CAL-MBDT})^2 + (U_{CAL-PFWNET})^2 + (U_{CAL-PSTMNET})^2 + (U_{CAL-CMPNET})^2\end{array}\right\}^{1/2}$$

7.12.2.2. The random component of calorimetric uncertainty is the summarized in the table below. [Unit 1, Attachment A, Table 9A; Unit 2, Attachment A, Table 9B]

Unit	SG	$U_{CAL-MFW-IND}$, BTU/hr	$U_{CAL-MFW-MDEP}$, BTU/hr	$U_{CAL-MFW-TDEP}$, BTU/hr	$U_{CAL-TFW}$, BTU/hr
1	1	-26416664	0	-7897918	-12792798
	2	-21758665	0	-7888070	-12792798
2	1	-22236282	-13156631	-8119493	-12792798
	2	-23418015	-13156631	-8134264	-12792798

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

Unit	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
1	-5484494	-194014	-5800099	-1238707	-45742502
2	-5484494	-194014	-5800099	-1238707	-51728156

7.12.3. Bias Component

7.12.3.1. The bias component of calorimetric uncertainty is the determined from

$$U_{CAL-BIAS} = B_{CAL-PFWNET} + B_{CAL-PSTMNET} + B_{CAL-CONST}$$

7.12.3.2. The bias component of calorimetric uncertainty is the same for both units and is summarized in the table below: [Attachment A, Table 9B]

$B_{CAL-PFWNET}$, BTU/hr	$B_{CAL-PSTMNET}$, BTU/hr	$B_{CAL-CONST}$ BTU/hr	$U_{CAL-BIAS}$, BTU/hr
0	-1615442	-6465656	-8081098

7.12.4. Total Calorimetric Uncertainty:

7.12.4.1. The total uncertainty is the sum of the random and bias components for calorimetric uncertainty and is summarized in the table below.

$$U_{CAL-TOT} = U_{CAL-RAND} + U_{CAL-BIAS}$$

7.12.4.2. Calorimetric uncertainty, expressed in Megawatts, is given by:

$$U_{CAL-TOT(MW)} = \frac{U_{CAL-TOT}}{(3.412141\,BTU/hr/W)(1E6\,W/MW)}$$

7.12.4.3. Based on a Rated Thermal Power (RTP) of 2737 MW(th), calorimetric uncertainty, expressed as percentage of rated thermal power is given by.

$$U_{CAL-TOT(\%RTP)} = \frac{U_{CAL-TOT(MW)}}{(2737\,MW)}(100\%)$$

7.12.4.4. Total Calorimetric Uncertainty is expressed in the table below. Calorimetric uncertainty, expressed in Megawatts, has been rounded up to the nearest 0.01 MW for conservatism. Calorimetric uncertainty, expressed as a percentage of rated thermal power @ 2737 MW(th), is rounded up to the nearest 0.0001% for conservatism. [Unit 1, Attachment A, Table 10A1; Unit 2, Attachment A, Table 10A2]

Unit	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, MW	$U_{CAL-TOT}$, %RTP
1	-45742502	-8081098	-53823600	-15.78	-0.5766%
2	-51728156	-8081098	-59809254	-17.53	-0.6405%

7.12.5. Total Calorimetric Uncertainty, Single Side of Interest:

7.12.5.1. Since only negative calorimetric uncertainty is considered to ensure power remains below 2754 MW, the methodology established in Reference 6.13, Section 8.1, "Correction for Setpoints with a Single Side of Interest" may be applied. The calorimetric uncertainty calculated previously is based upon a 95% confidence level (1.96 standard deviations). The random component of calorimetric uncertainty may be reduced by a correction of (1.645/1.96).

$$U_{CAL-TOT(SS)} = \left(\frac{1.645}{1.96}\right) U_{CAL-RAND} + U_{CAL-BIAS}$$

7.12.5.2. Calorimetric uncertainty, with the correction applied, is tabulated below. [Unit 1, Attachment A, Table 11A; Unit 2, Attachment A, Table 11B]

Unit	$U_{CAL-RAND(SS)}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-TOT(SS)}$, BTU/hr	$U_{CAL-TOT(SS)}$, MW	$U_{CAL-TOT(SS)}$, %RTP
1	-38391029	-8081098	-46472127	-13.62	-0.4977%
2	-43414703	-8081098	-51495801	-15.10	-0.5517%

8.0 RESULTS/SUMMARY

8.1. From a review of the tables in Attachment A, the most conservative calorimetric uncertainty for the plant conditions evaluated in this calculation occurs at a steam pressure of 860 PSIA, a feedwater temperature of 428 degrees F and a feedwater pressure of 770 PSIA.

8.2. Total Calorimetric Uncertainty at most limiting conditions

Unit	$U_{CAL-TOT}$, MW	$U_{CAL-TOT}$, %RTP
1	-15.78	-0.5766%
2	-17.53	-0.6405%

8.3. Total Calorimetric Uncertainty, corrected for single side of interest at most limiting conditions

Unit	$U_{CAL-TOT(SS)}$, MW	$U_{CAL-TOT(SS)}$, %RTP
1	-13.62	-0.4977%
2	-15.10	-0.5517%

8.4. From a review of the tables in Attachment A, the lowest magnitude of calorimetric uncertainty for the plant conditions evaluated in this calculation occurs at a steam pressure of 840 PSIA, a feedwater temperature of 452 degrees F and a feedwater pressure of 870 PSIA.

Total Calorimetric Uncertainty, corrected for single side of interest at these conditions

Unit	$U_{CAL-TOT}$, MW	$U_{CAL-TOT}$, %RTP
1	-13.14	-0.4801%
2	-14.55	-0.5317%

9.0 CONCLUSION

9.1. Since the only direction of interest is actual power > indicated power, single side of interest can be applied to calorimetric uncertainty. Therefore, the calorimetric uncertainty of both units is bound by a value of -15.10 MW (-0.5517% Rated Thermal Power @ 2737 MW(th)) for the following plant conditions:

9.1.1. Actual Feedwater flow < 6220 klbm/hr

9.1.1.1. Since uncertainty is maximized at higher feedwater rates, the indicated feedwater flow at 2737 MW is given by:

$M_{FW-IND} = M_{FW}(1 - U_{MFW\%})$

9.1.1.2. Indicated feedwater flow shall be less than or equal to the values listed below:

Header	Actual FW flow, klbm/hr	Total Uncertainty, % Flow, $U_{MFW\%}$	Maximum Indicated Flow, klbm/hr
11	6220	+/- 0.56%	6185.17
12	6220	+/- 0.47%	6190.77
21	6220	+/- 0.55%	6185.79
22	6220	+/- 0.57%	6184.55

9.1.2. Actual Feedwater Temperature between 428 deg. F and 452 deg. F.

9.1.2.1. As shown in Attachment A, calorimetric uncertainty is maximized at lower actual feedwater temperatures. Therefore, the minimum indicated value of feedwater temperature is given by $T_{FW-IND} = T_{FW} + U_{TFW} = 428$ deg. F +1.88 deg. F = 429.88 deg. F.

9.1.2.2. As shown in Attachment A, the contribution to calorimetric uncertainty from feedwater temperature measurement uncertainty increases with feedwater temperature. However, a negative calorimetric uncertainty results when indicated temperature is greater than actual temperature. Therefore, the maximum indicated value of feedwater temperature is the given by the maximum assumed feedwater temperature, 452 deg. F.

[At an indicated temperature of 452 deg. F, actual temperature could be as low as 450.12 deg. F or as high as 453.88 deg. F. Negative uncertainty only results when indicated temperature is greater than actual temperature. Therefore, the uncertainty resulting when actual temperature is greater than indicated temperature does not need to be considered. An actual temperature of 450.12 deg. F is bound by the assumed temperature range.]

9.1.3. Actual Feedwater Pressure between 770 PSIA and 870 PSIA:

9.1.3.1. As shown in Attachment A, calorimetric uncertainty is maximized at lower actual feedwater pressures. Therefore, the minimum indicated value of feedwater pressure is given by $P_{FW-IND} = P_{FW} + U_{PFW} + B_{PFW} = 770$ PSIA +27.57 PSI + 0.04 PSI = 797.61 PSIA

9.1.3.2. If both steam generator inputs are available, the random uncertainty of the average steam generator pressure may be used. Therefore, the minimum indicated value of feedwater pressure is given by

$$P_{FW-IND} = P_{FW} + U_{PFW-AVE} + B_{PFW} = P_{FW} + \frac{\sqrt{2}}{2}U_{PFW} + B_{PFW}$$

$P_{FW-IND} = 770$ PSIA +19.49 PSI + 0.04 PSI = 789.53 PSIA

9.1.3.3. As shown in Attachment A, the contribution to calorimetric uncertainty from feedwater pressure measurement uncertainty increases with feedwater pressure. However, a negative calorimetric uncertainty results when indicated pressure is greater than actual pressure. Therefore, the maximum indicated value of feedwater pressure is the given by the maximum assumed feedwater pressure, 870 PSIA.

[At an indicated pressure of 870 PSIA, actual temperature could be as low as 842.43 psia or as high as 897.61 psia. Negative uncertainty only results when indicated pressure is greater than actual pressure. Therefore, the uncertainty resulting when actual pressure is greater than indicated pressure does not need to be considered. An actual pressure of 842.43 psia is bound by the assumed temperature range.]

9.1.4. Actual Main Steam Pressure between 770 PSIA to 870 PSIA.

9.1.4.1. As shown in Attachment A, there is no clear trend between steam pressure and the contribution to calorimetric uncertainty. Therefore, uncertainty will be applied to both minimum and maximum steam pressures when evaluating indicated pressure.

[Unlike other parameters, the contribution to calorimetric uncertainty from main steam pressure does not trend consistently as pressure increases. The most probable cause is round-off errors introduced by using Reference 6.11 as the basis for steam enthalpies. A more consistent trend should be observed if the NIST 1995 steam tables were adopted. Adoption of the NIST 1995 steam tables would require modifications to the plant computer code, which is based on the ASME 1967 tables. Adoption of the NIST 1995 steam tables could also result in a slight decrease in calorimetric uncertainty.]

9.1.4.2. The maximum value of indicated steam pressure is given by

$P_{STM-IND} = P_{STM} - U_{PSTM} = 870$ PSIA - 19.8 PSI = 850.2 PSIA

9.1.4.3. The minimum indicated value of steam pressure is given by

$P_{STM-IND} = P_{STM} + U_{PSTM} + B_{PSTM} = 770$ PSIA +19.8 PSI + 3.4 PSI = 793.2 PSIA

[Note - a negative calorimetric uncertainty results when indicated steam pressure is greater than actual pressure. Therefore, this condition must be evaluated, regardless of the trend between steam pressure and calorimetric uncertainty.]

9.2. Calorimetric uncertainty may be reduced by using the tables in Attachment A for a narrower range of plant conditions.

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

Table 1A, Feedwater Enthalpies at Nominal Values (No applied uncertainty)

BOLD values indicate values from Steam Tables. Other values determined through interpolation
ITALICIZED values are not used to determine calorimetric uncertainty but are included for interpolation of other values.
Source: ASME Steam Tables, Fifth Edition

P_{FW}, PSIA	*750*	770	780	790	800	810	820
T_{FW}, DEG F	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm
460	*441.64*	*441.6480*	*441.6520*	*441.6560*	*441.66*	*441.6640*	*441.6680*
452	*432.6480*	432.6592	432.6648	432.6704	432.6760	432.6816	432.6872
450	*430.4000*	430.4120	430.4180	430.4240	430.4300	430.4360	430.4420
448	*428.1760*	428.1880	428.1940	428.2000	428.2060	428.2124	428.2188
446	*425.9520*	425.9640	425.9700	425.9760	425.9820	425.9888	425.9956
444	*423.7280*	423.7400	423.7460	423.7520	423.7580	423.7652	423.7724
442	*421.5040*	421.5160	421.5220	421.5280	421.5340	421.5416	421.5492
440	*419.28*	419.2920	419.2980	419.3040	419.31	419.3180	419.3260
438	*417.0740*	417.0868	417.0932	417.0996	417.1060	417.1140	417.1220
436	*414.8680*	414.8816	414.8884	414.8952	414.9020	414.9100	414.9180
434	*412.6620*	412.6764	412.6836	412.6908	412.6980	412.7060	412.7140
432	*410.4560*	410.4712	410.4788	410.4864	410.4940	410.5020	410.5100
430	*408.2500*	408.2660	408.2740	408.2820	408.2900	408.2980	408.3060
428	*406.0620*	406.0780	406.0860	406.0940	406.1020	406.1104	406.1188
420	*397.31*	*397.3260*	*397.3340*	*397.3420*	*397.35*	*397.3600*	*397.3700*

830	840	850	860	870	*880*	*900*	P_{FW}, PSIA
h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	h_{FW}, BTU/lbm	T_{FW}, DEG F
441.6720	*441.6760*	*441.68*	*441.6840*	*441.6880*	*441.6920*	*441.7*	*460*
432.6928	432.6984	432.70	432.7096	432.7152	*432.7208*	*432.732*	452
430.4480	430.4540	430.46	430.4660	430.4720	*430.4780*	*430.49*	450
428.2252	428.2316	428.24	428.2440	428.2500	*428.2560*	*428.268*	448
426.0024	426.0092	426.02	426.0220	426.0280	*426.0340*	*426.046*	446
423.7796	423.7868	423.79	423.8000	423.8060	*423.8120*	*423.824*	444
421.5568	421.5644	421.57	421.5780	421.5840	*421.5900*	*421.602*	442
419.3340	419.3420	419.35	419.3560	419.3620	*419.3680*	*419.38*	440
417.1300	417.1380	417.15	417.1524	417.1588	*417.1652*	*417.178*	438
414.9260	414.9340	414.94	414.9488	414.9556	*414.9624*	*414.976*	436
412.7220	412.7300	412.74	412.7452	412.7524	*412.7596*	*412.774*	434
410.5180	410.5260	410.53	410.5416	410.5492	*410.5568*	*410.572*	432
408.3140	408.3220	408.33	408.3380	408.3460	*408.3540*	*408.37*	430
406.1272	406.1356	406.14	406.1524	406.1608	*406.1692*	*406.186*	428
397.3800	*397.3900*	*397.40*	*397.4100*	*397.4200*	*397.4300*	*397.45*	*420*

Table 1B, Feedwater Enthalpies with Temperature Uncertainty Applied

Determined from interpolation of Table 1A

	P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$T_{FW} + U_{TFW}$, DEG F	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm
452	453.88	434.7716	434.7768	434.7820	434.7872	434.7925	434.7977	434.8029	434.8081	434.8134	434.8186	434.8238
450	451.88	432.5244	432.5300	432.5356	432.5412	432.5469	432.5525	432.5581	432.5637	432.5694	432.5750	432.5806
448	449.88	430.2786	430.2846	430.2906	430.2966	430.3026	430.3086	430.3146	430.3207	430.3267	430.3327	430.3387
446	447.88	428.0546	428.0606	428.0666	428.0726	428.0790	428.0854	428.0918	428.0983	428.1047	428.1107	428.1167
444	445.88	425.8306	425.8366	425.8426	425.8486	425.8554	425.8622	425.8690	425.8759	425.8827	425.8887	425.8947
442	443.88	423.6066	423.6126	423.6186	423.6246	423.6318	423.6390	423.6462	423.6535	423.6607	423.6667	423.6727
440	441.88	421.3826	421.3886	421.3946	421.4006	421.4082	421.4158	421.4234	421.4311	421.4387	421.4447	421.4507
438	439.88	419.1597	419.1657	419.1717	419.1778	419.1858	419.1938	419.2018	419.2098	419.2178	419.2238	419.2298
436	437.88	416.9545	416.9609	416.9673	416.9738	416.9818	416.9898	416.9978	417.0058	417.0138	417.0202	417.0266
434	435.88	414.7493	414.7561	414.7629	414.7698	414.7778	414.7858	414.7938	414.8018	414.8098	414.8166	414.8234
432	433.88	412.5441	412.5513	412.5585	412.5658	412.5738	412.5818	412.5898	412.5978	412.6058	412.6130	412.6202
430	431.88	410.3389	410.3465	410.3541	410.3618	410.3698	410.3778	410.3858	410.3938	410.4018	410.4094	410.4170
428	429.88	408.1347	408.1427	408.1507	408.1587	408.1667	408.1748	408.1828	408.1908	408.1988	408.2069	408.2149

Table 1C, Feedwater Enthalpies with Pressure Uncertainty Applied

Determined from interpolation of Table 1A

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
$P_{FW} + U_{PFW}$, PSIA	797.57	807.57	817.57	827.57	837.57	847.57	857.57	867.57	877.57	887.57	897.57
T_{FW}, DEG F	h_{FWt}, BTU/lbm	h_{FWt}, BTU/lbm	h_{FWt}, BTU/lbm	h_{FWt}, BTU/lbm	h_{FWt}, BTU/lbm	h_{FWt}, BTU/lbm	h_{FWt}, BTU/lbm	h_{FWt}, BTU/lbm	h_{FWt}, BTU/lbm	h_{FWt}, BTU/lbm	h_{FWt}, BTU/lbm
452	432.6746	432.6802	432.6858	432.6914	432.6970	432.7026	432.7082	432.7138	432.7194	432.7250	432.7306
450	430.4285	430.4345	430.4405	430.4465	430.4525	430.4585	430.4645	430.4705	430.4765	430.4825	430.4885
448	428.2045	428.2109	428.2173	428.2236	428.2300	428.2364	428.2425	428.2485	428.2545	428.2605	428.2665
446	425.9805	425.9873	425.9940	426.0007	426.0075	426.0143	426.0204	426.0265	426.0325	426.0385	426.0445
444	423.7565	423.7636	423.7707	423.7779	423.7851	423.7923	423.7983	423.8044	423.8105	423.8165	423.8225
442	421.5325	421.5400	421.5475	421.5550	421.5626	421.5702	421.5763	421.5824	421.5885	421.5945	421.6005
440	419.3085	419.3164	419.3242	419.3321	419.3401	419.3481	419.3542	419.3604	419.3665	419.3725	419.3785
438	417.1044	417.1123	417.1202	417.1281	417.1361	417.1441	417.1506	417.1571	417.1636	417.1700	417.1764
436	414.9003	414.9083	414.9162	414.9241	414.9321	414.9401	414.9470	414.9539	414.9607	414.9675	414.9743
434	412.6963	412.7042	412.7121	412.7201	412.7281	412.7361	412.7433	412.7506	412.7579	412.7651	412.7723
432	410.4922	410.5001	410.5081	410.5161	410.5241	410.5321	410.5397	410.5473	410.5550	410.5626	410.5702
430	408.2881	408.2961	408.3041	408.3121	408.3201	408.3281	408.3361	408.3441	408.3521	408.3601	408.3681
428	406.1001	406.1084	406.1168	406.1252	406.1336	406.1420	406.1504	406.1588	406.1672	406.1756	406.1840

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Table 1D, Feedwater Enthalpies with Pressure Bias Applied

Determined from interpolation of Table 1A

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
$P_{FW} + B_{PFW}$, PSIA	770.04	780.04	790.04	800.04	810.04	820.04	830.04	840.04	850.04	860.04	870.04
T_{FW}, DEG F	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm	h_{FWc}, BTU/lbm
452	432.6592	432.6648	432.6704	432.6760	432.6816	432.6872	432.6928	432.6984	432.7040	432.7096	432.7152
450	430.4120	430.4180	430.4240	430.4300	430.4360	430.4420	430.4480	430.4540	430.4600	430.4660	430.4720
448	428.1880	428.1940	428.2000	428.2060	428.2124	428.2188	428.2252	428.2316	428.2380	428.2440	428.2500
446	425.9640	425.9700	425.9760	425.9820	425.9888	425.9956	426.0024	426.0092	426.0160	426.0220	426.0280
444	423.7400	423.7460	423.7520	423.7580	423.7652	423.7724	423.7796	423.7868	423.7940	423.8000	423.8060
442	421.5160	421.5220	421.5280	421.5340	421.5416	421.5492	421.5568	421.5644	421.5720	421.5780	421.5840
440	419.2920	419.2980	419.3040	419.3100	419.3180	419.3260	419.3340	419.3420	419.3500	419.3560	419.3620
438	417.0868	417.0932	417.0996	417.1060	417.1140	417.1220	417.1300	417.1380	417.1460	417.1524	417.1588
436	414.8816	414.8884	414.8952	414.9020	414.9100	414.9180	414.9260	414.9340	414.9420	414.9488	414.9556
434	412.6764	412.6836	412.6908	412.6980	412.7060	412.7140	412.7220	412.7300	412.7380	412.7452	412.7524
432	410.4712	410.4788	410.4864	410.4940	410.5020	410.5100	410.5180	410.5260	410.5340	410.5416	410.5492
430	408.2660	408.2740	408.2820	408.2900	408.2980	408.3060	408.3140	408.3220	408.3300	408.3380	408.3460
428	406.0780	406.0860	406.0940	406.1020	406.1104	406.1188	406.1272	406.1356	406.1440	406.1524	406.1608

Table 2A, Main Steam Enthalpies at Nominal Values (No applied uncertainty)

ITALICIZED values are not used to determine calorimetric uncertainty but are included for interpolation of other values.
Source: ASME Steam Tables, Fifth Edition

P_{STM}, PSIA	h_{GS}, BTU/lbm	h_{FG}, BTU/lbm	h_{FS}, BTU/lbm
890	*1196.7*	*671.6*	*525.1*
880	*1197.0*	*673.6*	*523.4*
870	1197.3	675.6	521.8
860	1197.7	677.6	520.1
850	1198.0	679.5	518.4
840	1198.2	681.5	516.7
830	1198.5	683.5	515.0
820	1198.8	685.5	513.3
810	1199.1	687.6	511.6
800	1199.4	689.6	509.8
790	1199.7	691.6	508.1
780	1199.9	693.6	506.3
770	1200.2	695.7	504.5
760	*1200.4*	*697.7*	*502.7*
750	*1200.7*	*699.8*	*500.9*

Table 2B, Main Steam Enthalpies with Pressure Uncertainty Applied in Positive Direction

Determined from interpolation of Table 2A

P_{STM}, PSIA	$P_{FW} + U_{PFW}$, PSIA	$h_{GS\varepsilon+}$, BTU/lbm	$h_{FS\varepsilon+}$, BTU/lbm
870	889.8	1196.706	525.067
860	879.8	1197.007	523.367
850	869.8	1197.307	521.766
840	859.8	1197.705	520.066
830	849.8	1198.005	518.366
820	839.8	1198.206	516.666
810	829.8	1198.506	514.966
800	819.8	1198.806	513.265
790	809.8	1199.106	511.565
780	799.8	1199.405	509.765
770	789.8	1199.705	508.064

Table 2C, Main Steam Enthalpies with Pressure Uncertainty Applied in Negative Direction

Determined from interpolation of Table 2A

P_{STM}, PSIA	$P_{FW} - U_{PFW}$, PSIA	$h_{GS\varepsilon-}$, BTU/lbm	$h_{FS\varepsilon-}$, BTU/lbm
870	850.2	1197.993	518.434
860	840.2	1198.195	516.734
850	830.2	1198.495	515.034
840	820.2	1198.794	513.334
830	810.2	1199.094	511.634
820	800.2	1199.394	509.835
810	790.2	1199.694	508.135
800	780.2	1199.895	506.335
790	770.2	1200.195	504.536
780	760.2	1200.395	502.736
770	750.2	1200.695	500.936

Table 2D, Main Steam Enthalpies with Positive Bias Applied

Determined from interpolation of Table 2A

P_{STM}, PSIA	$P_{FW} + B_{PFW}$, PSIA	$h_{GS\varepsilon+}$, BTU/lbm	$h_{FS\varepsilon+}$, BTU/lbm
870	873.4	1197.198	522.344
860	863.4	1197.564	520.678
850	853.4	1197.898	518.978
840	843.4	1198.132	517.278
830	833.4	1198.398	515.578
820	823.4	1198.698	513.878
810	813.4	1198.998	512.178
800	803.4	1199.298	510.412
790	793.4	1199.598	508.678
780	783.4	1199.832	506.912
770	773.4	1200.098	505.112

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Tables 3A1 through 3C2, Feedwater Flow Contribution to Calorimetric Uncertainty, $U_{CAL-MFW} = U_{MFW}(h_{GS} - h_{FW})$, Step 7.6.5

Table 3A1, Feedwater Flow Independent Contribution to Calorimetric Uncertainty, Unit 1

P_{STM}	870										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-25516293	-25516106	-25515919	-25515732	-25515545	-25515359	-25515172	-25514985	-25514798	-25514611	-25514424
450	-25591283	-25591082	-25590882	-25590682	-25590482	-25590282	-25590081	-25589881	-25589681	-25589481	-25589280
448	-25665498	-25665298	-25665098	-25664898	-25664684	-25664470	-25664257	-25664043	-25663830	-25663629	-25663429
446	-25739714	-25739513	-25739313	-25739113	-25738886	-25738659	-25738432	-25738205	-25737978	-25737778	-25737578
444	-25813929	-25813729	-25813529	-25813329	-25813088	-25812848	-25812608	-25812368	-25812127	-25811927	-25811727
442	-25888145	-25887945	-25887744	-25887544	-25887291	-25887037	-25886783	-25886530	-25886276	-25886076	-25885876
440	-25962360	-25962160	-25961960	-25961760	-25961493	-25961226	-25960959	-25960692	-25960425	-25960225	-25960024
438	-26035949	-26035735	-26035521	-26035308	-26035041	-26034774	-26034507	-26034240	-26033973	-26033759	-26033546
436	-26109537	-26109310	-26109083	-26108856	-26108589	-26108322	-26108055	-26107788	-26107521	-26107294	-26107067
434	-26183125	-26182885	-26182644	-26182404	-26182137	-26181870	-26181603	-26181336	-26181069	-26180829	-26180589
432	-26256713	-26256459	-26256206	-26255952	-26255685	-26255418	-26255151	-26254884	-26254617	-26254364	-26254110
430	-26330301	-26330034	-26329767	-26329500	-26329233	-26328966	-26328700	-26328433	-26328166	-26327899	-26327632
428	-26403316	-26403049	-26402782	-26402515	-26402234	-26401954	-26401674	-26401393	-26401113	-26400833	-26400552
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21017055	-21016901	-21016747	-21016593	-21016439	-21016285	-21016131	-21015977	-21015823	-21015669	-21015515
450	-21078822	-21078657	-21078492	-21078327	-21078162	-21077997	-21077832	-21077667	-21077502	-21077337	-21077172
448	-21139951	-21139786	-21139621	-21139456	-21139280	-21139104	-21138928	-21138752	-21138577	-21138412	-21138247
446	-21201080	-21200915	-21200750	-21200585	-21200398	-21200212	-21200025	-21199838	-21199651	-21199486	-21199321
444	-21262209	-21262044	-21261880	-21261715	-21261517	-21261319	-21261121	-21260923	-21260725	-21260560	-21260395
442	-21323339	-21323174	-21323009	-21322844	-21322635	-21322426	-21322217	-21322008	-21321799	-21321635	-21321470
440	-21384468	-21384303	-21384138	-21383973	-21383753	-21383533	-21383314	-21383094	-21382874	-21382709	-21382544
438	-21445080	-21444905	-21444729	-21444553	-21444333	-21444113	-21443893	-21443673	-21443453	-21443277	-21443101
436	-21505693	-21505506	-21505319	-21505132	-21504912	-21504692	-21504473	-21504253	-21504033	-21503846	-21503659
434	-21566306	-21566108	-21565910	-21565712	-21565492	-21565272	-21565052	-21564832	-21564612	-21564414	-21564217
432	-21626918	-21626709	-21626500	-21626291	-21626071	-21625852	-21625632	-21625412	-21625192	-21624983	-21624774
430	-21687531	-21687311	-21687091	-21686871	-21686651	-21686431	-21686211	-21685991	-21685771	-21685552	-21685332
428	-21747670	-21747450	-21747231	-21747011	-21746780	-21746549	-21746318	-21746087	-21745856	-21745625	-21745394

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P_{STM}	860										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-25529641	-25529454	-25529267	-25529080	-25528894	-25528707	-25528520	-25528333	-25528146	-25527959	-25527772
450	-25604631	-25604431	-25604230	-25604030	-25603830	-25603630	-25603429	-25603229	-25603029	-25602829	-25602629
448	-25678846	-25678646	-25678446	-25678246	-25678032	-25677818	-25677605	-25677391	-25677178	-25676978	-25676777
446	-25753062	-25752862	-25752661	-25752461	-25752234	-25752007	-25751780	-25751554	-25751327	-25751126	-25750926
444	-25827277	-25827077	-25826877	-25826677	-25826436	-25826196	-25825956	-25825716	-25825475	-25825275	-25825075
442	-25901493	-25901293	-25901092	-25900892	-25900639	-25900385	-25900131	-25899878	-25899624	-25899424	-25899224
440	-25975708	-25975508	-25975308	-25975108	-25974841	-25974574	-25974307	-25974040	-25973773	-25973573	-25973373
438	-26049297	-26049083	-26048870	-26048656	-26048389	-26048122	-26047855	-26047588	-26047321	-26047108	-26046894
436	-26122885	-26122658	-26122431	-26122204	-26121937	-26121670	-26121403	-26121136	-26120869	-26120642	-26120415
434	-26196473	-26196233	-26195993	-26195752	-26195485	-26195218	-26194951	-26194684	-26194417	-26194177	-26193937
432	-26270061	-26269808	-26269554	-26269300	-26269033	-26268766	-26268499	-26268233	-26267966	-26267712	-26267458
430	-26343649	-26343382	-26343115	-26342849	-26342582	-26342315	-26342048	-26341781	-26341514	-26341247	-26340980
428	-26416664	-26416397	-26416130	-26415863	-26415582	-26415302	-26415022	-26414741	-26414461	-26414181	-26413901
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21028049	-21027895	-21027741	-21027587	-21027433	-21027280	-21027126	-21026972	-21026818	-21026664	-21026510
450	-21089816	-21089651	-21089486	-21089321	-21089156	-21088991	-21088827	-21088662	-21088497	-21088332	-21088167
448	-21150945	-21150780	-21150616	-21150451	-21150275	-21150099	-21149923	-21149747	-21149571	-21149406	-21149241
446	-21212075	-21211910	-21211745	-21211580	-21211393	-21211206	-21211019	-21210832	-21210645	-21210480	-21210315
444	-21273204	-21273039	-21272874	-21272709	-21272511	-21272313	-21272115	-21271918	-21271720	-21271555	-21271390
442	-21334333	-21334168	-21334003	-21333838	-21333629	-21333421	-21333212	-21333003	-21332794	-21332629	-21332464
440	-21395462	-21395297	-21395133	-21394968	-21394748	-21394528	-21394308	-21394088	-21393868	-21393703	-21393538
438	-21456075	-21455899	-21455723	-21455547	-21455327	-21455107	-21454888	-21454668	-21454448	-21454272	-21454096
436	-21516687	-21516501	-21516314	-21516127	-21515907	-21515687	-21515467	-21515247	-21515027	-21514840	-21514653
434	-21577300	-21577102	-21576904	-21576706	-21576486	-21576266	-21576047	-21575827	-21575607	-21575409	-21575211
432	-21637912	-21637704	-21637495	-21637286	-21637066	-21636846	-21636626	-21636406	-21636186	-21635977	-21635769
430	-21698525	-21698305	-21698085	-21697865	-21697645	-21697426	-21697206	-21696986	-21696766	-21696546	-21696326
428	-21758665	-21758445	-21758225	-21758005	-21757774	-21757543	-21757312	-21757082	-21756851	-21756620	-21756389

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	850										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-25539652	-25539465	-25539278	-25539091	-25538905	-25538718	-25538531	-25538344	-25538157	-25537970	-25537783
450	-25614642	-25614442	-25614241	-25614041	-25613841	-25613641	-25613441	-25613240	-25613040	-25612840	-25612640
448	-25688857	-25688657	-25688457	-25688257	-25688043	-25687830	-25687616	-25687402	-25687189	-25686989	-25686788
446	-25763073	-25762873	-25762672	-25762472	-25762245	-25762018	-25761792	-25761565	-25761338	-25761137	-25760937
444	-25837288	-25837088	-25836888	-25836688	-25836448	-25836207	-25835967	-25835727	-25835486	-25835286	-25835086
442	-25911504	-25911304	-25911104	-25910903	-25910650	-25910396	-25910143	-25909889	-25909635	-25909435	-25909235
440	-25985720	-25985519	-25985319	-25985119	-25984852	-25984585	-25984318	-25984051	-25983784	-25983584	-25983384
438	-26059308	-26059094	-26058881	-26058667	-26058400	-26058133	-26057866	-26057599	-26057332	-26057119	-26056905
436	-26132896	-26132669	-26132442	-26132215	-26131948	-26131681	-26131414	-26131147	-26130880	-26130653	-26130427
434	-26206484	-26206244	-26206004	-26205763	-26205496	-26205229	-26204962	-26204695	-26204429	-26204188	-26203948
432	-26280072	-26279819	-26279565	-26279311	-26279045	-26278778	-26278511	-26278244	-26277977	-26277723	-26277469
430	-26353661	-26353394	-26353127	-26352860	-26352593	-26352326	-26352059	-26351792	-26351525	-26351258	-26350991
428	-26426675	-26426408	-26426141	-26425874	-26425594	-26425313	-26425033	-26424753	-26424472	-26424192	-26423912
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21036295	-21036141	-21035987	-21035833	-21035679	-21035525	-21035371	-21035218	-21035064	-21034910	-21034756
450	-21098062	-21097897	-21097732	-21097567	-21097402	-21097237	-21097072	-21096908	-21096743	-21096578	-21096413
448	-21159191	-21159026	-21158861	-21158696	-21158521	-21158345	-21158169	-21157993	-21157817	-21157652	-21157487
446	-21220320	-21220156	-21219991	-21219826	-21219639	-21219452	-21219265	-21219078	-21218891	-21218726	-21218561
444	-21281450	-21281285	-21281120	-21280955	-21280757	-21280559	-21280361	-21280163	-21279965	-21279801	-21279636
442	-21342579	-21342414	-21342249	-21342084	-21341875	-21341666	-21341458	-21341249	-21341040	-21340875	-21340710
440	-21403708	-21403543	-21403378	-21403214	-21402994	-21402774	-21402554	-21402334	-21402114	-21401949	-21401784
438	-21464321	-21464145	-21463969	-21463793	-21463573	-21463353	-21463133	-21462913	-21462694	-21462518	-21462342
436	-21524933	-21524746	-21524559	-21524373	-21524153	-21523933	-21523713	-21523493	-21523273	-21523086	-21522899
434	-21585546	-21585348	-21585150	-21584952	-21584732	-21584512	-21584292	-21584073	-21583853	-21583655	-21583457
432	-21646158	-21645949	-21645741	-21645532	-21645312	-21645092	-21644872	-21644652	-21644432	-21644223	-21644014
430	-21706771	-21706551	-21706331	-21706111	-21705891	-21705671	-21705452	-21705232	-21705012	-21704792	-21704572
428	-21766911	-21766691	-21766471	-21766251	-21766020	-21765789	-21765558	-21765327	-21765097	-21764866	-21764635

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	840										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-25546326	-25546139	-25545952	-25545766	-25545579	-25545392	-25545205	-25545018	-25544831	-25544644	-25544457
450	-25621316	-25621116	-25620915	-25620715	-25620515	-25620315	-25620115	-25619914	-25619714	-25619514	-25619314
448	-25695531	-25695331	-25695131	-25694931	-25694717	-25694504	-25694290	-25694076	-25693863	-25693663	-25693462
446	-25769747	-25769547	-25769347	-25769146	-25768919	-25768692	-25768466	-25768239	-25768012	-25767812	-25767611
444	-25843963	-25843762	-25843562	-25843362	-25843122	-25842881	-25842641	-25842401	-25842161	-25841960	-25841760
442	-25918178	-25917978	-25917778	-25917577	-25917324	-25917070	-25916817	-25916563	-25916309	-25916109	-25915909
440	-25992394	-25992193	-25991993	-25991793	-25991526	-25991259	-25990992	-25990725	-25990458	-25990258	-25990058
438	-26065982	-26065768	-26065555	-26065341	-26065074	-26064807	-26064540	-26064273	-26064006	-26063793	-26063579
436	-26139570	-26139343	-26139116	-26138889	-26138622	-26138355	-26138088	-26137821	-26137554	-26137328	-26137101
434	-26213158	-26212918	-26212678	-26212437	-26212170	-26211903	-26211637	-26211370	-26211103	-26210862	-26210622
432	-26286746	-26286493	-26286239	-26285986	-26285719	-26285452	-26285185	-26284918	-26284651	-26284397	-26284143
430	-26360335	-26360068	-26359801	-26359534	-26359267	-26359000	-26358733	-26358466	-26358199	-26357932	-26357665
428	-26433349	-26433082	-26432815	-26432548	-26432268	-26431987	-26431707	-26431427	-26431146	-26430866	-26430586
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21041792	-21041638	-21041484	-21041330	-21041177	-21041023	-21040869	-21040715	-21040561	-21040407	-21040253
450	-21103559	-21103394	-21103229	-21103064	-21102900	-21102735	-21102570	-21102405	-21102240	-21102075	-21101910
448	-21164688	-21164524	-21164359	-21164194	-21164018	-21163842	-21163666	-21163490	-21163314	-21163149	-21162984
446	-21225818	-21225653	-21225488	-21225323	-21225136	-21224949	-21224762	-21224575	-21224388	-21224224	-21224059
444	-21286947	-21286782	-21286617	-21286452	-21286254	-21286056	-21285859	-21285661	-21285463	-21285298	-21285133
442	-21348076	-21347911	-21347746	-21347581	-21347373	-21347164	-21346955	-21346746	-21346537	-21346372	-21346207
440	-21409205	-21409041	-21408876	-21408711	-21408491	-21408271	-21408051	-21407831	-21407611	-21407446	-21407281
438	-21469818	-21469642	-21469466	-21469290	-21469070	-21468851	-21468631	-21468411	-21468191	-21468015	-21467839
436	-21530431	-21530244	-21530057	-21529870	-21529650	-21529430	-21529210	-21528990	-21528770	-21528583	-21528397
434	-21591043	-21590845	-21590647	-21590449	-21590229	-21590010	-21589790	-21589570	-21589350	-21589152	-21588954
432	-21651656	-21651447	-21651238	-21651029	-21650809	-21650589	-21650369	-21650149	-21649929	-21649721	-21649512
430	-21712268	-21712048	-21711828	-21711608	-21711389	-21711169	-21710949	-21710729	-21710509	-21710289	-21710069
428	-21772408	-21772188	-21771968	-21771748	-21771517	-21771286	-21771056	-21770825	-21770594	-21770363	-21770132

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	830										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-25556337	-25556150	-25555964	-25555777	-25555590	-25555403	-25555216	-25555029	-25554842	-25554655	-25554469
450	-25631327	-25631127	-25630927	-25630726	-25630526	-25630326	-25630126	-25629925	-25629725	-25629525	-25629325
448	-25705543	-25705342	-25705142	-25704942	-25704728	-25704515	-25704301	-25704088	-25703874	-25703674	-25703474
446	-25779758	-25779558	-25779358	-25779157	-25778930	-25778704	-25778477	-25778250	-25778023	-25777823	-25777622
444	-25853974	-25853773	-25853573	-25853373	-25853133	-25852892	-25852652	-25852412	-25852172	-25851971	-25851771
442	-25928189	-25927989	-25927789	-25927589	-25927335	-25927081	-25926828	-25926574	-25926320	-25926120	-25925920
440	-26002405	-26002205	-26002004	-26001804	-26001537	-26001270	-26001003	-26000736	-26000469	-26000269	-26000069
438	-26075993	-26075779	-26075566	-26075352	-26075085	-26074818	-26074551	-26074284	-26074017	-26073804	-26073590
436	-26149581	-26149354	-26149127	-26148900	-26148633	-26148366	-26148099	-26147832	-26147566	-26147339	-26147112
434	-26223169	-26222929	-26222689	-26222448	-26222182	-26221915	-26221648	-26221381	-26221114	-26220873	-26220633
432	-26296757	-26296504	-26296250	-26295997	-26295730	-26295463	-26295196	-26294929	-26294662	-26294408	-26294155
430	-26370346	-26370079	-26369812	-26369545	-26369278	-26369011	-26368744	-26368477	-26368210	-26367943	-26367676
428	-26443360	-26443093	-26442826	-26442559	-26442279	-26441998	-26441718	-26441438	-26441157	-26440877	-26440597
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21050038	-21049884	-21049730	-21049576	-21049422	-21049268	-21049115	-21048961	-21048807	-21048653	-21048499
450	-21111805	-21111640	-21111475	-21111310	-21111145	-21110980	-21110816	-21110651	-21110486	-21110321	-21110156
448	-21172934	-21172769	-21172604	-21172440	-21172264	-21172088	-21171912	-21171736	-21171560	-21171395	-21171230
446	-21234064	-21233899	-21233734	-21233569	-21233382	-21233195	-21233008	-21232821	-21232634	-21232469	-21232304
444	-21295193	-21295028	-21294863	-21294698	-21294500	-21294302	-21294104	-21293906	-21293709	-21293544	-21293379
442	-21356322	-21356157	-21355992	-21355827	-21355618	-21355410	-21355201	-21354992	-21354783	-21354618	-21354453
440	-21417451	-21417286	-21417122	-21416957	-21416737	-21416517	-21416297	-21416077	-21415857	-21415692	-21415527
438	-21478064	-21477888	-21477712	-21477536	-21477316	-21477096	-21476876	-21476657	-21476437	-21476261	-21476085
436	-21538676	-21538489	-21538303	-21538116	-21537896	-21537676	-21537456	-21537236	-21537016	-21536829	-21536642
434	-21599289	-21599091	-21598893	-21598695	-21598475	-21598255	-21598036	-21597816	-21597596	-21597398	-21597200
432	-21659901	-21659693	-21659484	-21659275	-21659055	-21658835	-21658615	-21658395	-21658175	-21657966	-21657758
430	-21720514	-21720294	-21720074	-21719854	-21719634	-21719415	-21719195	-21718975	-21718755	-21718535	-21718315
428	-21780654	-21780434	-21780214	-21779994	-21779763	-21779532	-21779301	-21779071	-21778840	-21778609	-21778378

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	820										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-25566348	-25566161	-25565975	-25565788	-25565601	-25565414	-25565227	-25565040	-25564853	-25564666	-25564480
450	-25641338	-25641138	-25640938	-25640737	-25640537	-25640337	-25640137	-25639937	-25639736	-25639536	-25639336
448	-25715554	-25715353	-25715153	-25714953	-25714739	-25714526	-25714312	-25714099	-25713885	-25713685	-25713485
446	-25789769	-25789569	-25789369	-25789169	-25788942	-25788715	-25788488	-25788261	-25788034	-25787834	-25787633
444	-25863985	-25863784	-25863584	-25863384	-25863144	-25862904	-25862663	-25862423	-25862183	-25861983	-25861782
442	-25938200	-25938000	-25937800	-25937600	-25937346	-25937092	-25936839	-25936585	-25936332	-25936131	-25935931
440	-26012416	-26012216	-26012015	-26011815	-26011548	-26011281	-26011014	-26010747	-26010480	-26010280	-26010080
438	-26086004	-26085790	-26085577	-26085363	-26085096	-26084829	-26084562	-26084295	-26084028	-26083815	-26083601
436	-26159592	-26159365	-26159138	-26158911	-26158644	-26158378	-26158111	-26157844	-26157577	-26157350	-26157123
434	-26233180	-26232940	-26232700	-26232460	-26232193	-26231926	-26231659	-26231392	-26231125	-26230884	-26230644
432	-26306769	-26306515	-26306261	-26306008	-26305741	-26305474	-26305207	-26304940	-26304673	-26304419	-26304166
430	-26380357	-26380090	-26379823	-26379556	-26379289	-26379022	-26378755	-26378488	-26378221	-26377954	-26377687
428	-26453371	-26453104	-26452837	-26452570	-26452290	-26452009	-26451729	-26451449	-26451169	-26450888	-26450608
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21058284	-21058130	-21057976	-21057822	-21057668	-21057514	-21057360	-21057206	-21057053	-21056899	-21056745
450	-21120051	-21119886	-21119721	-21119556	-21119391	-21119226	-21119061	-21118896	-21118732	-21118567	-21118402
448	-21181180	-21181015	-21180850	-21180685	-21180509	-21180334	-21180158	-21179982	-21179806	-21179641	-21179476
446	-21242309	-21242144	-21241980	-21241815	-21241628	-21241441	-21241254	-21241067	-21240880	-21240715	-21240550
444	-21303439	-21303274	-21303109	-21302944	-21302746	-21302548	-21302350	-21302152	-21301954	-21301790	-21301625
442	-21364568	-21364403	-21364238	-21364073	-21363864	-21363655	-21363446	-21363238	-21363029	-21362864	-21362699
440	-21425697	-21425532	-21425367	-21425202	-21424983	-21424763	-21424543	-21424323	-21424103	-21423938	-21423773
438	-21486310	-21486134	-21485958	-21485782	-21485562	-21485342	-21485122	-21484902	-21484683	-21484507	-21484331
436	-21546922	-21546735	-21546548	-21546362	-21546142	-21545922	-21545702	-21545482	-21545262	-21545075	-21544888
434	-21607535	-21607337	-21607139	-21606941	-21606721	-21606501	-21606281	-21606062	-21605842	-21605644	-21605446
432	-21668147	-21667938	-21667730	-21667521	-21667301	-21667081	-21666861	-21666641	-21666421	-21666212	-21666003
430	-21728760	-21728540	-21728320	-21728100	-21727880	-21727660	-21727440	-21727221	-21727001	-21726781	-21726561
428	-21788900	-21788680	-21788460	-21788240	-21788009	-21787778	-21787547	-21787316	-21787085	-21786855	-21786624

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	810										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr
452	-25576359	-25576173	-25575986	-25575799	-25575612	-25575425	-25575238	-25575051	-25574864	-25574678	-25574491
450	-25651349	-25651149	-25650949	-25650749	-25650548	-25650348	-25650148	-25649948	-25649747	-25649547	-25649347
448	-25725565	-25725364	-25725164	-25724964	-25724750	-25724537	-25724323	-25724110	-25723896	-25723696	-25723496
446	-25799780	-25799580	-25799380	-25799180	-25798953	-25798726	-25798499	-25798272	-25798045	-25797845	-25797645
444	-25873996	-25873796	-25873595	-25873395	-25873155	-25872915	-25872674	-25872434	-25872194	-25871994	-25871793
442	-25948211	-25948011	-25947811	-25947611	-25947357	-25947103	-25946850	-25946596	-25946343	-25946142	-25945942
440	-26022427	-26022227	-26022026	-26021826	-26021559	-26021292	-26021025	-26020758	-26020491	-26020291	-26020091
438	-26096015	-26095802	-26095588	-26095374	-26095107	-26094840	-26094573	-26094307	-26094040	-26093826	-26093612
436	-26169603	-26169376	-26169149	-26168923	-26168656	-26168389	-26168122	-26167855	-26167588	-26167361	-26167134
434	-26243191	-26242951	-26242711	-26242471	-26242204	-26241937	-26241670	-26241403	-26241136	-26240896	-26240655
432	-26316780	-26316526	-26316272	-26316019	-26315752	-26315485	-26315218	-26314951	-26314684	-26314430	-26314177
430	-26390368	-26390101	-26389834	-26389567	-26389300	-26389033	-26388766	-26388499	-26388232	-26387965	-26387698
428	-26463382	-26463115	-26462848	-26462581	-26462301	-26462021	-26461740	-26461460	-26461180	-26460899	-26460619
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr
452	-21066530	-21066376	-21066222	-21066068	-21065914	-21065760	-21065606	-21065452	-21065298	-21065144	-21064991
450	-21128297	-21128132	-21127967	-21127802	-21127637	-21127472	-21127307	-21127142	-21126977	-21126812	-21126648
448	-21189426	-21189261	-21189096	-21188931	-21188755	-21188579	-21188404	-21188228	-21188052	-21187887	-21187722
446	-21250555	-21250390	-21250225	-21250061	-21249874	-21249687	-21249500	-21249313	-21249126	-21248961	-21248796
444	-21311685	-21311520	-21311355	-21311190	-21310992	-21310794	-21310596	-21310398	-21310200	-21310035	-21309870
442	-21372814	-21372649	-21372484	-21372319	-21372110	-21371901	-21371692	-21371483	-21371275	-21371110	-21370945
440	-21433943	-21433778	-21433613	-21433448	-21433228	-21433009	-21432789	-21432569	-21432349	-21432184	-21432019
438	-21494556	-21494380	-21494204	-21494028	-21493808	-21493588	-21493368	-21493148	-21492928	-21492752	-21492577
436	-21555168	-21554981	-21554794	-21554607	-21554387	-21554168	-21553948	-21553728	-21553508	-21553321	-21553134
434	-21615781	-21615583	-21615385	-21615187	-21614967	-21614747	-21614527	-21614307	-21614087	-21613890	-21613692
432	-21676393	-21676184	-21675975	-21675766	-21675547	-21675327	-21675107	-21674887	-21674667	-21674458	-21674249
430	-21737006	-21736786	-21736566	-21736346	-21736126	-21735906	-21735686	-21735466	-21735247	-21735027	-21734807
428	-21797145	-21796926	-21796706	-21796486	-21796255	-21796024	-21795793	-21795562	-21795331	-21795100	-21794870

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	800										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-25586371	-25586184	-25585997	-25585810	-25585623	-25585436	-25585249	-25585062	-25584876	-25584689	-25584502
450	-25661360	-25661160	-25660960	-25660760	-25660559	-25660359	-25660159	-25659959	-25659758	-25659558	-25659358
448	-25735576	-25735376	-25735175	-25734975	-25734762	-25734548	-25734334	-25734121	-25733907	-25733707	-25733507
446	-25809791	-25809591	-25809391	-25809191	-25808964	-25808737	-25808510	-25808283	-25808056	-25807856	-25807656
444	-25884007	-25883807	-25883606	-25883406	-25883166	-25882926	-25882685	-25882445	-25882205	-25882005	-25881804
442	-25958222	-25958022	-25957822	-25957622	-25957368	-25957115	-25956861	-25956607	-25956354	-25956153	-25955953
440	-26032438	-26032238	-26032038	-26031837	-26031570	-26031303	-26031036	-26030769	-26030503	-26030302	-26030102
438	-26106026	-26105813	-26105599	-26105385	-26105119	-26104852	-26104585	-26104318	-26104051	-26103837	-26103624
436	-26179614	-26179387	-26179161	-26178934	-26178667	-26178400	-26178133	-26177866	-26177599	-26177372	-26177145
434	-26253203	-26252962	-26252722	-26252482	-26252215	-26251948	-26251681	-26251414	-26251147	-26250907	-26250666
432	-26326791	-26326537	-26326284	-26326030	-26325763	-26325496	-26325229	-26324962	-26324695	-26324441	-26324188
430	-26400379	-26400112	-26399845	-26399578	-26399311	-26399044	-26398777	-26398510	-26398243	-26397976	-26397709
428	-26473393	-26473126	-26472859	-26472592	-26472312	-26472032	-26471751	-26471471	-26471191	-26470910	-26470630
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810.	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21074776	-21074622	-21074468	-21074314	-21074160	-21074006	-21073852	-21073698	-21073544	-21073390	-21073236
450	-21136543	-21136378	-21136213	-21136048	-21135883	-21135718	-21135553	-21135388	-21135223	-21135058	-21134893
448	-21197672	-21197507	-21197342	-21197177	-21197001	-21196825	-21196649	-21196473	-21196298	-21196133	-21195968
446	-21258801	-21258636	-21258471	-21258306	-21258119	-21257933	-21257746	-21257559	-21257372	-21257207	-21257042
444	-21319930	-21319765	-21319601	-21319436	-21319238	-21319040	-21318842	-21318644	-21318446	-21318281	-21318116
442	-21381060	-21380895	-21380730	-21380565	-21380356	-21380147	-21379938	-21379729	-21379520	-21379355	-21379191
440	-21442189	-21442024	-21441859	-21441694	-21441474	-21441254	-21441034	-21440815	-21440595	-21440430	-21440265
438	-21502801	-21502626	-21502450	-21502274	-21502054	-21501834	-21501614	-21501394	-21501174	-21500998	-21500822
436	-21563414	-21563227	-21563040	-21562853	-21562633	-21562413	-21562194	-21561974	-21561754	-21561567	-21561380
434	-21624026	-21623829	-21623631	-21623433	-21623213	-21622993	-21622773	-21622553	-21622333	-21622135	-21621938
432	-21684639	-21684430	-21684221	-21684012	-21683792	-21683573	-21683353	-21683133	-21682913	-21682704	-21682495
430	-21745252	-21745032	-21744812	-21744592	-21744372	-21744152	-21743932	-21743712	-21743492	-21743273	-21743053
428	-21805391	-21805171	-21804952	-21804732	-21804501	-21804270	-21804039	-21803808	-21803577	-21803346	-21803115

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	780										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-25603056	-25602869	-25602682	-25602495	-25602308	-25602121	-25601934	-25601748	-25601561	-25601374	-25601187
450	-25678045	-25677845	-25677645	-25677445	-25677245	-25677044	-25676844	-25676644	-25676444	-25676243	-25676043
448	-25752261	-25752061	-25751861	-25751660	-25751447	-25751233	-25751020	-25750806	-25750592	-25750392	-25750192
446	-25826477	-25826276	-25826076	-25825876	-25825649	-25825422	-25825195	-25824968	-25824741	-25824541	-25824341
444	-25900692	-25900492	-25900292	-25900091	-25899851	-25899611	-25899371	-25899130	-25898890	-25898690	-25898490
442	-25974908	-25974707	-25974507	-25974307	-25974053	-25973800	-25973546	-25973292	-25973039	-25972839	-25972638
440	-26049123	-26048923	-26048723	-26048522	-26048256	-26047989	-26047722	-26047455	-26047188	-26046987	-26046787
438	-26122711	-26122498	-26122284	-26122071	-26121804	-26121537	-26121270	-26121003	-26120736	-26120522	-26120309
436	-26196300	-26196073	-26195846	-26195619	-26195352	-26195085	-26194818	-26194551	-26194284	-26194057	-26193830
434	-26269888	-26269647	-26269407	-26269167	-26268900	-26268633	-26268366	-26268099	-26267832	-26267592	-26267352
432	-26343476	-26343222	-26342969	-26342715	-26342448	-26342181	-26341914	-26341647	-26341380	-26341127	-26340873
430	-26417064	-26416797	-26416530	-26416263	-26415996	-26415729	-26415462	-26415195	-26414928	-26414661	-26414394
428	-26490078	-26489811	-26489544	-26489277	-26488997	-26488717	-26488436	-26488156	-26487876	-26487596	-26487315
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21088519	-21088365	-21088211	-21088057	-21087903	-21087749	-21087595	-21087441	-21087287	-21087133	-21086980
450	-21150286	-21150121	-21149956	-21149791	-21149626	-21149461	-21149296	-21149131	-21148966	-21148801	-21148637
448	-21211415	-21211250	-21211085	-21210920	-21210744	-21210568	-21210392	-21210217	-21210041	-21209876	-21209711
446	-21272544	-21272379	-21272214	-21272049	-21271863	-21271676	-21271489	-21271302	-21271115	-21270950	-21270785
444	-21333673	-21333509	-21333344	-21333179	-21332981	-21332783	-21332585	-21332387	-21332189	-21332024	-21331859
442	-21394803	-21394638	-21394473	-21394308	-21394099	-21393890	-21393681	-21393472	-21393264	-21393099	-21392934
440	-21455932	-21455767	-21455602	-21455437	-21455217	-21454997	-21454778	-21454558	-21454338	-21454173	-21454008
438	-21516545	-21516369	-21516193	-21516017	-21515797	-21515577	-21515357	-21515137	-21514917	-21514741	-21514566
436	-21577157	-21576970	-21576783	-21576596	-21576376	-21576157	-21575937	-21575717	-21575497	-21575310	-21575123
434	-21637770	-21637572	-21637374	-21637176	-21636956	-21636736	-21636516	-21636296	-21636076	-21635879	-21635681
432	-21698382	-21698173	-21697964	-21697755	-21697536	-21697316	-21697096	-21696876	-21696656	-21696447	-21696238
430	-21758995	-21758775	-21758555	-21758335	-21758115	-21757895	-21757675	-21757455	-21757236	-21757016	-21756796
428	-21819134	-21818914	-21818695	-21818475	-21818244	-21818013	-21817782	-21817551	-21817320	-21817089	-21816859

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	770										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-25613067	-25612880	-25612693	-25612506	-25612319	-25612132	-25611946	-25611759	-25611572	-25611385	-25611198
450	-25688056	-25687856	-25687656	-25687456	-25687256	-25687055	-25686855	-25686655	-25686455	-25686255	-25686054
448	-25762272	-25762072	-25761872	-25761671	-25761458	-25761244	-25761031	-25760817	-25760604	-25760403	-25760203
446	-25836488	-25836287	-25836087	-25835887	-25835660	-25835433	-25835206	-25834979	-25834752	-25834552	-25834352
444	-25910703	-25910503	-25910303	-25910102	-25909862	-25909622	-25909382	-25909141	-25908901	-25908701	-25908501
442	-25984919	-25984718	-25984518	-25984318	-25984064	-25983811	-25983557	-25983304	-25983050	-25982850	-25982650
440	-26059134	-26058934	-26058734	-26058534	-26058267	-26058000	-26057733	-26057466	-26057199	-26056999	-26056798
438	-26132722	-26132509	-26132295	-26132082	-26131815	-26131548	-26131281	-26131014	-26130747	-26130533	-26130320
436	-26206311	-26206084	-26205857	-26205630	-26205363	-26205096	-26204829	-26204562	-26204295	-26204068	-26203841
434	-26279899	-26279659	-26279418	-26279178	-26278911	-26278644	-26278377	-26278110	-26277843	-26277603	-26277363
432	-26353487	-26353233	-26352980	-26352726	-26352459	-26352192	-26351925	-26351658	-26351391	-26351138	-26350884
430	-26427075	-26426808	-26426541	-26426274	-26426007	-26425740	-26425473	-26425206	-26424939	-26424672	-26424406
428	-26500089	-26499822	-26499555	-26499288	-26499008	-26498728	-26498448	-26498167	-26497887	-26497607	-26497326
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21096765	-21096611	-21096457	-21096303	-21096149	-21095995	-21095841	-21095687	-21095533	-21095379	-21095225
450	-21158532	-21158367	-21158202	-21158037	-21157872	-21157707	-21157542	-21157377	-21157212	-21157047	-21156882
448	-21219661	-21219496	-21219331	-21219166	-21218990	-21218814	-21218638	-21218462	-21218286	-21218122	-21217957
446	-21280790	-21280625	-21280460	-21280295	-21280108	-21279921	-21279735	-21279548	-21279361	-21279196	-21279031
444	-21341919	-21341754	-21341589	-21341425	-21341227	-21341029	-21340831	-21340633	-21340435	-21340270	-21340105
442	-21403049	-21402884	-21402719	-21402554	-21402345	-21402136	-21401927	-21401718	-21401509	-21401344	-21401180
440	-21464178	-21464013	-21463848	-21463683	-21463463	-21463243	-21463023	-21462804	-21462584	-21462419	-21462254
438	-21524790	-21524614	-21524439	-21524263	-21524043	-21523823	-21523603	-21523383	-21523163	-21522987	-21522811
436	-21585403	-21585216	-21585029	-21584842	-21584622	-21584402	-21584183	-21583963	-21583743	-21583556	-21583369
434	-21646015	-21645818	-21645620	-21645422	-21645202	-21644982	-21644762	-21644542	-21644322	-21644124	-21643926
432	-21706628	-21706419	-21706210	-21706001	-21705781	-21705561	-21705342	-21705122	-21704902	-21704693	-21704484
430	-21767240	-21767021	-21766801	-21766581	-21766361	-21766141	-21765921	-21765701	-21765481	-21765261	-21765042
428	-21827380	-21827160	-21826940	-21826721	-21826490	-21826259	-21826028	-21825797	-21825566	-21825335	-21825104

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

Table 3A2, Feedwater Flow Independent Contribution to Calorimetric Uncertainty, Unit 2

P_{STM}	870										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21478393	-21478236	-21478078	-21477921	-21477764	-21477607	-21477449	-21477292	-21477135	-21476977	-21476820
450	-21541516	-21541347	-21541179	-21541010	-21540842	-21540673	-21540505	-21540336	-21540168	-21539999	-21539830
448	-21603987	-21603818	-21603650	-21603481	-21603302	-21603122	-21602942	-21602762	-21602582	-21602414	-21602245
446	-21666458	-21666289	-21666121	-21665952	-21665761	-21665570	-21665379	-21665188	-21664997	-21664829	-21664660
444	-21728929	-21728761	-21728592	-21728423	-21728221	-21728019	-21727817	-21727615	-21727412	-21727244	-21727075
442	-21791400	-21791232	-21791063	-21790895	-21790681	-21790468	-21790254	-21790041	-21789827	-21789659	-21789490
440	-21853871	-21853703	-21853534	-21853366	-21853141	-21852916	-21852692	-21852467	-21852242	-21852074	-21851905
438	-21915814	-21915635	-21915455	-21915275	-21915050	-21914826	-21914601	-21914376	-21914151	-21913972	-21913792
436	-21977757	-21977566	-21977375	-21977184	-21976960	-21976735	-21976510	-21976285	-21976061	-21975870	-21975679
434	-22039700	-22039498	-22039296	-22039094	-22038869	-22038644	-22038419	-22038195	-22037970	-22037768	-22037566
432	-22101643	-22101430	-22101216	-22101003	-22100778	-22100553	-22100329	-22100104	-22099879	-22099666	-22099452
430	-22163586	-22163362	-22163137	-22162912	-22162687	-22162463	-22162238	-22162013	-22161789	-22161564	-22161339
428	-22225046	-22224821	-22224597	-22224372	-22224136	-22223900	-22223664	-22223428	-22223192	-22222956	-22222720
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-22619849	-22619683	-22619518	-22619352	-22619186	-22619021	-22618855	-22618689	-22618524	-22618358	-22618192
450	-22686326	-22686149	-22685971	-22685794	-22685616	-22685439	-22685261	-22685084	-22684906	-22684729	-22684551
448	-22752117	-22751940	-22751762	-22751585	-22751395	-22751206	-22751017	-22750828	-22750638	-22750461	-22750283
446	-22817908	-22817731	-22817553	-22817376	-22817175	-22816974	-22816772	-22816571	-22816370	-22816193	-22816015
444	-22883699	-22883522	-22883344	-22883167	-22882954	-22882741	-22882528	-22882315	-22882102	-22881925	-22881747
442	-22949491	-22949313	-22949136	-22948958	-22948733	-22948508	-22948284	-22948059	-22947834	-22947656	-22947479
440	-23015282	-23015104	-23014927	-23014749	-23014512	-23014276	-23014039	-23013803	-23013566	-23013388	-23013211
438	-23080517	-23080327	-23080138	-23079949	-23079712	-23079475	-23079239	-23079002	-23078765	-23078576	-23078387
436	-23145751	-23145550	-23145349	-23145148	-23144911	-23144675	-23144438	-23144201	-23143965	-23143764	-23143562
434	-23210986	-23210773	-23210560	-23210347	-23210111	-23209874	-23209637	-23209401	-23209164	-23208951	-23208738
432	-23276221	-23275997	-23275772	-23275547	-23275310	-23275074	-23274837	-23274600	-23274364	-23274139	-23273914
430	-23341456	-23341220	-23340983	-23340746	-23340510	-23340273	-23340036	-23339800	-23339563	-23339326	-23339090
428	-23406182	-23405946	-23405709	-23405472	-23405224	-23404975	-23404727	-23404478	-23404230	-23403981	-23403733

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	860										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21489629	-21489472	-21489314	-21489157	-21489000	-21488842	-21488685	-21488528	-21488370	-21488213	-21488056
450	-21552752	-21552583	-21552415	-21552246	-21552077	-21551909	-21551740	-21551572	-21551403	-21551235	-21551066
448	-21615223	-21615054	-21614886	-21614717	-21614537	-21614358	-21614178	-21613998	-21613818	-21613650	-21613481
446	-21677694	-21677525	-21677357	-21677188	-21676997	-21676806	-21676615	-21676424	-21676233	-21676065	-21675896
444	-21740165	-21739996	-21739828	-21739659	-21739457	-21739255	-21739053	-21738850	-21738648	-21738480	-21738311
442	-21802636	-21802467	-21802299	-21802130	-21801917	-21801703	-21801490	-21801276	-21801063	-21800894	-21800726
440	-21865107	-21864939	-21864770	-21864601	-21864377	-21864152	-21863927	-21863703	-21863478	-21863309	-21863141
438	-21927050	-21926870	-21926691	-21926511	-21926286	-21926061	-21925837	-21925612	-21925387	-21925207	-21925028
436	-21988993	-21988802	-21988611	-21988420	-21988195	-21987971	-21987746	-21987521	-21987296	-21987105	-21986914
434	-22050936	-22050734	-22050532	-22050329	-22050105	-22049880	-22049655	-22049431	-22049206	-22049004	-22048801
432	-22112879	-22112666	-22112452	-22112239	-22112014	-22111789	-22111565	-22111340	-22111115	-22110902	-22110688
430	-22174822	-22174597	-22174373	-22174148	-22173923	-22173699	-22173474	-22173249	-22173024	-22172800	-22172575
428	-22236282	-22236057	-22235833	-22235608	-22235372	-22235136	-22234900	-22234664	-22234428	-22234192	-22233956
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-22631682	-22631516	-22631350	-22631185	-22631019	-22630853	-22630688	-22630522	-22630356	-22630191	-22630025
450	-22698159	-22697982	-22697804	-22697627	-22697449	-22697272	-22697094	-22696917	-22696739	-22696562	-22696384
448	-22763950	-22763773	-22763595	-22763418	-22763228	-22763039	-22762850	-22762660	-22762471	-22762294	-22762116
446	-22829741	-22829564	-22829386	-22829209	-22829008	-22828807	-22828605	-22828404	-22828203	-22828026	-22827848
444	-22895532	-22895355	-22895177	-22895000	-22894787	-22894574	-22894361	-22894148	-22893935	-22893757	-22893580
442	-22961323	-22961146	-22960968	-22960791	-22960566	-22960341	-22960117	-22959892	-22959667	-22959489	-22959312
440	-23027115	-23026937	-23026760	-23026582	-23026345	-23026109	-23025872	-23025635	-23025399	-23025221	-23025044
438	-23092349	-23092160	-23091971	-23091781	-23091545	-23091308	-23091072	-23090835	-23090598	-23090409	-23090220
436	-23157584	-23157383	-23157182	-23156981	-23156744	-23156508	-23156271	-23156034	-23155798	-23155596	-23155395
434	-23222819	-23222606	-23222393	-23222180	-23221944	-23221707	-23221470	-23221234	-23220997	-23220784	-23220571
432	-23288054	-23287829	-23287605	-23287380	-23287143	-23286906	-23286670	-23286433	-23286197	-23285972	-23285747
430	-23353289	-23353053	-23352816	-23352579	-23352343	-23352106	-23351869	-23351633	-23351396	-23351159	-23350923
428	-23418015	-23417779	-23417542	-23417305	-23417057	-23416808	-23416560	-23416311	-23416063	-23415814	-23415566

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	850										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21498056	-21497898	-21497741	-21497584	-21497427	-21497269	-21497112	-21496955	-21496797	-21496640	-21496483
450	-21561178	-21561010	-21560841	-21560673	-21560504	-21560336	-21560167	-21559999	-21559830	-21559662	-21559493
448	-21623650	-21623481	-21623312	-21623144	-21622964	-21622784	-21622605	-21622425	-21622245	-21622077	-21621908
446	-21686121	-21685952	-21685784	-21685615	-21685424	-21685233	-21685042	-21684851	-21684660	-21684491	-21684323
444	-21748592	-21748423	-21748255	-21748086	-21747884	-21747682	-21747479	-21747277	-21747075	-21746906	-21746738
442	-21811063	-21810894	-21810726	-21810557	-21810344	-21810130	-21809917	-21809703	-21809490	-21809321	-21809153
440	-21873534	-21873365	-21873197	-21873028	-21872804	-21872579	-21872354	-21872129	-21871905	-21871736	-21871568
438	-21935477	-21935297	-21935117	-21934938	-21934713	-21934488	-21934263	-21934039	-21933814	-21933634	-21933455
436	-21997420	-21997229	-21997038	-21996847	-21996622	-21996398	-21996173	-21995948	-21995723	-21995532	-21995341
434	-22059363	-22059161	-22058958	-22058756	-22058532	-22058307	-22058082	-22057857	-22057633	-22057430	-22057228
432	-22121306	-22121092	-22120879	-22120666	-22120441	-22120216	-22119991	-22119767	-22119542	-22119328	-22119115
430	-22183249	-22183024	-22182800	-22182575	-22182350	-22182125	-22181901	-22181676	-22181451	-22181227	-22181002
428	-22244709	-22244484	-22244259	-22244035	-22243799	-22243563	-22243327	-22243091	-22242855	-22242619	-22242383
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-22640556	-22640391	-22640225	-22640059	-22639894	-22639728	-22639562	-22639397	-22639231	-22639066	-22638900
450	-22707034	-22706856	-22706679	-22706501	-22706324	-22706146	-22705969	-22705791	-22705614	-22705436	-22705259
448	-22772825	-22772647	-22772470	-22772292	-22772103	-22771914	-22771724	-22771535	-22771346	-22771168	-22770991
446	-22838616	-22838439	-22838261	-22838084	-22837882	-22837681	-22837480	-22837279	-22837078	-22836900	-22836723
444	-22904407	-22904230	-22904052	-22903875	-22903662	-22903449	-22903236	-22903023	-22902810	-22902632	-22902455
442	-22970198	-22970021	-22969843	-22969666	-22969441	-22969216	-22968991	-22968766	-22968542	-22968364	-22968187
440	-23035989	-23035812	-23035634	-23035457	-23035220	-23034983	-23034747	-23034510	-23034273	-23034096	-23033918
438	-23101224	-23101035	-23100846	-23100656	-23100420	-23100183	-23099946	-23099710	-23099473	-23099284	-23099094
436	-23166459	-23166258	-23166057	-23165856	-23165619	-23165382	-23165146	-23164909	-23164672	-23164471	-23164270
434	-23231694	-23231481	-23231268	-23231055	-23230818	-23230582	-23230345	-23230108	-23229872	-23229659	-23229446
432	-23296929	-23296704	-23296479	-23296254	-23296018	-23295781	-23295545	-23295308	-23295071	-23294846	-23294622
430	-23362164	-23361927	-23361691	-23361454	-23361217	-23360981	-23360744	-23360507	-23360271	-23360034	-23359797
428	-23426890	-23426653	-23426417	-23426180	-23425932	-23425683	-23425435	-23425186	-23424938	-23424689	-23424441

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	830										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21512100	-21511943	-21511786	-21511629	-21511471	-21511314	-21511157	-21510999	-21510842	-21510685	-21510527
450	-21575223	-21575055	-21574886	-21574718	-21574549	-21574381	-21574212	-21574043	-21573875	-21573706	-21573538
448	-21637694	-21637526	-21637357	-21637189	-21637009	-21636829	-21636649	-21636470	-21636290	-21636121	-21635953
446	-21700165	-21699997	-21699828	-21699660	-21699469	-21699278	-21699087	-21698896	-21698705	-21698536	-21698368
444	-21762637	-21762468	-21762299	-21762131	-21761929	-21761726	-21761524	-21761322	-21761120	-21760951	-21760783
442	-21825108	-21824939	-21824771	-21824602	-21824389	-21824175	-21823962	-21823748	-21823535	-21823366	-21823198
440	-21887579	-21887410	-21887242	-21887073	-21886848	-21886624	-21886399	-21886174	-21885950	-21885781	-21885612
438	-21949522	-21949342	-21949162	-21948982	-21948758	-21948533	-21948308	-21948084	-21947859	-21947679	-21947499
436	-22011465	-22011274	-22011083	-22010892	-22010667	-22010442	-22010218	-22009993	-22009768	-22009577	-22009386
434	-22073408	-22073205	-22073003	-22072801	-22072576	-22072352	-22072127	-22071902	-22071677	-22071475	-22071273
432	-22135351	-22135137	-22134924	-22134710	-22134486	-22134261	-22134036	-22133811	-22133587	-22133373	-22133160
430	-22197294	-22197069	-22196844	-22196620	-22196395	-22196170	-22195945	-22195721	-22195496	-22195271	-22195047
428	-22258754	-22258529	-22258304	-22258079	-22257844	-22257608	-22257372	-22257136	-22256900	-22256664	-22256428
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-22655348	-22655182	-22655016	-22654851	-22654685	-22654519	-22654354	-22654188	-22654022	-22653857	-22653691
450	-22721825	-22721648	-22721470	-22721293	-22721115	-22720938	-22720760	-22720583	-22720405	-22720228	-22720050
448	-22787616	-22787439	-22787261	-22787084	-22786894	-22786705	-22786516	-22786326	-22786137	-22785959	-22785782
446	-22853407	-22853230	-22853052	-22852875	-22852674	-22852472	-22852271	-22852070	-22851869	-22851691	-22851514
444	-22919198	-22919021	-22918843	-22918666	-22918453	-22918240	-22918027	-22917814	-22917601	-22917423	-22917246
442	-22984989	-22984812	-22984634	-22984457	-22984232	-22984007	-22983782	-22983558	-22983333	-22983155	-22982978
440	-23050780	-23050603	-23050425	-23050248	-23050011	-23049775	-23049538	-23049301	-23049065	-23048887	-23048710
438	-23116015	-23115826	-23115637	-23115447	-23115211	-23114974	-23114737	-23114501	-23114264	-23114075	-23113885
436	-23181250	-23181049	-23180848	-23180647	-23180410	-23180173	-23179937	-23179700	-23179463	-23179262	-23179061
434	-23246485	-23246272	-23246059	-23245846	-23245610	-23245373	-23245136	-23244900	-23244663	-23244450	-23244237
432	-23311720	-23311495	-23311270	-23311046	-23310809	-23310572	-23310336	-23310099	-23309862	-23309638	-23309413
430	-23376955	-23376718	-23376482	-23376245	-23376008	-23375772	-23375535	-23375298	-23375062	-23374825	-23374588
428	-23441681	-23441445	-23441208	-23440971	-23440723	-23440474	-23440226	-23439977	-23439729	-23439480	-23439232

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	820										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21520527	-21520370	-21520213	-21520055	-21519898	-21519741	-21519584	-21519426	-21519269	-21519112	-21518954
450	-21583650	-21583482	-21583313	-21583144	-21582976	-21582807	-21582639	-21582470	-21582302	-21582133	-21581965
448	-21646121	-21645953	-21645784	-21645616	-21645436	-21645256	-21645076	-21644896	-21644717	-21644548	-21644380
446	-21708592	-21708424	-21708255	-21708087	-21707896	-21707705	-21707514	-21707323	-21707132	-21706963	-21706795
444	-21771063	-21770895	-21770726	-21770558	-21770356	-21770153	-21769951	-21769749	-21769547	-21769378	-21769209
442	-21833534	-21833366	-21833197	-21833029	-21832815	-21832602	-21832388	-21832175	-21831961	-21831793	-21831624
440	-21896006	-21895837	-21895668	-21895500	-21895275	-21895051	-21894826	-21894601	-21894376	-21894208	-21894039
438	-21957949	-21957769	-21957589	-21957409	-21957185	-21956960	-21956735	-21956510	-21956286	-21956106	-21955926
436	-22019892	-22019701	-22019510	-22019319	-22019094	-22018869	-22018644	-22018420	-22018195	-22018004	-22017813
434	-22081835	-22081632	-22081430	-22081228	-22081003	-22080778	-22080554	-22080329	-22080104	-22079902	-22079700
432	-22143778	-22143564	-22143351	-22143137	-22142912	-22142688	-22142463	-22142238	-22142014	-22141800	-22141587
430	-22205721	-22205496	-22205271	-22205046	-22204822	-22204597	-22204372	-22204148	-22203923	-22203698	-22203473
428	-22267180	-22266956	-22266731	-22266506	-22266270	-22266034	-22265798	-22265563	-22265327	-22265091	-22264855
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-22664222	-22664057	-22663891	-22663725	-22663560	-22663394	-22663228	-22663063	-22662897	-22662731	-22662566
450	-22730700	-22730522	-22730345	-22730167	-22729990	-22729812	-22729635	-22729457	-22729280	-22729102	-22728925
448	-22796491	-22796313	-22796136	-22795958	-22795769	-22795580	-22795390	-22795201	-22795012	-22794834	-22794657
446	-22862282	-22862104	-22861927	-22861749	-22861548	-22861347	-22861146	-22860945	-22860744	-22860566	-22860389
444	-22928073	-22927895	-22927718	-22927540	-22927327	-22927114	-22926901	-22926688	-22926475	-22926298	-22926121
442	-22993864	-22993687	-22993509	-22993332	-22993107	-22992882	-22992657	-22992432	-22992207	-22992030	-22991852
440	-23059655	-23059478	-23059300	-23059123	-23058886	-23058649	-23058413	-23058176	-23057939	-23057762	-23057584
438	-23124890	-23124701	-23124511	-23124322	-23124085	-23123849	-23123612	-23123375	-23123139	-23122949	-23122760
436	-23190125	-23189924	-23189723	-23189521	-23189285	-23189048	-23188812	-23188575	-23188338	-23188137	-23187936
434	-23255360	-23255147	-23254934	-23254721	-23254484	-23254248	-23254011	-23253774	-23253538	-23253325	-23253112
432	-23320595	-23320370	-23320145	-23319920	-23319684	-23319447	-23319210	-23318974	-23318737	-23318512	-23318287
430	-23385830	-23385593	-23385356	-23385120	-23384883	-23384646	-23384410	-23384173	-23383936	-23383700	-23383463
428	-23450556	-23450319	-23450083	-23449846	-23449597	-23449349	-23449100	-23448852	-23448603	-23448355	-23448106

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	810										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21528954	-21528797	-21528640	-21528482	-21528325	-21528168	-21528010	-21527853	-21527696	-21527538	-21527381
450	-21592077	-21591908	-21591740	-21591571	-21591403	-21591234	-21591066	-21590897	-21590729	-21590560	-21590392
448	-21654548	-21654380	-21654211	-21654042	-21653863	-21653683	-21653503	-21653323	-21653144	-21652975	-21652806
446	-21717019	-21716851	-21716682	-21716514	-21716323	-21716132	-21715940	-21715749	-21715558	-21715390	-21715221
444	-21779490	-21779322	-21779153	-21778985	-21778782	-21778580	-21778378	-21778176	-21777973	-21777805	-21777636
442	-21841961	-21841793	-21841624	-21841456	-21841242	-21841029	-21840815	-21840602	-21840388	-21840220	-21840051
440	-21904432	-21904264	-21904095	-21903927	-21903702	-21903477	-21903253	-21903028	-21902803	-21902635	-21902466
438	-21966375	-21966196	-21966016	-21965836	-21965611	-21965387	-21965162	-21964937	-21964713	-21964533	-21964353
436	-22028318	-22028127	-22027936	-22027745	-22027521	-22027296	-22027071	-22026847	-22026622	-22026431	-22026240
434	-22090261	-22090059	-22089857	-22089655	-22089430	-22089205	-22088981	-22088756	-22088531	-22088329	-22088127
432	-22152204	-22151991	-22151777	-22151564	-22151339	-22151115	-22150890	-22150665	-22150440	-22150227	-22150013
430	-22214147	-22213923	-22213698	-22213473	-22213249	-22213024	-22212799	-22212574	-22212350	-22212125	-22211900
428	-22275607	-22275383	-22275158	-22274933	-22274697	-22274461	-22274225	-22273989	-22273753	-22273517	-22273282
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-22673097	-22672931	-22672766	-22672600	-22672434	-22672269	-22672103	-22671937	-22671772	-22671606	-22671440
450	-22739574	-22739397	-22739219	-22739042	-22738864	-22738687	-22738509	-22738332	-22738154	-22737977	-22737799
448	-22805365	-22805188	-22805010	-22804833	-22804644	-22804454	-22804265	-22804076	-22803886	-22803709	-22803531
446	-22871157	-22870979	-22870802	-22870624	-22870423	-22870222	-22870021	-22869819	-22869618	-22869441	-22869263
444	-22936948	-22936770	-22936593	-22936415	-22936202	-22935989	-22935776	-22935563	-22935350	-22935173	-22934995
442	-23002739	-23002561	-23002384	-23002206	-23001981	-23001757	-23001532	-23001307	-23001082	-23000905	-23000727
440	-23068530	-23068352	-23068175	-23067997	-23067761	-23067524	-23067287	-23067051	-23066814	-23066637	-23066459
438	-23133765	-23133575	-23133386	-23133197	-23132960	-23132723	-23132487	-23132250	-23132013	-23131824	-23131635
436	-23199000	-23198798	-23198597	-23198396	-23198160	-23197923	-23197686	-23197450	-23197213	-23197012	-23196811
434	-23264235	-23264022	-23263809	-23263596	-23263359	-23263122	-23262886	-23262649	-23262412	-23262199	-23261986
432	-23329470	-23329245	-23329020	-23328795	-23328558	-23328322	-23328085	-23327848	-23327612	-23327387	-23327162
430	-23394704	-23394468	-23394231	-23393994	-23393758	-23393521	-23393285	-23393048	-23392811	-23392575	-23392338
428	-23459431	-23459194	-23458957	-23458721	-23458472	-23458224	-23457975	-23457727	-23457478	-23457230	-23456981

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	800										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21537381	-21537224	-21537066	-21536909	-21536752	-21536595	-21536437	-21536280	-21536123	-21535965	-21535808
450	-21600504	-21600335	-21600167	-21599998	-21599830	-21599661	-21599493	-21599324	-21599156	-21598987	-21598818
448	-21662975	-21662806	-21662638	-21662469	-21662290	-21662110	-21661930	-21661750	-21661570	-21661402	-21661233
446	-21725446	-21725277	-21725109	-21724940	-21724749	-21724558	-21724367	-21724176	-21723985	-21723817	-21723648
444	-21787917	-21787749	-21787580	-21787411	-21787209	-21787007	-21786805	-21786602	-21786400	-21786232	-21786063
442	-21850388	-21850220	-21850051	-21849883	-21849669	-21849456	-21849242	-21849029	-21848815	-21848647	-21848478
440	-21912859	-21912691	-21912522	-21912354	-21912129	-21911904	-21911680	-21911455	-21911230	-21911062	-21910893
438	-21974802	-21974623	-21974443	-21974263	-21974038	-21973814	-21973589	-21973364	-21973139	-21972960	-21972780
436	-22036745	-22036554	-22036363	-22036172	-22035948	-22035723	-22035498	-22035273	-22035049	-22034858	-22034667
434	-22098688	-22098486	-22098284	-22098082	-22097857	-22097632	-22097407	-22097183	-22096958	-22096756	-22096553
432	-22160631	-22160418	-22160204	-22159991	-22159766	-22159541	-22159317	-22159092	-22158867	-22158654	-22158440
430	-22222574	-22222350	-22222125	-22221900	-22221675	-22221451	-22221226	-22221001	-22220777	-22220552	-22220327
428	-22284034	-22283809	-22283585	-22283360	-22283124	-22282888	-22282652	-22282416	-22282180	-22281944	-22281708
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-22681972	-22681806	-22681640	-22681475	-22681309	-22681143	-22680978	-22680812	-22680646	-22680481	-22680315
450	-22748449	-22748272	-22748094	-22747917	-22747739	-22747562	-22747384	-22747207	-22747029	-22746852	-22746674
448	-22814240	-22814063	-22813885	-22813708	-22813518	-22813329	-22813140	-22812950	-22812761	-22812584	-22812406
446	-22880031	-22879854	-22879676	-22879499	-22879298	-22879096	-22878895	-22878694	-22878493	-22878315	-22878138
444	-22945822	-22945645	-22945467	-22945290	-22945077	-22944864	-22944651	-22944438	-22944225	-22944047	-22943870
442	-23011613	-23011436	-23011258	-23011081	-23010856	-23010631	-23010406	-23010182	-23009957	-23009779	-23009602
440	-23077404	-23077227	-23077050	-23076872	-23076635	-23076399	-23076162	-23075925	-23075689	-23075511	-23075334
438	-23142639	-23142450	-23142261	-23142071	-23141835	-23141598	-23141361	-23141125	-23140888	-23140699	-23140509
436	-23207874	-23207673	-23207472	-23207271	-23207034	-23206798	-23206561	-23206324	-23206088	-23205886	-23205685
434	-23273109	-23272896	-23272683	-23272470	-23272234	-23271997	-23271760	-23271524	-23271287	-23271074	-23270861
432	-23338344	-23338119	-23337895	-23337670	-23337433	-23337196	-23336960	-23336723	-23336486	-23336262	-23336037
430	-23403579	-23403342	-23403106	-23402869	-23402633	-23402396	-23402159	-23401923	-23401686	-23401449	-23401213
428	-23468305	-23468069	-23467832	-23467595	-23467347	-23467098	-23466850	-23466601	-23466353	-23466104	-23465856

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	790										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21545808	-21545651	-21545493	-21545336	-21545179	-21545021	-21544864	-21544707	-21544549	-21544392	-21544235
450	-21608931	-21608762	-21608594	-21608425	-21608257	-21608088	-21607919	-21607751	-21607582	-21607414	-21607245
448	-21671402	-21671233	-21671065	-21670896	-21670716	-21670537	-21670357	-21670177	-21669997	-21669829	-21669660
446	-21733873	-21733704	-21733536	-21733367	-21733176	-21732985	-21732794	-21732603	-21732412	-21732244	-21732075
444	-21796344	-21796175	-21796007	-21795838	-21795636	-21795434	-21795232	-21795029	-21794827	-21794659	-21794490
442	-21858815	-21858646	-21858478	-21858309	-21858096	-21857882	-21857669	-21857455	-21857242	-21857073	-21856905
440	-21921286	-21921118	-21920949	-21920781	-21920556	-21920331	-21920106	-21919882	-21919657	-21919488	-21919320
438	-21983229	-21983049	-21982870	-21982690	-21982465	-21982240	-21982016	-21981791	-21981566	-21981386	-21981207
436	-22045172	-22044981	-22044790	-22044599	-22044374	-22044150	-22043925	-22043700	-22043476	-22043285	-22043094
434	-22107115	-22106913	-22106711	-22106508	-22106284	-22106059	-22105834	-22105610	-22105385	-22105183	-22104980
432	-22169058	-22168845	-22168631	-22168418	-22168193	-22167968	-22167744	-22167519	-22167294	-22167081	-22166867
430	-22231001	-22230776	-22230552	-22230327	-22230102	-22229878	-22229653	-22229428	-22229203	-22228979	-22228754
428	-22292461	-22292236	-22292012	-22291787	-22291551	-22291315	-22291079	-22290843	-22290607	-22290371	-22290135
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-22690846	-22690681	-22690515	-22690349	-22690184	-22690018	-22689852	-22689687	-22689521	-22689355	-22689190
450	-22757324	-22757146	-22756969	-22756791	-22756614	-22756436	-22756259	-22756081	-22755904	-22755726	-22755549
448	-22823115	-22822937	-22822760	-22822582	-22822393	-22822204	-22822014	-22821825	-22821636	-22821458	-22821281
446	-22888906	-22888728	-22888551	-22888373	-22888172	-22887971	-22887770	-22887569	-22887368	-22887190	-22887013
444	-22954697	-22954520	-22954342	-22954165	-22953952	-22953739	-22953526	-22953313	-22953100	-22952922	-22952745
442	-23020488	-23020311	-23020133	-23019956	-23019731	-23019506	-23019281	-23019056	-23018831	-23018654	-23018477
440	-23086279	-23086102	-23085924	-23085747	-23085510	-23085273	-23085037	-23084800	-23084563	-23084386	-23084208
438	-23151514	-23151325	-23151135	-23150946	-23150709	-23150473	-23150236	-23150000	-23149763	-23149574	-23149384
436	-23216749	-23216548	-23216347	-23216146	-23215909	-23215672	-23215436	-23215199	-23214962	-23214761	-23214560
434	-23281984	-23281771	-23281558	-23281345	-23281108	-23280872	-23280635	-23280398	-23280162	-23279949	-23279736
432	-23347219	-23346994	-23346769	-23346544	-23346308	-23346071	-23345834	-23345598	-23345361	-23345136	-23344911
430	-23412454	-23412217	-23411981	-23411744	-23411507	-23411271	-23411034	-23410797	-23410561	-23410324	-23410087
428	-23477180	-23476943	-23476707	-23476470	-23476221	-23475973	-23475725	-23475476	-23475228	-23474979	-23474731

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	780										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr
452	-21551426	-21551268	-21551111	-21550954	-21550797	-21550639	-21550482	-21550325	-21550167	-21550010	-21549853
450	-21614549	-21614380	-21614211	-21614043	-21613874	-21613706	-21613537	-21613369	-21613200	-21613032	-21612863
448	-21677020	-21676851	-21676683	-21676514	-21676334	-21676155	-21675975	-21675795	-21675615	-21675447	-21675278
446	-21739491	-21739322	-21739154	-21738985	-21738794	-21738603	-21738412	-21738221	-21738030	-21737862	-21737693
444	-21801962	-21801793	-21801625	-21801456	-21801254	-21801052	-21800849	-21800647	-21800445	-21800276	-21800108
442	-21864433	-21864264	-21864096	-21863927	-21863714	-21863500	-21863287	-21863073	-21862860	-21862691	-21862523
440	-21926904	-21926735	-21926567	-21926398	-21926174	-21925949	-21925724	-21925500	-21925275	-21925106	-21924938
438	-21988847	-21988667	-21988487	-21988308	-21988083	-21987858	-21987634	-21987409	-21987184	-21987004	-21986825
436	-22050790	-22050599	-22050408	-22050217	-22049992	-22049768	-22049543	-22049318	-22049093	-22048902	-22048711
434	-22112733	-22112531	-22112329	-22112126	-22111902	-22111677	-22111452	-22111227	-22111003	-22110800	-22110598
432	-22174676	-22174463	-22174249	-22174036	-22173811	-22173586	-22173361	-22173137	-22172912	-22172699	-22172485
430	-22236619	-22236394	-22236170	-22235945	-22235720	-22235495	-22235271	-22235046	-22234821	-22234597	-22234372
428	-22298079	-22297854	-22297630	-22297405	-22297169	-22296933	-22296697	-22296461	-22296225	-22295989	-22295753
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr	$U_{MFW\text{-}IND}$, lbm/hr
452	-22696763	-22696597	-22696432	-22696266	-22696100	-22695935	-22695769	-22695603	-22695438	-22695272	-22695106
450	-22763240	-22763063	-22762885	-22762708	-22762530	-22762353	-22762175	-22761998	-22761820	-22761643	-22761465
448	-22829031	-22828854	-22828676	-22828499	-22828310	-22828120	-22827931	-22827742	-22827552	-22827375	-22827197
446	-22894822	-22894645	-22894467	-22894290	-22894089	-22893888	-22893686	-22893485	-22893284	-22893107	-22892929
444	-22960613	-22960436	-22960259	-22960081	-22959868	-22959655	-22959442	-22959229	-22959016	-22958839	-22958661
442	-23026405	-23026227	-23026050	-23025872	-23025647	-23025422	-23025198	-23024973	-23024748	-23024570	-23024393
440	-23092196	-23092018	-23091841	-23091663	-23091427	-23091190	-23090953	-23090717	-23090480	-23090302	-23090125
438	-23157431	-23157241	-23157052	-23156863	-23156626	-23156389	-23156153	-23155916	-23155679	-23155490	-23155301
436	-23222666	-23222464	-23222263	-23222062	-23221825	-23221589	-23221352	-23221115	-23220879	-23220678	-23220476
434	-23287900	-23287687	-23287474	-23287261	-23287025	-23286788	-23286551	-23286315	-23286078	-23285865	-23285652
432	-23353135	-23352911	-23352686	-23352461	-23352224	-23351988	-23351751	-23351514	-23351278	-23351053	-23350828
430	-23418370	-23418134	-23417897	-23417660	-23417424	-23417187	-23416950	-23416714	-23416477	-23416240	-23416004
428	-23483096	-23482860	-23482623	-23482386	-23482138	-23481889	-23481641	-23481392	-23481144	-23480896	-23480647

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	770										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-21559853	-21559695	-21559538	-21559381	-21559223	-21559066	-21558909	-21558752	-21558594	-21558437	-21558280
450	-21622975	-21622807	-21622638	-21622470	-21622301	-21622133	-21621964	-21621796	-21621627	-21621459	-21621290
448	-21685447	-21685278	-21685109	-21684941	-21684761	-21684581	-21684402	-21684222	-21684042	-21683874	-21683705
446	-21747918	-21747749	-21747581	-21747412	-21747221	-21747030	-21746839	-21746648	-21746457	-21746288	-21746120
444	-21810389	-21810220	-21810052	-21809883	-21809681	-21809479	-21809276	-21809074	-21808872	-21808703	-21808535
442	-21872860	-21872691	-21872523	-21872354	-21872141	-21871927	-21871714	-21871500	-21871287	-21871118	-21870950
440	-21935331	-21935162	-21934994	-21934825	-21934601	-21934376	-21934151	-21933926	-21933702	-21933533	-21933365
438	-21997274	-21997094	-21996914	-21996735	-21996510	-21996285	-21996060	-21995836	-21995611	-21995431	-21995251
436	-22059217	-22059026	-22058835	-22058644	-22058419	-22058194	-22057970	-22057745	-22057520	-22057329	-22057138
434	-22121160	-22120958	-22120755	-22120553	-22120328	-22120104	-22119879	-22119654	-22119430	-22119227	-22119025
432	-22183103	-22182889	-22182676	-22182462	-22182238	-22182013	-22181788	-22181564	-22181339	-22181125	-22180912
430	-22245046	-22244821	-22244596	-22244372	-22244147	-22243922	-22243698	-22243473	-22243248	-22243023	-22242799
428	-22306506	-22306281	-22306056	-22305832	-22305596	-22305360	-22305124	-22304888	-22304652	-22304416	-22304180
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-22705638	-22705472	-22705306	-22705141	-22704975	-22704809	-22704644	-22704478	-22704312	-22704147	-22703981
450	-22772115	-22771937	-22771760	-22771582	-22771405	-22771227	-22771050	-22770872	-22770695	-22770518	-22770340
448	-22837906	-22837729	-22837551	-22837374	-22837184	-22836995	-22836806	-22836616	-22836427	-22836249	-22836072
446	-22903697	-22903520	-22903342	-22903165	-22902963	-22902762	-22902561	-22902360	-22902159	-22901981	-22901804
444	-22969488	-22969311	-22969133	-22968956	-22968743	-22968530	-22968317	-22968104	-22967891	-22967713	-22967536
442	-23035279	-23035102	-23034924	-23034747	-23034522	-23034297	-23034072	-23033847	-23033623	-23033445	-23033268
440	-23101070	-23100893	-23100715	-23100538	-23100301	-23100065	-23099828	-23099591	-23099355	-23099177	-23099000
438	-23166305	-23166116	-23165927	-23165737	-23165501	-23165264	-23165027	-23164791	-23164554	-23164365	-23164175
436	-23231540	-23231339	-23231138	-23230937	-23230700	-23230463	-23230227	-23229990	-23229753	-23229552	-23229351
434	-23296775	-23296562	-23296349	-23296136	-23295900	-23295663	-23295426	-23295190	-23294953	-23294740	-23294527
432	-23362010	-23361785	-23361560	-23361336	-23361099	-23360862	-23360626	-23360389	-23360152	-23359927	-23359703
430	-23427245	-23427008	-23426772	-23426535	-23426298	-23426062	-23425825	-23425588	-23425352	-23425115	-23424878
428	-23491971	-23491734	-23491498	-23491261	-23491013	-23490764	-23490516	-23490267	-23490019	-23489770	-23489522

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

Table 3B1, Feedwater Flow Piping Configuration Contribution to Calorimetric Uncertainty, Unit 1

All Steam Pressures:

	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	0	0	0	0	0	0	0	0	0	0	0
450	0	0	0	0	0	0	0	0	0	0	0
448	0	0	0	0	0	0	0	0	0	0	0
446	0	0	0	0	0	0	0	0	0	0	0
444	0	0	0	0	0	0	0	0	0	0	0
442	0	0	0	0	0	0	0	0	0	0	0
440	0	0	0	0	0	0	0	0	0	0	0
438	0	0	0	0	0	0	0	0	0	0	0
436	0	0	0	0	0	0	0	0	0	0	0
434	0	0	0	0	0	0	0	0	0	0	0
432	0	0	0	0	0	0	0	0	0	0	0
430	0	0	0	0	0	0	0	0	0	0	0
428	0	0	0	0	0	0	0	0	0	0	0

	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	0	0	0	0	0	0	0	0	0	0	0
450	0	0	0	0	0	0	0	0	0	0	0
448	0	0	0	0	0	0	0	0	0	0	0
446	0	0	0	0	0	0	0	0	0	0	0
444	0	0	0	0	0	0	0	0	0	0	0
442	0	0	0	0	0	0	0	0	0	0	0
440	0	0	0	0	0	0	0	0	0	0	0
438	0	0	0	0	0	0	0	0	0	0	0
436	0	0	0	0	0	0	0	0	0	0	0
434	0	0	0	0	0	0	0	0	0	0	0
432	0	0	0	0	0	0	0	0	0	0	0
430	0	0	0	0	0	0	0	0	0	0	0
428	0	0	0	0	0	0	0	0	0	0	0

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

Table 3B2, Feedwater Flow Piping Configuration Contribution to Calorimetric Uncertainty, Unit 2

P_{STM}	870										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12708208	-12708115	-12708022	-12707929	-12707835	-12707742	-12707649	-12707556	-12707463	-12707370	-12707277
450	-12745556	-12745456	-12745356	-12745257	-12745157	-12745057	-12744958	-12744858	-12744758	-12744658	-12744559
448	-12782518	-12782419	-12782319	-12782219	-12782113	-12782006	-12781900	-12781794	-12781687	-12781588	-12781488
446	-12819481	-12819381	-12819281	-12819182	-12819069	-12818956	-12818843	-12818730	-12818617	-12818517	-12818417
444	-12856443	-12856344	-12856244	-12856144	-12856025	-12855905	-12855785	-12855666	-12855546	-12855446	-12855347
442	-12893406	-12893306	-12893207	-12893107	-12892980	-12892854	-12892728	-12892602	-12892475	-12892376	-12892276
440	-12930368	-12930269	-12930169	-12930069	-12929936	-12929803	-12929670	-12929537	-12929405	-12929305	-12929205
438	-12967019	-12966912	-12966806	-12966699	-12966566	-12966434	-12966301	-12966168	-12966035	-12965928	-12965822
436	-13003669	-13003556	-13003443	-13003330	-13003197	-13003064	-13002931	-13002798	-13002665	-13002552	-13002439
434	-13040319	-13040199	-13040079	-13039960	-13039827	-13039694	-13039561	-13039428	-13039295	-13039175	-13039056
432	-13076969	-13076842	-13076716	-13076590	-13076457	-13076324	-13076191	-13076058	-13075925	-13075799	-13075672
430	-13113619	-13113486	-13113353	-13113220	-13113087	-13112954	-13112821	-13112688	-13112555	-13112422	-13112289
428	-13149983	-13149850	-13149717	-13149584	-13149445	-13149305	-13149165	-13149026	-13148886	-13148747	-13148607
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12708208	-12708115	-12708022	-12707929	-12707835	-12707742	-12707649	-12707556	-12707463	-12707370	-12707277
450	-12745556	-12745456	-12745356	-12745257	-12745157	-12745057	-12744958	-12744858	-12744758	-12744658	-12744559
448	-12782518	-12782419	-12782319	-12782219	-12782113	-12782006	-12781900	-12781794	-12781687	-12781588	-12781488
446	-12819481	-12819381	-12819281	-12819182	-12819069	-12818956	-12818843	-12818730	-12818617	-12818517	-12818417
444	-12856443	-12856344	-12856244	-12856144	-12856025	-12855905	-12855785	-12855666	-12855546	-12855446	-12855347
442	-12893406	-12893306	-12893207	-12893107	-12892980	-12892854	-12892728	-12892602	-12892475	-12892376	-12892276
440	-12930368	-12930269	-12930169	-12930069	-12929936	-12929803	-12929670	-12929537	-12929405	-12929305	-12929205
438	-12967019	-12966912	-12966806	-12966699	-12966566	-12966434	-12966301	-12966168	-12966035	-12965928	-12965822
436	-13003669	-13003556	-13003443	-13003330	-13003197	-13003064	-13002931	-13002798	-13002665	-13002552	-13002439
434	-13040319	-13040199	-13040079	-13039960	-13039827	-13039694	-13039561	-13039428	-13039295	-13039175	-13039056
432	-13076969	-13076842	-13076716	-13076590	-13076457	-13076324	-13076191	-13076058	-13075925	-13075799	-13075672
430	-13113619	-13113486	-13113353	-13113220	-13113087	-13112954	-13112821	-13112688	-13112555	-13112422	-13112289
428	-13149983	-13149850	-13149717	-13149584	-13149445	-13149305	-13149165	-13149026	-13148886	-13148747	-13148607

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	860										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12714856	-12714763	-12714670	-12714576	-12714483	-12714390	-12714297	-12714204	-12714111	-12714018	-12713925
450	-12752204	-12752104	-12752004	-12751905	-12751805	-12751705	-12751605	-12751506	-12751406	-12751306	-12751207
448	-12789166	-12789067	-12788967	-12788867	-12788761	-12788654	-12788548	-12788442	-12788335	-12788236	-12788136
446	-12826129	-12826029	-12825929	-12825830	-12825717	-12825604	-12825491	-12825378	-12825265	-12825165	-12825065
444	-12863091	-12862992	-12862892	-12862792	-12862673	-12862553	-12862433	-12862314	-12862194	-12862094	-12861994
442	-12900054	-12899954	-12899854	-12899755	-12899628	-12899502	-12899376	-12899249	-12899123	-12899023	-12898924
440	-12937016	-12936917	-12936817	-12936717	-12936584	-12936451	-12936318	-12936185	-12936052	-12935953	-12935853
438	-12973666	-12973560	-12973454	-12973347	-12973214	-12973081	-12972949	-12972816	-12972683	-12972576	-12972470
436	-13010317	-13010204	-13010091	-13009978	-13009845	-13009712	-13009579	-13009446	-13009313	-13009200	-13009087
434	-13046967	-13046847	-13046727	-13046608	-13046475	-13046342	-13046209	-13046076	-13045943	-13045823	-13045704
432	-13083617	-13083490	-13083364	-13083238	-13083105	-13082972	-13082839	-13082706	-13082573	-13082447	-13082320
430	-13120267	-13120134	-13120001	-13119868	-13119735	-13119602	-13119469	-13119336	-13119203	-13119070	-13118937
428	-13156631	-13156498	-13156365	-13156232	-13156092	-13155953	-13155813	-13155674	-13155534	-13155394	-13155255

	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12714856	-12714763	-12714670	-12714576	-12714483	-12714390	-12714297	-12714204	-12714111	-12714018	-12713925
450	-12752204	-12752104	-12752004	-12751905	-12751805	-12751705	-12751605	-12751506	-12751406	-12751306	-12751207
448	-12789166	-12789067	-12788967	-12788867	-12788761	-12788654	-12788548	-12788442	-12788335	-12788236	-12788136
446	-12826129	-12826029	-12825929	-12825830	-12825717	-12825604	-12825491	-12825378	-12825265	-12825165	-12825065
444	-12863091	-12862992	-12862892	-12862792	-12862673	-12862553	-12862433	-12862314	-12862194	-12862094	-12861994
442	-12900054	-12899954	-12899854	-12899755	-12899628	-12899502	-12899376	-12899249	-12899123	-12899023	-12898924
440	-12937016	-12936917	-12936817	-12936717	-12936584	-12936451	-12936318	-12936185	-12936052	-12935953	-12935853
438	-12973666	-12973560	-12973454	-12973347	-12973214	-12973081	-12972949	-12972816	-12972683	-12972576	-12972470
436	-13010317	-13010204	-13010091	-13009978	-13009845	-13009712	-13009579	-13009446	-13009313	-13009200	-13009087
434	-13046967	-13046847	-13046727	-13046608	-13046475	-13046342	-13046209	-13046076	-13045943	-13045823	-13045704
432	-13083617	-13083490	-13083364	-13083238	-13083105	-13082972	-13082839	-13082706	-13082573	-13082447	-13082320
430	-13120267	-13120134	-13120001	-13119868	-13119735	-13119602	-13119469	-13119336	-13119203	-13119070	-13118937
428	-13156631	-13156498	-13156365	-13156232	-13156092	-13155953	-13155813	-13155674	-13155534	-13155394	-13155255

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	850										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12719842	-12719749	-12719655	-12719562	-12719469	-12719376	-12719283	-12719190	-12719097	-12719004	-12718911
450	-12757190	-12757090	-12756990	-12756891	-12756791	-12756691	-12756591	-12756492	-12756392	-12756292	-12756193
448	-12794152	-12794053	-12793953	-12793853	-12793747	-12793640	-12793534	-12793428	-12793321	-12793222	-12793122
446	-12831115	-12831015	-12830915	-12830816	-12830703	-12830590	-12830477	-12830364	-12830251	-12830151	-12830051
444	-12868077	-12867978	-12867878	-12867778	-12867658	-12867539	-12867419	-12867300	-12867180	-12867080	-12866980
442	-12905040	-12904940	-12904840	-12904741	-12904614	-12904488	-12904362	-12904235	-12904109	-12904009	-12903910
440	-12942002	-12941903	-12941803	-12941703	-12941570	-12941437	-12941304	-12941171	-12941038	-12940939	-12940839
438	-12978652	-12978546	-12978440	-12978333	-12978200	-12978067	-12977934	-12977802	-12977669	-12977562	-12977456
436	-13015303	-13015189	-13015076	-13014963	-13014831	-13014698	-13014565	-13014432	-13014299	-13014186	-13014073
434	-13051953	-13051833	-13051713	-13051594	-13051461	-13051328	-13051195	-13051062	-13050929	-13050809	-13050689
432	-13088603	-13088476	-13088350	-13088224	-13088091	-13087958	-13087825	-13087692	-13087559	-13087433	-13087306
430	-13125253	-13125120	-13124987	-13124854	-13124721	-13124588	-13124455	-13124322	-13124189	-13124056	-13123923
428	-13161617	-13161484	-13161351	-13161218	-13161078	-13160939	-13160799	-13160660	-13160520	-13160380	-13160241
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12719842	-12719749	-12719655	-12719562	-12719469	-12719376	-12719283	-12719190	-12719097	-12719004	-12718911
450	-12757190	-12757090	-12756990	-12756891	-12756791	-12756691	-12756591	-12756492	-12756392	-12756292	-12756193
448	-12794152	-12794053	-12793953	-12793853	-12793747	-12793640	-12793534	-12793428	-12793321	-12793222	-12793122
446	-12831115	-12831015	-12830915	-12830816	-12830703	-12830590	-12830477	-12830364	-12830251	-12830151	-12830051
444	-12868077	-12867978	-12867878	-12867778	-12867658	-12867539	-12867419	-12867300	-12867180	-12867080	-12866980
442	-12905040	-12904940	-12904840	-12904741	-12904614	-12904488	-12904362	-12904235	-12904109	-12904009	-12903910
440	-12942002	-12941903	-12941803	-12941703	-12941570	-12941437	-12941304	-12941171	-12941038	-12940939	-12940839
438	-12978652	-12978546	-12978440	-12978333	-12978200	-12978067	-12977934	-12977802	-12977669	-12977562	-12977456
436	-13015303	-13015189	-13015076	-13014963	-13014831	-13014698	-13014565	-13014432	-13014299	-13014186	-13014073
434	-13051953	-13051833	-13051713	-13051594	-13051461	-13051328	-13051195	-13051062	-13050929	-13050809	-13050689
432	-13088603	-13088476	-13088350	-13088224	-13088091	-13087958	-13087825	-13087692	-13087559	-13087433	-13087306
430	-13125253	-13125120	-13124987	-13124854	-13124721	-13124588	-13124455	-13124322	-13124189	-13124056	-13123923
428	-13161617	-13161484	-13161351	-13161218	-13161078	-13160939	-13160799	-13160660	-13160520	-13160380	-13160241

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	840										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12723166	-12723073	-12722979	-12722886	-12722793	-12722700	-12722607	-12722514	-12722421	-12722328	-12722235
450	-12760514	-12760414	-12760314	-12760215	-12760115	-12760015	-12759915	-12759816	-12759716	-12759616	-12759517
448	-12797476	-12797377	-12797277	-12797177	-12797071	-12796964	-12796858	-12796752	-12796645	-12796546	-12796446
446	-12834439	-12834339	-12834239	-12834140	-12834027	-12833914	-12833801	-12833688	-12833575	-12833475	-12833375
444	-12871401	-12871302	-12871202	-12871102	-12870982	-12870863	-12870743	-12870623	-12870504	-12870404	-12870304
442	-12908364	-12908264	-12908164	-12908065	-12907938	-12907812	-12907686	-12907559	-12907433	-12907333	-12907234
440	-12945326	-12945227	-12945127	-12945027	-12944894	-12944761	-12944628	-12944495	-12944362	-12944263	-12944163
438	-12981976	-12981870	-12981764	-12981657	-12981524	-12981391	-12981258	-12981125	-12980993	-12980886	-12980780
436	-13018626	-13018513	-13018400	-13018287	-13018154	-13018022	-13017889	-13017756	-13017623	-13017510	-13017397
434	-13055277	-13055157	-13055037	-13054918	-13054785	-13054652	-13054519	-13054386	-13054253	-13054133	-13054013
432	-13091927	-13091800	-13091674	-13091548	-13091415	-13091282	-13091149	-13091016	-13090883	-13090757	-13090630
430	-13128577	-13128444	-13128311	-13128178	-13128045	-13127912	-13127779	-13127646	-13127513	-13127380	-13127247
428	-13164941	-13164808	-13164675	-13164542	-13164402	-13164263	-13164123	-13163984	-13163844	-13163704	-13163565
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12723166	-12723073	-12722979	-12722886	-12722793	-12722700	-12722607	-12722514	-12722421	-12722328	-12722235
450	-12760514	-12760414	-12760314	-12760215	-12760115	-12760015	-12759915	-12759816	-12759716	-12759616	-12759517
448	-12797476	-12797377	-12797277	-12797177	-12797071	-12796964	-12796858	-12796752	-12796645	-12796546	-12796446
446	-12834439	-12834339	-12834239	-12834140	-12834027	-12833914	-12833801	-12833688	-12833575	-12833475	-12833375
444	-12871401	-12871302	-12871202	-12871102	-12870982	-12870863	-12870743	-12870623	-12870504	-12870404	-12870304
442	-12908364	-12908264	-12908164	-12908065	-12907938	-12907812	-12907686	-12907559	-12907433	-12907333	-12907234
440	-12945326	-12945227	-12945127	-12945027	-12944894	-12944761	-12944628	-12944495	-12944362	-12944263	-12944163
438	-12981976	-12981870	-12981764	-12981657	-12981524	-12981391	-12981258	-12981125	-12980993	-12980886	-12980780
436	-13018626	-13018513	-13018400	-13018287	-13018154	-13018022	-13017889	-13017756	-13017623	-13017510	-13017397
434	-13055277	-13055157	-13055037	-13054918	-13054785	-13054652	-13054519	-13054386	-13054253	-13054133	-13054013
432	-13091927	-13091800	-13091674	-13091548	-13091415	-13091282	-13091149	-13091016	-13090883	-13090757	-13090630
430	-13128577	-13128444	-13128311	-13128178	-13128045	-13127912	-13127779	-13127646	-13127513	-13127380	-13127247
428	-13164941	-13164808	-13164675	-13164542	-13164402	-13164263	-13164123	-13163984	-13163844	-13163704	-13163565

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	830										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12728152	-12728058	-12727965	-12727872	-12727779	-12727686	-12727593	-12727500	-12727407	-12727314	-12727221
450	-12765500	-12765400	-12765300	-12765201	-12765101	-12765001	-12764901	-12764802	-12764702	-12764602	-12764502
448	-12802462	-12802362	-12802263	-12802163	-12802057	-12801950	-12801844	-12801738	-12801631	-12801531	-12801432
446	-12839425	-12839325	-12839225	-12839126	-12839013	-12838900	-12838787	-12838673	-12838560	-12838461	-12838361
444	-12876387	-12876288	-12876188	-12876088	-12875968	-12875849	-12875729	-12875609	-12875490	-12875390	-12875290
442	-12913350	-12913250	-12913150	-12913051	-12912924	-12912798	-12912672	-12912545	-12912419	-12912319	-12912220
440	-12950312	-12950213	-12950113	-12950013	-12949880	-12949747	-12949614	-12949481	-12949348	-12949249	-12949149
438	-12986962	-12986856	-12986750	-12986643	-12986510	-12986377	-12986244	-12986111	-12985978	-12985872	-12985766
436	-13023612	-13023499	-13023386	-13023273	-13023140	-13023007	-13022875	-13022742	-13022609	-13022496	-13022383
434	-13060263	-13060143	-13060023	-13059904	-13059771	-13059638	-13059505	-13059372	-13059239	-13059119	-13058999
432	-13096913	-13096786	-13096660	-13096534	-13096401	-13096268	-13096135	-13096002	-13095869	-13095743	-13095616
430	-13133563	-13133430	-13133297	-13133164	-13133031	-13132898	-13132765	-13132632	-13132499	-13132366	-13132233
428	-13169927	-13169794	-13169661	-13169528	-13169388	-13169249	-13169109	-13168970	-13168830	-13168690	-13168551
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12728152	-12728058	-12727965	-12727872	-12727779	-12727686	-12727593	-12727500	-12727407	-12727314	-12727221
450	-12765500	-12765400	-12765300	-12765201	-12765101	-12765001	-12764901	-12764802	-12764702	-12764602	-12764502
448	-12802462	-12802362	-12802263	-12802163	-12802057	-12801950	-12801844	-12801738	-12801631	-12801531	-12801432
446	-12839425	-12839325	-12839225	-12839126	-12839013	-12838900	-12838787	-12838673	-12838560	-12838461	-12838361
444	-12876387	-12876288	-12876188	-12876088	-12875968	-12875849	-12875729	-12875609	-12875490	-12875390	-12875290
442	-12913350	-12913250	-12913150	-12913051	-12912924	-12912798	-12912672	-12912545	-12912419	-12912319	-12912220
440	-12950312	-12950213	-12950113	-12950013	-12949880	-12949747	-12949614	-12949481	-12949348	-12949249	-12949149
438	-12986962	-12986856	-12986750	-12986643	-12986510	-12986377	-12986244	-12986111	-12985978	-12985872	-12985766
436	-13023612	-13023499	-13023386	-13023273	-13023140	-13023007	-13022875	-13022742	-13022609	-13022496	-13022383
434	-13060263	-13060143	-13060023	-13059904	-13059771	-13059638	-13059505	-13059372	-13059239	-13059119	-13058999
432	-13096913	-13096786	-13096660	-13096534	-13096401	-13096268	-13096135	-13096002	-13095869	-13095743	-13095616
430	-13133563	-13133430	-13133297	-13133164	-13133031	-13132898	-13132765	-13132632	-13132499	-13132366	-13132233
428	-13169927	-13169794	-13169661	-13169528	-13169388	-13169249	-13169109	-13168970	-13168830	-13168690	-13168551

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	820										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12733138	-12733044	-12732951	-12732858	-12732765	-12732672	-12732579	-12732486	-12732393	-12732300	-12732207
450	-12770486	-12770386	-12770286	-12770186	-12770087	-12769987	-12769887	-12769788	-12769688	-12769588	-12769488
448	-12807448	-12807348	-12807249	-12807149	-12807043	-12806936	-12806830	-12806724	-12806617	-12806517	-12806418
446	-12844411	-12844311	-12844211	-12844112	-12843998	-12843885	-12843772	-12843659	-12843546	-12843447	-12843347
444	-12881373	-12881273	-12881174	-12881074	-12880954	-12880835	-12880715	-12880595	-12880476	-12880376	-12880276
442	-12918336	-12918236	-12918136	-12918037	-12917910	-12917784	-12917658	-12917531	-12917405	-12917305	-12917206
440	-12955298	-12955199	-12955099	-12954999	-12954866	-12954733	-12954600	-12954467	-12954334	-12954235	-12954135
438	-12991948	-12991842	-12991736	-12991629	-12991496	-12991363	-12991230	-12991097	-12990964	-12990858	-12990752
436	-13028598	-13028485	-13028372	-13028259	-13028126	-13027993	-13027860	-13027728	-13027595	-13027482	-13027369
434	-13065248	-13065129	-13065009	-13064889	-13064757	-13064624	-13064491	-13064358	-13064225	-13064105	-13063985
432	-13101899	-13101772	-13101646	-13101520	-13101387	-13101254	-13101121	-13100988	-13100855	-13100728	-13100602
430	-13138549	-13138416	-13138283	-13138150	-13138017	-13137884	-13137751	-13137618	-13137485	-13137352	-13137219
428	-13174913	-13174780	-13174647	-13174514	-13174374	-13174235	-13174095	-13173956	-13173816	-13173676	-13173537
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12733138	-12733044	-12732951	-12732858	-12732765	-12732672	-12732579	-12732486	-12732393	-12732300	-12732207
450	-12770486	-12770386	-12770286	-12770186	-12770087	-12769987	-12769887	-12769788	-12769688	-12769588	-12769488
448	-12807448	-12807348	-12807249	-12807149	-12807043	-12806936	-12806830	-12806724	-12806617	-12806517	-12806418
446	-12844411	-12844311	-12844211	-12844112	-12843998	-12843885	-12843772	-12843659	-12843546	-12843447	-12843347
444	-12881373	-12881273	-12881174	-12881074	-12880954	-12880835	-12880715	-12880595	-12880476	-12880376	-12880276
442	-12918336	-12918236	-12918136	-12918037	-12917910	-12917784	-12917658	-12917531	-12917405	-12917305	-12917206
440	-12955298	-12955199	-12955099	-12954999	-12954866	-12954733	-12954600	-12954467	-12954334	-12954235	-12954135
438	-12991948	-12991842	-12991736	-12991629	-12991496	-12991363	-12991230	-12991097	-12990964	-12990858	-12990752
436	-13028598	-13028485	-13028372	-13028259	-13028126	-13027993	-13027860	-13027728	-13027595	-13027482	-13027369
434	-13065248	-13065129	-13065009	-13064889	-13064757	-13064624	-13064491	-13064358	-13064225	-13064105	-13063985
432	-13101899	-13101772	-13101646	-13101520	-13101387	-13101254	-13101121	-13100988	-13100855	-13100728	-13100602
430	-13138549	-13138416	-13138283	-13138150	-13138017	-13137884	-13137751	-13137618	-13137485	-13137352	-13137219
428	-13174913	-13174780	-13174647	-13174514	-13174374	-13174235	-13174095	-13173956	-13173816	-13173676	-13173537

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	810										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12738123	-12738030	-12737937	-12737844	-12737751	-12737658	-12737565	-12737472	-12737379	-12737286	-12737193
450	-12775472	-12775372	-12775272	-12775172	-12775073	-12774973	-12774873	-12774774	-12774674	-12774574	-12774474
448	-12812434	-12812334	-12812235	-12812135	-12812029	-12811922	-12811816	-12811709	-12811603	-12811503	-12811404
446	-12849397	-12849297	-12849197	-12849097	-12848984	-12848871	-12848758	-12848645	-12848532	-12848433	-12848333
444	-12886359	-12886259	-12886160	-12886060	-12885940	-12885821	-12885701	-12885581	-12885462	-12885362	-12885262
442	-12923322	-12923222	-12923122	-12923023	-12922896	-12922770	-12922644	-12922517	-12922391	-12922291	-12922192
440	-12960284	-12960184	-12960085	-12959985	-12959852	-12959719	-12959586	-12959453	-12959320	-12959221	-12959121
438	-12996934	-12996828	-12996722	-12996615	-12996482	-12996349	-12996216	-12996083	-12995950	-12995844	-12995738
436	-13033584	-13033471	-13033358	-13033245	-13033112	-13032979	-13032846	-13032713	-13032580	-13032467	-13032354
434	-13070234	-13070115	-13069995	-13069875	-13069742	-13069609	-13069477	-13069344	-13069211	-13069091	-13068971
432	-13106884	-13106758	-13106632	-13106506	-13106373	-13106240	-13106107	-13105974	-13105841	-13105714	-13105588
430	-13143535	-13143402	-13143269	-13143136	-13143003	-13142870	-13142737	-13142604	-13142471	-13142338	-13142205
428	-13179899	-13179766	-13179633	-13179500	-13179360	-13179221	-13179081	-13178941	-13178802	-13178662	-13178523
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12738123	-12738030	-12737937	-12737844	-12737751	-12737658	-12737565	-12737472	-12737379	-12737286	-12737193
450	-12775472	-12775372	-12775272	-12775172	-12775073	-12774973	-12774873	-12774774	-12774674	-12774574	-12774474
448	-12812434	-12812334	-12812235	-12812135	-12812029	-12811922	-12811816	-12811709	-12811603	-12811503	-12811404
446	-12849397	-12849297	-12849197	-12849097	-12848984	-12848871	-12848758	-12848645	-12848532	-12848433	-12848333
444	-12886359	-12886259	-12886160	-12886060	-12885940	-12885821	-12885701	-12885581	-12885462	-12885362	-12885262
442	-12923322	-12923222	-12923122	-12923023	-12922896	-12922770	-12922644	-12922517	-12922391	-12922291	-12922192
440	-12960284	-12960184	-12960085	-12959985	-12959852	-12959719	-12959586	-12959453	-12959320	-12959221	-12959121
438	-12996934	-12996828	-12996722	-12996615	-12996482	-12996349	-12996216	-12996083	-12995950	-12995844	-12995738
436	-13033584	-13033471	-13033358	-13033245	-13033112	-13032979	-13032846	-13032713	-13032580	-13032467	-13032354
434	-13070234	-13070115	-13069995	-13069875	-13069742	-13069609	-13069477	-13069344	-13069211	-13069091	-13068971
432	-13106884	-13106758	-13106632	-13106506	-13106373	-13106240	-13106107	-13105974	-13105841	-13105714	-13105588
430	-13143535	-13143402	-13143269	-13143136	-13143003	-13142870	-13142737	-13142604	-13142471	-13142338	-13142205
428	-13179899	-13179766	-13179633	-13179500	-13179360	-13179221	-13179081	-13178941	-13178802	-13178662	-13178523

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	800										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12743109	-12743016	-12742923	-12742830	-12742737	-12742644	-12742551	-12742458	-12742365	-12742272	-12742179
450	-12780458	-12780358	-12780258	-12780158	-12780059	-12779959	-12779859	-12779759	-12779660	-12779560	-12779460
448	-12817420	-12817320	-12817221	-12817121	-12817015	-12816908	-12816802	-12816695	-12816589	-12816489	-12816390
446	-12854383	-12854283	-12854183	-12854083	-12853970	-12853857	-12853744	-12853631	-12853518	-12853419	-12853319
444	-12891345	-12891245	-12891146	-12891046	-12890926	-12890807	-12890687	-12890567	-12890448	-12890348	-12890248
442	-12928308	-12928208	-12928108	-12928008	-12927882	-12927756	-12927630	-12927503	-12927377	-12927277	-12927177
440	-12965270	-12965170	-12965071	-12964971	-12964838	-12964705	-12964572	-12964439	-12964306	-12964206	-12964107
438	-13001920	-13001814	-13001707	-13001601	-13001468	-13001335	-13001202	-13001069	-13000936	-13000830	-13000724
436	-13038570	-13038457	-13038344	-13038231	-13038098	-13037965	-13037832	-13037699	-13037566	-13037453	-13037340
434	-13075220	-13075101	-13074981	-13074861	-13074728	-13074595	-13074462	-13074330	-13074197	-13074077	-13073957
432	-13111870	-13111744	-13111618	-13111491	-13111359	-13111226	-13111093	-13110960	-13110827	-13110700	-13110574
430	-13148520	-13148388	-13148255	-13148122	-13147989	-13147856	-13147723	-13147590	-13147457	-13147324	-13147191
428	-13184885	-13184752	-13184619	-13184486	-13184346	-13184207	-13184067	-13183927	-13183788	-13183648	-13183509
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12743109	-12743016	-12742923	-12742830	-12742737	-12742644	-12742551	-12742458	-12742365	-12742272	-12742179
450	-12780458	-12780358	-12780258	-12780158	-12780059	-12779959	-12779859	-12779759	-12779660	-12779560	-12779460
448	-12817420	-12817320	-12817221	-12817121	-12817015	-12816908	-12816802	-12816695	-12816589	-12816489	-12816390
446	-12854383	-12854283	-12854183	-12854083	-12853970	-12853857	-12853744	-12853631	-12853518	-12853419	-12853319
444	-12891345	-12891245	-12891146	-12891046	-12890926	-12890807	-12890687	-12890567	-12890448	-12890348	-12890248
442	-12928308	-12928208	-12928108	-12928008	-12927882	-12927756	-12927630	-12927503	-12927377	-12927277	-12927177
440	-12965270	-12965170	-12965071	-12964971	-12964838	-12964705	-12964572	-12964439	-12964306	-12964206	-12964107
438	-13001920	-13001814	-13001707	-13001601	-13001468	-13001335	-13001202	-13001069	-13000936	-13000830	-13000724
436	-13038570	-13038457	-13038344	-13038231	-13038098	-13037965	-13037832	-13037699	-13037566	-13037453	-13037340
434	-13075220	-13075101	-13074981	-13074861	-13074728	-13074595	-13074462	-13074330	-13074197	-13074077	-13073957
432	-13111870	-13111744	-13111618	-13111491	-13111359	-13111226	-13111093	-13110960	-13110827	-13110700	-13110574
430	-13148520	-13148388	-13148255	-13148122	-13147989	-13147856	-13147723	-13147590	-13147457	-13147324	-13147191
428	-13184885	-13184752	-13184619	-13184486	-13184346	-13184207	-13184067	-13183927	-13183788	-13183648	-13183509

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	790										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12748095	-12748002	-12747909	-12747816	-12747723	-12747630	-12747537	-12747444	-12747351	-12747258	-12747165
450	-12785443	-12785344	-12785244	-12785144	-12785045	-12784945	-12784845	-12784745	-12784646	-12784546	-12784446
448	-12822406	-12822306	-12822207	-12822107	-12822000	-12821894	-12821788	-12821681	-12821575	-12821475	-12821376
446	-12859369	-12859269	-12859169	-12859069	-12858956	-12858843	-12858730	-12858617	-12858504	-12858405	-12858305
444	-12896331	-12896231	-12896132	-12896032	-12895912	-12895793	-12895673	-12895553	-12895434	-12895334	-12895234
442	-12933294	-12933194	-12933094	-12932994	-12932868	-12932742	-12932615	-12932489	-12932363	-12932263	-12932163
440	-12970256	-12970156	-12970057	-12969957	-12969824	-12969691	-12969558	-12969425	-12969292	-12969192	-12969093
438	-13006906	-13006800	-13006693	-13006587	-13006454	-13006321	-13006188	-13006055	-13005922	-13005816	-13005710
436	-13043556	-13043443	-13043330	-13043217	-13043084	-13042951	-13042818	-13042685	-13042552	-13042439	-13042326
434	-13080206	-13080087	-13079967	-13079847	-13079714	-13079581	-13079448	-13079315	-13079183	-13079063	-13078943
432	-13116856	-13116730	-13116604	-13116477	-13116344	-13116212	-13116079	-13115946	-13115813	-13115686	-13115560
430	-13153506	-13153373	-13153241	-13153108	-13152975	-13152842	-13152709	-13152576	-13152443	-13152310	-13152177
428	-13189871	-13189738	-13189605	-13189472	-13189332	-13189193	-13189053	-13188913	-13188774	-13188634	-13188495
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12748095	-12748002	-12747909	-12747816	-12747723	-12747630	-12747537	-12747444	-12747351	-12747258	-12747165
450	-12785443	-12785344	-12785244	-12785144	-12785045	-12784945	-12784845	-12784745	-12784646	-12784546	-12784446
448	-12822406	-12822306	-12822207	-12822107	-12822000	-12821894	-12821788	-12821681	-12821575	-12821475	-12821376
446	-12859369	-12859269	-12859169	-12859069	-12858956	-12858843	-12858730	-12858617	-12858504	-12858405	-12858305
444	-12896331	-12896231	-12896132	-12896032	-12895912	-12895793	-12895673	-12895553	-12895434	-12895334	-12895234
442	-12933294	-12933194	-12933094	-12932994	-12932868	-12932742	-12932615	-12932489	-12932363	-12932263	-12932163
440	-12970256	-12970156	-12970057	-12969957	-12969824	-12969691	-12969558	-12969425	-12969292	-12969192	-12969093
438	-13006906	-13006800	-13006693	-13006587	-13006454	-13006321	-13006188	-13006055	-13005922	-13005816	-13005710
436	-13043556	-13043443	-13043330	-13043217	-13043084	-13042951	-13042818	-13042685	-13042552	-13042439	-13042326
434	-13080206	-13080087	-13079967	-13079847	-13079714	-13079581	-13079448	-13079315	-13079183	-13079063	-13078943
432	-13116856	-13116730	-13116604	-13116477	-13116344	-13116212	-13116079	-13115946	-13115813	-13115686	-13115560
430	-13153506	-13153373	-13153241	-13153108	-13152975	-13152842	-13152709	-13152576	-13152443	-13152310	-13152177
428	-13189871	-13189738	-13189605	-13189472	-13189332	-13189193	-13189053	-13188913	-13188774	-13188634	-13188495

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	780										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12751419	-12751326	-12751233	-12751140	-12751047	-12750954	-12750861	-12750768	-12750675	-12750582	-12750489
450	-12788767	-12788668	-12788568	-12788468	-12788369	-12788269	-12788169	-12788069	-12787970	-12787870	-12787770
448	-12825730	-12825630	-12825531	-12825431	-12825324	-12825218	-12825112	-12825005	-12824899	-12824799	-12824700
446	-12862692	-12862593	-12862493	-12862393	-12862280	-12862167	-12862054	-12861941	-12861828	-12861729	-12861629
444	-12899655	-12899555	-12899456	-12899356	-12899236	-12899117	-12898997	-12898877	-12898758	-12898658	-12898558
442	-12936618	-12936518	-12936418	-12936318	-12936192	-12936066	-12935939	-12935813	-12935687	-12935587	-12935487
440	-12973580	-12973480	-12973381	-12973281	-12973148	-12973015	-12972882	-12972749	-12972616	-12972516	-12972417
438	-13010230	-13010124	-13010017	-13009911	-13009778	-13009645	-13009512	-13009379	-13009246	-13009140	-13009034
436	-13046880	-13046767	-13046654	-13046541	-13046408	-13046275	-13046142	-13046009	-13045876	-13045763	-13045650
434	-13083530	-13083411	-13083291	-13083171	-13083038	-13082905	-13082772	-13082639	-13082506	-13082387	-13082267
432	-13120180	-13120054	-13119928	-13119801	-13119668	-13119535	-13119403	-13119270	-13119137	-13119010	-13118884
430	-13156830	-13156697	-13156565	-13156432	-13156299	-13156166	-13156033	-13155900	-13155767	-13155634	-13155501
428	-13193195	-13193062	-13192929	-13192796	-13192656	-13192517	-13192377	-13192237	-13192098	-13191958	-13191819
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12751419	-12751326	-12751233	-12751140	-12751047	-12750954	-12750861	-12750768	-12750675	-12750582	-12750489
450	-12788767	-12788668	-12788568	-12788468	-12788369	-12788269	-12788169	-12788069	-12787970	-12787870	-12787770
448	-12825730	-12825630	-12825531	-12825431	-12825324	-12825218	-12825112	-12825005	-12824899	-12824799	-12824700
446	-12862692	-12862593	-12862493	-12862393	-12862280	-12862167	-12862054	-12861941	-12861828	-12861729	-12861629
444	-12899655	-12899555	-12899456	-12899356	-12899236	-12899117	-12898997	-12898877	-12898758	-12898658	-12898558
442	-12936618	-12936518	-12936418	-12936318	-12936192	-12936066	-12935939	-12935813	-12935687	-12935587	-12935487
440	-12973580	-12973480	-12973381	-12973281	-12973148	-12973015	-12972882	-12972749	-12972616	-12972516	-12972417
438	-13010230	-13010124	-13010017	-13009911	-13009778	-13009645	-13009512	-13009379	-13009246	-13009140	-13009034
436	-13046880	-13046767	-13046654	-13046541	-13046408	-13046275	-13046142	-13046009	-13045876	-13045763	-13045650
434	-13083530	-13083411	-13083291	-13083171	-13083038	-13082905	-13082772	-13082639	-13082506	-13082387	-13082267
432	-13120180	-13120054	-13119928	-13119801	-13119668	-13119535	-13119403	-13119270	-13119137	-13119010	-13118884
430	-13156830	-13156697	-13156565	-13156432	-13156299	-13156166	-13156033	-13155900	-13155767	-13155634	-13155501
428	-13193195	-13193062	-13192929	-13192796	-13192656	-13192517	-13192377	-13192237	-13192098	-13191958	-13191819

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	770										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12756405	-12756312	-12756219	-12756126	-12756033	-12755940	-12755847	-12755754	-12755661	-12755568	-12755475
450	-12793753	-12793654	-12793554	-12793454	-12793355	-12793255	-12793155	-12793055	-12792956	-12792856	-12792756
448	-12830716	-12830616	-12830516	-12830417	-12830310	-12830204	-12830098	-12829991	-12829885	-12829785	-12829685
446	-12867678	-12867579	-12867479	-12867379	-12867266	-12867153	-12867040	-12866927	-12866814	-12866714	-12866615
444	-12904641	-12904541	-12904442	-12904342	-12904222	-12904102	-12903983	-12903863	-12903743	-12903644	-12903544
442	-12941603	-12941504	-12941404	-12941304	-12941178	-12941052	-12940925	-12940799	-12940673	-12940573	-12940473
440	-12978566	-12978466	-12978367	-12978267	-12978134	-12978001	-12977868	-12977735	-12977602	-12977502	-12977403
438	-13015216	-13015110	-13015003	-13014897	-13014764	-13014631	-13014498	-13014365	-13014232	-13014126	-13014019
436	-13051866	-13051753	-13051640	-13051527	-13051394	-13051261	-13051128	-13050995	-13050862	-13050749	-13050636
434	-13088516	-13088397	-13088277	-13088157	-13088024	-13087891	-13087758	-13087625	-13087492	-13087373	-13087253
432	-13125166	-13125040	-13124914	-13124787	-13124654	-13124521	-13124388	-13124256	-13124123	-13123996	-13123870
430	-13161816	-13161683	-13161550	-13161417	-13161285	-13161152	-13161019	-13160886	-13160753	-13160620	-13160487
428	-13198181	-13198048	-13197915	-13197782	-13197642	-13197502	-13197363	-13197223	-13197084	-13196944	-13196804
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-12756405	-12756312	-12756219	-12756126	-12756033	-12755940	-12755847	-12755754	-12755661	-12755568	-12755475
450	-12793753	-12793654	-12793554	-12793454	-12793355	-12793255	-12793155	-12793055	-12792956	-12792856	-12792756
448	-12830716	-12830616	-12830516	-12830417	-12830310	-12830204	-12830098	-12829991	-12829885	-12829785	-12829685
446	-12867678	-12867579	-12867479	-12867379	-12867266	-12867153	-12867040	-12866927	-12866814	-12866714	-12866615
444	-12904641	-12904541	-12904442	-12904342	-12904222	-12904102	-12903983	-12903863	-12903743	-12903644	-12903544
442	-12941603	-12941504	-12941404	-12941304	-12941178	-12941052	-12940925	-12940799	-12940673	-12940573	-12940473
440	-12978566	-12978466	-12978367	-12978267	-12978134	-12978001	-12977868	-12977735	-12977602	-12977502	-12977403
438	-13015216	-13015110	-13015003	-13014897	-13014764	-13014631	-13014498	-13014365	-13014232	-13014126	-13014019
436	-13051866	-13051753	-13051640	-13051527	-13051394	-13051261	-13051128	-13050995	-13050862	-13050749	-13050636
434	-13088516	-13088397	-13088277	-13088157	-13088024	-13087891	-13087758	-13087625	-13087492	-13087373	-13087253
432	-13125166	-13125040	-13124914	-13124787	-13124654	-13124521	-13124388	-13124256	-13124123	-13123996	-13123870
430	-13161816	-13161683	-13161550	-13161417	-13161285	-13161152	-13161019	-13160886	-13160753	-13160620	-13160487
428	-13198181	-13198048	-13197915	-13197782	-13197642	-13197502	-13197363	-13197223	-13197084	-13196944	-13196804

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

Table 3C1, Feedwater Flow Temperature Contribution to Calorimetric Uncertainty, Unit 1

P_{STM}	870										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7628730	-7628674	-7628618	-7628562	-7628506	-7628450	-7628394	-7628338	-7628283	-7628227	-7628171
450	-7651150	-7651090	-7651030	-7650970	-7650910	-7650850	-7650790	-7650731	-7650671	-7650611	-7650551
448	-7673338	-7673278	-7673218	-7673159	-7673095	-7673031	-7672967	-7672903	-7672839	-7672779	-7672720
446	-7695527	-7695467	-7695407	-7695347	-7695279	-7695211	-7695144	-7695076	-7695008	-7694948	-7694888
444	-7717715	-7717655	-7717596	-7717536	-7717464	-7717392	-7717320	-7717248	-7717177	-7717117	-7717057
442	-7739904	-7739844	-7739784	-7739724	-7739648	-7739573	-7739497	-7739421	-7739345	-7739285	-7739225
440	-7762092	-7762033	-7761973	-7761913	-7761833	-7761753	-7761673	-7761594	-7761514	-7761454	-7761394
438	-7784093	-7784030	-7783966	-7783902	-7783822	-7783742	-7783662	-7783583	-7783503	-7783439	-7783375
436	-7806094	-7806027	-7805959	-7805891	-7805811	-7805731	-7805652	-7805572	-7805492	-7805424	-7805356
434	-7828096	-7828024	-7827952	-7827880	-7827800	-7827720	-7827641	-7827561	-7827481	-7827409	-7827337
432	-7850097	-7850021	-7849945	-7849869	-7849789	-7849709	-7849630	-7849550	-7849470	-7849394	-7849318
430	-7872098	-7872018	-7871938	-7871858	-7871778	-7871698	-7871619	-7871539	-7871459	-7871379	-7871299
428	-7893927	-7893847	-7893767	-7893688	-7893604	-7893520	-7893436	-7893352	-7893268	-7893185	-7893101
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7619217	-7619162	-7619106	-7619050	-7618994	-7618938	-7618883	-7618827	-7618771	-7618715	-7618659
450	-7641609	-7641550	-7641490	-7641430	-7641370	-7641311	-7641251	-7641191	-7641131	-7641071	-7641012
448	-7663770	-7663711	-7663651	-7663591	-7663527	-7663463	-7663400	-7663336	-7663272	-7663212	-7663153
446	-7685931	-7685872	-7685812	-7685752	-7685684	-7685616	-7685549	-7685481	-7685413	-7685353	-7685294
444	-7708092	-7708032	-7707973	-7707913	-7707841	-7707769	-7707698	-7707626	-7707554	-7707494	-7707435
442	-7730253	-7730193	-7730134	-7730074	-7729998	-7729922	-7729847	-7729771	-7729695	-7729635	-7729576
440	-7752414	-7752354	-7752294	-7752235	-7752155	-7752075	-7751996	-7751916	-7751836	-7751776	-7751717
438	-7774388	-7774324	-7774260	-7774196	-7774117	-7774037	-7773957	-7773877	-7773798	-7773734	-7773670
436	-7796361	-7796293	-7796226	-7796158	-7796078	-7795998	-7795919	-7795839	-7795759	-7795692	-7795624
434	-7818335	-7818263	-7818191	-7818120	-7818040	-7817960	-7817880	-7817801	-7817721	-7817649	-7817577
432	-7840308	-7840233	-7840157	-7840081	-7840001	-7839922	-7839842	-7839762	-7839683	-7839607	-7839531
430	-7862282	-7862202	-7862123	-7862043	-7861963	-7861883	-7861804	-7861724	-7861644	-7861565	-7861485
428	-7884084	-7884004	-7883925	-7883845	-7883761	-7883678	-7883594	-7883510	-7883426	-7883343	-7883259

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	860										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7632720	-7632664	-7632609	-7632553	-7632497	-7632441	-7632385	-7632329	-7632273	-7632217	-7632162
450	-7655140	-7655080	-7655021	-7654961	-7654901	-7654841	-7654781	-7654721	-7654661	-7654602	-7654542
448	-7677329	-7677269	-7677209	-7677149	-7677085	-7677022	-7676958	-7676894	-7676830	-7676770	-7676710
446	-7699517	-7699458	-7699398	-7699338	-7699270	-7699202	-7699134	-7699067	-7698999	-7698939	-7698879
444	-7721706	-7721646	-7721586	-7721526	-7721455	-7721383	-7721311	-7721239	-7721167	-7721107	-7721048
442	-7743895	-7743835	-7743775	-7743715	-7743639	-7743563	-7743488	-7743412	-7743336	-7743276	-7743216
440	-7766083	-7766023	-7765963	-7765904	-7765824	-7765744	-7765664	-7765584	-7765505	-7765445	-7765385
438	-7788084	-7788020	-7787957	-7787893	-7787813	-7787733	-7787653	-7787573	-7787494	-7787430	-7787366
436	-7810085	-7810017	-7809950	-7809882	-7809802	-7809722	-7809642	-7809562	-7809483	-7809415	-7809347
434	-7832086	-7832014	-7831943	-7831871	-7831791	-7831711	-7831631	-7831551	-7831472	-7831400	-7831328
432	-7854087	-7854011	-7853936	-7853860	-7853780	-7853700	-7853620	-7853541	-7853461	-7853385	-7853309
430	-7876088	-7876008	-7875929	-7875849	-7875769	-7875689	-7875609	-7875530	-7875450	-7875370	-7875290
428	-7897918	-7897838	-7897758	-7897678	-7897594	-7897511	-7897427	-7897343	-7897259	-7897175	-7897092
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7623203	-7623147	-7623092	-7623036	-7622980	-7622924	-7622868	-7622813	-7622757	-7622701	-7622645
450	-7645595	-7645535	-7645476	-7645416	-7645356	-7645296	-7645237	-7645177	-7645117	-7645057	-7644997
448	-7667756	-7667696	-7667637	-7667577	-7667513	-7667449	-7667385	-7667322	-7667258	-7667198	-7667138
446	-7689917	-7689857	-7689797	-7689738	-7689670	-7689602	-7689534	-7689467	-7689399	-7689339	-7689279
444	-7712078	-7712018	-7711958	-7711899	-7711827	-7711755	-7711683	-7711612	-7711540	-7711480	-7711420
442	-7734239	-7734179	-7734119	-7734060	-7733984	-7733908	-7733832	-7733757	-7733681	-7733621	-7733561
440	-7756400	-7756340	-7756280	-7756220	-7756141	-7756061	-7755981	-7755902	-7755822	-7755762	-7755702
438	-7778373	-7778310	-7778246	-7778182	-7778102	-7778023	-7777943	-7777863	-7777783	-7777720	-7777656
436	-7800347	-7800279	-7800211	-7800144	-7800064	-7799984	-7799905	-7799825	-7799745	-7799677	-7799610
434	-7822321	-7822249	-7822177	-7822105	-7822026	-7821946	-7821866	-7821786	-7821707	-7821635	-7821563
432	-7844294	-7844218	-7844143	-7844067	-7843987	-7843908	-7843828	-7843748	-7843668	-7843593	-7843517
430	-7866268	-7866188	-7866108	-7866029	-7865949	-7865869	-7865789	-7865710	-7865630	-7865550	-7865471
428	-7888070	-7887990	-7887910	-7887831	-7887747	-7887663	-7887580	-7887496	-7887412	-7887329	-7887245

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	850										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7635713	-7635657	-7635602	-7635546	-7635490	-7635434	-7635378	-7635322	-7635266	-7635210	-7635155
450	-7658133	-7658074	-7658014	-7657954	-7657894	-7657834	-7657774	-7657714	-7657654	-7657595	-7657535
448	-7680322	-7680262	-7680202	-7680142	-7680079	-7680015	-7679951	-7679887	-7679823	-7679763	-7679703
446	-7702511	-7702451	-7702391	-7702331	-7702263	-7702195	-7702127	-7702060	-7701992	-7701932	-7701872
444	-7724699	-7724639	-7724579	-7724520	-7724448	-7724376	-7724304	-7724232	-7724160	-7724100	-7724041
442	-7746888	-7746828	-7746768	-7746708	-7746632	-7746556	-7746481	-7746405	-7746329	-7746269	-7746209
440	-7769076	-7769016	-7768957	-7768897	-7768817	-7768737	-7768657	-7768577	-7768498	-7768438	-7768378
438	-7791077	-7791013	-7790950	-7790886	-7790806	-7790726	-7790646	-7790566	-7790487	-7790423	-7790359
436	-7813078	-7813010	-7812943	-7812875	-7812795	-7812715	-7812635	-7812556	-7812476	-7812408	-7812340
434	-7835079	-7835007	-7834936	-7834864	-7834784	-7834704	-7834624	-7834545	-7834465	-7834393	-7834321
432	-7857080	-7857005	-7856929	-7856853	-7856773	-7856693	-7856613	-7856534	-7856454	-7856378	-7856302
430	-7879081	-7879002	-7878922	-7878842	-7878762	-7878682	-7878602	-7878523	-7878443	-7878363	-7878283
428	-7900911	-7900831	-7900751	-7900671	-7900588	-7900504	-7900420	-7900336	-7900252	-7900168	-7900085
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7626192	-7626137	-7626081	-7626025	-7625969	-7625913	-7625858	-7625802	-7625746	-7625690	-7625634
450	-7648585	-7648525	-7648465	-7648405	-7648345	-7648286	-7648226	-7648166	-7648106	-7648046	-7647987
448	-7670745	-7670686	-7670626	-7670566	-7670502	-7670439	-7670375	-7670311	-7670247	-7670187	-7670128
446	-7692906	-7692847	-7692787	-7692727	-7692659	-7692592	-7692524	-7692456	-7692388	-7692328	-7692269
444	-7715067	-7715008	-7714948	-7714888	-7714816	-7714744	-7714673	-7714601	-7714529	-7714469	-7714410
442	-7737228	-7737168	-7737109	-7737049	-7736973	-7736897	-7736822	-7736746	-7736670	-7736610	-7736551
440	-7759389	-7759329	-7759270	-7759210	-7759130	-7759050	-7758971	-7758891	-7758811	-7758751	-7758692
438	-7781363	-7781299	-7781235	-7781171	-7781092	-7781012	-7780932	-7780853	-7780773	-7780709	-7780645
436	-7803336	-7803269	-7803201	-7803133	-7803053	-7802974	-7802894	-7802814	-7802734	-7802667	-7802599
434	-7825310	-7825238	-7825166	-7825095	-7825015	-7824935	-7824856	-7824776	-7824696	-7824624	-7824553
432	-7847283	-7847208	-7847132	-7847056	-7846977	-7846897	-7846817	-7846737	-7846658	-7846582	-7846506
430	-7869257	-7869177	-7869098	-7869018	-7868938	-7868858	-7868779	-7868699	-7868619	-7868540	-7868460
428	-7891059	-7890980	-7890900	-7890820	-7890736	-7890653	-7890569	-7890485	-7890402	-7890318	-7890234

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	840										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7637709	-7637653	-7637597	-7637541	-7637485	-7637429	-7637373	-7637318	-7637262	-7637206	-7637150
450	-7660129	-7660069	-7660009	-7659949	-7659889	-7659829	-7659770	-7659710	-7659650	-7659590	-7659530
448	-7682317	-7682257	-7682198	-7682138	-7682074	-7682010	-7681946	-7681882	-7681818	-7681759	-7681699
446	-7704506	-7704446	-7704386	-7704326	-7704258	-7704191	-7704123	-7704055	-7703987	-7703927	-7703867
444	-7726694	-7726635	-7726575	-7726515	-7726443	-7726371	-7726299	-7726228	-7726156	-7726096	-7726036
442	-7748883	-7748823	-7748763	-7748703	-7748628	-7748552	-7748476	-7748400	-7748324	-7748264	-7748205
440	-7771072	-7771012	-7770952	-7770892	-7770812	-7770732	-7770653	-7770573	-7770493	-7770433	-7770373
438	-7793073	-7793009	-7792945	-7792881	-7792801	-7792721	-7792642	-7792562	-7792482	-7792418	-7792354
436	-7815074	-7815006	-7814938	-7814870	-7814790	-7814711	-7814631	-7814551	-7814471	-7814403	-7814335
434	-7837075	-7837003	-7836931	-7836859	-7836779	-7836700	-7836620	-7836540	-7836460	-7836388	-7836316
432	-7859076	-7859000	-7858924	-7858848	-7858768	-7858689	-7858609	-7858529	-7858449	-7858373	-7858298
430	-7881077	-7880997	-7880917	-7880837	-7880757	-7880678	-7880598	-7880518	-7880438	-7880358	-7880279
428	-7902906	-7902826	-7902747	-7902667	-7902583	-7902499	-7902415	-7902331	-7902248	-7902164	-7902080
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7628185	-7628130	-7628074	-7628018	-7627962	-7627906	-7627851	-7627795	-7627739	-7627683	-7627627
450	-7650577	-7650518	-7650458	-7650398	-7650338	-7650279	-7650219	-7650159	-7650099	-7650039	-7649980
448	-7672738	-7672679	-7672619	-7672559	-7672495	-7672431	-7672368	-7672304	-7672240	-7672180	-7672121
446	-7694899	-7694840	-7694780	-7694720	-7694652	-7694584	-7694517	-7694449	-7694381	-7694321	-7694262
444	-7717060	-7717000	-7716941	-7716881	-7716809	-7716737	-7716666	-7716594	-7716522	-7716462	-7716403
442	-7739221	-7739161	-7739102	-7739042	-7738966	-7738890	-7738815	-7738739	-7738663	-7738603	-7738544
440	-7761382	-7761322	-7761262	-7761203	-7761123	-7761043	-7760964	-7760884	-7760804	-7760744	-7760685
438	-7783356	-7783292	-7783228	-7783164	-7783085	-7783005	-7782925	-7782845	-7782766	-7782702	-7782638
436	-7805329	-7805261	-7805194	-7805126	-7805046	-7804966	-7804887	-7804807	-7804727	-7804660	-7804592
434	-7827303	-7827231	-7827159	-7827088	-7827008	-7826928	-7826848	-7826769	-7826689	-7826617	-7826545
432	-7849276	-7849201	-7849125	-7849049	-7848969	-7848890	-7848810	-7848730	-7848651	-7848575	-7848499
430	-7871250	-7871170	-7871091	-7871011	-7870931	-7870851	-7870772	-7870692	-7870612	-7870533	-7870453
428	-7893052	-7892972	-7892893	-7892813	-7892729	-7892646	-7892562	-7892478	-7892394	-7892311	-7892227

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	830										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7640702	-7640646	-7640590	-7640534	-7640478	-7640422	-7640367	-7640311	-7640255	-7640199	-7640143
450	-7663122	-7663062	-7663002	-7662942	-7662882	-7662822	-7662763	-7662703	-7662643	-7662583	-7662523
448	-7685310	-7685251	-7685191	-7685131	-7685067	-7685003	-7684939	-7684875	-7684812	-7684752	-7684692
446	-7707499	-7707439	-7707379	-7707319	-7707252	-7707184	-7707116	-7707048	-7706980	-7706920	-7706860
444	-7729688	-7729628	-7729568	-7729508	-7729436	-7729364	-7729292	-7729221	-7729149	-7729089	-7729029
442	-7751876	-7751816	-7751756	-7751697	-7751621	-7751545	-7751469	-7751393	-7751317	-7751258	-7751198
440	-7774065	-7774005	-7773945	-7773885	-7773805	-7773725	-7773646	-7773566	-7773486	-7773426	-7773366
438	-7796066	-7796002	-7795938	-7795874	-7795794	-7795715	-7795635	-7795555	-7795475	-7795411	-7795347
436	-7818067	-7817999	-7817931	-7817863	-7817783	-7817704	-7817624	-7817544	-7817464	-7817396	-7817328
434	-7840068	-7839996	-7839924	-7839852	-7839772	-7839693	-7839613	-7839533	-7839453	-7839381	-7839310
432	-7862069	-7861993	-7861917	-7861841	-7861761	-7861682	-7861602	-7861522	-7861442	-7861366	-7861291
430	-7884070	-7883990	-7883910	-7883830	-7883751	-7883671	-7883591	-7883511	-7883431	-7883351	-7883272
428	-7905899	-7905819	-7905740	-7905660	-7905576	-7905492	-7905408	-7905325	-7905241	-7905157	-7905073
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7631175	-7631119	-7631063	-7631007	-7630951	-7630896	-7630840	-7630784	-7630728	-7630672	-7630617
450	-7653567	-7653507	-7653447	-7653387	-7653328	-7653268	-7653208	-7653148	-7653088	-7653029	-7652969
448	-7675728	-7675668	-7675608	-7675548	-7675485	-7675421	-7675357	-7675293	-7675229	-7675170	-7675110
446	-7697889	-7697829	-7697769	-7697709	-7697642	-7697574	-7697506	-7697438	-7697370	-7697311	-7697251
444	-7720050	-7719990	-7719930	-7719870	-7719798	-7719727	-7719655	-7719583	-7719511	-7719452	-7719392
442	-7742210	-7742151	-7742091	-7742031	-7741955	-7741880	-7741804	-7741728	-7741652	-7741593	-7741533
440	-7764371	-7764312	-7764252	-7764192	-7764112	-7764033	-7763953	-7763873	-7763793	-7763734	-7763674
438	-7786345	-7786281	-7786217	-7786154	-7786074	-7785994	-7785914	-7785835	-7785755	-7785691	-7785628
436	-7808319	-7808251	-7808183	-7808115	-7808036	-7807956	-7807876	-7807796	-7807717	-7807649	-7807581
434	-7830292	-7830220	-7830149	-7830077	-7829997	-7829917	-7829838	-7829758	-7829678	-7829607	-7829535
432	-7852266	-7852190	-7852114	-7852039	-7851959	-7851879	-7851799	-7851720	-7851640	-7851564	-7851488
430	-7874239	-7874160	-7874080	-7874000	-7873920	-7873841	-7873761	-7873681	-7873602	-7873522	-7873442
428	-7896041	-7895962	-7895882	-7895802	-7895719	-7895635	-7895551	-7895468	-7895384	-7895300	-7895216

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	820										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7643695	-7643639	-7643583	-7643527	-7643471	-7643415	-7643360	-7643304	-7643248	-7643192	-7643136
450	-7666115	-7666055	-7665995	-7665935	-7665875	-7665816	-7665756	-7665696	-7665636	-7665576	-7665516
448	-7688303	-7688244	-7688184	-7688124	-7688060	-7687996	-7687932	-7687868	-7687805	-7687745	-7687685
446	-7710492	-7710432	-7710372	-7710312	-7710245	-7710177	-7710109	-7710041	-7709973	-7709913	-7709854
444	-7732681	-7732621	-7732561	-7732501	-7732429	-7732357	-7732286	-7732214	-7732142	-7732082	-7732022
442	-7754869	-7754809	-7754749	-7754690	-7754614	-7754538	-7754462	-7754386	-7754310	-7754251	-7754191
440	-7777058	-7776998	-7776938	-7776878	-7776798	-7776719	-7776639	-7776559	-7776479	-7776419	-7776359
438	-7799059	-7798995	-7798931	-7798867	-7798787	-7798708	-7798628	-7798548	-7798468	-7798404	-7798340
436	-7821060	-7820992	-7820924	-7820856	-7820776	-7820697	-7820617	-7820537	-7820457	-7820389	-7820322
434	-7843061	-7842989	-7842917	-7842845	-7842766	-7842686	-7842606	-7842526	-7842446	-7842374	-7842303
432	-7865062	-7864986	-7864910	-7864834	-7864755	-7864675	-7864595	-7864515	-7864435	-7864359	-7864284
430	-7887063	-7886983	-7886903	-7886823	-7886744	-7886664	-7886584	-7886504	-7886424	-7886345	-7886265
428	-7908892	-7908812	-7908733	-7908653	-7908569	-7908485	-7908401	-7908318	-7908234	-7908150	-7908066
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7634164	-7634108	-7634052	-7633997	-7633941	-7633885	-7633829	-7633773	-7633718	-7633662	-7633606
450	-7656556	-7656496	-7656437	-7656377	-7656317	-7656257	-7656197	-7656138	-7656078	-7656018	-7655958
448	-7678717	-7678657	-7678597	-7678538	-7678474	-7678410	-7678346	-7678283	-7678219	-7678159	-7678099
446	-7700878	-7700818	-7700758	-7700699	-7700631	-7700563	-7700495	-7700428	-7700360	-7700300	-7700240
444	-7723039	-7722979	-7722919	-7722860	-7722788	-7722716	-7722644	-7722573	-7722501	-7722441	-7722381
442	-7745200	-7745140	-7745080	-7745020	-7744945	-7744869	-7744793	-7744718	-7744642	-7744582	-7744522
440	-7767361	-7767301	-7767241	-7767181	-7767102	-7767022	-7766942	-7766862	-7766783	-7766723	-7766663
438	-7789334	-7789271	-7789207	-7789143	-7789063	-7788984	-7788904	-7788824	-7788744	-7788681	-7788617
436	-7811308	-7811240	-7811172	-7811105	-7811025	-7810945	-7810865	-7810786	-7810706	-7810638	-7810570
434	-7833281	-7833210	-7833138	-7833066	-7832986	-7832907	-7832827	-7832747	-7832668	-7832596	-7832524
432	-7855255	-7855179	-7855104	-7855028	-7854948	-7854868	-7854789	-7854709	-7854629	-7854554	-7854478
430	-7877229	-7877149	-7877069	-7876989	-7876910	-7876830	-7876750	-7876671	-7876591	-7876511	-7876431
428	-7899031	-7898951	-7898871	-7898792	-7898708	-7898624	-7898541	-7898457	-7898373	-7898289	-7898206

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	810										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7646688	-7646632	-7646576	-7646520	-7646464	-7646409	-7646353	-7646297	-7646241	-7646185	-7646129
450	-7669108	-7669048	-7668988	-7668928	-7668868	-7668809	-7668749	-7668689	-7668629	-7668569	-7668509
448	-7691297	-7691237	-7691177	-7691117	-7691053	-7690989	-7690925	-7690862	-7690798	-7690738	-7690678
446	-7713485	-7713425	-7713365	-7713306	-7713238	-7713170	-7713102	-7713034	-7712966	-7712906	-7712847
444	-7735674	-7735614	-7735554	-7735494	-7735422	-7735350	-7735279	-7735207	-7735135	-7735075	-7735015
442	-7757862	-7757802	-7757743	-7757683	-7757607	-7757531	-7757455	-7757379	-7757304	-7757244	-7757184
440	-7780051	-7779991	-7779931	-7779871	-7779791	-7779712	-7779632	-7779552	-7779472	-7779412	-7779352
438	-7802052	-7801988	-7801924	-7801860	-7801780	-7801701	-7801621	-7801541	-7801461	-7801397	-7801334
436	-7824053	-7823985	-7823917	-7823849	-7823770	-7823690	-7823610	-7823530	-7823450	-7823382	-7823315
434	-7846054	-7845982	-7845910	-7845838	-7845759	-7845679	-7845599	-7845519	-7845439	-7845367	-7845296
432	-7868055	-7867979	-7867903	-7867827	-7867748	-7867668	-7867588	-7867508	-7867428	-7867353	-7867277
430	-7890056	-7889976	-7889896	-7889816	-7889737	-7889657	-7889577	-7889497	-7889417	-7889338	-7889258
428	-7911885	-7911806	-7911726	-7911646	-7911562	-7911478	-7911394	-7911311	-7911227	-7911143	-7911059
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7637153	-7637098	-7637042	-7636986	-7636930	-7636874	-7636819	-7636763	-7636707	-7636651	-7636595
450	-7659545	-7659486	-7659426	-7659366	-7659306	-7659247	-7659187	-7659127	-7659067	-7659007	-7658948
448	-7681706	-7681647	-7681587	-7681527	-7681463	-7681399	-7681336	-7681272	-7681208	-7681148	-7681089
446	-7703867	-7703807	-7703748	-7703688	-7703620	-7703552	-7703485	-7703417	-7703349	-7703289	-7703230
444	-7726028	-7725968	-7725909	-7725849	-7725777	-7725705	-7725634	-7725562	-7725490	-7725430	-7725371
442	-7748189	-7748129	-7748070	-7748010	-7747934	-7747858	-7747783	-7747707	-7747631	-7747571	-7747512
440	-7770350	-7770290	-7770230	-7770171	-7770091	-7770011	-7769932	-7769852	-7769772	-7769712	-7769653
438	-7792324	-7792260	-7792196	-7792132	-7792053	-7791973	-7791893	-7791813	-7791734	-7791670	-7791606
436	-7814297	-7814229	-7814162	-7814094	-7814014	-7813934	-7813855	-7813775	-7813695	-7813628	-7813560
434	-7836271	-7836199	-7836127	-7836056	-7835976	-7835896	-7835816	-7835737	-7835657	-7835585	-7835513
432	-7858244	-7858169	-7858093	-7858017	-7857937	-7857858	-7857778	-7857698	-7857619	-7857543	-7857467
430	-7880218	-7880138	-7880059	-7879979	-7879899	-7879819	-7879740	-7879660	-7879580	-7879501	-7879421
428	-7902020	-7901940	-7901861	-7901781	-7901697	-7901614	-7901530	-7901446	-7901362	-7901279	-7901195

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	800										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7649681	-7649625	-7649569	-7649513	-7649457	-7649402	-7649346	-7649290	-7649234	-7649178	-7649122
450	-7672101	-7672041	-7671981	-7671921	-7671862	-7671802	-7671742	-7671682	-7671622	-7671562	-7671502
448	-7694290	-7694230	-7694170	-7694110	-7694046	-7693982	-7693918	-7693855	-7693791	-7693731	-7693671
446	-7716478	-7716418	-7716358	-7716299	-7716231	-7716163	-7716095	-7716027	-7715959	-7715900	-7715840
444	-7738667	-7738607	-7738547	-7738487	-7738415	-7738343	-7738272	-7738200	-7738128	-7738068	-7738008
442	-7760855	-7760795	-7760736	-7760676	-7760600	-7760524	-7760448	-7760372	-7760297	-7760237	-7760177
440	-7783044	-7782984	-7782924	-7782864	-7782785	-7782705	-7782625	-7782545	-7782465	-7782405	-7782346
438	-7805045	-7804981	-7804917	-7804853	-7804774	-7804694	-7804614	-7804534	-7804454	-7804390	-7804327
436	-7827046	-7826978	-7826910	-7826842	-7826763	-7826683	-7826603	-7826523	-7826443	-7826375	-7826308
434	-7849047	-7848975	-7848903	-7848831	-7848752	-7848672	-7848592	-7848512	-7848432	-7848361	-7848289
432	-7871048	-7870972	-7870896	-7870820	-7870741	-7870661	-7870581	-7870501	-7870421	-7870346	-7870270
430	-7893049	-7892969	-7892889	-7892810	-7892730	-7892650	-7892570	-7892490	-7892410	-7892331	-7892251
428	-7914878	-7914799	-7914719	-7914639	-7914555	-7914471	-7914388	-7914304	-7914220	-7914136	-7914052
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7640143	-7640087	-7640031	-7639975	-7639919	-7639864	-7639808	-7639752	-7639696	-7639640	-7639585
450	-7662535	-7662475	-7662415	-7662355	-7662296	-7662236	-7662176	-7662116	-7662056	-7661997	-7661937
448	-7684696	-7684636	-7684576	-7684516	-7684453	-7684389	-7684325	-7684261	-7684197	-7684138	-7684078
446	-7706857	-7706797	-7706737	-7706677	-7706609	-7706542	-7706474	-7706406	-7706338	-7706279	-7706219
444	-7729018	-7728958	-7728898	-7728838	-7728766	-7728695	-7728623	-7728551	-7728479	-7728420	-7728360
442	-7751178	-7751119	-7751059	-7750999	-7750923	-7750848	-7750772	-7750696	-7750620	-7750561	-7750501
440	-7773339	-7773280	-7773220	-7773160	-7773080	-7773001	-7772921	-7772841	-7772761	-7772702	-7772642
438	-7795313	-7795249	-7795185	-7795122	-7795042	-7794962	-7794882	-7794803	-7794723	-7794659	-7794596
436	-7817287	-7817219	-7817151	-7817083	-7817004	-7816924	-7816844	-7816764	-7816685	-7816617	-7816549
434	-7839260	-7839188	-7839117	-7839045	-7838965	-7838885	-7838806	-7838726	-7838646	-7838575	-7838503
432	-7861234	-7861158	-7861082	-7861007	-7860927	-7860847	-7860767	-7860688	-7860608	-7860532	-7860456
430	-7883207	-7883128	-7883048	-7882968	-7882888	-7882809	-7882729	-7882649	-7882570	-7882490	-7882410
428	-7905009	-7904930	-7904850	-7904770	-7904687	-7904603	-7904519	-7904436	-7904352	-7904268	-7904184

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	790										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7652674	-7652618	-7652562	-7652506	-7652451	-7652395	-7652339	-7652283	-7652227	-7652171	-7652115
450	-7675094	-7675034	-7674974	-7674914	-7674855	-7674795	-7674735	-7674675	-7674615	-7674555	-7674495
448	-7697283	-7697223	-7697163	-7697103	-7697039	-7696975	-7696912	-7696848	-7696784	-7696724	-7696664
446	-7719471	-7719411	-7719352	-7719292	-7719224	-7719156	-7719088	-7719020	-7718952	-7718893	-7718833
444	-7741660	-7741600	-7741540	-7741480	-7741408	-7741337	-7741265	-7741193	-7741121	-7741061	-7741001
442	-7763848	-7763789	-7763729	-7763669	-7763593	-7763517	-7763441	-7763366	-7763290	-7763230	-7763170
440	-7786037	-7785977	-7785917	-7785857	-7785778	-7785698	-7785618	-7785538	-7785458	-7785398	-7785339
438	-7808038	-7807974	-7807910	-7807846	-7807767	-7807687	-7807607	-7807527	-7807447	-7807383	-7807320
436	-7830039	-7829971	-7829903	-7829835	-7829756	-7829676	-7829596	-7829516	-7829436	-7829369	-7829301
434	-7852040	-7851968	-7851896	-7851825	-7851745	-7851665	-7851585	-7851505	-7851425	-7851354	-7851282
432	-7874041	-7873965	-7873889	-7873814	-7873734	-7873654	-7873574	-7873494	-7873414	-7873339	-7873263
430	-7896042	-7895962	-7895882	-7895803	-7895723	-7895643	-7895563	-7895483	-7895404	-7895324	-7895244
428	-7917871	-7917792	-7917712	-7917632	-7917548	-7917464	-7917381	-7917297	-7917213	-7917129	-7917045
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7643132	-7643076	-7643020	-7642965	-7642909	-7642853	-7642797	-7642741	-7642686	-7642630	-7642574
450	-7665524	-7665464	-7665405	-7665345	-7665285	-7665225	-7665165	-7665106	-7665046	-7664986	-7664926
448	-7687685	-7687625	-7687565	-7687506	-7687442	-7687378	-7687314	-7687251	-7687187	-7687127	-7687067
446	-7709846	-7709786	-7709726	-7709667	-7709599	-7709531	-7709463	-7709396	-7709328	-7709268	-7709208
444	-7732007	-7731947	-7731887	-7731828	-7731756	-7731684	-7731612	-7731541	-7731469	-7731409	-7731349
442	-7754168	-7754108	-7754048	-7753988	-7753913	-7753837	-7753761	-7753685	-7753610	-7753550	-7753490
440	-7776329	-7776269	-7776209	-7776149	-7776070	-7775990	-7775910	-7775830	-7775751	-7775691	-7775631
438	-7798302	-7798239	-7798175	-7798111	-7798031	-7797952	-7797872	-7797792	-7797712	-7797649	-7797585
436	-7820276	-7820208	-7820140	-7820073	-7819993	-7819913	-7819833	-7819754	-7819674	-7819606	-7819538
434	-7842249	-7842178	-7842106	-7842034	-7841954	-7841875	-7841795	-7841715	-7841636	-7841564	-7841492
432	-7864223	-7864147	-7864072	-7863996	-7863916	-7863836	-7863757	-7863677	-7863597	-7863522	-7863446
430	-7886197	-7886117	-7886037	-7885957	-7885878	-7885798	-7885718	-7885639	-7885559	-7885479	-7885399
428	-7907999	-7907919	-7907839	-7907760	-7907676	-7907592	-7907509	-7907425	-7907341	-7907257	-7907174

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	780										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7654669	-7654614	-7654558	-7654502	-7654446	-7654390	-7654334	-7654278	-7654222	-7654167	-7654111
450	-7677089	-7677030	-7676970	-7676910	-7676850	-7676790	-7676730	-7676670	-7676611	-7676551	-7676491
448	-7699278	-7699218	-7699158	-7699098	-7699035	-7698971	-7698907	-7698843	-7698779	-7698719	-7698659
446	-7721467	-7721407	-7721347	-7721287	-7721219	-7721151	-7721083	-7721016	-7720948	-7720888	-7720828
444	-7743655	-7743595	-7743535	-7743476	-7743404	-7743332	-7743260	-7743188	-7743116	-7743057	-7742997
442	-7765844	-7765784	-7765724	-7765664	-7765588	-7765513	-7765437	-7765361	-7765285	-7765225	-7765165
440	-7788032	-7787972	-7787913	-7787853	-7787773	-7787693	-7787613	-7787533	-7787454	-7787394	-7787334
438	-7810033	-7809970	-7809906	-7809842	-7809762	-7809682	-7809602	-7809523	-7809443	-7809379	-7809315
436	-7832034	-7831967	-7831899	-7831831	-7831751	-7831671	-7831591	-7831512	-7831432	-7831364	-7831296
434	-7854035	-7853964	-7853892	-7853820	-7853740	-7853660	-7853580	-7853501	-7853421	-7853349	-7853277
432	-7876036	-7875961	-7875885	-7875809	-7875729	-7875649	-7875569	-7875490	-7875410	-7875334	-7875258
430	-7898037	-7897958	-7897878	-7897798	-7897718	-7897638	-7897559	-7897479	-7897399	-7897319	-7897239
428	-7919867	-7919787	-7919707	-7919627	-7919544	-7919460	-7919376	-7919292	-7919208	-7919125	-7919041
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7645125	-7645069	-7645013	-7644958	-7644902	-7644846	-7644790	-7644734	-7644679	-7644623	-7644567
450	-7667517	-7667457	-7667397	-7667338	-7667278	-7667218	-7667158	-7667099	-7667039	-7666979	-7666919
448	-7689678	-7689618	-7689558	-7689499	-7689435	-7689371	-7689307	-7689243	-7689180	-7689120	-7689060
446	-7711839	-7711779	-7711719	-7711659	-7711592	-7711524	-7711456	-7711388	-7711321	-7711261	-7711201
444	-7734000	-7733940	-7733880	-7733820	-7733749	-7733677	-7733605	-7733533	-7733462	-7733402	-7733342
442	-7756161	-7756101	-7756041	-7755981	-7755906	-7755830	-7755754	-7755678	-7755603	-7755543	-7755483
440	-7778322	-7778262	-7778202	-7778142	-7778063	-7777983	-7777903	-7777823	-7777744	-7777684	-7777624
438	-7800295	-7800231	-7800168	-7800104	-7800024	-7799944	-7799865	-7799785	-7799705	-7799641	-7799578
436	-7822269	-7822201	-7822133	-7822065	-7821986	-7821906	-7821826	-7821747	-7821667	-7821599	-7821531
434	-7844242	-7844171	-7844099	-7844027	-7843947	-7843868	-7843788	-7843708	-7843629	-7843557	-7843485
432	-7866216	-7866140	-7866064	-7865989	-7865909	-7865829	-7865750	-7865670	-7865590	-7865514	-7865439
430	-7888189	-7888110	-7888030	-7887950	-7887871	-7887791	-7887711	-7887631	-7887552	-7887472	-7887392
428	-7909992	-7909912	-7909832	-7909753	-7909669	-7909585	-7909501	-7909418	-7909334	-7909250	-7909167

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	770										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7657662	-7657607	-7657551	-7657495	-7657439	-7657383	-7657327	-7657271	-7657215	-7657160	-7657104
450	-7680083	-7680023	-7679963	-7679903	-7679843	-7679783	-7679723	-7679663	-7679604	-7679544	-7679484
448	-7702271	-7702211	-7702151	-7702091	-7702028	-7701964	-7701900	-7701836	-7701772	-7701712	-7701653
446	-7724460	-7724400	-7724340	-7724280	-7724212	-7724144	-7724077	-7724009	-7723941	-7723881	-7723821
444	-7746648	-7746588	-7746529	-7746469	-7746397	-7746325	-7746253	-7746181	-7746109	-7746050	-7745990
442	-7768837	-7768777	-7768717	-7768657	-7768581	-7768506	-7768430	-7768354	-7768278	-7768218	-7768158
440	-7791025	-7790966	-7790906	-7790846	-7790766	-7790686	-7790606	-7790527	-7790447	-7790387	-7790327
438	-7813026	-7812963	-7812899	-7812835	-7812755	-7812675	-7812595	-7812516	-7812436	-7812372	-7812308
436	-7835027	-7834960	-7834892	-7834824	-7834744	-7834664	-7834584	-7834505	-7834425	-7834357	-7834289
434	-7857028	-7856957	-7856885	-7856813	-7856733	-7856653	-7856574	-7856494	-7856414	-7856342	-7856270
432	-7879029	-7878954	-7878878	-7878802	-7878722	-7878642	-7878563	-7878483	-7878403	-7878327	-7878251
430	-7901030	-7900951	-7900871	-7900791	-7900711	-7900631	-7900552	-7900472	-7900392	-7900312	-7900232
428	-7922860	-7922780	-7922700	-7922620	-7922537	-7922453	-7922369	-7922285	-7922201	-7922118	-7922034
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7648114	-7648058	-7648003	-7647947	-7647891	-7647835	-7647779	-7647724	-7647668	-7647612	-7647556
450	-7670506	-7670447	-7670387	-7670327	-7670267	-7670207	-7670148	-7670088	-7670028	-7669968	-7669908
448	-7692667	-7692607	-7692548	-7692488	-7692424	-7692360	-7692297	-7692233	-7692169	-7692109	-7692049
446	-7714828	-7714768	-7714709	-7714649	-7714581	-7714513	-7714446	-7714378	-7714310	-7714250	-7714190
444	-7736989	-7736929	-7736870	-7736810	-7736738	-7736666	-7736594	-7736523	-7736451	-7736391	-7736331
442	-7759150	-7759090	-7759030	-7758971	-7758895	-7758819	-7758743	-7758668	-7758592	-7758532	-7758472
440	-7781311	-7781251	-7781191	-7781132	-7781052	-7780972	-7780892	-7780813	-7780733	-7780673	-7780613
438	-7803284	-7803221	-7803157	-7803093	-7803013	-7802934	-7802854	-7802774	-7802695	-7802631	-7802567
436	-7825258	-7825190	-7825123	-7825055	-7824975	-7824895	-7824816	-7824736	-7824656	-7824588	-7824521
434	-7847232	-7847160	-7847088	-7847016	-7846937	-7846857	-7846777	-7846698	-7846618	-7846546	-7846474
432	-7869205	-7869130	-7869054	-7868978	-7868898	-7868819	-7868739	-7868659	-7868579	-7868504	-7868428
430	-7891179	-7891099	-7891019	-7890940	-7890860	-7890780	-7890701	-7890621	-7890541	-7890461	-7890382
428	-7912981	-7912901	-7912822	-7912742	-7912658	-7912574	-7912491	-7912407	-7912323	-7912240	-7912156

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

Table 3C2, Feedwater Flow Piping Configuration Contribution to Calorimetric Uncertainty, Unit 2

P_{STM}	870										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7842752	-7842695	-7842638	-7842580	-7842523	-7842465	-7842408	-7842350	-7842293	-7842236	-7842178
450	-7865802	-7865740	-7865678	-7865617	-7865555	-7865494	-7865432	-7865371	-7865309	-7865248	-7865186
448	-7888613	-7888551	-7888489	-7888428	-7888362	-7888297	-7888231	-7888165	-7888100	-7888038	-7887977
446	-7911424	-7911362	-7911301	-7911239	-7911169	-7911100	-7911030	-7910960	-7910890	-7910829	-7910767
444	-7934235	-7934173	-7934112	-7934050	-7933976	-7933902	-7933829	-7933755	-7933681	-7933619	-7933558
442	-7957046	-7956984	-7956923	-7956861	-7956783	-7956705	-7956627	-7956549	-7956471	-7956410	-7956348
440	-7979857	-7979795	-7979734	-7979672	-7979590	-7979508	-7979426	-7979344	-7979262	-7979200	-7979139
438	-8002475	-8002410	-8002344	-8002278	-8002196	-8002114	-8002032	-8001950	-8001868	-8001802	-8001737
436	-8025093	-8025024	-8024954	-8024884	-8024802	-8024720	-8024638	-8024556	-8024474	-8024404	-8024334
434	-8047712	-8047638	-8047564	-8047490	-8047408	-8047326	-8047244	-8047162	-8047080	-8047006	-8046932
432	-8070330	-8070252	-8070174	-8070096	-8070014	-8069932	-8069850	-8069768	-8069686	-8069608	-8069530
430	-8092948	-8092866	-8092784	-8092702	-8092620	-8092538	-8092456	-8092374	-8092292	-8092210	-8092128
428	-8115390	-8115308	-8115226	-8115144	-8115058	-8114972	-8114885	-8114799	-8114713	-8114627	-8114541
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7857021	-7856963	-7856906	-7856848	-7856790	-7856733	-7856675	-7856618	-7856560	-7856503	-7856445
450	-7880112	-7880050	-7879988	-7879927	-7879865	-7879803	-7879742	-7879680	-7879618	-7879557	-7879495
448	-7902964	-7902903	-7902841	-7902779	-7902713	-7902648	-7902582	-7902516	-7902450	-7902389	-7902327
446	-7925817	-7925755	-7925693	-7925632	-7925562	-7925492	-7925422	-7925352	-7925282	-7925221	-7925159
444	-7948669	-7948608	-7948546	-7948484	-7948410	-7948336	-7948262	-7948188	-7948114	-7948053	-7947991
442	-7971522	-7971460	-7971399	-7971337	-7971259	-7971181	-7971103	-7971025	-7970947	-7970885	-7970823
440	-7994375	-7994313	-7994251	-7994190	-7994107	-7994025	-7993943	-7993861	-7993779	-7993717	-7993655
438	-8017034	-8016968	-8016902	-8016837	-8016754	-8016672	-8016590	-8016508	-8016426	-8016360	-8016294
436	-8039693	-8039623	-8039554	-8039484	-8039402	-8039319	-8039237	-8039155	-8039073	-8039003	-8038933
434	-8062353	-8062279	-8062205	-8062131	-8062049	-8061966	-8061884	-8061802	-8061720	-8061646	-8061572
432	-8085012	-8084934	-8084856	-8084778	-8084696	-8084613	-8084531	-8084449	-8084367	-8084289	-8084211
430	-8107672	-8107589	-8107507	-8107425	-8107343	-8107261	-8107178	-8107096	-8107014	-8106932	-8106849
428	-8130154	-8130072	-8129990	-8129908	-8129821	-8129735	-8129649	-8129562	-8129476	-8129390	-8129303

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	860										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7846855	-7846798	-7846740	-7846683	-7846625	-7846568	-7846511	-7846453	-7846396	-7846338	-7846281
450	-7869904	-7869843	-7869781	-7869720	-7869658	-7869597	-7869535	-7869473	-7869412	-7869350	-7869289
448	-7892715	-7892654	-7892592	-7892531	-7892465	-7892399	-7892334	-7892268	-7892202	-7892141	-7892079
446	-7915526	-7915465	-7915403	-7915342	-7915272	-7915202	-7915133	-7915063	-7914993	-7914931	-7914870
444	-7938337	-7938276	-7938214	-7938153	-7938079	-7938005	-7937931	-7937857	-7937784	-7937722	-7937661
442	-7961149	-7961087	-7961025	-7960964	-7960886	-7960808	-7960730	-7960652	-7960574	-7960513	-7960451
440	-7983960	-7983898	-7983837	-7983775	-7983693	-7983611	-7983529	-7983447	-7983365	-7983303	-7983242
438	-8006578	-8006512	-8006447	-8006381	-8006299	-8006217	-8006135	-8006053	-8005971	-8005905	-8005839
436	-8029196	-8029126	-8029057	-8028987	-8028905	-8028823	-8028741	-8028659	-8028577	-8028507	-8028437
434	-8051814	-8051741	-8051667	-8051593	-8051511	-8051429	-8051347	-8051265	-8051183	-8051109	-8051035
432	-8074433	-8074355	-8074277	-8074199	-8074117	-8074035	-8073953	-8073871	-8073788	-8073711	-8073633
430	-8097051	-8096969	-8096887	-8096805	-8096723	-8096641	-8096559	-8096476	-8096394	-8096312	-8096230
428	-8119493	-8119411	-8119329	-8119247	-8119160	-8119074	-8118988	-8118902	-8118816	-8118730	-8118643
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7861131	-7861073	-7861016	-7860958	-7860901	-7860843	-7860786	-7860728	-7860670	-7860613	-7860555
450	-7884222	-7884160	-7884099	-7884037	-7883975	-7883914	-7883852	-7883790	-7883729	-7883667	-7883605
448	-7907074	-7907013	-7906951	-7906889	-7906824	-7906758	-7906692	-7906626	-7906561	-7906499	-7906437
446	-7929927	-7929865	-7929804	-7929742	-7929672	-7929602	-7929532	-7929463	-7929393	-7929331	-7929269
444	-7952780	-7952718	-7952656	-7952595	-7952521	-7952447	-7952373	-7952299	-7952225	-7952163	-7952101
442	-7975632	-7975570	-7975509	-7975447	-7975369	-7975291	-7975213	-7975135	-7975057	-7974995	-7974933
440	-7998485	-7998423	-7998361	-7998300	-7998218	-7998135	-7998053	-7997971	-7997889	-7997827	-7997765
438	-8021144	-8021078	-8021013	-8020947	-8020865	-8020782	-8020700	-8020618	-8020536	-8020470	-8020404
436	-8043804	-8043734	-8043664	-8043594	-8043512	-8043429	-8043347	-8043265	-8043183	-8043113	-8043043
434	-8066463	-8066389	-8066315	-8066241	-8066159	-8066077	-8065994	-8065912	-8065830	-8065756	-8065682
432	-8089122	-8089044	-8088966	-8088888	-8088806	-8088724	-8088641	-8088559	-8088477	-8088399	-8088321
430	-8111782	-8111699	-8111617	-8111535	-8111453	-8111371	-8111288	-8111206	-8111124	-8111042	-8110960
428	-8134264	-8134182	-8134100	-8134018	-8133931	-8133845	-8133759	-8133672	-8133586	-8133500	-8133414

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	850										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7849932	-7849875	-7849817	-7849760	-7849702	-7849645	-7849588	-7849530	-7849473	-7849415	-7849358
450	-7872981	-7872920	-7872858	-7872797	-7872735	-7872674	-7872612	-7872550	-7872489	-7872427	-7872366
448	-7895792	-7895731	-7895669	-7895608	-7895542	-7895476	-7895411	-7895345	-7895279	-7895218	-7895156
446	-7918603	-7918542	-7918480	-7918419	-7918349	-7918279	-7918210	-7918140	-7918070	-7918009	-7917947
444	-7941414	-7941353	-7941291	-7941230	-7941156	-7941082	-7941008	-7940934	-7940861	-7940799	-7940738
442	-7964226	-7964164	-7964102	-7964041	-7963963	-7963885	-7963807	-7963729	-7963651	-7963590	-7963528
440	-7987037	-7986975	-7986914	-7986852	-7986770	-7986688	-7986606	-7986524	-7986442	-7986380	-7986319
438	-8009655	-8009589	-8009524	-8009458	-8009376	-8009294	-8009212	-8009130	-8009048	-8008982	-8008916
436	-8032273	-8032203	-8032134	-8032064	-8031982	-8031900	-8031818	-8031736	-8031654	-8031584	-8031514
434	-8054891	-8054818	-8054744	-8054670	-8054588	-8054506	-8054424	-8054342	-8054260	-8054186	-8054112
432	-8077510	-8077432	-8077354	-8077276	-8077194	-8077112	-8077030	-8076948	-8076866	-8076788	-8076710
430	-8100128	-8100046	-8099964	-8099882	-8099800	-8099718	-8099636	-8099554	-8099471	-8099389	-8099307
428	-8122570	-8122488	-8122406	-8122324	-8122237	-8122151	-8122065	-8121979	-8121893	-8121807	-8121720
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7864213	-7864156	-7864098	-7864041	-7863983	-7863926	-7863868	-7863811	-7863753	-7863696	-7863638
450	-7887304	-7887243	-7887181	-7887119	-7887058	-7886996	-7886935	-7886873	-7886811	-7886750	-7886688
448	-7910157	-7910095	-7910034	-7909972	-7909906	-7909841	-7909775	-7909709	-7909643	-7909582	-7909520
446	-7933010	-7932948	-7932886	-7932825	-7932755	-7932685	-7932615	-7932545	-7932475	-7932414	-7932352
444	-7955862	-7955801	-7955739	-7955677	-7955603	-7955529	-7955455	-7955381	-7955307	-7955246	-7955184
442	-7978715	-7978653	-7978591	-7978530	-7978452	-7978374	-7978296	-7978217	-7978139	-7978078	-7978016
440	-8001567	-8001506	-8001444	-8001382	-8001300	-8001218	-8001136	-8001054	-8000971	-8000910	-8000848
438	-8024227	-8024161	-8024095	-8024029	-8023947	-8023865	-8023783	-8023701	-8023618	-8023553	-8023487
436	-8046886	-8046816	-8046746	-8046677	-8046594	-8046512	-8046430	-8046348	-8046265	-8046196	-8046126
434	-8069546	-8069472	-8069398	-8069324	-8069241	-8069159	-8069077	-8068995	-8068913	-8068839	-8068765
432	-8092205	-8092127	-8092049	-8091971	-8091888	-8091806	-8091724	-8091642	-8091560	-8091482	-8091403
430	-8114864	-8114782	-8114700	-8114618	-8114536	-8114453	-8114371	-8114289	-8114207	-8114125	-8114042
428	-8137347	-8137265	-8137183	-8137100	-8137014	-8136928	-8136841	-8136755	-8136669	-8136583	-8136496

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	840										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7851984	-7851926	-7851869	-7851811	-7851754	-7851696	-7851639	-7851582	-7851524	-7851467	-7851409
450	-7875033	-7874971	-7874910	-7874848	-7874786	-7874725	-7874663	-7874602	-7874540	-7874479	-7874417
448	-7897844	-7897782	-7897721	-7897659	-7897593	-7897528	-7897462	-7897396	-7897331	-7897269	-7897208
446	-7920655	-7920593	-7920532	-7920470	-7920400	-7920331	-7920261	-7920191	-7920121	-7920060	-7919998
444	-7943466	-7943404	-7943343	-7943281	-7943207	-7943134	-7943060	-7942986	-7942912	-7942850	-7942789
442	-7966277	-7966215	-7966154	-7966092	-7966014	-7965936	-7965858	-7965780	-7965703	-7965641	-7965579
440	-7989088	-7989026	-7988965	-7988903	-7988821	-7988739	-7988657	-7988575	-7988493	-7988432	-7988370
438	-8011706	-8011641	-8011575	-8011509	-8011427	-8011345	-8011263	-8011181	-8011099	-8011033	-8010968
436	-8034324	-8034255	-8034185	-8034115	-8034033	-8033951	-8033869	-8033787	-8033705	-8033635	-8033565
434	-8056943	-8056869	-8056795	-8056721	-8056639	-8056557	-8056475	-8056393	-8056311	-8056237	-8056163
432	-8079561	-8079483	-8079405	-8079327	-8079245	-8079163	-8079081	-8078999	-8078917	-8078839	-8078761
430	-8102179	-8102097	-8102015	-8101933	-8101851	-8101769	-8101687	-8101605	-8101523	-8101441	-8101359
428	-8124621	-8124539	-8124457	-8124375	-8124289	-8124203	-8124116	-8124030	-8123944	-8123858	-8123772
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7866269	-7866211	-7866153	-7866096	-7866038	-7865981	-7865923	-7865866	-7865808	-7865751	-7865693
450	-7889360	-7889298	-7889236	-7889175	-7889113	-7889051	-7888990	-7888928	-7888866	-7888805	-7888743
448	-7912212	-7912150	-7912089	-7912027	-7911961	-7911896	-7911830	-7911764	-7911698	-7911637	-7911575
446	-7935065	-7935003	-7934941	-7934880	-7934810	-7934740	-7934670	-7934600	-7934530	-7934469	-7934407
444	-7957917	-7957856	-7957794	-7957732	-7957658	-7957584	-7957510	-7957436	-7957362	-7957301	-7957239
442	-7980770	-7980708	-7980647	-7980585	-7980507	-7980429	-7980351	-7980273	-7980194	-7980133	-7980071
440	-8003622	-8003561	-8003499	-8003437	-8003355	-8003273	-8003191	-8003109	-8003026	-8002965	-8002903
438	-8026282	-8026216	-8026150	-8026085	-8026002	-8025920	-8025838	-8025756	-8025674	-8025608	-8025542
436	-8048941	-8048871	-8048801	-8048732	-8048649	-8048567	-8048485	-8048403	-8048321	-8048251	-8048181
434	-8071601	-8071527	-8071453	-8071379	-8071296	-8071214	-8071132	-8071050	-8070968	-8070894	-8070820
432	-8094260	-8094182	-8094104	-8094026	-8093944	-8093861	-8093779	-8093697	-8093615	-8093537	-8093459
430	-8116919	-8116837	-8116755	-8116673	-8116591	-8116508	-8116426	-8116344	-8116262	-8116180	-8116097
428	-8139402	-8139320	-8139238	-8139155	-8139069	-8138983	-8138897	-8138810	-8138724	-8138638	-8138551

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	830										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7855061	-7855003	-7854946	-7854888	-7854831	-7854773	-7854716	-7854659	-7854601	-7854544	-7854486
450	-7878110	-7878048	-7877987	-7877925	-7877863	-7877802	-7877740	-7877679	-7877617	-7877556	-7877494
448	-7900921	-7900859	-7900798	-7900736	-7900670	-7900605	-7900539	-7900474	-7900408	-7900346	-7900285
446	-7923732	-7923670	-7923609	-7923547	-7923477	-7923408	-7923338	-7923268	-7923198	-7923137	-7923075
444	-7946543	-7946481	-7946420	-7946358	-7946284	-7946211	-7946137	-7946063	-7945989	-7945927	-7945866
442	-7969354	-7969292	-7969231	-7969169	-7969091	-7969013	-7968935	-7968858	-7968780	-7968718	-7968656
440	-7992165	-7992103	-7992042	-7991980	-7991898	-7991816	-7991734	-7991652	-7991570	-7991509	-7991447
438	-8014783	-8014718	-8014652	-8014586	-8014504	-8014422	-8014340	-8014258	-8014176	-8014110	-8014045
436	-8037402	-8037332	-8037262	-8037192	-8037110	-8037028	-8036946	-8036864	-8036782	-8036712	-8036643
434	-8060020	-8059946	-8059872	-8059798	-8059716	-8059634	-8059552	-8059470	-8059388	-8059314	-8059240
432	-8082638	-8082560	-8082482	-8082404	-8082322	-8082240	-8082158	-8082076	-8081994	-8081916	-8081838
430	-8105256	-8105174	-8105092	-8105010	-8104928	-8104846	-8104764	-8104682	-8104600	-8104518	-8104436
428	-8127698	-8127616	-8127534	-8127452	-8127366	-8127280	-8127193	-8127107	-8127021	-8126935	-8126849
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7869351	-7869294	-7869236	-7869179	-7869121	-7869063	-7869006	-7868948	-7868891	-7868833	-7868776
450	-7892442	-7892381	-7892319	-7892257	-7892196	-7892134	-7892072	-7892011	-7891949	-7891887	-7891826
448	-7915295	-7915233	-7915171	-7915110	-7915044	-7914978	-7914912	-7914847	-7914781	-7914719	-7914658
446	-7938147	-7938086	-7938024	-7937962	-7937892	-7937823	-7937753	-7937683	-7937613	-7937551	-7937490
444	-7961000	-7960938	-7960877	-7960815	-7960741	-7960667	-7960593	-7960519	-7960445	-7960383	-7960322
442	-7983852	-7983791	-7983729	-7983668	-7983589	-7983511	-7983433	-7983355	-7983277	-7983215	-7983154
440	-8006705	-8006643	-8006582	-8006520	-8006438	-8006356	-8006273	-8006191	-8006109	-8006047	-8005986
438	-8029364	-8029299	-8029233	-8029167	-8029085	-8029003	-8028921	-8028838	-8028756	-8028690	-8028625
436	-8052024	-8051954	-8051884	-8051814	-8051732	-8051650	-8051568	-8051485	-8051403	-8051333	-8051263
434	-8074683	-8074609	-8074535	-8074461	-8074379	-8074297	-8074215	-8074132	-8074050	-8073976	-8073902
432	-8097343	-8097265	-8097186	-8097108	-8097026	-8096944	-8096862	-8096780	-8096697	-8096619	-8096541
430	-8120002	-8119920	-8119838	-8119755	-8119673	-8119591	-8119509	-8119427	-8119344	-8119262	-8119180
428	-8142485	-8142403	-8142320	-8142238	-8142152	-8142065	-8141979	-8141893	-8141807	-8141720	-8141634

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	820										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7858138	-7858080	-7858023	-7857965	-7857908	-7857850	-7857793	-7857736	-7857678	-7857621	-7857563
450	-7881187	-7881125	-7881064	-7881002	-7880941	-7880879	-7880817	-7880756	-7880694	-7880633	-7880571
448	-7903998	-7903936	-7903875	-7903813	-7903747	-7903682	-7903616	-7903551	-7903485	-7903423	-7903362
446	-7926809	-7926747	-7926686	-7926624	-7926554	-7926485	-7926415	-7926345	-7926275	-7926214	-7926152
444	-7949620	-7949558	-7949497	-7949435	-7949361	-7949288	-7949214	-7949140	-7949066	-7949005	-7948943
442	-7972431	-7972369	-7972308	-7972246	-7972168	-7972090	-7972013	-7971935	-7971857	-7971795	-7971734
440	-7995242	-7995181	-7995119	-7995057	-7994975	-7994893	-7994811	-7994729	-7994647	-7994586	-7994524
438	-8017860	-8017795	-8017729	-8017663	-8017581	-8017499	-8017417	-8017335	-8017253	-8017187	-8017122
436	-8040479	-8040409	-8040339	-8040269	-8040187	-8040105	-8040023	-8039941	-8039859	-8039789	-8039720
434	-8063097	-8063023	-8062949	-8062875	-8062793	-8062711	-8062629	-8062547	-8062465	-8062391	-8062317
432	-8085715	-8085637	-8085559	-8085481	-8085399	-8085317	-8085235	-8085153	-8085071	-8084993	-8084915
430	-8108333	-8108251	-8108169	-8108087	-8108005	-8107923	-8107841	-8107759	-8107677	-8107595	-8107513
428	-8130775	-8130693	-8130611	-8130529	-8130443	-8130357	-8130271	-8130184	-8130098	-8130012	-8129926
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7872434	-7872376	-7872319	-7872261	-7872204	-7872146	-7872089	-7872031	-7871973	-7871916	-7871858
450	-7895525	-7895463	-7895401	-7895340	-7895278	-7895217	-7895155	-7895093	-7895032	-7894970	-7894908
448	-7918377	-7918316	-7918254	-7918192	-7918127	-7918061	-7917995	-7917929	-7917864	-7917802	-7917740
446	-7941230	-7941168	-7941107	-7941045	-7940975	-7940905	-7940835	-7940765	-7940696	-7940634	-7940572
444	-7964083	-7964021	-7963959	-7963898	-7963824	-7963750	-7963676	-7963602	-7963528	-7963466	-7963404
442	-7986935	-7986873	-7986812	-7986750	-7986672	-7986594	-7986516	-7986438	-7986360	-7986298	-7986236
440	-8009788	-8009726	-8009664	-8009603	-8009521	-8009438	-8009356	-8009274	-8009192	-8009130	-8009068
438	-8032447	-8032381	-8032316	-8032250	-8032168	-8032085	-8032003	-8031921	-8031839	-8031773	-8031707
436	-8055106	-8055037	-8054967	-8054897	-8054815	-8054732	-8054650	-8054568	-8054486	-8054416	-8054346
434	-8077766	-8077692	-8077618	-8077544	-8077462	-8077380	-8077297	-8077215	-8077133	-8077059	-8076985
432	-8100425	-8100347	-8100269	-8100191	-8100109	-8100027	-8099944	-8099862	-8099780	-8099702	-8099624
430	-8123085	-8123002	-8122920	-8122838	-8122756	-8122674	-8122591	-8122509	-8122427	-8122345	-8122263
428	-8145567	-8145485	-8145403	-8145321	-8145234	-8145148	-8145062	-8144975	-8144889	-8144803	-8144717

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	810										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7861215	-7861157	-7861100	-7861042	-7860985	-7860927	-7860870	-7860813	-7860755	-7860698	-7860640
450	-7884264	-7884202	-7884141	-7884079	-7884018	-7883956	-7883894	-7883833	-7883771	-7883710	-7883648
448	-7907075	-7907013	-7906952	-7906890	-7906825	-7906759	-7906693	-7906628	-7906562	-7906500	-7906439
446	-7929886	-7929824	-7929763	-7929701	-7929631	-7929562	-7929492	-7929422	-7929353	-7929291	-7929229
444	-7952697	-7952635	-7952574	-7952512	-7952438	-7952365	-7952291	-7952217	-7952143	-7952082	-7952020
442	-7975508	-7975446	-7975385	-7975323	-7975245	-7975167	-7975090	-7975012	-7974934	-7974872	-7974811
440	-7998319	-7998258	-7998196	-7998134	-7998052	-7997970	-7997888	-7997806	-7997724	-7997663	-7997601
438	-8020937	-8020872	-8020806	-8020740	-8020658	-8020576	-8020494	-8020412	-8020330	-8020265	-8020199
436	-8043556	-8043486	-8043416	-8043346	-8043264	-8043182	-8043100	-8043018	-8042936	-8042866	-8042797
434	-8066174	-8066100	-8066026	-8065952	-8065870	-8065788	-8065706	-8065624	-8065542	-8065468	-8065394
432	-8088792	-8088714	-8088636	-8088558	-8088476	-8088394	-8088312	-8088230	-8088148	-8088070	-8087992
430	-8111410	-8111328	-8111246	-8111164	-8111082	-8111000	-8110918	-8110836	-8110754	-8110672	-8110590
428	-8133852	-8133770	-8133688	-8133606	-8133520	-8133434	-8133348	-8133261	-8133175	-8133089	-8133003
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7875516	-7875459	-7875401	-7875344	-7875286	-7875229	-7875171	-7875114	-7875056	-7874999	-7874941
450	-7898607	-7898546	-7898484	-7898422	-7898361	-7898299	-7898238	-7898176	-7898114	-7898053	-7897991
448	-7921460	-7921398	-7921337	-7921275	-7921209	-7921144	-7921078	-7921012	-7920946	-7920885	-7920823
446	-7944313	-7944251	-7944189	-7944128	-7944058	-7943988	-7943918	-7943848	-7943778	-7943717	-7943655
444	-7967165	-7967104	-7967042	-7966980	-7966906	-7966832	-7966758	-7966684	-7966610	-7966549	-7966487
442	-7990018	-7989956	-7989894	-7989833	-7989755	-7989677	-7989598	-7989520	-7989442	-7989381	-7989319
440	-8012870	-8012809	-8012747	-8012685	-8012603	-8012521	-8012439	-8012357	-8012274	-8012213	-8012151
438	-8035530	-8035464	-8035398	-8035332	-8035250	-8035168	-8035086	-8035004	-8034921	-8034856	-8034790
436	-8058189	-8058119	-8058049	-8057979	-8057897	-8057815	-8057733	-8057651	-8057568	-8057499	-8057429
434	-8080849	-8080775	-8080701	-8080627	-8080544	-8080462	-8080380	-8080298	-8080216	-8080142	-8080068
432	-8103508	-8103430	-8103352	-8103274	-8103191	-8103109	-8103027	-8102945	-8102863	-8102785	-8102706
430	-8126167	-8126085	-8126003	-8125921	-8125839	-8125756	-8125674	-8125592	-8125510	-8125427	-8125345
428	-8148650	-8148568	-8148486	-8148403	-8148317	-8148231	-8148144	-8148058	-8147972	-8147885	-8147799

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	800										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7864292	-7864234	-7864177	-7864119	-7864062	-7864005	-7863947	-7863890	-7863832	-7863775	-7863717
450	-7887341	-7887279	-7887218	-7887156	-7887095	-7887033	-7886971	-7886910	-7886848	-7886787	-7886725
448	-7910152	-7910090	-7910029	-7909967	-7909902	-7909836	-7909770	-7909705	-7909639	-7909577	-7909516
446	-7932963	-7932901	-7932840	-7932778	-7932709	-7932639	-7932569	-7932499	-7932430	-7932368	-7932306
444	-7955774	-7955712	-7955651	-7955589	-7955516	-7955442	-7955368	-7955294	-7955220	-7955159	-7955097
442	-7978585	-7978524	-7978462	-7978400	-7978322	-7978245	-7978167	-7978089	-7978011	-7977949	-7977888
440	-8001396	-8001335	-8001273	-8001212	-8001129	-8001047	-8000965	-8000883	-8000801	-8000740	-8000678
438	-8024014	-8023949	-8023883	-8023817	-8023735	-8023653	-8023571	-8023489	-8023407	-8023342	-8023276
436	-8046633	-8046563	-8046493	-8046423	-8046341	-8046259	-8046177	-8046095	-8046013	-8045943	-8045874
434	-8069251	-8069177	-8069103	-8069029	-8068947	-8068865	-8068783	-8068701	-8068619	-8068545	-8068471
432	-8091869	-8091791	-8091713	-8091635	-8091553	-8091471	-8091389	-8091307	-8091225	-8091147	-8091069
430	-8114487	-8114405	-8114323	-8114241	-8114159	-8114077	-8113995	-8113913	-8113831	-8113749	-8113667
428	-8136929	-8136847	-8136765	-8136683	-8136597	-8136511	-8136425	-8136338	-8136252	-8136166	-8136080
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7878599	-7878542	-7878484	-7878426	-7878369	-7878311	-7878254	-7878196	-7878139	-7878081	-7878024
450	-7901690	-7901628	-7901567	-7901505	-7901443	-7901382	-7901320	-7901258	-7901197	-7901135	-7901074
448	-7924543	-7924481	-7924419	-7924358	-7924292	-7924226	-7924160	-7924095	-7924029	-7923967	-7923906
446	-7947395	-7947334	-7947272	-7947210	-7947140	-7947071	-7947001	-7946931	-7946861	-7946799	-7946738
444	-7970248	-7970186	-7970124	-7970063	-7969989	-7969915	-7969841	-7969767	-7969693	-7969631	-7969570
442	-7993100	-7993039	-7992977	-7992915	-7992837	-7992759	-7992681	-7992603	-7992525	-7992463	-7992402
440	-8015953	-8015891	-8015830	-8015768	-8015686	-8015604	-8015521	-8015439	-8015357	-8015295	-8015234
438	-8038612	-8038547	-8038481	-8038415	-8038333	-8038251	-8038168	-8038086	-8038004	-8037938	-8037873
436	-8061272	-8061202	-8061132	-8061062	-8060980	-8060898	-8060816	-8060733	-8060651	-8060581	-8060511
434	-8083931	-8083857	-8083783	-8083709	-8083627	-8083545	-8083463	-8083380	-8083298	-8083224	-8083150
432	-8106591	-8106512	-8106434	-8106356	-8106274	-8106192	-8106110	-8106027	-8105945	-8105867	-8105789
430	-8129250	-8129168	-8129086	-8129003	-8128921	-8128839	-8128757	-8128675	-8128592	-8128510	-8128428
428	-8151733	-8151650	-8151568	-8151486	-8151400	-8151313	-8151227	-8151141	-8151054	-8150968	-8150882

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	790										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7867369	-7867311	-7867254	-7867196	-7867139	-7867082	-7867024	-7866967	-7866909	-7866852	-7866794
450	-7890418	-7890356	-7890295	-7890233	-7890172	-7890110	-7890049	-7889987	-7889925	-7889864	-7889802
448	-7913229	-7913167	-7913106	-7913044	-7912979	-7912913	-7912847	-7912782	-7912716	-7912654	-7912593
446	-7936040	-7935978	-7935917	-7935855	-7935786	-7935716	-7935646	-7935576	-7935507	-7935445	-7935383
444	-7958851	-7958789	-7958728	-7958666	-7958593	-7958519	-7958445	-7958371	-7958297	-7958236	-7958174
442	-7981662	-7981601	-7981539	-7981477	-7981400	-7981322	-7981244	-7981166	-7981088	-7981026	-7980965
440	-8004473	-8004412	-8004350	-8004289	-8004206	-8004124	-8004042	-8003960	-8003878	-8003817	-8003755
438	-8027091	-8027026	-8026960	-8026894	-8026812	-8026730	-8026648	-8026566	-8026484	-8026419	-8026353
436	-8049710	-8049640	-8049570	-8049500	-8049418	-8049336	-8049254	-8049172	-8049090	-8049020	-8048951
434	-8072328	-8072254	-8072180	-8072106	-8072024	-8071942	-8071860	-8071778	-8071696	-8071622	-8071548
432	-8094946	-8094868	-8094790	-8094712	-8094630	-8094548	-8094466	-8094384	-8094302	-8094224	-8094146
430	-8117564	-8117482	-8117400	-8117318	-8117236	-8117154	-8117072	-8116990	-8116908	-8116826	-8116744
428	-8140006	-8139924	-8139842	-8139760	-8139674	-8139588	-8139502	-8139415	-8139329	-8139243	-8139157
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7881682	-7881624	-7881567	-7881509	-7881452	-7881394	-7881336	-7881279	-7881221	-7881164	-7881106
450	-7904773	-7904711	-7904649	-7904588	-7904526	-7904464	-7904403	-7904341	-7904279	-7904218	-7904156
448	-7927625	-7927564	-7927502	-7927440	-7927375	-7927309	-7927243	-7927177	-7927111	-7927050	-7926988
446	-7950478	-7950416	-7950355	-7950293	-7950223	-7950153	-7950083	-7950013	-7949944	-7949882	-7949820
444	-7973330	-7973269	-7973207	-7973145	-7973071	-7972997	-7972924	-7972850	-7972776	-7972714	-7972652
442	-7996183	-7996121	-7996060	-7995998	-7995920	-7995842	-7995764	-7995686	-7995608	-7995546	-7995484
440	-8019036	-8018974	-8018912	-8018851	-8018768	-8018686	-8018604	-8018522	-8018440	-8018378	-8018316
438	-8041695	-8041629	-8041563	-8041498	-8041415	-8041333	-8041251	-8041169	-8041087	-8041021	-8040955
436	-8064354	-8064285	-8064215	-8064145	-8064063	-8063980	-8063898	-8063816	-8063734	-8063664	-8063594
434	-8087014	-8086940	-8086866	-8086792	-8086710	-8086627	-8086545	-8086463	-8086381	-8086307	-8086233
432	-8109673	-8109595	-8109517	-8109439	-8109357	-8109274	-8109192	-8109110	-8109028	-8108950	-8108872
430	-8132333	-8132250	-8132168	-8132086	-8132004	-8131922	-8131839	-8131757	-8131675	-8131593	-8131511
428	-8154815	-8154733	-8154651	-8154569	-8154482	-8154396	-8154310	-8154223	-8154137	-8154051	-8153964

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	780										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7869420	-7869363	-7869305	-7869248	-7869190	-7869133	-7869075	-7869018	-7868961	-7868903	-7868846
450	-7892469	-7892408	-7892346	-7892285	-7892223	-7892161	-7892100	-7892038	-7891977	-7891915	-7891854
448	-7915280	-7915219	-7915157	-7915096	-7915030	-7914964	-7914899	-7914833	-7914767	-7914706	-7914644
446	-7938091	-7938030	-7937968	-7937907	-7937837	-7937767	-7937697	-7937628	-7937558	-7937496	-7937435
444	-7960902	-7960841	-7960779	-7960718	-7960644	-7960570	-7960496	-7960422	-7960348	-7960287	-7960225
442	-7983713	-7983652	-7983590	-7983529	-7983451	-7983373	-7983295	-7983217	-7983139	-7983078	-7983016
440	-8006525	-8006463	-8006401	-8006340	-8006258	-8006176	-8006094	-8006012	-8005930	-8005868	-8005807
438	-8029143	-8029077	-8029011	-8028946	-8028864	-8028782	-8028700	-8028618	-8028536	-8028470	-8028404
436	-8051761	-8051691	-8051622	-8051552	-8051470	-8051388	-8051306	-8051224	-8051142	-8051072	-8051002
434	-8074379	-8074305	-8074232	-8074158	-8074076	-8073994	-8073912	-8073830	-8073747	-8073674	-8073600
432	-8096998	-8096920	-8096842	-8096764	-8096682	-8096600	-8096518	-8096435	-8096353	-8096275	-8096197
430	-8119616	-8119534	-8119452	-8119370	-8119288	-8119206	-8119123	-8119041	-8118959	-8118877	-8118795
428	-8142058	-8141976	-8141894	-8141811	-8141725	-8141639	-8141553	-8141467	-8141381	-8141295	-8141208
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7883737	-7883679	-7883622	-7883564	-7883507	-7883449	-7883392	-7883334	-7883276	-7883219	-7883161
450	-7906828	-7906766	-7906704	-7906643	-7906581	-7906520	-7906458	-7906396	-7906335	-7906273	-7906211
448	-7929680	-7929619	-7929557	-7929495	-7929430	-7929364	-7929298	-7929232	-7929167	-7929105	-7929043
446	-7952533	-7952471	-7952410	-7952348	-7952278	-7952208	-7952138	-7952068	-7951999	-7951937	-7951875
444	-7975386	-7975324	-7975262	-7975201	-7975127	-7975053	-7974979	-7974905	-7974831	-7974769	-7974707
442	-7998238	-7998176	-7998115	-7998053	-7997975	-7997897	-7997819	-7997741	-7997663	-7997601	-7997539
440	-8021091	-8021029	-8020967	-8020906	-8020824	-8020741	-8020659	-8020577	-8020495	-8020433	-8020371
438	-8043750	-8043684	-8043619	-8043553	-8043471	-8043388	-8043306	-8043224	-8043142	-8043076	-8043010
436	-8066409	-8066340	-8066270	-8066200	-8066118	-8066035	-8065953	-8065871	-8065789	-8065719	-8065649
434	-8089069	-8088995	-8088921	-8088847	-8088765	-8088683	-8088600	-8088518	-8088436	-8088362	-8088288
432	-8111728	-8111650	-8111572	-8111494	-8111412	-8111330	-8111247	-8111165	-8111083	-8111005	-8110927
430	-8134388	-8134305	-8134223	-8134141	-8134059	-8133977	-8133894	-8133812	-8133730	-8133648	-8133566
428	-8156870	-8156788	-8156706	-8156624	-8156537	-8156451	-8156365	-8156278	-8156192	-8156106	-8156020

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P_{STM}	770										
	STEAM GENERATOR 1										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7872497	-7872440	-7872382	-7872325	-7872267	-7872210	-7872152	-7872095	-7872038	-7871980	-7871923
450	-7895546	-7895485	-7895423	-7895362	-7895300	-7895238	-7895177	-7895115	-7895054	-7894992	-7894931
448	-7918357	-7918296	-7918234	-7918173	-7918107	-7918041	-7917976	-7917910	-7917844	-7917783	-7917721
446	-7941168	-7941107	-7941045	-7940984	-7940914	-7940844	-7940774	-7940705	-7940635	-7940573	-7940512
444	-7963979	-7963918	-7963856	-7963795	-7963721	-7963647	-7963573	-7963499	-7963426	-7963364	-7963302
442	-7986790	-7986729	-7986667	-7986606	-7986528	-7986450	-7986372	-7986294	-7986216	-7986155	-7986093
440	-8009602	-8009540	-8009478	-8009417	-8009335	-8009253	-8009171	-8009089	-8009007	-8008945	-8008884
438	-8032220	-8032154	-8032089	-8032023	-8031941	-8031859	-8031777	-8031695	-8031613	-8031547	-8031481
436	-8054838	-8054768	-8054699	-8054629	-8054547	-8054465	-8054383	-8054301	-8054219	-8054149	-8054079
434	-8077456	-8077382	-8077309	-8077235	-8077153	-8077071	-8076989	-8076907	-8076824	-8076751	-8076677
432	-8100075	-8099997	-8099919	-8099841	-8099759	-8099677	-8099595	-8099512	-8099430	-8099352	-8099275
430	-8122693	-8122611	-8122529	-8122447	-8122365	-8122283	-8122200	-8122118	-8122036	-8121954	-8121872
428	-8145135	-8145053	-8144971	-8144888	-8144802	-8144716	-8144630	-8144544	-8144458	-8144372	-8144285
	STEAM GENERATOR 2										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr	$U_{MFW-IND}$, lbm/hr
452	-7886819	-7886762	-7886704	-7886647	-7886589	-7886532	-7886474	-7886417	-7886359	-7886302	-7886244
450	-7909910	-7909849	-7909787	-7909725	-7909664	-7909602	-7909540	-7909479	-7909417	-7909356	-7909294
448	-7932763	-7932701	-7932640	-7932578	-7932512	-7932447	-7932381	-7932315	-7932249	-7932188	-7932126
446	-7955616	-7955554	-7955492	-7955431	-7955361	-7955291	-7955221	-7955151	-7955081	-7955020	-7954958
444	-7978468	-7978406	-7978345	-7978283	-7978209	-7978135	-7978061	-7977987	-7977913	-7977852	-7977790
442	-8001321	-8001259	-8001197	-8001136	-8001058	-8000980	-8000901	-8000823	-8000745	-8000684	-8000622
440	-8024173	-8024112	-8024050	-8023988	-8023906	-8023824	-8023742	-8023660	-8023577	-8023516	-8023454
438	-8046833	-8046767	-8046701	-8046635	-8046553	-8046471	-8046389	-8046307	-8046224	-8046159	-8046093
436	-8069492	-8069422	-8069352	-8069282	-8069200	-8069118	-8069036	-8068954	-8068871	-8068802	-8068732
434	-8092152	-8092078	-8092004	-8091930	-8091847	-8091765	-8091683	-8091601	-8091519	-8091445	-8091371
432	-8114811	-8114733	-8114655	-8114577	-8114494	-8114412	-8114330	-8114248	-8114166	-8114088	-8114009
430	-8137470	-8137388	-8137306	-8137224	-8137141	-8137059	-8136977	-8136895	-8136813	-8136730	-8136648
428	-8159953	-8159871	-8159789	-8159706	-8159620	-8159534	-8159447	-8159361	-8159275	-8159188	-8159102

Table 4, Blowdown Flow Contribution to Calorimetric Uncertainty, Step 7.7.3

$$U_{CAL\text{-}MBDT} = -U_{MBDT}(h_{FG})$$

P_{STM}, PSIA	$U_{CAL\text{-}MBDT}$, BTU/hr
870	-5468306
860	-5484494
850	-5499873
840	-5516061
830	-5532249
820	-5548437
810	-5565434
800	-5581622
790	-5597810
780	-5613998
770	-5630996

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Table 5, Feedwater Temperature Contribution To Calorimetric Uncertainty, Step 7.8.4

$$U_{CAL-TFWNET} = [M_{FW}(h_{FW-0} - h_{FW-\varepsilon TFW})]$$

Applicable to each steam generators of both units.

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TFWNET}$, BTU/hr	$U_{CAL-TFWNET}$, BTU/hr	$U_{CAL-TFWNET}$, BTU/hr	$U_{CAL-TFWNET}$, BTU/hr	$U_{CAL-TFWNET}$, BTU/hr	$U_{CAL-TFWNET}$, BTU/hr	$U_{CAL-TFWNET}$, BTU/hr	$U_{CAL-TFWNET}$, BTU/hr	$U_{CAL-TFWNET}$, BTU/hr	$U_{CAL-TFWNET}$, BTU/hr	$U_{CAL-TFWNET}$, BTU/hr
453.88	-13138929	-13136590	-13134252	-13131913	-13129574	-13127235	-13124897	-13122558	-13120219	-13117880	-13115542
451.88	-13138929	-13136590	-13134252	-13131913	-13129574	-13127235	-13124897	-13122558	-13120219	-13117880	-13115542
449.88	-13003283	-13003283	-13003283	-13003283	-13000944	-12998606	-12996267	-12993928	-12991590	-12991590	-12991590
447.88	-13003283	-13003283	-13003283	-13003283	-13000944	-12998606	-12996267	-12993928	-12991590	-12991590	-12991590
445.88	-13003283	-13003283	-13003283	-13003283	-13000944	-12998606	-12996267	-12993928	-12991590	-12991590	-12991590
443.88	-13003283	-13003283	-13003283	-13003283	-13000944	-12998606	-12996267	-12993928	-12991590	-12991590	-12991590
441.88	-13003283	-13003283	-13003283	-13003283	-13000944	-12998606	-12996267	-12993928	-12991590	-12991590	-12991590
439.88	-12893363	-12891025	-12888686	-12886347	-12886347	-12886347	-12886347	-12886347	-12886347	-12884008	-12881670
437.88	-12893363	-12891025	-12888686	-12886347	-12886347	-12886347	-12886347	-12886347	-12886347	-12884008	-12881670
435.88	-12893363	-12891025	-12888686	-12886347	-12886347	-12886347	-12886347	-12886347	-12886347	-12884008	-12881670
433.88	-12893363	-12891025	-12888686	-12886347	-12886347	-12886347	-12886347	-12886347	-12886347	-12884008	-12881670
431.88	-12893363	-12891025	-12888686	-12886347	-12886347	-12886347	-12886347	-12886347	-12886347	-12884008	-12881670
429.88	-12792798	-12792798	-12792798	-12792798	-12790460	-12788121	-12785782	-12783444	-12781105	-12778766	-12776427

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Tables 6A and 6B, Feedwater Pressure Contribution To Calorimetric Uncertainty, Steps 7.9.3 and 7.9.4

Table 6A, Feedwater Pressure Contribution To Calorimetric Uncertainty, Random Component $U_{CAL-PFWNET} = \sqrt{2}[M_{FW}(h_{FW-0} - h_{FW-\varepsilon PFW})]$

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr	$U_{CAL-PFWNET}$, BTU/hr
452	-135810	-135810	-135810	-135810	-135810	-135810	-135810	-135810	-135810	-135810	-135810
450	-145510	-145510	-145510	-145510	-145510	-145510	-145510	-145510	-145510	-145510	-145510
448	-145510	-148744	-151977	-155211	-155211	-155211	-151977	-148744	-145510	-145510	-145510
446	-145510	-151977	-158444	-164912	-164912	-164912	-158444	-151977	-145510	-145510	-145510
444	-145510	-155211	-164912	-174612	-174612	-174612	-164912	-155211	-145510	-145510	-145510
442	-145510	-158444	-171379	-184313	-184313	-184313	-171379	-158444	-145510	-145510	-145510
440	-145510	-161678	-177846	-194014	-194014	-194014	-177846	-161678	-145510	-145510	-145510
438	-155211	-168145	-181079	-194014	-194014	-194014	-181079	-168145	-155211	-155211	-155211
436	-164912	-174612	-184313	-194014	-194014	-194014	-184313	-174612	-164912	-164912	-164912
434	-174612	-181079	-187546	-194014	-194014	-194014	-187546	-181079	-174612	-174612	-174612
432	-184313	-187546	-190780	-194014	-194014	-194014	-190780	-187546	-184313	-184313	-184313
430	-194014	-194014	-194014	-194014	-194014	-194014	-194014	-194014	-194014	-194014	-194014
428	-194014	-197247	-200481	-203714	-203714	-203714	-203714	-203714	-203714	-203714	-203714

Table 6B, Feedwater Pressure Contribution To Calorimetric Uncertainty, Bias Component $B_{CAL-PFWNET} = 2M_{FW}(h_{FW-0} - h_{FW-\varepsilon PFW})$

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$B_{CAL-TFWNET}$, BTU/hr	$B_{CAL-TFWNET}$, BTU/hr	$B_{CAL-TFWNET}$, BTU/hr	$B_{CAL-TFWNET}$, BTU/hr	$B_{CAL-TFWNET}$, BTU/hr	$B_{CAL-TFWNET}$, BTU/hr	$B_{CAL-TFWNET}$, BTU/hr	$B_{CAL-TFWNET}$, BTU/hr	$B_{CAL-TFWNET}$, BTU/hr	$B_{CAL-TFWNET}$, BTU/hr	$B_{CAL-TFWNET}$, BTU/hr
452	0	0	0	0	0	0	0	0	0	0	0
450	0	0	0	0	0	0	0	0	0	0	0
448	0	0	0	0	0	0	0	0	0	0	0
446	0	0	0	0	0	0	0	0	0	0	0
444	0	0	0	0	0	0	0	0	0	0	0
442	0	0	0	0	0	0	0	0	0	0	0
440	0	0	0	0	0	0	0	0	0	0	0
438	0	0	0	0	0	0	0	0	0	0	0
436	0	0	0	0	0	0	0	0	0	0	0
434	0	0	0	0	0	0	0	0	0	0	0
432	0	0	0	0	0	0	0	0	0	0	0
430	0	0	0	0	0	0	0	0	0	0	0
428	0	0	0	0	0	0	0	0	0	0	0

Tables 7A through 7C Main Steam Pressure Contribution To Calorimetric Uncertainty, Steps 7.10.3 and 7.10.4

Table 7A, Main Steam Pressure Contribution To Calorimetric Uncertainty, Random Component, Positive Direction

$$U_{CAL-PSTM1} = (M_{FW1} - M_{BD1})(h_{GS1-\varepsilon PSTM} - h_{GS1-0}) + (M_{BD1})(h_{FS1-\varepsilon PSTM} - h_{FS1-0})$$

$$U_{CAL-PSTM2} = (M_{FW2} - M_{BD2})(h_{GS2-\varepsilon PSTM} - h_{GS2-0}) + (M_{BD2})(h_{FS2-\varepsilon PSTM} - h_{FS2-0})$$

$$U_{CAL-PSTMNET} = -\{(U_{CAL-PSTM1})^2 + (U_{CAL-PSTM2})^2\}^{1/2}$$

	SG1	SG2	COMBINED
P_{STM}, PSIA	$U_{CAL-PSTM+}$, BTU/hr	$U_{CAL-PSTM+}$, BTU/hr	$U_{CAL-PSTM+NET}$, BTU/hr
870	-3343329	-3632904	-4937190
860	-3950100	-4247100	-5800099
850	-3941091	-4245516	-5792806
840	-2727549	-3017124	-4067255
830	-2727549	-3017124	-4067255
820	-3334320	-3631320	-4929926
810	-3334320	-3631320	-4929926
800	-3325311	-3629736	-4922670
790	-3325311	-3629736	-4922670
780	-2718540	-3015540	-4060042
770	-2709531	-3013956	-4052837

Table 7B, Main Steam Pressure Contribution To Calorimetric Uncertainty, Random Component, Negative Direction

$$U_{CAL-PSTM1} = (M_{FW1} - M_{BD1})(h_{GS1-\varepsilon PSTM} - h_{GS1-0}) + (M_{BD1})(h_{FS1-\varepsilon PSTM} - h_{FS1-0})$$

$$U_{CAL-PSTM2} = (M_{FW2} - M_{BD2})(h_{GS2-\varepsilon PSTM} - h_{GS2-0}) + (M_{BD2})(h_{FS2-\varepsilon PSTM} - h_{FS2-0})$$

$$U_{CAL-PSTMNET} = +\{(U_{CAL-PSTM1})^2 + (U_{CAL-PSTM2})^2\}^{1/2}$$

	SG1	SG2	COMBINED
P_{STM}, PSIA	$U_{CAL-PSTM-}$, BTU/hr	$U_{CAL-PSTM-}$, BTU/hr	$U_{CAL-PSTM-NET}$, BTU/hr
870	3941091	4245516	5792806
860	2727549	3017124	4067255
850	2727549	3017124	4067255
840	3334320	3631320	4929926
830	3334320	3631320	4929926
820	3325311	3629736	4922670
810	3325311	3629736	4922670
800	2718540	3015540	4060042
790	2709531	3013956	4052837
780	2709531	3013956	4052837
770	2709531	3013956	4052837

Table 7C, Main Steam Pressure Contribution To Calorimetric Uncertainty, Bias Component

$$B_{CAL-PSTM1} = (M_{FW1} - M_{BD1})(h_{GS1-EPSTM} - h_{GS1-0}) + (M_{BD1})(h_{FS1-EPSTM} - h_{FS1-0})$$

$$B_{CAL-PSTM2} = (M_{FW2} - M_{BD2})(h_{GS2-EPSTM} - h_{GS2-0}) + (M_{BD2})(h_{FS2-EPSTM} - h_{FS2-0})$$

$$B_{CAL-PSTMNET} = B_{CAL-PSTM1} + B_{CAL-PSTM2}$$

	SG1	SG2	COMBINED
P_{STM}, PSIA	$B_{CAL-PSTM+}$, BTU/hr	$B_{CAL-PSTM+}$, BTU/hr	$B_{CAL-PSTM+}$, BTU/hr
870	-575654	-624104	-1199758
860	-780946	-834496	-1615442
850	-572560	-623560	-1196120
840	-364174	-412624	-776798
830	-572560	-623560	-1196120
820	-572560	-623560	-1196120
810	-572560	-623560	-1196120
800	-569466	-623016	-1192482
790	-572560	-623560	-1196120
780	-361080	-412080	-773160
770	-569466	-623016	-1192482

Table 8A, Plant Computer Determination Of Enthalpy, Step 7.11.4

Value is not dependent on thermodynamic properties of feedwater or steam. The net contribution to calorimetric uncertainty is the same as calculated in Section 7.

$U_{CAL-CMPNET}$, BTU/hr
-1238707

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Table 9A1 through 9B, Uncertainty Summary, Steps 7.12.2 and 7.12.3

Table 9A1, Summary of Unit 1 Random Uncertainty

$$U_{CAL-RAND} = \left\{ \begin{array}{l} (U_{CAL-MFW-IND1})^2 + (U_{CAL-MFW-IND2})^2 + (U_{CAL-MFW-MDEP1} + U_{CAL-MFW-MDEP2})^2 \\ + (U_{CAL-MFW-TDEP1} + U_{CAL-TFW1})^2 + (U_{CAL-MFW-TDEP2} + U_{CAL-TFW2})^2 \\ + (U_{CAL-MBDT})^2 + (U_{CAL-PFWNET})^2 + (U_{CAL-PSTMNET})^2 + (U_{CAL-CMPNET})^2 \end{array} \right\}^{1/2}$$

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
870	-4937190	-5468306	-1238707	5.5813E+13

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44842225	-44839829	-44837433	-44835038	-44832642	-44830247	-44827851	-44825456	-44823061	-44820667	-44818272
450	-44934646	-44932235	-44929825	-44927415	-44925005	-44922596	-44920186	-44917776	-44915367	-44912958	-44910549
448	-44900990	-44900753	-44900517	-44900281	-44897864	-44895447	-44893019	-44890591	-44888164	-44887917	-44887670
446	-44992630	-44992404	-44992179	-44991955	-44989524	-44987092	-44984638	-44982184	-44979732	-44979485	-44979237
444	-45084311	-45084096	-45083883	-45083672	-45081226	-45078780	-45076298	-45073818	-45071340	-45071092	-45070845
442	-45176033	-45175829	-45175628	-45175432	-45172971	-45170511	-45167999	-45165492	-45162988	-45162741	-45162493
440	-45267794	-45267602	-45267415	-45267233	-45264758	-45262283	-45259742	-45257206	-45254676	-45254429	-45254181
438	-45258280	-45255926	-45253575	-45251228	-45250897	-45250566	-45250182	-45249802	-45249425	-45247024	-45244624
436	-45349474	-45347095	-45344718	-45342343	-45342012	-45341681	-45341310	-45340941	-45340574	-45338159	-45335743
434	-45440708	-45438303	-45435899	-45433497	-45433166	-45432835	-45432477	-45432119	-45431763	-45429333	-45426904
432	-45531982	-45529551	-45527119	-45524688	-45524357	-45524026	-45523682	-45523337	-45522993	-45520548	-45518104
430	-45623296	-45620837	-45618377	-45615918	-45615587	-45615256	-45614925	-45614593	-45614262	-45611803	-45609344
428	-45622588	-45622271	-45621953	-45621636	-45619167	-45616699	-45614230	-45611762	-45609294	-45606826	-45604358

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
860	-5800099	-5484494	-1238707	6.5255E+13

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44963792	-44961403	-44959013	-44956623	-44954234	-44951844	-44949455	-44947066	-44944677	-44942288	-44939899
450	-45056005	-45053601	-45051197	-45048793	-45046389	-45043985	-45041581	-45039178	-45036774	-45034371	-45031968
448	-45022457	-45022221	-45021985	-45021749	-45019338	-45016927	-45014506	-45012084	-45009663	-45009416	-45009170
446	-45113891	-45113666	-45113441	-45113218	-45110792	-45108367	-45105918	-45103471	-45101025	-45100778	-45100531
444	-45205367	-45205153	-45204940	-45204730	-45202290	-45199850	-45197373	-45194899	-45192427	-45192181	-45191934
442	-45296884	-45296681	-45296481	-45296285	-45293830	-45291375	-45288870	-45286369	-45283871	-45283624	-45283377
440	-45388442	-45388250	-45388063	-45387882	-45385413	-45382944	-45380409	-45377879	-45375356	-45375109	-45374862
438	-45378974	-45376625	-45374280	-45371939	-45371609	-45371279	-45370895	-45370516	-45370140	-45367745	-45365350
436	-45469966	-45467592	-45465221	-45462852	-45462522	-45462192	-45461822	-45461453	-45461087	-45458678	-45456268
434	-45560999	-45558600	-45556202	-45553805	-45553474	-45553144	-45552787	-45552431	-45552075	-45549651	-45547227
432	-45652072	-45649647	-45647221	-45644796	-45644466	-45644135	-45643791	-45643448	-45643104	-45640665	-45638227
430	-45743187	-45740733	-45738279	-45735826	-45735495	-45735165	-45734835	-45734504	-45734174	-45731720	-45729267
428	-45742502	-45742185	-45741868	-45741552	-45739089	-45736627	-45734164	-45731702	-45729240	-45726778	-45724316

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
850	-5792806	-5499873	-1238707	6.5340E+13

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44977034	-44974645	-44972255	-44969866	-44967477	-44965088	-44962699	-44960310	-44957921	-44955533	-44953144
450	-45069251	-45066847	-45064443	-45062039	-45059636	-45057232	-45054829	-45052426	-45050022	-45047619	-45045217
448	-45035725	-45035489	-45035253	-45035018	-45032607	-45030196	-45027775	-45025353	-45022933	-45022686	-45022439
446	-45127163	-45126938	-45126713	-45126490	-45124064	-45121639	-45119191	-45116744	-45114298	-45114051	-45113804
444	-45218643	-45218428	-45218216	-45218005	-45215565	-45213126	-45210650	-45208176	-45205705	-45205458	-45205211
442	-45310163	-45309960	-45309760	-45309564	-45307109	-45304655	-45302150	-45299649	-45297152	-45296905	-45296658
440	-45401725	-45401532	-45401346	-45401165	-45398696	-45396227	-45393692	-45391163	-45388640	-45388393	-45388146
438	-45392275	-45389927	-45387582	-45385241	-45384911	-45384581	-45384197	-45383818	-45383442	-45381047	-45378653
436	-45483271	-45480897	-45478526	-45476158	-45475828	-45475497	-45475127	-45474759	-45474392	-45471983	-45469574
434	-45574307	-45571908	-45569510	-45567114	-45566783	-45566453	-45566096	-45565740	-45565384	-45562960	-45560537
432	-45665384	-45662958	-45660533	-45658108	-45657778	-45657448	-45657104	-45656760	-45656416	-45653978	-45651540
430	-45756502	-45754048	-45751595	-45749142	-45748811	-45748481	-45748150	-45747820	-45747489	-45745036	-45742583
428	-45755834	-45755517	-45755200	-45754883	-45752421	-45749959	-45747497	-45745035	-45742573	-45740111	-45737650

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
840	-4067255	-5516061	-1238707	4.8504E+13

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44797721	-44795322	-44792923	-44790523	-44788124	-44785726	-44783327	-44780928	-44778530	-44776131	-44773733
450	-44890327	-44887913	-44885500	-44883086	-44880672	-44878259	-44875846	-44873433	-44871020	-44868607	-44866194
448	-44856676	-44856439	-44856202	-44855965	-44853545	-44851124	-44848693	-44846262	-44843831	-44843583	-44843336
446	-44948499	-44948272	-44948047	-44947822	-44945387	-44942952	-44940494	-44938037	-44935581	-44935333	-44935085
444	-45040362	-45040146	-45039933	-45039721	-45037272	-45034822	-45032336	-45029852	-45027371	-45027123	-45026875
442	-45132264	-45132060	-45131859	-45131662	-45129198	-45126733	-45124218	-45121707	-45119200	-45118952	-45118704
440	-45224206	-45224013	-45223825	-45223644	-45221165	-45218686	-45216141	-45213602	-45211068	-45210820	-45210572
438	-45214730	-45212372	-45210017	-45207667	-45207336	-45207004	-45206619	-45206238	-45205861	-45203456	-45201052
436	-45306102	-45303719	-45301339	-45298960	-45298629	-45298298	-45297926	-45297556	-45297188	-45294769	-45292351
434	-45397514	-45395105	-45392698	-45390292	-45389960	-45389628	-45389270	-45388912	-45388555	-45386121	-45383688
432	-45488965	-45486530	-45484095	-45481660	-45481328	-45480997	-45480651	-45480306	-45479961	-45477513	-45475065
430	-45580455	-45577992	-45575529	-45573066	-45572734	-45572402	-45572070	-45571739	-45571407	-45568944	-45566481
428	-45579796	-45579478	-45579159	-45578841	-45576369	-45573897	-45571425	-45568954	-45566482	-45564010	-45561539

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
830	-4067255	-5532249	-1238707	4.8683E+13

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44812073	-44809674	-44807275	-44804877	-44802478	-44800079	-44797681	-44795283	-44792885	-44790487	-44788089
450	-44904681	-44902267	-44899854	-44897440	-44895027	-44892614	-44890202	-44887789	-44885376	-44882964	-44880551
448	-44871053	-44870816	-44870579	-44870342	-44867922	-44865502	-44863071	-44860640	-44858210	-44857962	-44857714
446	-44962877	-44962651	-44962425	-44962201	-44959766	-44957331	-44954873	-44952417	-44949961	-44949713	-44949465
444	-45054741	-45054526	-45054312	-45054101	-45051651	-45049202	-45046717	-45044233	-45041752	-45041504	-45041256
442	-45146645	-45146440	-45146240	-45146043	-45143579	-45141115	-45138600	-45136089	-45133582	-45133334	-45133086
440	-45238588	-45238395	-45238207	-45238026	-45235547	-45233069	-45230524	-45227985	-45225452	-45225204	-45224956
438	-45229131	-45226773	-45224419	-45222069	-45221737	-45221406	-45221021	-45220640	-45220262	-45217859	-45215455
436	-45320504	-45318122	-45315741	-45313363	-45313032	-45312700	-45312329	-45311959	-45311591	-45309172	-45306754
434	-45411917	-45409509	-45407102	-45404696	-45404364	-45404032	-45403674	-45403316	-45402959	-45400526	-45398093
432	-45503369	-45500934	-45498500	-45496065	-45495734	-45495402	-45495057	-45494711	-45494366	-45491919	-45489471
430	-45594860	-45592397	-45589935	-45587472	-45587140	-45586809	-45586477	-45586145	-45585813	-45583351	-45580888
428	-45594218	-45593900	-45593581	-45593263	-45590792	-45588320	-45585848	-45583377	-45580906	-45578435	-45575964

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
820	-4929926	-5548437	-1238707	5.6624E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44912921	-44910527	-44908133	-44905740	-44903346	-44900952	-44898559	-44896166	-44893773	-44891380	-44888987
450	-45005352	-45002944	-45000535	-44998127	-44995719	-44993311	-44990903	-44988495	-44986088	-44983680	-44981273
448	-44971812	-44971575	-44971339	-44971103	-44968688	-44966273	-44963847	-44961421	-44958996	-44958748	-44958501
446	-45063462	-45063236	-45063011	-45062787	-45060357	-45057927	-45055474	-45053023	-45050572	-45050325	-45050077
444	-45155152	-45154937	-45154724	-45154513	-45152068	-45149624	-45147144	-45144665	-45142189	-45141942	-45141694
442	-45246882	-45246678	-45246478	-45246281	-45243822	-45241363	-45238854	-45236348	-45233846	-45233599	-45233351
440	-45338652	-45338459	-45338272	-45338091	-45335618	-45333144	-45330605	-45328071	-45325543	-45325296	-45325048
438	-45329232	-45326879	-45324529	-45322184	-45321853	-45321523	-45321138	-45320758	-45320381	-45317982	-45315584
436	-45420433	-45418056	-45415681	-45413307	-45412977	-45412646	-45412275	-45411905	-45411538	-45409125	-45406712
434	-45511676	-45509272	-45506870	-45504469	-45504138	-45503807	-45503449	-45503092	-45502736	-45500308	-45497880
432	-45602958	-45600528	-45598098	-45595669	-45595338	-45595007	-45594662	-45594318	-45593973	-45591530	-45589088
430	-45694280	-45691822	-45689364	-45686907	-45686575	-45686244	-45685913	-45685582	-45685250	-45682793	-45680336
428	-45693655	-45693338	-45693020	-45692703	-45690236	-45687769	-45685302	-45682836	-45680370	-45677903	-45675437

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
810	-4929926	-5565434	-1238707	5.6813E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44927357	-44924963	-44922569	-44920176	-44917783	-44915390	-44912997	-44910604	-44908211	-44905818	-44903426
450	-45019789	-45017381	-45014973	-45012565	-45010157	-45007749	-45005342	-45002935	-45000527	-44998120	-44995713
448	-44986272	-44986036	-44985799	-44985563	-44983148	-44980733	-44978308	-44975882	-44973458	-44973210	-44972963
446	-45077923	-45077697	-45077472	-45077248	-45074818	-45072389	-45069937	-45067486	-45065035	-45064788	-45064541
444	-45169614	-45169399	-45169186	-45168975	-45166531	-45164087	-45161607	-45159129	-45156653	-45156406	-45156159
442	-45261346	-45261142	-45260941	-45260744	-45258286	-45255828	-45253318	-45250813	-45248312	-45248064	-45247817
440	-45353117	-45352924	-45352737	-45352556	-45350083	-45347610	-45345071	-45342537	-45340010	-45339762	-45339515
438	-45343715	-45341362	-45339014	-45336669	-45336338	-45336007	-45335623	-45335242	-45334866	-45332467	-45330069
436	-45434918	-45432541	-45430166	-45427793	-45427462	-45427131	-45426760	-45426391	-45426024	-45423611	-45421198
434	-45526161	-45523758	-45521357	-45518956	-45518625	-45518294	-45517936	-45517579	-45517222	-45514795	-45512367
432	-45617444	-45615015	-45612585	-45610157	-45609826	-45609494	-45609150	-45608805	-45608461	-45606018	-45603576
430	-45708767	-45706310	-45703852	-45701395	-45701064	-45700733	-45700401	-45700070	-45699739	-45697282	-45694825
428	-45708160	-45707842	-45707524	-45707207	-45704740	-45702274	-45699808	-45697342	-45694876	-45692410	-45689944

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
800	-4922670	-5581622	-1238707	5.6922E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44940902	-44938509	-44936115	-44933722	-44931329	-44928937	-44926544	-44924151	-44921759	-44919367	-44916974
450	-45033337	-45030929	-45028522	-45026114	-45023707	-45021300	-45018892	-45016485	-45014079	-45011672	-45009265
448	-44999843	-44999607	-44999370	-44999134	-44996720	-44994305	-44991880	-44989455	-44987030	-44986783	-44986536
446	-45091497	-45091271	-45091046	-45090822	-45088393	-45085964	-45083512	-45081061	-45078611	-45078364	-45078116
444	-45183191	-45182976	-45182763	-45182552	-45180109	-45177665	-45175185	-45172708	-45170232	-45169985	-45169737
442	-45274926	-45274722	-45274521	-45274325	-45271866	-45269408	-45266900	-45264395	-45261894	-45261646	-45261398
440	-45366700	-45366507	-45366320	-45366139	-45363666	-45361193	-45358655	-45356122	-45353595	-45353347	-45353099
438	-45357317	-45354964	-45352616	-45350271	-45349940	-45349610	-45349225	-45348845	-45348468	-45346070	-45343672
436	-45448522	-45446145	-45443771	-45441398	-45441068	-45440737	-45440365	-45439996	-45439629	-45437216	-45434804
434	-45539768	-45537366	-45534964	-45532564	-45532233	-45531902	-45531544	-45531187	-45530830	-45528403	-45525976
432	-45631054	-45628625	-45626196	-45623767	-45623436	-45623105	-45622760	-45622416	-45622072	-45619630	-45617188
430	-45722380	-45719923	-45717466	-45715009	-45714678	-45714346	-45714015	-45713684	-45713353	-45710896	-45708439
428	-45721789	-45721471	-45721153	-45720836	-45718370	-45715904	-45713438	-45710972	-45708507	-45706041	-45703576

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
790	-4922670	-5597810	-1238707	5.7103E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44955248	-44952855	-44950463	-44948070	-44945677	-44943285	-44940893	-44938500	-44936108	-44933716	-44931325
450	-45047685	-45045278	-45042870	-45040463	-45038056	-45035649	-45033243	-45030836	-45028429	-45026023	-45023617
448	-45014215	-45013978	-45013741	-45013505	-45011091	-45008677	-45006252	-45003828	-45001403	-45001156	-45000909
446	-45105870	-45105644	-45105419	-45105194	-45102766	-45100337	-45097886	-45095435	-45092986	-45092738	-45092491
444	-45197565	-45197350	-45197137	-45196926	-45194483	-45192040	-45189560	-45187083	-45184608	-45184361	-45184113
442	-45289301	-45289097	-45288897	-45288700	-45286242	-45283784	-45281276	-45278771	-45276271	-45276023	-45275776
440	-45381077	-45380884	-45380697	-45380515	-45378043	-45375571	-45373032	-45370500	-45367973	-45367725	-45367478
438	-45371712	-45369360	-45367012	-45364667	-45364337	-45364006	-45363622	-45363241	-45362864	-45360467	-45358069
436	-45462919	-45460542	-45458168	-45455796	-45455465	-45455134	-45454763	-45454394	-45454027	-45451614	-45449202
434	-45554166	-45551764	-45549363	-45546963	-45546632	-45546301	-45545943	-45545585	-45545229	-45542802	-45540375
432	-45645453	-45643024	-45640596	-45638167	-45637836	-45637505	-45637160	-45636816	-45636472	-45634030	-45631588
430	-45736780	-45734323	-45731866	-45729410	-45729079	-45728747	-45728416	-45728085	-45727754	-45725297	-45722841
428	-45736206	-45735888	-45735570	-45735253	-45732787	-45730321	-45727856	-45725390	-45722925	-45720460	-45717995

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

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P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
780	-4060042	-5613998	-1238707	4.9535E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44879243	-44876846	-44874449	-44872052	-44869655	-44867258	-44864862	-44862465	-44860069	-44857672	-44855276
450	-44971857	-44969445	-44967033	-44964622	-44962211	-44959799	-44957388	-44954977	-44952567	-44950156	-44947745
448	-44938338	-44938101	-44937864	-44937628	-44935209	-44932791	-44930361	-44927932	-44925504	-44925256	-44925008
446	-45030168	-45029942	-45029716	-45029492	-45027059	-45024626	-45022170	-45019715	-45017261	-45017013	-45016765
444	-45122038	-45121822	-45121609	-45121398	-45118950	-45116502	-45114019	-45111537	-45109058	-45108810	-45108562
442	-45213947	-45213743	-45213542	-45213345	-45210883	-45208421	-45205908	-45203399	-45200894	-45200646	-45200398
440	-45305896	-45305703	-45305515	-45305334	-45302857	-45300380	-45297837	-45295300	-45292769	-45292521	-45292273
438	-45296526	-45294170	-45291818	-45289469	-45289138	-45288806	-45288421	-45288040	-45287663	-45285261	-45282859
436	-45387904	-45385524	-45383145	-45380769	-45380437	-45380106	-45379734	-45379364	-45378996	-45376580	-45374163
434	-45479322	-45476916	-45474510	-45472106	-45471774	-45471443	-45471084	-45470726	-45470369	-45467938	-45465507
432	-45570779	-45568346	-45565913	-45563481	-45563149	-45562817	-45562472	-45562126	-45561782	-45559336	-45556890
430	-45662275	-45659814	-45657353	-45654892	-45654560	-45654229	-45653897	-45653565	-45653233	-45650772	-45648312
428	-45661711	-45661393	-45661074	-45660756	-45658286	-45655816	-45653346	-45650877	-45648407	-45645938	-45643468

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
770	-4052837	-5630996	-1238707	4.9668E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-44893078	-44890681	-44888285	-44885888	-44883491	-44881095	-44878699	-44876303	-44873907	-44871511	-44869115
450	-44985695	-44983283	-44980872	-44978461	-44976050	-44973639	-44971228	-44968818	-44966407	-44963997	-44961586
448	-44952199	-44951962	-44951725	-44951488	-44949070	-44946652	-44944223	-44941795	-44939366	-44939119	-44938871
446	-45044031	-45043805	-45043579	-45043355	-45040922	-45038489	-45036034	-45033579	-45031126	-45030878	-45030630
444	-45135903	-45135688	-45135474	-45135263	-45132816	-45130369	-45127885	-45125404	-45122925	-45122677	-45122429
442	-45227815	-45227611	-45227410	-45227213	-45224751	-45222289	-45219777	-45217268	-45214763	-45214515	-45214267
440	-45319766	-45319573	-45319385	-45319203	-45316727	-45314251	-45311708	-45309172	-45306641	-45306393	-45306144
438	-45310415	-45308059	-45305707	-45303359	-45303027	-45302696	-45302311	-45301930	-45301552	-45299151	-45296749
436	-45401795	-45399415	-45397036	-45394660	-45394329	-45393997	-45393626	-45393256	-45392888	-45390472	-45388055
434	-45493215	-45490809	-45488404	-45486000	-45485668	-45485337	-45484978	-45484620	-45484263	-45481832	-45479401
432	-45584674	-45582241	-45579809	-45577377	-45577045	-45576713	-45576368	-45576023	-45575678	-45573232	-45570786
430	-45676172	-45673711	-45671251	-45668790	-45668459	-45668127	-45667795	-45667463	-45667131	-45664671	-45662210
428	-45675625	-45675306	-45674988	-45674670	-45672200	-45669731	-45667261	-45664792	-45662323	-45659853	-45657384

Table 9A2, Summary of Unit 2 Random Uncertainty

$$U_{CAL-RAND} = \left\{ \begin{array}{l} (U_{CAL-MFW-IND1})^2 + (U_{CAL-MFW-IND2})^2 + (U_{CAL-MFW-MDEP1} + U_{CAL-MFW-MDEP2})^2 \\ + (U_{CAL-MFW-TDEP1} + U_{CAL-TFW1})^2 + (U_{CAL-MFW-TDEP2} + U_{CAL-TFW2})^2 \\ + (U_{CAL-PFWNET})^2 + (U_{CAL-PSTMNET})^2 + (U_{CAL-CMPNET})^2 \end{array} \right\}^{1/2}$$

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
870	-4937190	-5468306	-1238707	5.5813E+13

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50555564	-50553340	-50551116	-50548892	-50546668	-50544444	-50542221	-50539998	-50537775	-50535551	-50533329
450	-50668882	-50666640	-50664398	-50662156	-50659914	-50657673	-50655431	-50653190	-50650949	-50648707	-50646466
448	-50668910	-50668617	-50668323	-50668030	-50665778	-50663525	-50661263	-50659002	-50656740	-50656437	-50656134
446	-50781243	-50780959	-50780676	-50780393	-50778123	-50775852	-50773561	-50771271	-50768982	-50768679	-50768376
444	-50893618	-50893344	-50893071	-50892800	-50890511	-50888223	-50885902	-50883583	-50881266	-50880963	-50880659
442	-51006034	-51005769	-51005508	-51005250	-51002943	-51000636	-50998284	-50995936	-50993591	-50993287	-50992984
440	-51118492	-51118237	-51117987	-51117742	-51115417	-51113092	-51110708	-51108330	-51105956	-51105653	-51105349
438	-51140052	-51137857	-51135665	-51133477	-51133072	-51132667	-51132214	-51131765	-51131319	-51129084	-51126848
436	-51251768	-51249546	-51247326	-51245108	-51244703	-51244297	-51243856	-51243417	-51242980	-51240726	-51238472
434	-51363525	-51361275	-51359026	-51356778	-51356372	-51355967	-51355537	-51355109	-51354681	-51352409	-51350137
432	-51475322	-51473043	-51470765	-51468486	-51468081	-51467675	-51467257	-51466840	-51466423	-51464132	-51461842
430	-51587160	-51584851	-51582542	-51580234	-51579828	-51579422	-51579016	-51578611	-51578205	-51575896	-51573588
428	-51616497	-51616104	-51615710	-51615316	-51612995	-51610673	-51608352	-51606030	-51603709	-51601388	-51599067

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P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
860	-5800099	-5484494	-1238707	6.5255E+13

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50668992	-50666772	-50664552	-50662333	-50660114	-50657895	-50655676	-50653457	-50651238	-50649020	-50646801
450	-50782110	-50779872	-50777635	-50775397	-50773160	-50770923	-50768686	-50766449	-50764212	-50761975	-50759739
448	-50782168	-50781875	-50781582	-50781289	-50779041	-50776794	-50774536	-50772279	-50770022	-50769720	-50769417
446	-50894303	-50894020	-50893737	-50893455	-50891189	-50888923	-50886636	-50884351	-50882066	-50881764	-50881461
444	-51006481	-51006207	-51005934	-51005664	-51003380	-51001096	-50998779	-50996465	-50994153	-50993850	-50993547
442	-51118701	-51118436	-51118175	-51117917	-51115615	-51113313	-51110965	-51108622	-51106281	-51105978	-51105676
440	-51230962	-51230708	-51230459	-51230214	-51227894	-51225573	-51223194	-51220820	-51218451	-51218149	-51217846
438	-51252509	-51250318	-51248131	-51245947	-51245543	-51245138	-51244687	-51244238	-51243793	-51241562	-51239331
436	-51364032	-51361814	-51359598	-51357384	-51356980	-51356575	-51356135	-51355697	-51355260	-51353011	-51350761
434	-51475596	-51473350	-51471105	-51468862	-51468457	-51468052	-51467624	-51467196	-51466769	-51464501	-51462233
432	-51587202	-51584927	-51582653	-51580378	-51579974	-51579569	-51579152	-51578735	-51578319	-51576033	-51573747
430	-51698848	-51696544	-51694239	-51691935	-51691530	-51691125	-51690720	-51690315	-51689910	-51687605	-51685301
428	-51728156	-51727763	-51727370	-51726977	-51724660	-51722343	-51720026	-51717709	-51715392	-51713076	-51710759

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
850	-5792806	-5499873	-1238707	6.5340E+13

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50684919	-50682700	-50680480	-50678261	-50676043	-50673824	-50671605	-50669387	-50667168	-50664950	-50662732
450	-50798041	-50795804	-50793567	-50791330	-50789093	-50786856	-50784619	-50782382	-50780146	-50777910	-50775673
448	-50798122	-50797829	-50797536	-50797244	-50794996	-50792748	-50790491	-50788234	-50785978	-50785675	-50785373
446	-50910261	-50909978	-50909695	-50909413	-50907147	-50904881	-50902595	-50900310	-50898026	-50897723	-50897421
444	-51022443	-51022169	-51021896	-51021626	-51019342	-51017058	-51014742	-51012428	-51010116	-51009814	-51009511
442	-51134666	-51134402	-51134141	-51133883	-51131581	-51129279	-51126932	-51124589	-51122249	-51121946	-51121643
440	-51246932	-51246678	-51246428	-51246184	-51243864	-51241543	-51239165	-51236791	-51234423	-51234120	-51233817
438	-51268497	-51266307	-51264120	-51261936	-51261532	-51261128	-51260676	-51260227	-51259782	-51257551	-51255320
436	-51380024	-51377806	-51375591	-51373377	-51372973	-51372568	-51372128	-51371689	-51371253	-51369004	-51366755
434	-51491591	-51489346	-51487102	-51484858	-51484453	-51484049	-51483620	-51483192	-51482765	-51480498	-51478230
432	-51603201	-51600926	-51598652	-51596378	-51595974	-51595569	-51595152	-51594735	-51594319	-51592033	-51589747
430	-51714851	-51712547	-51710242	-51707938	-51707533	-51707128	-51706723	-51706318	-51705913	-51703609	-51701305
428	-51744176	-51743783	-51743390	-51742997	-51740680	-51738363	-51736046	-51733730	-51731413	-51729097	-51726781

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P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
840	-4067255	-5516061	-1238707	4.8504E+13

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50528661	-50526434	-50524208	-50521982	-50519756	-50517530	-50515304	-50513078	-50510853	-50508627	-50506402
450	-50642158	-50639914	-50637670	-50635425	-50633181	-50630937	-50628693	-50626450	-50624206	-50621962	-50619719
448	-50642255	-50641961	-50641667	-50641373	-50639118	-50636864	-50634599	-50632335	-50630072	-50629768	-50629465
446	-50754764	-50754480	-50754196	-50753913	-50751640	-50749367	-50747074	-50744781	-50742490	-50742186	-50741883
444	-50867315	-50867040	-50866767	-50866495	-50864204	-50861913	-50859590	-50857269	-50854949	-50854645	-50854342
442	-50979906	-50979641	-50979379	-50979120	-50976811	-50974501	-50972147	-50969796	-50967449	-50967145	-50966841
440	-51092538	-51092282	-51092032	-51091787	-51089459	-51087132	-51084746	-51082365	-51079989	-51079685	-51079381
438	-51114185	-51111988	-51109794	-51107603	-51107198	-51106792	-51106339	-51105889	-51105442	-51103204	-51100966
436	-51226073	-51223848	-51221626	-51219406	-51219000	-51218594	-51218152	-51217712	-51217274	-51215018	-51212762
434	-51338001	-51335748	-51333497	-51331246	-51330840	-51330434	-51330004	-51329575	-51329147	-51326872	-51324598
432	-51449969	-51447687	-51445406	-51443125	-51442719	-51442313	-51441895	-51441477	-51441059	-51438766	-51436473
430	-51561976	-51559665	-51557354	-51555042	-51554636	-51554230	-51553823	-51553417	-51553011	-51550700	-51548389
428	-51591405	-51591011	-51590617	-51590223	-51587899	-51585574	-51583251	-51580927	-51578603	-51576280	-51573956

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
830	-4067255	-5532249	-1238707	4.8683E+13

P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50545576	-50543350	-50541124	-50538898	-50536672	-50534447	-50532221	-50529996	-50527771	-50525546	-50523321
450	-50659075	-50656831	-50654587	-50652343	-50650099	-50647856	-50645612	-50643369	-50641126	-50638882	-50636639
448	-50659194	-50658900	-50658606	-50658313	-50656058	-50653804	-50651540	-50649276	-50647013	-50646709	-50646406
446	-50771706	-50771421	-50771137	-50770854	-50768581	-50766309	-50764016	-50761724	-50759433	-50759129	-50758826
444	-50884258	-50883983	-50883709	-50883438	-50881147	-50878857	-50876534	-50874213	-50871894	-50871590	-50871286
442	-50996850	-50996585	-50996323	-50996064	-50993755	-50991446	-50989093	-50986742	-50984395	-50984091	-50983787
440	-51109483	-51109228	-51108978	-51108733	-51106405	-51104078	-51101692	-51099312	-51096936	-51096632	-51096328
438	-51131149	-51128952	-51126758	-51124568	-51124163	-51123757	-51123304	-51122854	-51122407	-51120170	-51117932
436	-51243038	-51240814	-51238592	-51236372	-51235966	-51235560	-51235119	-51234679	-51234241	-51231985	-51229729
434	-51354968	-51352716	-51350464	-51348214	-51347808	-51347402	-51346972	-51346543	-51346114	-51343840	-51341566
432	-51466937	-51464656	-51462375	-51460095	-51459688	-51459282	-51458864	-51458446	-51458028	-51455736	-51453443
430	-51578946	-51576635	-51574324	-51572013	-51571607	-51571200	-51570794	-51570388	-51569981	-51567671	-51565360
428	-51608391	-51607997	-51607603	-51607208	-51604885	-51602561	-51600237	-51597914	-51595591	-51593268	-51590945

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
820	-4929926	-5548437	-1238707	5.6624E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50639190	-50636968	-50634746	-50632523	-50630301	-50628080	-50625858	-50623636	-50621415	-50619194	-50616973
450	-50752520	-50750279	-50748039	-50745799	-50743559	-50741319	-50739079	-50736840	-50734600	-50732361	-50730122
448	-50752661	-50752368	-50752074	-50751781	-50749530	-50747280	-50745020	-50742760	-50740500	-50740197	-50739894
446	-50865005	-50864721	-50864437	-50864155	-50861886	-50859617	-50857328	-50855040	-50852753	-50852449	-50852146
444	-50977390	-50977115	-50976843	-50976572	-50974285	-50971998	-50969679	-50967362	-50965046	-50964743	-50964440
442	-51089816	-51089552	-51089290	-51089032	-51086726	-51084421	-51082071	-51079725	-51077381	-51077078	-51076775
440	-51202284	-51202029	-51201779	-51201534	-51199211	-51196887	-51194505	-51192129	-51189757	-51189454	-51189150
438	-51223935	-51221742	-51219552	-51217366	-51216960	-51216555	-51216103	-51215653	-51215207	-51212974	-51210740
436	-51335661	-51333440	-51331222	-51329006	-51328600	-51328195	-51327754	-51327315	-51326877	-51324625	-51322373
434	-51447427	-51445179	-51442931	-51440685	-51440279	-51439874	-51439444	-51439016	-51438588	-51436317	-51434047
432	-51559234	-51556956	-51554679	-51552403	-51551997	-51551591	-51551174	-51550756	-51550339	-51548050	-51545762
430	-51671081	-51668774	-51666466	-51664159	-51663753	-51663348	-51662942	-51662536	-51662130	-51659823	-51657516
428	-51700500	-51700106	-51699712	-51699318	-51696998	-51694678	-51692359	-51690039	-51687719	-51685400	-51683081

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
810	-4929926	-5565434	-1238707	5.6813E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50656178	-50653956	-50651734	-50649513	-50647291	-50645069	-50642848	-50640627	-50638406	-50636185	-50633964
450	-50769510	-50767269	-50765030	-50762790	-50760550	-50758311	-50756071	-50753832	-50751593	-50749354	-50747115
448	-50769674	-50769380	-50769087	-50768793	-50766543	-50764293	-50762033	-50759773	-50757514	-50757211	-50756908
446	-50882019	-50881735	-50881451	-50881169	-50878900	-50876632	-50874343	-50872055	-50869768	-50869465	-50869162
444	-50994405	-50994131	-50993858	-50993587	-50991300	-50989014	-50986695	-50984378	-50982063	-50981760	-50981457
442	-51106833	-51106568	-51106307	-51106048	-51103743	-51101439	-51099089	-51096743	-51094400	-51094096	-51093793
440	-51219302	-51219047	-51218797	-51218552	-51216229	-51213906	-51211525	-51209148	-51206777	-51206474	-51206170
438	-51240972	-51238779	-51236589	-51234403	-51233998	-51233593	-51233140	-51232691	-51232245	-51230011	-51227778
436	-51352698	-51350478	-51348260	-51346044	-51345639	-51345234	-51344793	-51344353	-51343916	-51341664	-51339413
434	-51464466	-51462218	-51459971	-51457725	-51457319	-51456914	-51456484	-51456056	-51455628	-51453358	-51451088
432	-51576274	-51573997	-51571720	-51569444	-51569038	-51568633	-51568215	-51567798	-51567380	-51565092	-51562804
430	-51688122	-51685815	-51683508	-51681202	-51680796	-51680390	-51679984	-51679579	-51679173	-51676866	-51674560
428	-51717557	-51717163	-51716770	-51716376	-51714056	-51711737	-51709417	-51707098	-51704779	-51702460	-51700141

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
800	-4922670	-5581622	-1238707	5.6922E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50672377	-50670155	-50667934	-50665712	-50663491	-50661270	-50659049	-50656828	-50654607	-50652387	-50650166
450	-50785712	-50783472	-50781232	-50778993	-50776753	-50774514	-50772275	-50770036	-50767797	-50765559	-50763320
448	-50785898	-50785605	-50785311	-50785018	-50782768	-50780518	-50778259	-50775999	-50773741	-50773437	-50773134
446	-50898247	-50897962	-50897679	-50897396	-50895128	-50892860	-50890572	-50888284	-50885998	-50885694	-50885391
444	-51010637	-51010362	-51010089	-51009818	-51007532	-51005245	-51002927	-51000611	-50998296	-50997993	-50997690
442	-51123068	-51122803	-51122541	-51122283	-51119978	-51117674	-51115324	-51112978	-51110636	-51110332	-51110029
440	-51235540	-51235285	-51235035	-51234790	-51232467	-51230144	-51227763	-51225387	-51223016	-51222713	-51222409
438	-51257228	-51255035	-51252846	-51250660	-51250254	-51249849	-51249397	-51248948	-51248502	-51246268	-51244035
436	-51368957	-51366738	-51364520	-51362304	-51361899	-51361493	-51361052	-51360613	-51360176	-51357924	-51355673
434	-51480728	-51478480	-51476233	-51473987	-51473582	-51473176	-51472747	-51472318	-51471891	-51469621	-51467351
432	-51592539	-51590262	-51587986	-51585710	-51585304	-51584898	-51584481	-51584063	-51583646	-51581358	-51579070
430	-51704390	-51702084	-51699777	-51697470	-51697065	-51696659	-51696253	-51695847	-51695442	-51693135	-51690829
428	-51733842	-51733448	-51733054	-51732660	-51730341	-51728022	-51725702	-51723383	-51721065	-51718746	-51716427

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
790	-4922670	-5597810	-1238707	5.7103E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50689286	-50687065	-50684843	-50682622	-50680401	-50678181	-50675960	-50673740	-50671519	-50669299	-50667079
450	-50802623	-50800383	-50798144	-50795905	-50793666	-50791427	-50789188	-50786950	-50784711	-50782473	-50780235
448	-50802832	-50802538	-50802245	-50801952	-50799702	-50797452	-50795193	-50792934	-50790676	-50790373	-50790070
446	-50915182	-50914898	-50914614	-50914332	-50912064	-50909796	-50907508	-50905221	-50902935	-50902632	-50902328
444	-51027574	-51027299	-51027026	-51026755	-51024469	-51022183	-51019865	-51017549	-51015235	-51014932	-51014628
442	-51140006	-51139741	-51139480	-51139221	-51136917	-51134613	-51132264	-51129918	-51127576	-51127273	-51126969
440	-51252480	-51252225	-51251975	-51251730	-51249408	-51247085	-51244704	-51242329	-51239958	-51239655	-51239351
438	-51274186	-51271994	-51269805	-51267619	-51267214	-51266809	-51266356	-51265907	-51265461	-51263228	-51260995
436	-51385917	-51383698	-51381480	-51379265	-51378859	-51378454	-51378013	-51377574	-51377137	-51374885	-51372634
434	-51497689	-51495442	-51493195	-51490950	-51490544	-51490139	-51489709	-51489281	-51488853	-51486583	-51484314
432	-51609502	-51607225	-51604949	-51602673	-51602268	-51601862	-51601444	-51601027	-51600610	-51598322	-51596034
430	-51721354	-51719048	-51716742	-51714435	-51714030	-51713624	-51713218	-51712813	-51712407	-51710101	-51707795
428	-51750822	-51750428	-51750034	-51749641	-51747322	-51745003	-51742684	-51740365	-51738046	-51735728	-51733410

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
780	-4060042	-5613998	-1238707	4.9535E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50624685	-50622461	-50620236	-50618012	-50615788	-50613564	-50611341	-50609117	-50606894	-50604670	-50602447
450	-50738192	-50735950	-50733708	-50731465	-50729223	-50726981	-50724740	-50722498	-50720256	-50718015	-50715774
448	-50738417	-50738123	-50737829	-50737536	-50735283	-50733030	-50730768	-50728506	-50726244	-50725941	-50725637
446	-50850936	-50850651	-50850367	-50850084	-50847813	-50845542	-50843251	-50840961	-50838671	-50838368	-50838064
444	-50963495	-50963220	-50962947	-50962675	-50960386	-50958097	-50955776	-50953456	-50951139	-50950835	-50950532
442	-51076095	-51075829	-51075567	-51075308	-51073001	-51070694	-51068342	-51065993	-51063647	-51063343	-51063040
440	-51188735	-51188479	-51188229	-51187984	-51185658	-51183332	-51180948	-51178569	-51176196	-51175892	-51175588
438	-51210485	-51208289	-51206097	-51203909	-51203503	-51203097	-51202644	-51202194	-51201747	-51199512	-51197276
436	-51322380	-51320158	-51317937	-51315719	-51315313	-51314907	-51314465	-51314025	-51313587	-51311333	-51309079
434	-51434316	-51432065	-51429816	-51427567	-51427161	-51426755	-51426325	-51425896	-51425467	-51423195	-51420922
432	-51546291	-51544012	-51541732	-51539454	-51539047	-51538641	-51538223	-51537805	-51537387	-51535096	-51532805
430	-51658306	-51655997	-51653687	-51651378	-51650972	-51650565	-51650159	-51649753	-51649346	-51647037	-51644728
428	-51687827	-51687432	-51687038	-51686644	-51684322	-51682000	-51679678	-51677356	-51675034	-51672713	-51670391

P_{STM}	$U_{CAL-PSTMNET}$, BTU/hr	$U_{CAL-MBDT}$, BTU/hr	$U_{CAL-CMPNET}$, BTU/hr	SUMSQ
770	-4052837	-5630996	-1238707	4.9668E+13

P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr	$U_{CAL-RAND}$, BTU/hr
452	-50641142	-50638918	-50636694	-50634471	-50632247	-50630023	-50627800	-50625577	-50623354	-50621131	-50618908
450	-50754652	-50752410	-50750168	-50747926	-50745685	-50743443	-50741202	-50738960	-50736719	-50734478	-50732237
448	-50754900	-50754606	-50754312	-50754018	-50751766	-50749513	-50747251	-50744990	-50742728	-50742425	-50742121
446	-50867421	-50867136	-50866852	-50866569	-50864299	-50862028	-50859737	-50857447	-50855158	-50854855	-50854551
444	-50979983	-50979708	-50979434	-50979163	-50976874	-50974585	-50972264	-50969946	-50967629	-50967325	-50967021
442	-51092585	-51092320	-51092058	-51091799	-51089492	-51087185	-51084833	-51082484	-51080139	-51079835	-51079532
440	-51205227	-51204972	-51204722	-51204476	-51202151	-51199826	-51197442	-51195064	-51192690	-51192386	-51192082
438	-51226996	-51224801	-51222609	-51220421	-51220015	-51219609	-51219156	-51218706	-51218260	-51216024	-51213789
436	-51338894	-51336672	-51334451	-51332233	-51331827	-51331421	-51330980	-51330540	-51330102	-51327848	-51325594
434	-51450832	-51448581	-51446332	-51444084	-51443678	-51443272	-51442842	-51442413	-51441984	-51439712	-51437440
432	-51562809	-51560530	-51558251	-51555973	-51555567	-51555160	-51554742	-51554324	-51553906	-51551616	-51549325
430	-51674827	-51672518	-51670209	-51667900	-51667493	-51667087	-51666681	-51666274	-51665868	-51663559	-51661250
428	-51704364	-51703970	-51703575	-51703181	-51700859	-51698537	-51696216	-51693894	-51691573	-51689252	-51686930

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

Table 9B, Summary of Bias Uncertainty

$U_{CAL-BIAS} = B_{CAL-PFWNET} + B_{CAL-PSTMNET} + B_{CAL-CONST}$

P_{STM}	870										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr	$U_{CAL-BIAS}$, BTU/hr
452	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
450	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
448	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
446	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
444	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
442	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
440	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
438	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
436	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
434	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
432	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
430	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
428	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	860										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr
452	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
450	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
448	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
446	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
444	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
442	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
440	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
438	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
436	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
434	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
432	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
430	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098
428	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098	-8081098

P_{STM}	850										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr
452	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
450	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
448	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
446	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
444	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
442	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
440	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
438	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
436	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
434	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
432	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
430	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414
428	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414	-7665414

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	840										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr
452	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
450	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
448	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
446	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
444	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
442	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
440	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
438	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
436	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
434	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
432	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
430	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454
428	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454	-7242454

P_{STM}	830										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr
452	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
450	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
448	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
446	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
444	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
442	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
440	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
438	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
436	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
434	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
432	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
430	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
428	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	820										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr
452	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
450	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
448	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
446	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
444	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
442	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
440	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
438	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
436	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
434	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
432	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
430	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
428	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776

P_{STM}	810										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr
452	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
450	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
448	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
446	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
444	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
442	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
440	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
438	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
436	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
434	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
432	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
430	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776
428	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776	-7661776

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	780										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr
452	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
450	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
448	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
446	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
444	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
442	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
440	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
438	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
436	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
434	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
432	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
430	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816
428	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816	-7238816

P_{STM}	770										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr	$U_{CAL\text{-}BIAS}$, BTU/hr
452	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
450	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
448	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
446	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
444	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
442	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
440	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
438	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
436	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
434	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
432	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
430	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138
428	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138	-7658138

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Tables 10A1 and 10A2, Total Calorimetric Uncertainty, Step 7.12.4

$U_{CAL\text{-}TOT} = U_{CAL\text{-}RAND} + U_{CAL\text{-}BIAS}$

Table 10A1, Total Calorimetric Uncertainty, Unit 1

P_{STM}	870										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr
452	-52507639	-52505243	-52502847	-52500452	-52498056	-52495661	-52493265	-52490870	-52488475	-52486081	-52483686
450	-52600060	-52597649	-52595239	-52592829	-52590419	-52588010	-52585600	-52583190	-52580781	-52578372	-52575963
448	-52566404	-52566167	-52565931	-52565695	-52563278	-52560861	-52558433	-52556005	-52553578	-52553331	-52553084
446	-52658044	-52657818	-52657593	-52657369	-52654938	-52652506	-52650052	-52647598	-52645146	-52644899	-52644651
444	-52749725	-52749510	-52749297	-52749086	-52746640	-52744194	-52741712	-52739232	-52736754	-52736506	-52736259
442	-52841447	-52841243	-52841042	-52840846	-52838385	-52835925	-52833413	-52830906	-52828402	-52828155	-52827907
440	-52933208	-52933016	-52932829	-52932647	-52930172	-52927697	-52925156	-52922620	-52920090	-52919843	-52919595
438	-52923694	-52921340	-52918989	-52916642	-52916311	-52915980	-52915596	-52915216	-52914839	-52912438	-52910038
436	-53014888	-53012509	-53010132	-53007757	-53007426	-53007095	-53006724	-53006355	-53005988	-53003573	-53001157
434	-53106122	-53103717	-53101313	-53098911	-53098580	-53098249	-53097891	-53097533	-53097177	-53094747	-53092318
432	-53197396	-53194965	-53192533	-53190102	-53189771	-53189440	-53189096	-53188751	-53188407	-53185962	-53183518
430	-53288710	-53286251	-53283791	-53281332	-53281001	-53280670	-53280339	-53280007	-53279676	-53277217	-53274758
428	-53288002	-53287685	-53287367	-53287050	-53284581	-53282113	-53279644	-53277176	-53274708	-53272240	-53269772

P_{STM}	860										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr
452	-53044890	-53042501	-53040111	-53037721	-53035332	-53032942	-53030553	-53028164	-53025775	-53023386	-53020997
450	-53137103	-53134699	-53132295	-53129891	-53127487	-53125083	-53122679	-53120276	-53117872	-53115469	-53113066
448	-53103555	-53103319	-53103083	-53102847	-53100436	-53098025	-53095604	-53093182	-53090761	-53090514	-53090268
446	-53194989	-53194764	-53194539	-53194316	-53191890	-53189465	-53187016	-53184569	-53182123	-53181876	-53181629
444	-53286465	-53286251	-53286038	-53285828	-53283388	-53280948	-53278471	-53275997	-53273525	-53273279	-53273032
442	-53377982	-53377779	-53377579	-53377383	-53374928	-53372473	-53369968	-53367467	-53364969	-53364722	-53364475
440	-53469540	-53469348	-53469161	-53468980	-53466511	-53464042	-53461507	-53458977	-53456454	-53456207	-53455960
438	-53460072	-53457723	-53455378	-53453037	-53452707	-53452377	-53451993	-53451614	-53451238	-53448843	-53446448
436	-53551064	-53548690	-53546319	-53543950	-53543620	-53543290	-53542920	-53542551	-53542185	-53539776	-53537366
434	-53642097	-53639698	-53637300	-53634903	-53634572	-53634242	-53633885	-53633529	-53633173	-53630749	-53628325
432	-53733170	-53730745	-53728319	-53725894	-53725564	-53725233	-53724889	-53724546	-53724202	-53721763	-53719325
430	-53824285	-53821831	-53819377	-53816924	-53816593	-53816263	-53815933	-53815602	-53815272	-53812818	-53810365
428	-53823600	-53823283	-53822966	-53822650	-53820187	-53817725	-53815262	-53812800	-53810338	-53807876	-53805414

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P_{STM}	850										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-52642448	-52640059	-52637669	-52635280	-52632891	-52630502	-52628113	-52625724	-52623335	-52620947	-52618558
450	-52734665	-52732261	-52729857	-52727453	-52725050	-52722646	-52720243	-52717840	-52715436	-52713033	-52710631
448	-52701139	-52700903	-52700667	-52700432	-52698021	-52695610	-52693189	-52690767	-52688347	-52688100	-52687853
446	-52792577	-52792352	-52792127	-52791904	-52789478	-52787053	-52784605	-52782158	-52779712	-52779465	-52779218
444	-52884057	-52883842	-52883630	-52883419	-52880979	-52878540	-52876064	-52873590	-52871119	-52870872	-52870625
442	-52975577	-52975374	-52975174	-52974978	-52972523	-52970069	-52967564	-52965063	-52962566	-52962319	-52962072
440	-53067139	-53066946	-53066760	-53066579	-53064110	-53061641	-53059106	-53056577	-53054054	-53053807	-53053560
438	-53057689	-53055341	-53052996	-53050655	-53050325	-53049995	-53049611	-53049232	-53048856	-53046461	-53044067
436	-53148685	-53146311	-53143940	-53141572	-53141242	-53140911	-53140541	-53140173	-53139806	-53137397	-53134988
434	-53239721	-53237322	-53234924	-53232528	-53232197	-53231867	-53231510	-53231154	-53230798	-53228374	-53225951
432	-53330798	-53328372	-53325947	-53323522	-53323192	-53322862	-53322518	-53322174	-53321830	-53319392	-53316954
430	-53421916	-53419462	-53417009	-53414556	-53414225	-53413895	-53413564	-53413234	-53412903	-53410450	-53407997
428	-53421248	-53420931	-53420614	-53420297	-53417835	-53415373	-53412911	-53410449	-53407987	-53405525	-53403064

P_{STM}	840										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-52040175	-52037776	-52035377	-52032977	-52030578	-52028180	-52025781	-52023382	-52020984	-52018585	-52016187
450	-52132781	-52130367	-52127954	-52125540	-52123126	-52120713	-52118300	-52115887	-52113474	-52111061	-52108648
448	-52099130	-52098893	-52098656	-52098419	-52095999	-52093578	-52091147	-52088716	-52086285	-52086037	-52085790
446	-52190953	-52190726	-52190501	-52190276	-52187841	-52185406	-52182948	-52180491	-52178035	-52177787	-52177539
444	-52282816	-52282600	-52282387	-52282175	-52279726	-52277276	-52274790	-52272306	-52269825	-52269577	-52269329
442	-52374718	-52374514	-52374313	-52374116	-52371652	-52369187	-52366672	-52364161	-52361654	-52361406	-52361158
440	-52466660	-52466467	-52466279	-52466098	-52463619	-52461140	-52458595	-52456056	-52453522	-52453274	-52453026
438	-52457184	-52454826	-52452471	-52450121	-52449790	-52449458	-52449073	-52448692	-52448315	-52445910	-52443506
436	-52548556	-52546173	-52543793	-52541414	-52541083	-52540752	-52540380	-52540010	-52539642	-52537223	-52534805
434	-52639968	-52637559	-52635152	-52632746	-52632414	-52632082	-52631724	-52631366	-52631009	-52628575	-52626142
432	-52731419	-52728984	-52726549	-52724114	-52723782	-52723451	-52723105	-52722760	-52722415	-52719967	-52717519
430	-52822909	-52820446	-52817983	-52815520	-52815188	-52814856	-52814524	-52814193	-52813861	-52811398	-52808935
428	-52822250	-52821932	-52821613	-52821295	-52818823	-52816351	-52813879	-52811408	-52808936	-52806464	-52803993

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P_{STM}	830										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-52473849	-52471450	-52469051	-52466653	-52464254	-52461855	-52459457	-52457059	-52454661	-52452263	-52449865
450	-52566457	-52564043	-52561630	-52559216	-52556803	-52554390	-52551978	-52549565	-52547152	-52544740	-52542327
448	-52532829	-52532592	-52532355	-52532118	-52529698	-52527278	-52524847	-52522416	-52519986	-52519738	-52519490
446	-52624653	-52624427	-52624201	-52623977	-52621542	-52619107	-52616649	-52614193	-52611737	-52611489	-52611241
444	-52716517	-52716302	-52716088	-52715877	-52713427	-52710978	-52708493	-52706009	-52703528	-52703280	-52703032
442	-52808421	-52808216	-52808016	-52807819	-52805355	-52802891	-52800376	-52797865	-52795358	-52795110	-52794862
440	-52900364	-52900171	-52899983	-52899802	-52897323	-52894845	-52892300	-52889761	-52887228	-52886980	-52886732
438	-52890907	-52888549	-52886195	-52883845	-52883513	-52883182	-52882797	-52882416	-52882038	-52879635	-52877231
436	-52982280	-52979898	-52977517	-52975139	-52974808	-52974476	-52974105	-52973735	-52973367	-52970948	-52968530
434	-53073693	-53071285	-53068878	-53066472	-53066140	-53065808	-53065450	-53065092	-53064735	-53062302	-53059869
432	-53165145	-53162710	-53160276	-53157841	-53157510	-53157178	-53156833	-53156487	-53156142	-53153695	-53151247
430	-53256636	-53254173	-53251711	-53249248	-53248916	-53248585	-53248253	-53247921	-53247589	-53245127	-53242664
428	-53255994	-53255676	-53255357	-53255039	-53252568	-53250096	-53247624	-53245153	-53242682	-53240211	-53237740

P_{STM}	820										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-52574697	-52572303	-52569909	-52567516	-52565122	-52562728	-52560335	-52557942	-52555549	-52553156	-52550763
450	-52667128	-52664720	-52662311	-52659903	-52657495	-52655087	-52652679	-52650271	-52647864	-52645456	-52643049
448	-52633588	-52633351	-52633115	-52632879	-52630464	-52628049	-52625623	-52623197	-52620772	-52620524	-52620277
446	-52725238	-52725012	-52724787	-52724563	-52722133	-52719703	-52717250	-52714799	-52712348	-52712101	-52711853
444	-52816928	-52816713	-52816500	-52816289	-52813844	-52811400	-52808920	-52806441	-52803965	-52803718	-52803470
442	-52908658	-52908454	-52908254	-52908057	-52905598	-52903139	-52900630	-52898124	-52895622	-52895375	-52895127
440	-53000428	-53000235	-53000048	-52999867	-52997394	-52994920	-52992381	-52989847	-52987319	-52987072	-52986824
438	-52991008	-52988655	-52986305	-52983960	-52983629	-52983299	-52982914	-52982534	-52982157	-52979758	-52977360
436	-53082209	-53079832	-53077457	-53075083	-53074753	-53074422	-53074051	-53073681	-53073314	-53070901	-53068488
434	-53173452	-53171048	-53168646	-53166245	-53165914	-53165583	-53165225	-53164868	-53164512	-53162084	-53159656
432	-53264734	-53262304	-53259874	-53257445	-53257114	-53256783	-53256438	-53256094	-53255749	-53253306	-53250864
430	-53356056	-53353598	-53351140	-53348683	-53348351	-53348020	-53347689	-53347358	-53347026	-53344569	-53342112
428	-53355431	-53355114	-53354796	-53354479	-53352012	-53349545	-53347078	-53344612	-53342146	-53339679	-53337213

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P_{STM}	810										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-52589133	-52586739	-52584345	-52581952	-52579559	-52577166	-52574773	-52572380	-52569987	-52567594	-52565202
450	-52681565	-52679157	-52676749	-52674341	-52671933	-52669525	-52667118	-52664711	-52662303	-52659896	-52657489
448	-52648048	-52647812	-52647575	-52647339	-52644924	-52642509	-52640084	-52637658	-52635234	-52634986	-52634739
446	-52739699	-52739473	-52739248	-52739024	-52736594	-52734165	-52731713	-52729262	-52726811	-52726564	-52726317
444	-52831390	-52831175	-52830962	-52830751	-52828307	-52825863	-52823383	-52820905	-52818429	-52818182	-52817935
442	-52923122	-52922918	-52922717	-52922520	-52920062	-52917604	-52915094	-52912589	-52910088	-52909840	-52909593
440	-53014893	-53014700	-53014513	-53014332	-53011859	-53009386	-53006847	-53004313	-53001786	-53001538	-53001291
438	-53005491	-53003138	-53000790	-52998445	-52998114	-52997783	-52997399	-52997018	-52996642	-52994243	-52991845
436	-53096694	-53094317	-53091942	-53089569	-53089238	-53088907	-53088536	-53088167	-53087800	-53085387	-53082974
434	-53187937	-53185534	-53183133	-53180732	-53180401	-53180070	-53179712	-53179355	-53178998	-53176571	-53174143
432	-53279220	-53276791	-53274361	-53271933	-53271602	-53271270	-53270926	-53270581	-53270237	-53267794	-53265352
430	-53370543	-53368086	-53365628	-53363171	-53362840	-53362509	-53362177	-53361846	-53361515	-53359058	-53356601
428	-53369936	-53369618	-53369300	-53368983	-53366516	-53364050	-53361584	-53359118	-53356652	-53354186	-53351720

P_{STM}	800										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-52599040	-52596647	-52594253	-52591860	-52589467	-52587075	-52584682	-52582289	-52579897	-52577505	-52575112
450	-52691475	-52689067	-52686660	-52684252	-52681845	-52679438	-52677030	-52674623	-52672217	-52669810	-52667403
448	-52657981	-52657745	-52657508	-52657272	-52654858	-52652443	-52650018	-52647593	-52645168	-52644921	-52644674
446	-52749635	-52749409	-52749184	-52748960	-52746531	-52744102	-52741650	-52739199	-52736749	-52736502	-52736254
444	-52841329	-52841114	-52840901	-52840690	-52838247	-52835803	-52833323	-52830846	-52828370	-52828123	-52827875
442	-52933064	-52932860	-52932659	-52932463	-52930004	-52927546	-52925038	-52922533	-52920032	-52919784	-52919536
440	-53024838	-53024645	-53024458	-53024277	-53021804	-53019331	-53016793	-53014260	-53011733	-53011485	-53011237
438	-53015455	-53013102	-53010754	-53008409	-53008078	-53007748	-53007363	-53006983	-53006606	-53004208	-53001810
436	-53106660	-53104283	-53101909	-53099536	-53099206	-53098875	-53098503	-53098134	-53097767	-53095354	-53092942
434	-53197906	-53195504	-53193102	-53190702	-53190371	-53190040	-53189682	-53189325	-53188968	-53186541	-53184114
432	-53289192	-53286763	-53284334	-53281905	-53281574	-53281243	-53280898	-53280554	-53280210	-53277768	-53275326
430	-53380518	-53378061	-53375604	-53373147	-53372816	-53372484	-53372153	-53371822	-53371491	-53369034	-53366577
428	-53379927	-53379609	-53379291	-53378974	-53376508	-53374042	-53371576	-53369110	-53366645	-53364179	-53361714

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	790										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-52617024	-52614631	-52612239	-52609846	-52607453	-52605061	-52602669	-52600276	-52597884	-52595492	-52593101
450	-52709461	-52707054	-52704646	-52702239	-52699832	-52697425	-52695019	-52692612	-52690205	-52687799	-52685393
448	-52675991	-52675754	-52675517	-52675281	-52672867	-52670453	-52668028	-52665604	-52663179	-52662932	-52662685
446	-52767646	-52767420	-52767195	-52766970	-52764542	-52762113	-52759662	-52757211	-52754762	-52754514	-52754267
444	-52859341	-52859126	-52858913	-52858702	-52856259	-52853816	-52851336	-52848859	-52846384	-52846137	-52845889
442	-52951077	-52950873	-52950673	-52950476	-52948018	-52945560	-52943052	-52940547	-52938047	-52937799	-52937552
440	-53042853	-53042660	-53042473	-53042291	-53039819	-53037347	-53034808	-53032276	-53029749	-53029501	-53029254
438	-53033488	-53031136	-53028788	-53026443	-53026113	-53025782	-53025398	-53025017	-53024640	-53022243	-53019845
436	-53124695	-53122318	-53119944	-53117572	-53117241	-53116910	-53116539	-53116170	-53115803	-53113390	-53110978
434	-53215942	-53213540	-53211139	-53208739	-53208408	-53208077	-53207719	-53207361	-53207005	-53204578	-53202151
432	-53307229	-53304800	-53302372	-53299943	-53299612	-53299281	-53298936	-53298592	-53298248	-53295806	-53293364
430	-53398556	-53396099	-53393642	-53391186	-53390855	-53390523	-53390192	-53389861	-53389530	-53387073	-53384617
428	-53397982	-53397664	-53397346	-53397029	-53394563	-53392097	-53389632	-53387166	-53384701	-53382236	-53379771

P_{STM}	780										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-52118059	-52115662	-52113265	-52110868	-52108471	-52106074	-52103678	-52101281	-52098885	-52096488	-52094092
450	-52210673	-52208261	-52205849	-52203438	-52201027	-52198615	-52196204	-52193793	-52191383	-52188972	-52186561
448	-52177154	-52176917	-52176680	-52176444	-52174025	-52171607	-52169177	-52166748	-52164320	-52164072	-52163824
446	-52268984	-52268758	-52268532	-52268308	-52265875	-52263442	-52260986	-52258531	-52256077	-52255829	-52255581
444	-52360854	-52360638	-52360425	-52360214	-52357766	-52355318	-52352835	-52350353	-52347874	-52347626	-52347378
442	-52452763	-52452559	-52452358	-52452161	-52449699	-52447237	-52444724	-52442215	-52439710	-52439462	-52439214
440	-52544712	-52544519	-52544331	-52544150	-52541673	-52539196	-52536653	-52534116	-52531585	-52531337	-52531089
438	-52535342	-52532986	-52530634	-52528285	-52527954	-52527622	-52527237	-52526856	-52526479	-52524077	-52521675
436	-52626720	-52624340	-52621961	-52619585	-52619253	-52618922	-52618550	-52618180	-52617812	-52615396	-52612979
434	-52718138	-52715732	-52713326	-52710922	-52710590	-52710259	-52709900	-52709542	-52709185	-52706754	-52704323
432	-52809595	-52807162	-52804729	-52802297	-52801965	-52801633	-52801288	-52800942	-52800598	-52798152	-52795706
430	-52901091	-52898630	-52896169	-52893708	-52893376	-52893045	-52892713	-52892381	-52892049	-52889588	-52887128
428	-52900527	-52900209	-52899890	-52899572	-52897102	-52894632	-52892162	-52889693	-52887223	-52884754	-52882284

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	770										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-52551216	-52548819	-52546423	-52544026	-52541629	-52539233	-52536837	-52534441	-52532045	-52529649	-52527253
450	-52643833	-52641421	-52639010	-52636599	-52634188	-52631777	-52629366	-52626956	-52624545	-52622135	-52619724
448	-52610337	-52610100	-52609863	-52609626	-52607208	-52604790	-52602361	-52599933	-52597504	-52597257	-52597009
446	-52702169	-52701943	-52701717	-52701493	-52699060	-52696627	-52694172	-52691717	-52689264	-52689016	-52688768
444	-52794041	-52793826	-52793612	-52793401	-52790954	-52788507	-52786023	-52783542	-52781063	-52780815	-52780567
442	-52885953	-52885749	-52885548	-52885351	-52882889	-52880427	-52877915	-52875406	-52872901	-52872653	-52872405
440	-52977904	-52977711	-52977523	-52977341	-52974865	-52972389	-52969846	-52967310	-52964779	-52964531	-52964282
438	-52968553	-52966197	-52963845	-52961497	-52961165	-52960834	-52960449	-52960068	-52959690	-52957289	-52954887
436	-53059933	-53057553	-53055174	-53052798	-53052467	-53052135	-53051764	-53051394	-53051026	-53048610	-53046193
434	-53151353	-53148947	-53146542	-53144138	-53143806	-53143475	-53143116	-53142758	-53142401	-53139970	-53137539
432	-53242812	-53240379	-53237947	-53235515	-53235183	-53234851	-53234506	-53234161	-53233816	-53231370	-53228924
430	-53334310	-53331849	-53329389	-53326928	-53326597	-53326265	-53325933	-53325601	-53325269	-53322809	-53320348
428	-53333763	-53333444	-53333126	-53332808	-53330338	-53327869	-53325399	-53322930	-53320461	-53317991	-53315522

Table 10A2, Total Calorimetric Uncertainty, Unit 2

P_{STM}	870										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-58220978	-58218754	-58216530	-58214306	-58212082	-58209858	-58207635	-58205412	-58203189	-58200965	-58198743
450	-58334296	-58332054	-58329812	-58327570	-58325328	-58323087	-58320845	-58318604	-58316363	-58314121	-58311880
448	-58334324	-58334031	-58333737	-58333444	-58331192	-58328939	-58326677	-58324416	-58322154	-58321851	-58321548
446	-58446657	-58446373	-58446090	-58445807	-58443537	-58441266	-58438975	-58436685	-58434396	-58434093	-58433790
444	-58559032	-58558758	-58558485	-58558214	-58555925	-58553637	-58551316	-58548997	-58546680	-58546377	-58546073
442	-58671448	-58671183	-58670922	-58670664	-58668357	-58666050	-58663698	-58661350	-58659005	-58658701	-58658398
440	-58783906	-58783651	-58783401	-58783156	-58780831	-58778506	-58776122	-58773744	-58771370	-58771067	-58770763
438	-58805466	-58803271	-58801079	-58798891	-58798486	-58798081	-58797628	-58797179	-58796733	-58794498	-58792262
436	-58917182	-58914960	-58912740	-58910522	-58910117	-58909711	-58909270	-58908831	-58908394	-58906140	-58903886
434	-59028939	-59026689	-59024440	-59022192	-59021786	-59021381	-59020951	-59020523	-59020095	-59017823	-59015551
432	-59140736	-59138457	-59136179	-59133900	-59133495	-59133089	-59132671	-59132254	-59131837	-59129546	-59127256
430	-59252574	-59250265	-59247956	-59245648	-59245242	-59244836	-59244430	-59244025	-59243619	-59241310	-59239002
428	-59281911	-59281518	-59281124	-59280730	-59278409	-59276087	-59273766	-59271444	-59269123	-59266802	-59264481

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	860										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-58750090	-58747870	-58745650	-58743431	-58741212	-58738993	-58736774	-58734555	-58732336	-58730118	-58727899
450	-58863208	-58860970	-58858733	-58856495	-58854258	-58852021	-58849784	-58847547	-58845310	-58843073	-58840837
448	-58863266	-58862973	-58862680	-58862387	-58860139	-58857892	-58855634	-58853377	-58851120	-58850818	-58850515
446	-58975401	-58975118	-58974835	-58974553	-58972287	-58970021	-58967734	-58965449	-58963164	-58962862	-58962559
444	-59087579	-59087305	-59087032	-59086762	-59084478	-59082194	-59079877	-59077563	-59075251	-59074948	-59074645
442	-59199799	-59199534	-59199273	-59199015	-59196713	-59194411	-59192063	-59189720	-59187379	-59187076	-59186774
440	-59312060	-59311806	-59311557	-59311312	-59308992	-59306671	-59304292	-59301918	-59299549	-59299247	-59298944
438	-59333607	-59331416	-59329229	-59327045	-59326641	-59326236	-59325785	-59325336	-59324891	-59322660	-59320429
436	-59445130	-59442912	-59440696	-59438482	-59438078	-59437673	-59437233	-59436795	-59436358	-59434109	-59431859
434	-59556694	-59554448	-59552203	-59549960	-59549555	-59549150	-59548722	-59548294	-59547867	-59545599	-59543331
432	-59668300	-59666025	-59663751	-59661476	-59661072	-59660667	-59660250	-59659833	-59659417	-59657131	-59654845
430	-59779946	-59777642	-59775337	-59773033	-59772628	-59772223	-59771818	-59771413	-59771008	-59768703	-59766399
428	-59809254	-59808861	-59808468	-59808075	-59805758	-59803441	-59801124	-59798807	-59796490	-59794174	-59791857

P_{STM}	850										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-58350333	-58348114	-58345894	-58343675	-58341457	-58339238	-58337019	-58334801	-58332582	-58330364	-58328146
450	-58463455	-58461218	-58458981	-58456744	-58454507	-58452270	-58450033	-58447796	-58445560	-58443324	-58441087
448	-58463536	-58463243	-58462950	-58462658	-58460410	-58458162	-58455905	-58453648	-58451392	-58451089	-58450787
446	-58575675	-58575392	-58575109	-58574827	-58572561	-58570295	-58568009	-58565724	-58563440	-58563137	-58562835
444	-58687857	-58687583	-58687310	-58687040	-58684756	-58682472	-58680156	-58677842	-58675530	-58675228	-58674925
442	-58800080	-58799816	-58799555	-58799297	-58796995	-58794693	-58792346	-58790003	-58787663	-58787360	-58787057
440	-58912346	-58912092	-58911842	-58911598	-58909278	-58906957	-58904579	-58902205	-58899837	-58899534	-58899231
438	-58933911	-58931721	-58929534	-58927350	-58926946	-58926542	-58926090	-58925641	-58925196	-58922965	-58920734
436	-59045438	-59043220	-59041005	-59038791	-59038387	-59037982	-59037542	-59037103	-59036667	-59034418	-59032169
434	-59157005	-59154760	-59152516	-59150272	-59149867	-59149463	-59149034	-59148606	-59148179	-59145912	-59143644
432	-59268615	-59266340	-59264066	-59261792	-59261388	-59260983	-59260566	-59260149	-59259733	-59257447	-59255161
430	-59380265	-59377961	-59375656	-59373352	-59372947	-59372542	-59372137	-59371732	-59371327	-59369023	-59366719
428	-59409590	-59409197	-59408804	-59408411	-59406094	-59403777	-59401460	-59399144	-59396827	-59394511	-59392195

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	840										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-57771115	-57768888	-57766662	-57764436	-57762210	-57759984	-57757758	-57755532	-57753307	-57751081	-57748856
450	-57884612	-57882368	-57880124	-57877879	-57875635	-57873391	-57871147	-57868904	-57866660	-57864416	-57862173
448	-57884709	-57884415	-57884121	-57883827	-57881572	-57879318	-57877053	-57874789	-57872526	-57872222	-57871919
446	-57997218	-57996934	-57996650	-57996367	-57994094	-57991821	-57989528	-57987235	-57984944	-57984640	-57984337
444	-58109769	-58109494	-58109221	-58108949	-58106658	-58104367	-58102044	-58099723	-58097403	-58097099	-58096796
442	-58222360	-58222095	-58221833	-58221574	-58219265	-58216955	-58214601	-58212250	-58209903	-58209599	-58209295
440	-58334992	-58334736	-58334486	-58334241	-58331913	-58329586	-58327200	-58324819	-58322443	-58322139	-58321835
438	-58356639	-58354442	-58352248	-58350057	-58349652	-58349246	-58348793	-58348343	-58347896	-58345658	-58343420
436	-58468527	-58466302	-58464080	-58461860	-58461454	-58461048	-58460606	-58460166	-58459728	-58457472	-58455216
434	-58580455	-58578202	-58575951	-58573700	-58573294	-58572888	-58572458	-58572029	-58571601	-58569326	-58567052
432	-58692423	-58690141	-58687860	-58685579	-58685173	-58684767	-58684349	-58683931	-58683513	-58681220	-58678927
430	-58804430	-58802119	-58799808	-58797496	-58797090	-58796684	-58796277	-58795871	-58795465	-58793154	-58790843
428	-58833859	-58833465	-58833071	-58832677	-58830353	-58828028	-58825705	-58823381	-58821057	-58818734	-58816410

P_{STM}	830										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-58207352	-58205126	-58202900	-58200674	-58198448	-58196223	-58193997	-58191772	-58189547	-58187322	-58185097
450	-58320851	-58318607	-58316363	-58314119	-58311875	-58309632	-58307388	-58305145	-58302902	-58300658	-58298415
448	-58320970	-58320676	-58320382	-58320089	-58317834	-58315580	-58313316	-58311052	-58308789	-58308485	-58308182
446	-58433482	-58433197	-58432913	-58432630	-58430357	-58428085	-58425792	-58423500	-58421209	-58420905	-58420602
444	-58546034	-58545759	-58545485	-58545214	-58542923	-58540633	-58538310	-58535989	-58533670	-58533366	-58533062
442	-58658626	-58658361	-58658099	-58657840	-58655531	-58653222	-58650869	-58648518	-58646171	-58645867	-58645563
440	-58771259	-58771004	-58770754	-58770509	-58768181	-58765854	-58763468	-58761088	-58758712	-58758408	-58758104
438	-58792925	-58790728	-58788534	-58786344	-58785939	-58785533	-58785080	-58784630	-58784183	-58781946	-58779708
436	-58904814	-58902590	-58900368	-58898148	-58897742	-58897336	-58896895	-58896455	-58896017	-58893761	-58891505
434	-59016744	-59014492	-59012240	-59009990	-59009584	-59009178	-59008748	-59008319	-59007890	-59005616	-59003342
432	-59128713	-59126432	-59124151	-59121871	-59121464	-59121058	-59120640	-59120222	-59119804	-59117512	-59115219
430	-59240722	-59238411	-59236100	-59233789	-59233383	-59232976	-59232570	-59232164	-59231757	-59229447	-59227136
428	-59270167	-59269773	-59269379	-59268984	-59266661	-59264337	-59262013	-59259690	-59257367	-59255044	-59252721

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	820										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-58300966	-58298744	-58296522	-58294299	-58292077	-58289856	-58287634	-58285412	-58283191	-58280970	-58278749
450	-58414296	-58412055	-58409815	-58407575	-58405335	-58403095	-58400855	-58398616	-58396376	-58394137	-58391898
448	-58414437	-58414144	-58413850	-58413557	-58411306	-58409056	-58406796	-58404536	-58402276	-58401973	-58401670
446	-58526781	-58526497	-58526213	-58525931	-58523662	-58521393	-58519104	-58516816	-58514529	-58514225	-58513922
444	-58639166	-58638891	-58638619	-58638348	-58636061	-58633774	-58631455	-58629138	-58626822	-58626519	-58626216
442	-58751592	-58751328	-58751066	-58750808	-58748502	-58746197	-58743847	-58741501	-58739157	-58738854	-58738551
440	-58864060	-58863805	-58863555	-58863310	-58860987	-58858663	-58856281	-58853905	-58851533	-58851230	-58850926
438	-58885711	-58883518	-58881328	-58879142	-58878736	-58878331	-58877879	-58877429	-58876983	-58874750	-58872516
436	-58997437	-58995216	-58992998	-58990782	-58990376	-58989971	-58989530	-58989091	-58988653	-58986401	-58984149
434	-59109203	-59106955	-59104707	-59102461	-59102055	-59101650	-59101220	-59100792	-59100364	-59098093	-59095823
432	-59221010	-59218732	-59216455	-59214179	-59213773	-59213367	-59212950	-59212532	-59212115	-59209826	-59207538
430	-59332857	-59330550	-59328242	-59325935	-59325529	-59325124	-59324718	-59324312	-59323906	-59321599	-59319292
428	-59362276	-59361882	-59361488	-59361094	-59358774	-59356454	-59354135	-59351815	-59349495	-59347176	-59344857

P_{STM}	810										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-58317954	-58315732	-58313510	-58311289	-58309067	-58306845	-58304624	-58302403	-58300182	-58297961	-58295740
450	-58431286	-58429045	-58426806	-58424566	-58422326	-58420087	-58417847	-58415608	-58413369	-58411130	-58408891
448	-58431450	-58431156	-58430863	-58430569	-58428319	-58426069	-58423809	-58421549	-58419290	-58418987	-58418684
446	-58543795	-58543511	-58543227	-58542945	-58540676	-58538408	-58536119	-58533831	-58531544	-58531241	-58530938
444	-58656181	-58655907	-58655634	-58655363	-58653076	-58650790	-58648471	-58646154	-58643839	-58643536	-58643233
442	-58768609	-58768344	-58768083	-58767824	-58765519	-58763215	-58760865	-58758519	-58756176	-58755872	-58755569
440	-58881078	-58880823	-58880573	-58880328	-58878005	-58875682	-58873301	-58870924	-58868553	-58868250	-58867946
438	-58902748	-58900555	-58898365	-58896179	-58895774	-58895369	-58894916	-58894467	-58894021	-58891787	-58889554
436	-59014474	-59012254	-59010036	-59007820	-59007415	-59007010	-59006569	-59006129	-59005692	-59003440	-59001189
434	-59126242	-59123994	-59121747	-59119501	-59119095	-59118690	-59118260	-59117832	-59117404	-59115134	-59112864
432	-59238050	-59235773	-59233496	-59231220	-59230814	-59230409	-59229991	-59229574	-59229156	-59226868	-59224580
430	-59349898	-59347591	-59345284	-59342978	-59342572	-59342166	-59341760	-59341355	-59340949	-59338642	-59336336
428	-59379333	-59378939	-59378546	-59378152	-59375832	-59373513	-59371193	-59368874	-59366555	-59364236	-59361917

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	800										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-58330515	-58328293	-58326072	-58323850	-58321629	-58319408	-58317187	-58314966	-58312745	-58310525	-58308304
450	-58443850	-58441610	-58439370	-58437131	-58434891	-58432652	-58430413	-58428174	-58425935	-58423697	-58421458
448	-58444036	-58443743	-58443449	-58443156	-58440906	-58438656	-58436397	-58434137	-58431879	-58431575	-58431272
446	-58556385	-58556100	-58555817	-58555534	-58553266	-58550998	-58548710	-58546422	-58544136	-58543832	-58543529
444	-58668775	-58668500	-58668227	-58667956	-58665670	-58663383	-58661065	-58658749	-58656434	-58656131	-58655828
442	-58781206	-58780941	-58780679	-58780421	-58778116	-58775812	-58773462	-58771116	-58768774	-58768470	-58768167
440	-58893678	-58893423	-58893173	-58892928	-58890605	-58888282	-58885901	-58883525	-58881154	-58880851	-58880547
438	-58915366	-58913173	-58910984	-58908798	-58908392	-58907987	-58907535	-58907086	-58906640	-58904406	-58902173
436	-59027095	-59024876	-59022658	-59020442	-59020037	-59019631	-59019190	-59018751	-59018314	-59016062	-59013811
434	-59138866	-59136618	-59134371	-59132125	-59131720	-59131314	-59130885	-59130456	-59130029	-59127759	-59125489
432	-59250677	-59248400	-59246124	-59243848	-59243442	-59243036	-59242619	-59242201	-59241784	-59239496	-59237208
430	-59362528	-59360222	-59357915	-59355608	-59355203	-59354797	-59354391	-59353985	-59353580	-59351273	-59348967
428	-59391980	-59391586	-59391192	-59390798	-59388479	-59386160	-59383840	-59381521	-59379203	-59376884	-59374565

P_{STM}	790										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-58351062	-58348841	-58346619	-58344398	-58342177	-58339957	-58337736	-58335516	-58333295	-58331075	-58328855
450	-58464399	-58462159	-58459920	-58457681	-58455442	-58453203	-58450964	-58448726	-58446487	-58444249	-58442011
448	-58464608	-58464314	-58464021	-58463728	-58461478	-58459228	-58456969	-58454710	-58452452	-58452149	-58451846
446	-58576958	-58576674	-58576390	-58576108	-58573840	-58571572	-58569284	-58566997	-58564711	-58564408	-58564104
444	-58689350	-58689075	-58688802	-58688531	-58686245	-58683959	-58681641	-58679325	-58677011	-58676708	-58676404
442	-58801782	-58801517	-58801256	-58800997	-58798693	-58796389	-58794040	-58791694	-58789352	-58789049	-58788745
440	-58914256	-58914001	-58913751	-58913506	-58911184	-58908861	-58906480	-58904105	-58901734	-58901431	-58901127
438	-58935962	-58933770	-58931581	-58929395	-58928990	-58928585	-58928132	-58927683	-58927237	-58925004	-58922771
436	-59047693	-59045474	-59043256	-59041041	-59040635	-59040230	-59039789	-59039350	-59038913	-59036661	-59034410
434	-59159465	-59157218	-59154971	-59152726	-59152320	-59151915	-59151485	-59151057	-59150629	-59148359	-59146090
432	-59271278	-59269001	-59266725	-59264449	-59264044	-59263638	-59263220	-59262803	-59262386	-59260098	-59257810
430	-59383130	-59380824	-59378518	-59376211	-59375806	-59375400	-59374994	-59374589	-59374183	-59371877	-59369571
428	-59412598	-59412204	-59411810	-59411417	-59409098	-59406779	-59404460	-59402141	-59399822	-59397504	-59395186

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	780										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-57863501	-57861277	-57859052	-57856828	-57854604	-57852380	-57850157	-57847933	-57845710	-57843486	-57841263
450	-57977008	-57974766	-57972524	-57970281	-57968039	-57965797	-57963556	-57961314	-57959072	-57956831	-57954590
448	-57977233	-57976939	-57976645	-57976352	-57974099	-57971846	-57969584	-57967322	-57965060	-57964757	-57964453
446	-58089752	-58089467	-58089183	-58088900	-58086629	-58084358	-58082067	-58079777	-58077487	-58077184	-58076880
444	-58202311	-58202036	-58201763	-58201491	-58199202	-58196913	-58194592	-58192272	-58189955	-58189651	-58189348
442	-58314911	-58314645	-58314383	-58314124	-58311817	-58309510	-58307158	-58304809	-58302463	-58302159	-58301856
440	-58427551	-58427295	-58427045	-58426800	-58424474	-58422148	-58419764	-58417385	-58415012	-58414708	-58414404
438	-58449301	-58447105	-58444913	-58442725	-58442319	-58441913	-58441460	-58441010	-58440563	-58438328	-58436092
436	-58561196	-58558974	-58556753	-58554535	-58554129	-58553723	-58553281	-58552841	-58552403	-58550149	-58547895
434	-58673132	-58670881	-58668632	-58666383	-58665977	-58665571	-58665141	-58664712	-58664283	-58662011	-58659738
432	-58785107	-58782828	-58780548	-58778270	-58777863	-58777457	-58777039	-58776621	-58776203	-58773912	-58771621
430	-58897122	-58894813	-58892503	-58890194	-58889788	-58889381	-58888975	-58888569	-58888162	-58885853	-58883544
428	-58926643	-58926248	-58925854	-58925460	-58923138	-58920816	-58918494	-58916172	-58913850	-58911529	-58909207

P_{STM}	770										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-58299280	-58297056	-58294832	-58292609	-58290385	-58288161	-58285938	-58283715	-58281492	-58279269	-58277046
450	-58412790	-58410548	-58408306	-58406064	-58403823	-58401581	-58399340	-58397098	-58394857	-58392616	-58390375
448	-58413038	-58412744	-58412450	-58412156	-58409904	-58407651	-58405389	-58403128	-58400866	-58400563	-58400259
446	-58525559	-58525274	-58524990	-58524707	-58522437	-58520166	-58517875	-58515585	-58513296	-58512993	-58512689
444	-58638121	-58637846	-58637572	-58637301	-58635012	-58632723	-58630402	-58628084	-58625767	-58625463	-58625159
442	-58750723	-58750458	-58750196	-58749937	-58747630	-58745323	-58742971	-58740622	-58738277	-58737973	-58737670
440	-58863365	-58863110	-58862860	-58862614	-58860289	-58857964	-58855580	-58853202	-58850828	-58850524	-58850220
438	-58885134	-58882939	-58880747	-58878559	-58878153	-58877747	-58877294	-58876844	-58876398	-58874162	-58871927
436	-58997032	-58994810	-58992589	-58990371	-58989965	-58989559	-58989118	-58988678	-58988240	-58985986	-58983732
434	-59108970	-59106719	-59104470	-59102222	-59101816	-59101410	-59100980	-59100551	-59100122	-59097850	-59095578
432	-59220947	-59218668	-59216389	-59214111	-59213705	-59213298	-59212880	-59212462	-59212044	-59209754	-59207463
430	-59332965	-59330656	-59328347	-59326038	-59325631	-59325225	-59324819	-59324412	-59324006	-59321697	-59319388
428	-59362502	-59362108	-59361713	-59361319	-59358997	-59356675	-59354354	-59352032	-59349711	-59347390	-59345068

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

Tables 11A1 and 11A2, Total Calorimetric Uncertainty, Single Side, Step 7.12.5

$$U_{CAL-TOT(SS)} = \left(\frac{1.645}{1.96}\right) U_{CAL-RAND} + U_{CAL-BIAS}$$

Table 11A1, Total Calorimetric Uncertainty, Unit 1

P_{STM}	870										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-45300853	-45298842	-45296831	-45294821	-45292810	-45290800	-45288789	-45286779	-45284769	-45282759	-45280749
450	-45378420	-45376397	-45374375	-45372352	-45370329	-45368307	-45366284	-45364262	-45362240	-45360218	-45358196
448	-45350173	-45349975	-45349776	-45349578	-45347550	-45345521	-45343483	-45341446	-45339409	-45339202	-45338994
446	-45427086	-45426896	-45426707	-45426519	-45424479	-45422438	-45420378	-45418319	-45416260	-45416053	-45415845
444	-45504032	-45503852	-45503673	-45503496	-45501443	-45499390	-45497307	-45495225	-45493146	-45492938	-45492730
442	-45581013	-45580842	-45580674	-45580509	-45578443	-45576378	-45574271	-45572166	-45570065	-45569857	-45569649
440	-45658027	-45657865	-45657708	-45657556	-45655479	-45653402	-45651269	-45649141	-45647017	-45646810	-45646602
438	-45650042	-45648066	-45646093	-45644123	-45643845	-45643568	-45643245	-45642926	-45642610	-45640595	-45638580
436	-45726580	-45724583	-45722588	-45720595	-45720317	-45720039	-45719728	-45719418	-45719110	-45717083	-45715056
434	-45803151	-45801133	-45799115	-45797099	-45796821	-45796543	-45796243	-45795943	-45795644	-45793605	-45791565
432	-45879756	-45877715	-45875675	-45873635	-45873357	-45873079	-45872790	-45872500	-45872211	-45870160	-45868108
430	-45956395	-45954331	-45952266	-45950202	-45949924	-45949646	-45949368	-45949091	-45948813	-45946749	-45944685
428	-45955801	-45955534	-45955267	-45955001	-45952929	-45950858	-45948786	-45946714	-45944643	-45942572	-45940500

P_{STM}	860										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-45818567	-45816561	-45814555	-45812550	-45810544	-45808539	-45806533	-45804528	-45802523	-45800518	-45798513
450	-45895960	-45893942	-45891924	-45889906	-45887889	-45885871	-45883854	-45881836	-45879819	-45877802	-45875785
448	-45867803	-45867605	-45867407	-45867209	-45865185	-45863162	-45861129	-45859097	-45857065	-45856858	-45856651
446	-45944543	-45944353	-45944165	-45943977	-45941942	-45939906	-45937851	-45935797	-45933744	-45933537	-45933329
444	-46021317	-46021137	-46020958	-46020782	-46018734	-46016686	-46014608	-46012531	-46010457	-46010250	-46010042
442	-46098126	-46097955	-46097787	-46097623	-46095562	-46093502	-46091400	-46089300	-46087204	-46086997	-46086790
440	-46174969	-46174807	-46174651	-46174499	-46172427	-46170354	-46168227	-46166104	-46163986	-46163779	-46163571
438	-46167023	-46165051	-46163083	-46161118	-46160841	-46160564	-46160242	-46159924	-46159608	-46157598	-46155588
436	-46243391	-46241399	-46239409	-46237420	-46237143	-46236866	-46236555	-46236246	-46235939	-46233917	-46231895
434	-46319793	-46317780	-46315767	-46313755	-46313478	-46313201	-46312901	-46312602	-46312304	-46310269	-46308235
432	-46396230	-46394194	-46392159	-46390123	-46389846	-46389569	-46389280	-46388992	-46388703	-46386656	-46384610
430	-46472701	-46470642	-46468582	-46466523	-46466246	-46465969	-46465691	-46465414	-46465137	-46463077	-46461019
428	-46472127	-46471861	-46471595	-46471329	-46469262	-46467195	-46465129	-46463062	-46460996	-46458929	-46456863

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

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P_{STM}	850										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-45413996	-45411991	-45409985	-45407980	-45405975	-45403970	-45401965	-45399960	-45397955	-45395950	-45393946
450	-45491393	-45489375	-45487357	-45485340	-45483323	-45481305	-45479288	-45477271	-45475254	-45473237	-45471221
448	-45463255	-45463056	-45462859	-45462661	-45460638	-45458614	-45456582	-45454550	-45452518	-45452311	-45452104
446	-45539997	-45539808	-45539620	-45539432	-45537397	-45535361	-45533307	-45531253	-45529200	-45528993	-45528786
444	-45616775	-45616595	-45616416	-45616240	-45614192	-45612145	-45610067	-45607990	-45605916	-45605709	-45605502
442	-45693587	-45693416	-45693248	-45693084	-45691024	-45688964	-45686862	-45684762	-45682667	-45682459	-45682252
440	-45770433	-45770271	-45770115	-45769963	-45767891	-45765819	-45763691	-45761569	-45759451	-45759244	-45759036
438	-45762502	-45760531	-45758563	-45756598	-45756321	-45756044	-45755723	-45755404	-45755088	-45753079	-45751069
436	-45838873	-45836881	-45834892	-45832903	-45832626	-45832349	-45832038	-45831729	-45831422	-45829400	-45827378
434	-45915279	-45913265	-45911253	-45909242	-45908964	-45908687	-45908387	-45908088	-45907790	-45905756	-45903722
432	-45991718	-45989683	-45987647	-45985612	-45985335	-45985058	-45984769	-45984480	-45984192	-45982146	-45980099
430	-46068192	-46066133	-46064074	-46062015	-46061738	-46061460	-46061183	-46060906	-46060628	-46058569	-46056511
428	-46067632	-46067366	-46067100	-46066834	-46064767	-46062701	-46060634	-46058568	-46056502	-46054436	-46052370

P_{STM}	840										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-44840542	-44838528	-44836514	-44834500	-44832487	-44830474	-44828460	-44826447	-44824434	-44822421	-44820408
450	-44918264	-44916238	-44914213	-44912187	-44910161	-44908136	-44906110	-44904085	-44902060	-44900035	-44898010
448	-44890021	-44889822	-44889624	-44889425	-44887393	-44885362	-44883321	-44881281	-44879241	-44879033	-44878825
446	-44967087	-44966897	-44966708	-44966519	-44964475	-44962432	-44960369	-44958306	-44956245	-44956037	-44955829
444	-45044186	-45044005	-45043826	-45043649	-45041593	-45039537	-45037450	-45035366	-45033283	-45033075	-45032867
442	-45121319	-45121147	-45120978	-45120813	-45118745	-45116677	-45114566	-45112458	-45110354	-45110146	-45109938
440	-45198484	-45198322	-45198165	-45198012	-45195932	-45193851	-45191715	-45189584	-45187458	-45187250	-45187041
438	-45190531	-45188552	-45186576	-45184603	-45184325	-45184047	-45183724	-45183404	-45183087	-45181069	-45179052
436	-45267218	-45265218	-45263220	-45261224	-45260946	-45260668	-45260356	-45260045	-45259737	-45257707	-45255677
434	-45343939	-45341917	-45339897	-45337877	-45337599	-45337321	-45337020	-45336719	-45336420	-45334377	-45332335
432	-45420692	-45418648	-45416605	-45414562	-45414283	-45414005	-45413715	-45413425	-45413136	-45411081	-45409027
430	-45497479	-45495411	-45493344	-45491277	-45490999	-45490720	-45490442	-45490163	-45489885	-45487818	-45485751
428	-45496926	-45496658	-45496391	-45496124	-45494050	-45491975	-45489900	-45487826	-45485751	-45483677	-45481603

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P_{STM}	830										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-45271909	-45269895	-45267882	-45265869	-45263856	-45261843	-45259830	-45257817	-45255804	-45253792	-45251779
450	-45349633	-45347607	-45345582	-45343556	-45341531	-45339506	-45337481	-45335456	-45333431	-45331406	-45329382
448	-45321410	-45321211	-45321012	-45320813	-45318782	-45316751	-45314710	-45312670	-45310631	-45310423	-45310215
446	-45398476	-45398286	-45398097	-45397909	-45395865	-45393822	-45391759	-45389697	-45387636	-45387428	-45387220
444	-45475577	-45475396	-45475217	-45475039	-45472983	-45470928	-45468842	-45466757	-45464675	-45464467	-45464259
442	-45552710	-45552538	-45552370	-45552205	-45550137	-45548069	-45545958	-45543851	-45541747	-45541539	-45541331
440	-45629877	-45629714	-45629557	-45629405	-45627325	-45625244	-45623109	-45620978	-45618852	-45618644	-45618436
438	-45621939	-45619960	-45617985	-45616012	-45615734	-45615456	-45615133	-45614813	-45614496	-45612479	-45610461
436	-45698627	-45696628	-45694630	-45692635	-45692356	-45692078	-45691766	-45691456	-45691147	-45689117	-45687088
434	-45775349	-45773328	-45771308	-45769288	-45769010	-45768732	-45768431	-45768130	-45767831	-45765789	-45763747
432	-45852103	-45850060	-45848017	-45845974	-45845695	-45845417	-45845127	-45844837	-45844548	-45842494	-45840439
430	-45928891	-45926824	-45924757	-45922690	-45922412	-45922133	-45921855	-45921576	-45921298	-45919231	-45917164
428	-45928352	-45928085	-45927818	-45927551	-45925476	-45923402	-45921327	-45919253	-45917179	-45915105	-45913031

P_{STM}	820										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-45356549	-45354540	-45352531	-45350522	-45348513	-45346504	-45344495	-45342487	-45340478	-45338470	-45336461
450	-45434125	-45432104	-45430082	-45428061	-45426040	-45424019	-45421998	-45419977	-45417957	-45415936	-45413916
448	-45405975	-45405777	-45405578	-45405380	-45403353	-45401326	-45399290	-45397254	-45395219	-45395011	-45394804
446	-45482896	-45482706	-45482517	-45482329	-45480290	-45478251	-45476192	-45474134	-45472078	-45471870	-45471662
444	-45559850	-45559669	-45559490	-45559313	-45557262	-45555211	-45553129	-45551049	-45548970	-45548763	-45548555
442	-45636838	-45636666	-45636498	-45636333	-45634269	-45632206	-45630100	-45627997	-45625897	-45625689	-45625481
440	-45713859	-45713697	-45713540	-45713388	-45711312	-45709236	-45707105	-45704978	-45702857	-45702649	-45702441
438	-45705953	-45703978	-45702006	-45700038	-45699760	-45699482	-45699160	-45698841	-45698524	-45696511	-45694498
436	-45782497	-45780502	-45778508	-45776516	-45776239	-45775961	-45775649	-45775339	-45775031	-45773006	-45770980
434	-45859075	-45857058	-45855042	-45853027	-45852749	-45852471	-45852171	-45851871	-45851572	-45849534	-45847496
432	-45935687	-45933648	-45931608	-45929570	-45929292	-45929014	-45928725	-45928435	-45928146	-45926096	-45924046
430	-46012332	-46010269	-46008207	-46006144	-46005866	-46005588	-46005310	-46005032	-46004754	-46002692	-46000629
428	-46011808	-46011541	-46011275	-46011009	-46008938	-46006868	-46004798	-46002728	-46000658	-45998588	-45996518

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P_{STM}	810										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-45368665	-45366656	-45364647	-45362638	-45360629	-45358621	-45356612	-45354604	-45352596	-45350588	-45348580
450	-45446242	-45444220	-45442199	-45440179	-45438158	-45436137	-45434117	-45432096	-45430076	-45428056	-45426035
448	-45418112	-45417913	-45417715	-45417516	-45415490	-45413463	-45411427	-45409392	-45407356	-45407149	-45406941
446	-45495033	-45494843	-45494654	-45494466	-45492427	-45490388	-45488330	-45486273	-45484216	-45484009	-45483801
444	-45571988	-45571807	-45571629	-45571451	-45569400	-45567349	-45565268	-45563188	-45561110	-45560902	-45560695
442	-45648977	-45648806	-45648637	-45648472	-45646409	-45644346	-45642240	-45640137	-45638038	-45637830	-45637622
440	-45725999	-45725837	-45725680	-45725528	-45723453	-45721377	-45719246	-45717120	-45714999	-45714791	-45714583
438	-45718108	-45716134	-45714162	-45712194	-45711917	-45711639	-45711317	-45710997	-45710681	-45708668	-45706655
436	-45794654	-45792658	-45790665	-45788674	-45788396	-45788118	-45787807	-45787497	-45787189	-45785164	-45783139
434	-45871233	-45869216	-45867200	-45865185	-45864908	-45864630	-45864329	-45864030	-45863731	-45861693	-45859655
432	-45947845	-45945806	-45943767	-45941729	-45941451	-45941173	-45940884	-45940595	-45940306	-45938256	-45936206
430	-46024491	-46022429	-46020366	-46018304	-46018026	-46017748	-46017470	-46017192	-46016914	-46014852	-46012790
428	-46023981	-46023715	-46023448	-46023182	-46021112	-46019042	-46016972	-46014902	-46012832	-46010763	-46008693

P_{STM}	800										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-45376395	-45374386	-45372378	-45370369	-45368361	-45366353	-45364345	-45362336	-45360329	-45358321	-45356313
450	-45453975	-45451954	-45449933	-45447912	-45445892	-45443872	-45441851	-45439831	-45437811	-45435791	-45433771
448	-45425864	-45425665	-45425467	-45425268	-45423242	-45421216	-45419180	-45417145	-45415110	-45414902	-45414695
446	-45502787	-45502598	-45502409	-45502221	-45500182	-45498143	-45496086	-45494028	-45491972	-45491765	-45491557
444	-45579745	-45579564	-45579386	-45579209	-45577158	-45575107	-45573026	-45570946	-45568869	-45568661	-45568453
442	-45656736	-45656565	-45656397	-45656232	-45654169	-45652106	-45650000	-45647898	-45645799	-45645591	-45645383
440	-45733761	-45733599	-45733442	-45733290	-45731215	-45729140	-45727009	-45724883	-45722762	-45722554	-45722346
438	-45725886	-45723912	-45721940	-45719973	-45719695	-45719417	-45719095	-45718776	-45718459	-45716447	-45714434
436	-45802434	-45800439	-45798446	-45796454	-45796177	-45795899	-45795588	-45795278	-45794970	-45792945	-45790920
434	-45879015	-45876999	-45874983	-45872968	-45872691	-45872413	-45872112	-45871813	-45871514	-45869476	-45867439
432	-45955630	-45953591	-45951553	-45949514	-45949236	-45948958	-45948669	-45948380	-45948091	-45946041	-45943992
430	-46032278	-46030216	-46028154	-46026092	-46025814	-46025536	-46025258	-46024980	-46024702	-46022640	-46020578
428	-46031782	-46031516	-46031249	-46030983	-46028913	-46026843	-46024773	-46022704	-46020635	-46018565	-46016496

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	790										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-45392074	-45390065	-45388057	-45386049	-45384041	-45382033	-45380025	-45378017	-45376010	-45374002	-45371995
450	-45469655	-45467634	-45465614	-45463593	-45461573	-45459553	-45457533	-45455513	-45453494	-45451474	-45449454
448	-45441563	-45441365	-45441166	-45440968	-45438942	-45436916	-45434881	-45432846	-45430811	-45430603	-45430396
446	-45518488	-45518298	-45518109	-45517921	-45515883	-45513845	-45511787	-45509730	-45507675	-45507467	-45507259
444	-45595447	-45595266	-45595087	-45594910	-45592860	-45590809	-45588728	-45586649	-45584572	-45584364	-45584157
442	-45672439	-45672268	-45672100	-45671935	-45669872	-45667809	-45665704	-45663602	-45661503	-45661295	-45661088
440	-45749465	-45749304	-45749146	-45748994	-45746919	-45744844	-45742714	-45740588	-45738468	-45738260	-45738052
438	-45741606	-45739632	-45737661	-45735693	-45735416	-45735138	-45734816	-45734496	-45734180	-45732168	-45730155
436	-45818154	-45816160	-45814167	-45812176	-45811898	-45811621	-45811309	-45810999	-45810691	-45808667	-45806642
434	-45894737	-45892721	-45890705	-45888691	-45888413	-45888136	-45887835	-45887535	-45887236	-45885199	-45883162
432	-45971353	-45969314	-45967276	-45965238	-45964960	-45964682	-45964393	-45964104	-45963815	-45961765	-45959716
430	-46048002	-46045940	-46043878	-46041816	-46041538	-46041260	-46040982	-46040704	-46040426	-46038365	-46036303
428	-46047520	-46047253	-46046987	-46046720	-46044651	-46042581	-46040512	-46038443	-46036374	-46034305	-46032236

P_{STM}	780										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-44905324	-44903312	-44901300	-44899288	-44897276	-44895265	-44893253	-44891242	-44889231	-44887220	-44885209
450	-44983053	-44981029	-44979005	-44976981	-44974957	-44972933	-44970910	-44968886	-44966863	-44964840	-44962817
448	-44954921	-44954722	-44954523	-44954325	-44952295	-44950265	-44948226	-44946188	-44944150	-44943942	-44943734
446	-45031993	-45031803	-45031614	-45031425	-45029383	-45027341	-45025280	-45023219	-45021160	-45020952	-45020744
444	-45109098	-45108917	-45108738	-45108560	-45106506	-45104452	-45102367	-45100285	-45098204	-45097996	-45097787
442	-45186236	-45186064	-45185896	-45185730	-45183664	-45181598	-45179489	-45177383	-45175280	-45175072	-45174864
440	-45263407	-45263245	-45263088	-45262935	-45260856	-45258778	-45256644	-45254514	-45252390	-45252182	-45251973
438	-45255543	-45253566	-45251591	-45249620	-45249342	-45249064	-45248741	-45248421	-45248104	-45246088	-45244073
436	-45332236	-45330238	-45328241	-45326247	-45325969	-45325690	-45325378	-45325068	-45324759	-45322731	-45320703
434	-45408961	-45406942	-45404923	-45402905	-45402627	-45402348	-45402047	-45401747	-45401447	-45399407	-45397366
432	-45485720	-45483678	-45481636	-45479594	-45479316	-45479037	-45478748	-45478458	-45478168	-45476115	-45474063
430	-45562511	-45560446	-45558380	-45556315	-45556036	-45555758	-45555479	-45555201	-45554922	-45552857	-45550792
428	-45562038	-45561770	-45561503	-45561236	-45559163	-45557090	-45555017	-45552945	-45550872	-45548799	-45546727

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	770										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-45336257	-45334246	-45332234	-45330223	-45328211	-45326200	-45324189	-45322178	-45320167	-45318156	-45316145
450	-45413989	-45411965	-45409941	-45407918	-45405894	-45403871	-45401847	-45399824	-45397801	-45395778	-45393755
448	-45385876	-45385677	-45385478	-45385280	-45383250	-45381221	-45379182	-45377144	-45375106	-45374898	-45374690
446	-45462950	-45462760	-45462571	-45462382	-45460340	-45458299	-45456238	-45454178	-45452118	-45451910	-45451702
444	-45540057	-45539876	-45539697	-45539519	-45537465	-45535412	-45533327	-45531245	-45529164	-45528956	-45528748
442	-45617197	-45617025	-45616857	-45616691	-45614625	-45612559	-45610450	-45608345	-45606243	-45606035	-45605826
440	-45694370	-45694208	-45694051	-45693898	-45691820	-45689741	-45687607	-45685478	-45683354	-45683146	-45682938
438	-45686522	-45684545	-45682570	-45680600	-45680322	-45680043	-45679720	-45679401	-45679084	-45677068	-45675052
436	-45763216	-45761218	-45759222	-45757228	-45756950	-45756672	-45756359	-45756049	-45755740	-45753712	-45751685
434	-45839943	-45837924	-45835905	-45833888	-45833610	-45833331	-45833030	-45832730	-45832430	-45830390	-45828350
432	-45916704	-45914662	-45912620	-45910579	-45910301	-45910022	-45909732	-45909443	-45909153	-45907100	-45905048
430	-45993497	-45991432	-45989366	-45987301	-45987023	-45986744	-45986466	-45986187	-45985909	-45983844	-45981779
428	-45993037	-45992770	-45992503	-45992236	-45990163	-45988091	-45986018	-45983945	-45981873	-45979801	-45977729

Table 11A2, Total Calorimetric Uncertainty, Unit 2

P_{STM}	870										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-50095976	-50094110	-50092243	-50090377	-50088510	-50086644	-50084778	-50082912	-50081046	-50079180	-50077315
450	-50191083	-50189201	-50187320	-50185438	-50183556	-50181675	-50179794	-50177913	-50176032	-50174151	-50172270
448	-50191107	-50190860	-50190614	-50190368	-50188477	-50186587	-50184689	-50182790	-50180893	-50180638	-50180384
446	-50285386	-50285148	-50284910	-50284673	-50282767	-50280861	-50278939	-50277017	-50275096	-50274841	-50274587
444	-50379701	-50379470	-50379241	-50379014	-50377093	-50375172	-50373224	-50371278	-50369334	-50369079	-50368825
442	-50474050	-50473828	-50473608	-50473391	-50471455	-50469519	-50467545	-50465574	-50463606	-50463352	-50463097
440	-50568434	-50568220	-50568010	-50567805	-50565853	-50563902	-50561901	-50559905	-50557913	-50557658	-50557404
438	-50586529	-50584687	-50582848	-50581011	-50580671	-50580331	-50579951	-50579574	-50579200	-50577323	-50575447
436	-50680291	-50678426	-50676563	-50674701	-50674361	-50674021	-50673650	-50673282	-50672915	-50671023	-50669132
434	-50774087	-50772198	-50770311	-50768424	-50768083	-50767743	-50767383	-50767023	-50766664	-50764757	-50762850
432	-50867917	-50866004	-50864091	-50862179	-50861839	-50861498	-50861148	-50860798	-50860447	-50858525	-50856603
430	-50961781	-50959843	-50957905	-50955967	-50955627	-50955286	-50954946	-50954605	-50954265	-50952327	-50950389
428	-50986403	-50986072	-50985742	-50985412	-50983463	-50981515	-50979566	-50977618	-50975670	-50973722	-50971774

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	860										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr
452	-50606859	-50604996	-50603133	-50601270	-50599408	-50597545	-50595683	-50593821	-50591959	-50590097	-50588235
450	-50701797	-50699919	-50698041	-50696163	-50694286	-50692408	-50690531	-50688653	-50686776	-50684899	-50683022
448	-50701846	-50701600	-50701354	-50701109	-50699222	-50697335	-50695441	-50693546	-50691652	-50691399	-50691145
446	-50795960	-50795722	-50795484	-50795247	-50793346	-50791444	-50789525	-50787607	-50785689	-50785435	-50785181
444	-50890109	-50889879	-50889650	-50889423	-50887506	-50885589	-50883645	-50881703	-50879762	-50879508	-50879254
442	-50984293	-50984071	-50983852	-50983636	-50981703	-50979771	-50977801	-50975834	-50973870	-50973616	-50973361
440	-51078513	-51078299	-51078090	-51077885	-51075937	-51073990	-51071993	-51070001	-51068013	-51067758	-51067504
438	-51096597	-51094758	-51092922	-51091089	-51090750	-51090411	-51090031	-51089655	-51089281	-51087409	-51085536
436	-51190196	-51188335	-51186475	-51184617	-51184278	-51183938	-51183568	-51183201	-51182834	-51180946	-51179058
434	-51283830	-51281945	-51280061	-51278178	-51277839	-51277499	-51277139	-51276780	-51276422	-51274518	-51272615
432	-51377499	-51375590	-51373681	-51371773	-51371433	-51371093	-51370743	-51370394	-51370044	-51368125	-51366207
430	-51471203	-51469269	-51467334	-51465400	-51465060	-51464721	-51464381	-51464041	-51463701	-51461767	-51459833
428	-51495801	-51495471	-51495141	-51494811	-51492866	-51490922	-51488977	-51487032	-51485088	-51483144	-51481199

P_{STM}	850										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr	$U_{CAL\text{-}TOT}$, BTU/hr
452	-50204542	-50202680	-50200817	-50198955	-50197093	-50195230	-50193368	-50191506	-50189644	-50187783	-50185921
450	-50299484	-50297607	-50295729	-50293851	-50291974	-50290097	-50288219	-50286342	-50284465	-50282588	-50280711
448	-50299552	-50299306	-50299060	-50298815	-50296928	-50295042	-50293148	-50291254	-50289360	-50289106	-50288852
446	-50393669	-50393431	-50393194	-50392957	-50391055	-50389154	-50387235	-50385317	-50383400	-50383146	-50382892
444	-50487821	-50487591	-50487363	-50487136	-50485219	-50483302	-50481358	-50479416	-50477476	-50477222	-50476968
442	-50582009	-50581787	-50581568	-50581352	-50579420	-50577487	-50575518	-50573551	-50571587	-50571333	-50571079
440	-50676232	-50676018	-50675809	-50675604	-50673657	-50671709	-50669713	-50667721	-50665733	-50665479	-50665224
438	-50694331	-50692493	-50690658	-50688825	-50688485	-50688146	-50687767	-50687390	-50687017	-50685144	-50683272
436	-50787934	-50786073	-50784213	-50782356	-50782016	-50781676	-50781307	-50780939	-50780572	-50778685	-50776797
434	-50881571	-50879687	-50877803	-50875920	-50875580	-50875240	-50874881	-50874522	-50874163	-50872260	-50870357
432	-50975243	-50973334	-50971426	-50969517	-50969178	-50968838	-50968488	-50968138	-50967789	-50965870	-50963952
430	-51068950	-51067016	-51065082	-51063148	-51062808	-51062468	-51062128	-51061788	-51061448	-51059515	-51057581
428	-51093562	-51093232	-51092902	-51092572	-51090627	-51088683	-51086739	-51084794	-51082850	-51080906	-51078962

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	840										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-49650437	-49648568	-49646700	-49644832	-49642963	-49641095	-49639227	-49637359	-49635491	-49633623	-49631756
450	-49745694	-49743810	-49741927	-49740043	-49738160	-49736276	-49734393	-49732510	-49730627	-49728744	-49726861
448	-49745775	-49745528	-49745282	-49745035	-49743143	-49741250	-49739350	-49737450	-49735550	-49735295	-49735040
446	-49840203	-49839964	-49839726	-49839488	-49837580	-49835673	-49833748	-49831824	-49829901	-49829646	-49829391
444	-49934665	-49934434	-49934205	-49933977	-49932054	-49930131	-49928181	-49926233	-49924286	-49924031	-49923777
442	-50029161	-50028938	-50028718	-50028501	-50026563	-50024625	-50022649	-50020676	-50018706	-50018451	-50018196
440	-50123691	-50123477	-50123267	-50123061	-50121107	-50119154	-50117151	-50115153	-50113159	-50112904	-50112649
438	-50141859	-50140015	-50138174	-50136335	-50135995	-50135654	-50135274	-50134896	-50134521	-50132643	-50130765
436	-50235765	-50233898	-50232033	-50230169	-50229829	-50229488	-50229117	-50228748	-50228381	-50226487	-50224594
434	-50329705	-50327814	-50325925	-50324036	-50323695	-50323354	-50322993	-50322633	-50322273	-50320365	-50318456
432	-50423678	-50421763	-50419848	-50417934	-50417593	-50417252	-50416901	-50416551	-50416200	-50414276	-50412351
430	-50517684	-50515744	-50513804	-50511865	-50511524	-50511183	-50510842	-50510501	-50510160	-50508220	-50506280
428	-50542384	-50542053	-50541722	-50541391	-50539440	-50537490	-50535539	-50533589	-50531639	-50529689	-50527739

P_{STM}	830										
P_{FW}, PSIA	770	780	790	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-50083956	-50082087	-50080219	-50078351	-50076483	-50074615	-50072747	-50070880	-50069012	-50067145	-50065277
450	-50179214	-50177331	-50175447	-50173564	-50171681	-50169798	-50167915	-50166032	-50164149	-50162267	-50160384
448	-50179314	-50179067	-50178821	-50178574	-50176682	-50174790	-50172890	-50170990	-50169090	-50168836	-50168581
446	-50273743	-50273504	-50273266	-50273029	-50271121	-50269214	-50267289	-50265366	-50263443	-50263188	-50262933
444	-50368207	-50367976	-50367746	-50367519	-50365596	-50363673	-50361724	-50359776	-50357830	-50357575	-50357320
442	-50462704	-50462481	-50462261	-50462044	-50460106	-50458169	-50456193	-50454220	-50452250	-50451995	-50451740
440	-50557235	-50557021	-50556811	-50556605	-50554652	-50552699	-50550696	-50548698	-50546705	-50546450	-50546195
438	-50575419	-50573575	-50571734	-50569896	-50569555	-50569215	-50568834	-50568457	-50568082	-50566204	-50564326
436	-50669326	-50667459	-50665594	-50663731	-50663390	-50663050	-50662679	-50662310	-50661942	-50660049	-50658156
434	-50763267	-50761377	-50759487	-50757599	-50757258	-50756917	-50756556	-50756196	-50755836	-50753928	-50752019
432	-50857241	-50855326	-50853412	-50851498	-50851157	-50850817	-50850465	-50850115	-50849764	-50847840	-50845916
430	-50951249	-50949309	-50947369	-50945430	-50945089	-50944748	-50944407	-50944066	-50943725	-50941785	-50939846
428	-50975962	-50975630	-50975300	-50974969	-50973018	-50971068	-50969118	-50967168	-50965218	-50963268	-50961319

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	820										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-50162525	-50160660	-50158795	-50156930	-50155065	-50153200	-50151335	-50149471	-50147606	-50145742	-50143878
450	-50257641	-50255761	-50253880	-50252000	-50250120	-50248240	-50246360	-50244481	-50242601	-50240722	-50238842
448	-50257760	-50257513	-50257267	-50257021	-50255132	-50253243	-50251346	-50249449	-50247553	-50247299	-50247044
446	-50352048	-50351809	-50351572	-50351334	-50349430	-50347526	-50345605	-50343684	-50341765	-50341510	-50341256
444	-50446371	-50446141	-50445912	-50445684	-50443765	-50441846	-50439899	-50437954	-50436011	-50435757	-50435502
442	-50540729	-50540507	-50540287	-50540070	-50538136	-50536201	-50534229	-50532259	-50530292	-50530038	-50529783
440	-50635121	-50634907	-50634698	-50634492	-50632542	-50630592	-50628593	-50626598	-50624608	-50624353	-50624098
438	-50653293	-50651452	-50649614	-50647779	-50647439	-50647099	-50646719	-50646342	-50645968	-50644093	-50642218
436	-50747063	-50745199	-50743337	-50741477	-50741137	-50740797	-50740427	-50740058	-50739691	-50737801	-50735911
434	-50840867	-50838979	-50837093	-50835208	-50834867	-50834527	-50834167	-50833807	-50833448	-50831542	-50829637
432	-50934704	-50932793	-50930882	-50928971	-50928631	-50928290	-50927940	-50927589	-50927239	-50925318	-50923397
430	-51028576	-51026640	-51024703	-51022767	-51022426	-51022086	-51021745	-51021405	-51021064	-51019128	-51017192
428	-51053267	-51052936	-51052606	-51052275	-51050328	-51048381	-51046434	-51044487	-51042540	-51040594	-51038647

P_{STM}	810										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-50176783	-50174918	-50173053	-50171188	-50169324	-50167459	-50165595	-50163731	-50161867	-50160003	-50158139
450	-50271900	-50270020	-50268140	-50266260	-50264381	-50262501	-50260621	-50258742	-50256863	-50254984	-50253104
448	-50272038	-50271791	-50271545	-50271299	-50269410	-50267522	-50265625	-50263729	-50261833	-50261578	-50261324
446	-50366327	-50366089	-50365851	-50365614	-50363710	-50361806	-50359885	-50357965	-50356046	-50355791	-50355537
444	-50460652	-50460421	-50460192	-50459965	-50458046	-50456127	-50454181	-50452236	-50450293	-50450039	-50449784
442	-50555011	-50554789	-50554569	-50554352	-50552418	-50550483	-50548511	-50546542	-50544576	-50544321	-50544067
440	-50649405	-50649190	-50648981	-50648775	-50646826	-50644876	-50642877	-50640883	-50638892	-50638638	-50638383
438	-50667592	-50665751	-50663913	-50662078	-50661738	-50661398	-50661019	-50660641	-50660267	-50658393	-50656518
436	-50761362	-50759499	-50757637	-50755777	-50755437	-50755097	-50754727	-50754358	-50753991	-50752101	-50750211
434	-50855167	-50853280	-50851394	-50849509	-50849169	-50848829	-50848468	-50848108	-50847749	-50845844	-50843939
432	-50949006	-50947095	-50945184	-50943273	-50942933	-50942593	-50942242	-50941892	-50941542	-50939621	-50937700
430	-51042879	-51040942	-51039006	-51037070	-51036730	-51036389	-51036049	-51035708	-51035368	-51033432	-51031496
428	-51067583	-51067252	-51066922	-51066592	-51064645	-51062698	-51060751	-51058805	-51056858	-51054912	-51052965

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	800										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-50186740	-50184875	-50183011	-50181146	-50179282	-50177418	-50175554	-50173690	-50171826	-50169962	-50168099
450	-50281860	-50279980	-50278101	-50276221	-50274342	-50272462	-50270583	-50268704	-50266825	-50264946	-50263067
448	-50282017	-50281771	-50281524	-50281278	-50279390	-50277501	-50275605	-50273709	-50271813	-50271559	-50271304
446	-50376309	-50376071	-50375833	-50375596	-50373692	-50371789	-50369868	-50367948	-50366029	-50365774	-50365520
444	-50470637	-50470406	-50470177	-50469950	-50468031	-50466112	-50464166	-50462222	-50460279	-50460025	-50459770
442	-50564998	-50564776	-50564556	-50564339	-50562405	-50560471	-50558499	-50556530	-50554564	-50554310	-50554055
440	-50659394	-50659180	-50658971	-50658765	-50656816	-50654866	-50652868	-50650874	-50648884	-50648629	-50648374
438	-50677597	-50675757	-50673919	-50672084	-50671744	-50671404	-50671025	-50670648	-50670273	-50668399	-50666525
436	-50771370	-50769507	-50767646	-50765786	-50765446	-50765106	-50764735	-50764367	-50764000	-50762110	-50760221
434	-50865177	-50863291	-50861405	-50859520	-50859180	-50858840	-50858479	-50858120	-50857760	-50855856	-50853951
432	-50959019	-50957108	-50955197	-50953287	-50952947	-50952606	-50952256	-50951905	-50951555	-50949635	-50947715
430	-51052894	-51050958	-51049022	-51047086	-51046746	-51046405	-51046065	-51045724	-51045384	-51043448	-51041512
428	-51077612	-51077282	-51076951	-51076621	-51074674	-51072728	-51070781	-51068835	-51066889	-51064942	-51062996

P_{STM}	790										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-50204570	-50202705	-50200841	-50198977	-50197113	-50195249	-50193385	-50191522	-50189658	-50187795	-50185931
450	-50299691	-50297812	-50295933	-50294053	-50292174	-50290295	-50288416	-50286537	-50284659	-50282780	-50280901
448	-50299867	-50299621	-50299374	-50299128	-50297240	-50295352	-50293456	-50291560	-50289665	-50289410	-50289156
446	-50394161	-50393922	-50393684	-50393447	-50391544	-50389641	-50387720	-50385801	-50383882	-50383627	-50383373
444	-50488489	-50488259	-50488030	-50487803	-50485884	-50483965	-50482020	-50480076	-50478134	-50477879	-50477625
442	-50582853	-50582630	-50582411	-50582194	-50580260	-50578326	-50576355	-50574386	-50572420	-50572166	-50571911
440	-50677250	-50677036	-50676826	-50676621	-50674672	-50672722	-50670724	-50668730	-50666741	-50666486	-50666231
438	-50695468	-50693628	-50691791	-50689956	-50689616	-50689276	-50688896	-50688519	-50688145	-50686271	-50684397
436	-50789242	-50787379	-50785518	-50783659	-50783319	-50782979	-50782608	-50782240	-50781873	-50779983	-50778094
434	-50883051	-50881165	-50879279	-50877394	-50877054	-50876714	-50876353	-50875994	-50875635	-50873730	-50871825
432	-50976893	-50974983	-50973073	-50971163	-50970822	-50970482	-50970131	-50969781	-50969431	-50967511	-50965591
430	-51070770	-51068834	-51066898	-51064963	-51064622	-51064282	-51063941	-51063601	-51063260	-51061325	-51059389
428	-51095502	-51095171	-51094840	-51094510	-51092564	-51090618	-51088671	-51086725	-51084779	-51082833	-51080888

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT A, CALORIMETRIC UNCERTAINTY USING ASME 1967 STEAM TABLES

P_{STM}	780										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-49727391	-49725524	-49723657	-49721791	-49719924	-49718058	-49716191	-49714325	-49712459	-49710593	-49708727
450	-49822656	-49820774	-49818892	-49817010	-49815128	-49813247	-49811365	-49809484	-49807603	-49805721	-49803840
448	-49822845	-49822598	-49822351	-49822105	-49820214	-49818323	-49816425	-49814526	-49812628	-49812373	-49812119
446	-49917280	-49917041	-49916803	-49916565	-49914659	-49912753	-49910830	-49908908	-49906987	-49906732	-49906477
444	-50011749	-50011518	-50011289	-50011061	-50009140	-50007219	-50005271	-50003324	-50001379	-50001124	-50000869
442	-50106253	-50106030	-50105810	-50105593	-50103656	-50101720	-50099745	-50097774	-50095806	-50095551	-50095296
440	-50200790	-50200575	-50200365	-50200159	-50198207	-50196256	-50194255	-50192258	-50190266	-50190011	-50189756
438	-50219044	-50217202	-50215362	-50213525	-50213184	-50212844	-50212464	-50212086	-50211711	-50209835	-50207958
436	-50312956	-50311091	-50309228	-50307366	-50307025	-50306684	-50306314	-50305944	-50305577	-50303685	-50301793
434	-50406902	-50405014	-50403126	-50401238	-50400898	-50400557	-50400196	-50399836	-50399476	-50397569	-50395662
432	-50500882	-50498969	-50497056	-50495143	-50494802	-50494461	-50494110	-50493759	-50493409	-50491486	-50489563
430	-50594894	-50592956	-50591018	-50589080	-50588739	-50588398	-50588057	-50587716	-50587375	-50585436	-50583498
428	-50619671	-50619340	-50619009	-50618678	-50616729	-50614780	-50612831	-50610883	-50608934	-50606986	-50605037

P_{STM}	770										
P_{FW}, PSIA	770	790	780	800	810	820	830	840	850	860	870
T_{FW}, DEG F	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr	$U_{CAL-TOT}$, BTU/hr
452	-50160525	-50158659	-50156792	-50154926	-50153059	-50151193	-50149327	-50147461	-50145595	-50143730	-50141864
450	-50255793	-50253911	-50252029	-50250148	-50248266	-50246385	-50244504	-50242622	-50240741	-50238860	-50236980
448	-50256000	-50255754	-50255507	-50255260	-50253370	-50251480	-50249581	-50247683	-50245785	-50245530	-50245276
446	-50350438	-50350199	-50349961	-50349723	-50347817	-50345912	-50343989	-50342067	-50340146	-50339891	-50339636
444	-50444909	-50444678	-50444449	-50444221	-50442300	-50440379	-50438431	-50436485	-50434541	-50434286	-50434031
442	-50539415	-50539192	-50538972	-50538755	-50536818	-50534882	-50532908	-50530937	-50528969	-50528714	-50528459
440	-50633954	-50633740	-50633529	-50633324	-50631372	-50629420	-50627420	-50625423	-50623432	-50623176	-50622921
438	-50652224	-50650381	-50648542	-50646705	-50646365	-50646024	-50645644	-50645266	-50644892	-50643015	-50641139
436	-50746138	-50744273	-50742410	-50740548	-50740207	-50739867	-50739496	-50739127	-50738759	-50736868	-50734976
434	-50840086	-50838197	-50836310	-50834423	-50834082	-50833741	-50833380	-50833020	-50832660	-50830753	-50828847
432	-50934067	-50932154	-50930242	-50928330	-50927989	-50927648	-50927297	-50926946	-50926595	-50924673	-50922750
430	-51028082	-51026144	-51024206	-51022268	-51021927	-51021586	-51021245	-51020904	-51020563	-51018625	-51016687
428	-51052872	-51052541	-51052210	-51051879	-51049930	-51047982	-51046033	-51044085	-51042137	-51040188	-51038240

ATTACHMENT B, EVALUATION OF BLOWDOWN FLOW ON CALORIMETRIC UNCERTAINTY

1. From Section 7.0, CALCULATION, only two terms are dependent upon the blowdown flow from the steam generators.

   - Main steam pressure measurement uncertainty, determined by the expressions
     11, 21 Steam Generators

     $$U_{CAL-PSTM1} = (M_{FW1} - M_{BD1})(h_{GS1-\varepsilon PSTM} - h_{GS1}) + (M_{BD1})(h_{FS1-\varepsilon PSTM} - h_{FS1})$$

     12, 22 Steam Generators

     $$U_{CAL-PSTM2} = (M_{FW2} - M_{BD2})(h_{GS2-\varepsilon PSTM} - h_{GS2}) + (M_{BD2})(h_{FS2-\varepsilon PSTM} - h_{FS2})$$

     Total

     $$U_{CAL-PSTMNET} = -\left\{(U_{CAL-PSTM1})^2 + (U_{CAL-PSTM2})^2\right\}^{1/2}$$

   - Plant computer uncertainty for the calculation of main steam enthalpy, determined by the expressions
     11, 21 Steam Generators

     $$U_{CAL-CMP(hGS)1} = (M_{FW1} - M_{BD1})(U_{PC-ENTH})$$

     $$U_{CAL-CMP(hFS)1} = (M_{BD1})(U_{PC-ENTH})$$

     12, 22 Steam Generators

     $$U_{CAL-CMP(hGS)2} = (M_{FW2} - M_{BD2})(U_{PC-ENTH})$$

     $$U_{CAL-CMP(hFS)1} = (M_{BD2})(U_{PC-ENTH})$$

     Total

     $$U_{CAL-\varepsilon CMP(hGS)NET} = -\left[(U_{CAL-CMP(hGS)1})^2 + (U_{CAL-CMP(hGS)2})^2\right]^{1/2}$$

     $$U_{CAL-\varepsilon CMP(hFS)NET} = -\left[(U_{CAL-CMP(hFS)1})^2 + (U_{CAL-CMP(hFS)2})^2\right]^{1/2}$$

2. The change in calorimetric uncertainty as a result of changes in blowdown flow is evaluated by reducing the blowdown flow through the 11 (21) Steam Generators in 5,000 lbm/hr increments. Blowdown flow through the 12 (22) Steam Generators is raised in 5,000 lbm/hr increments to maintain total blowdown flow constant. Using the equations above the uncertainty at each set of blowdown flows is calculated and tabulated.

3. As shown in the following tables, the contribution to calorimetric uncertainty for each term is maximized at a flow of 91000 lbm/hr through one steam generator and 16000 lbm/hr through the second steam generator.

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT B, EVALUATION OF BLOWDOWN FLOW ON CALORIMETRIC UNCERTAINTY

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS}, BTU/lbm	h_{GSt}, BTU/lbm	h_{FS}, BTU/lbm	h_{FSt}, BTU/lbm	$U_{CAL\text{-}PSTM+}$, BTU/hr		M_{FW}, lbm/hr	M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr		M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hFS)}$, BTU/hr	$U_{CAL\text{-}CMP(hFS)NET}$, BTU/hr
1	6220000	91000	1197.70	1197.01	520.10	523.37	-3950100		6220000	91000	-0.1	-612900	-872091		91000	-0.1	-9100	-9240
2	6220000	16000	1197.70	1197.01	520.10	523.37	-4247100		6220000	16000	-0.1	-620400			16000	-0.1	-1600	
						NET	-5800099											

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS}, BTU/lbm	h_{GSt}, BTU/lbm	h_{FS}, BTU/lbm	h_{FSt}, BTU/lbm	$U_{CAL\text{-}PSTM+}$, BTU/hr		M_{FW}, lbm/hr	M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr		M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hFS)}$, BTU/hr	$U_{CAL\text{-}CMP(hFS)NET}$, BTU/hr
1	6220000	86000	1197.70	1197.01	520.10	523.37	-3969900		6220000	86000	-0.1	-613400	-872087		86000	-0.1	-8600	-8853
2	6220000	21000	1197.70	1197.01	520.10	523.37	-4227300		6220000	21000	-0.1	-619900			21000	-0.1	-2100	
						NET	-5799153											

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS}, BTU/lbm	h_{GSt}, BTU/lbm	h_{FS}, BTU/lbm	h_{FSt}, BTU/lbm	$U_{CAL\text{-}PSTM+}$, BTU/hr		M_{FW}, lbm/hr	M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr		M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hFS)}$, BTU/hr	$U_{CAL\text{-}CMP(hFS)NET}$, BTU/hr
1	6220000	81000	1197.70	1197.01	520.10	523.37	-3989700		6220000	81000	-0.1	-613900	-872083		81000	-0.1	-8100	-8507
2	6220000	26000	1197.70	1197.01	520.10	523.37	-4207500		6220000	26000	-0.1	-619400			26000	-0.1	-2600	
						NET	-5798341											

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS}, BTU/lbm	h_{GSt}, BTU/lbm	h_{FS}, BTU/lbm	h_{FSt}, BTU/lbm	$U_{CAL\text{-}PSTM+}$, BTU/hr		M_{FW}, lbm/hr	M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr		M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hFS)}$, BTU/hr	$U_{CAL\text{-}CMP(hFS)NET}$, BTU/hr
1	6220000	76000	1197.70	1197.01	520.10	523.37	-4009500		6220000	76000	-0.1	-614400	-872081		76000	-0.1	-7600	-8208
2	6220000	31000	1197.70	1197.01	520.10	523.37	-4187700		6220000	31000	-0.1	-618900			31000	-0.1	-3100	
						NET	-5797665											

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS}, BTU/lbm	h_{GSt}, BTU/lbm	h_{FS}, BTU/lbm	h_{FSt}, BTU/lbm	$U_{CAL\text{-}PSTM+}$, BTU/hr		M_{FW}, lbm/hr	M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr		M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hFS)}$, BTU/hr	$U_{CAL\text{-}CMP(hFS)NET}$, BTU/hr
1	6220000	71000	1197.70	1197.01	520.10	523.37	-4029300		6220000	71000	-0.1	-614900	-872078		71000	-0.1	-7100	-7961
2	6220000	36000	1197.70	1197.01	520.10	523.37	-4167900		6220000	36000	-0.1	-618400			36000	-0.1	-3600	
						NET	-5797124											

CALORIMETRIC UNCERTAINTY USING THE AMAG CROSSFLOW ULTRASONIC FLOWMETER

ATTACHMENT B, EVALUATION OF BLOWDOWN FLOW ON CALORIMETRIC UNCERTAINTY

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS}, BTU/lbm	h_{GSt}, BTU/lbm	h_{FS}, BTU/lbm	h_{FSt}, BTU/lbm	$U_{CAL\text{-}PSTM+}$, BTU/hr
1	6220000	66000	1197.70	1197.01	520.10	523.37	-4049100
2	6220000	41000	1197.70	1197.01	520.10	523.37	-4148100
						NET	-5796718

M_{FW}, lbm/hr	M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr
6220000	66000	-0.1	-615400	-872077
6220000	41000	-0.1	-617900	

M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr
66000	-0.1	-6600	-7770
41000	-0.1	-4100	

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS}, BTU/lbm	h_{GSt}, BTU/lbm	h_{FS}, BTU/lbm	h_{FSt}, BTU/lbm	$U_{CAL\text{-}PSTM+}$, BTU/hr
1	6220000	61000	1197.70	1197.01	520.10	523.37	-4068900
2	6220000	46000	1197.70	1197.01	520.10	523.37	-4128300
						NET	-5796448

M_{FW}, lbm/hr	M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr
6220000	61000	-0.1	-615900	-872075
6220000	46000	-0.1	-617400	

M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr
61000	-0.1	-6100	-7640
46000	-0.1	-4600	

SG	M_{FW}, lbm/hr	M_{BD}, lbm/hr	h_{GS}, BTU/lbm	h_{GSt}, BTU/lbm	h_{FS}, BTU/lbm	h_{FSt}, BTU/lbm	$U_{CAL\text{-}PSTM+}$, BTU/hr
1	6220000	56000	1197.70	1197.01	520.10	523.37	-4088700
2	6220000	51000	1197.70	1197.01	520.10	523.37	-4108500
						NET	-5796313

M_{FW}, lbm/hr	M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr
6220000	56000	-0.1	-616400	-872075
6220000	51000	-0.1	-616900	

M_{BD}, lbm/hr	$U_{PC\text{-}ENTH}$, BTU/lbm	$U_{CAL\text{-}CMP(hGS)}$, BTU/hr	$U_{CAL\text{-}CMP(hGS)NET}$, BTU/hr
56000	-0.1	-5600	-7574
51000	-0.1	-5100	

ATTACHMENT C, EVALUATION OF MOISTURE CARRYOVER ON CALORIMETRIC POWER

1. Calorimetric power is calculated for a moisture carryover of 1. The indicated gross thermal output of one steam generator and can be represented by

$$Q_{SG} = (M_{FW})(h_{GS} - h_{FW}) + (M_{BD})(h_{FS} - h_{GS})$$

2. If carryover exists, the following expression applies to the actual gross thermal output of one steam generator.

$$Q_{SG} = (M_{FW})[(1-X)h_{FS} + Xh_{GS} - h_{FW}] + (XM_{BD})(h_{FS} - h_{GS})$$

3. Uncertainty is the difference between the indicated and actual values

$$U_{QSG} = (M_{FW} - M_{BD})(1-X)(h_{GS} - h_{FS})$$

4. This expression is always greater than or equal to zero since
   - Feedwater flow is always greater than blowdown flow.
   - Steam quality must be between 0 (wet steam) and 1 (dry steam)
   - The saturated vapor component of steam enthalpy is always greater than the saturated liquid component of steam enthalpy.
5. Therefore, indicated thermal output is always greater than actual thermal output, which is conservative.

ATTACHMENT (3)

MARKED UP TECHNICAL SPECIFICATION PAGES

Renewed Operating License Page 3 (Unit 1)

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1.1-5

rules, regulations, and orders of the Commission, now or hereafter applicable; and is subject to the additional conditions specified and incorporated below:

(1) Maximum Power Level

The licensee is authorized to operate the facility at steady-state reactor core power levels not in excess of ~~2700~~ 2737 megawatts-thermal in accordance with the conditions specified herein.

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 237 , are hereby incorporated into this license. The licensee shall operate the facility in accordance with the Technical Specifications.

(a) For Surveillance Requirements (SRs) that are new, in Amendment 227 to Facility Operating License No. DPR-53, the first performance is due at the end of the first surveillance interval that begins at implementation of Amendment 227. For SRs that existed prior to Amendment 227, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the Surveillance was last performed prior to implementation of Amendment 227.

(3) Additional Conditions

The Additional Conditions contained in Appendix C as revised through Amendment No. 237 are hereby incorporated into this license. Calvert Cliffs Nuclear Power Plant, Inc. shall operate the facility in accordance with the Additional Conditions.

(4) Secondary Water Chemistry Monitoring Program

The Calvert Cliffs Nuclear Power Plant, Inc., shall implement a secondary water chemistry monitoring program to inhibit steam generator tube degradation. This program shall include:

a. Identification of a sampling schedule for the critical parameters and control points for these parameters;

b. Identification of the procedures used to quantify parameters that are critical to control points;

C. This license is deemed to contain and is subject to the conditions set forth in 10 CFR Chapter I and is subject to all applicable provisions of the Act, and the rules, regulations, and orders of the Commission, now or hereafter applicable; and is subject to the additional conditions specified and incorporated below:

(1) Maximum Power Level

The licensee is authorized to operate the facility at reactor steady-state core power levels not in excess of ~~2700~~ 2737 megawatts-thermal in accordance with the conditions specified herein.

(2) Technical Specifications

The Technical Specifications contained in Appendices A and B, as revised through Amendment No. 209, are hereby incorporated into this license. The licensee shall operate the facility in accordance with the Technical Specifications.

(a) For Surveillance Requirements (SRs) that are new, in Amendment 201 to Facility Operating License No. DPR-69, the first performance is due at the end of the first surveillance interval that begins at implementation of Amendment 201. For SRs that existed prior to Amendment 201, including SRs with modified acceptance criteria and SRs whose frequency of performance is being extended, the first performance is due at the end of the first surveillance interval that begins on the date the Surveillance was last performed prior to implementation of Amendment 201.

(3) Less Than Four Pump Operation

The licensee shall not operate the reactor at power levels in excess of five (5) percent of rated thermal power with less than four (4) reactor coolant pumps in operation. This condition shall remain in effect until the licensee has submitted safety analyses for less than four pump operation, and approval for such operation has been granted by the Commission by amendment of this license.

(4) Environmental Monitoring Program

If harmful effects or evidence of irreversible damage are detected by the biological monitoring program, hydrological monitoring program, and the radiological monitoring program specified in the Appendix B Technical Specifications, the licensee will provide to the staff a detailed analysis of the problem and a program of remedial action to be taken to eliminate or significantly reduce the detrimental effects or damage.

1.1 Definitions

capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, normal or emergency electrical power, cooling and seal water, lubrication, and other auxiliary equipment that are required for the system, subsystem, train, component, or device to perform its specified safety function(s) are also capable of performing their related support function(s).

PHYSICS TESTS

PHYSICS TESTS shall be those tests performed to measure the fundamental nuclear characteristics of the reactor core and related instrumentation. These tests are:

a. Described in Chapter 13, Initial Tests and Operation of the Updated Final Safety Analysis Report;

b. Authorized under the provisions of 10 CFR 50.59; or

c. Otherwise approved by the Nuclear Regulatory Commission.

RATED THERMAL POWER (RTP)

RTP shall be a total reactor core heat transfer rate to the reactor coolant of ~~2700~~ 2737 MWt.

REACTOR PROTECTIVE SYSTEM (RPS) RESPONSE TIME

The RPS RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its RPS trip setpoint at the channel sensor until electrical power to the CEAs drive mechanism is interrupted. The response time may be measured by means of any series of sequential, overlapping, or total steps so that the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and methodology for verification have been previously reviewed and approved by the NRC.