POINT BEACH

November 20, 2009

NRC 2009-0123
10 CFR 50.90

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

Point Beach Nuclear Plant, Units 1 and 2
Dockets 50-266 and 50-301
Renewed License Nos. DPR-24 and DPR-27

License Amendment Request 261
Extended Power Uprate
Response to Request for Additional Information

References: (1) FPL Energy Point Beach, LLC letter to NRC, dated April 7, 2009, License Amendment Request 261, Extended Power Uprate (ML091250564)

(2) NRC electronic mail to NextEra Energy Point Beach, LLC, dated November 2, 2009, Point Beach Nuclear Plant, Units 1 and 2 - Request for Additional Information from Instrumentation and Control Branch RE: Auxiliary Feedwater (ML093060166)

NextEra Energy Point Beach, LLC (NextEra) submitted License Amendment Request (LAR) 261 (Reference 1) to the NRC pursuant to 10 CFR 50.90. The proposed amendment would increase each unit's licensed thermal power level from 1540 megawatts thermal (MWt) to 1800 MWt, and revise the Technical Specifications to support operation at the increased thermal power level.

Via Reference (2), the NRC staff determined that additional information is required to enable the staff's continued review of the request. Enclosure 1 provides the NextEra response to the NRC staff's request. Enclosure 2 provides the calculation for the auxiliary feedwater pump low suction pressure setpoint, as requested by the staff.

This letter contains no new Regulatory Commitments and no revisions to existing Regulatory Commitments.

The information contained in this letter does not alter the no significant hazards consideration determination contained in Reference (1) and continues to satisfy the criteria of 10 CFR 51.22 for categorical exclusion from the requirements for an environmental assessment.

In accordance with 10 CFR 50.91, a copy of this letter is being provided to the designated Wisconsin Official.

I declare under penalty of perjury that the foregoing is true and correct.
Executed on November 20, 2009.

Very truly yours,

NextEra Energy Point Beach, LLC

Larry Meyer
Site Vice President

Enclosures

cc: Administrator, Region III, USNRC
Project Manager, Point Beach Nuclear Plant, USNRC
Resident Inspector, Point Beach Nuclear Plant, USNRC
PSCW

ENCLOSURE 1

NEXTERA ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

LICENSE AMENDMENT REQUEST 261
EXTENDED POWER UPRATE

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

Via electronic mail (Reference 1), the NRC staff determined that additional information is required to enable the Instrument and Control Branch to continue its review of the auxiliary feedwater portion of License Amendment Request (LAR) 261, Extended Power Uprate (Reference 2). The following information is provided by NextEra Energy Point Beach, LLC (NextEra) in response to the NRC staff's request.

Question 1

Please provide the complete calculation used to obtain the LSSS value of the new Function 6.e, Auxiliary Feedwater, AFW Pump Suction Transfer on Suction Pressure Low.

NextEra Response

The requested calculation is provided in Enclosure 2. Section 1.2, Purpose, of Enclosure 2 states that the scope of the current revision of this calculation is the turbine-driven auxiliary feedwater (TDAFW) pump and that a subsequent revision to this calculation will address the motor-driven auxiliary feedwater (MDAFW) pumps. The Technical Specification (TS) Function 6.e, Limiting Safety System Setting (LSSS) value for AFW pump suction transfer on suction pressure low, bounds the MDAFW pump value. TS Function 6.e was previously submitted via Reference (3).

References

(1) NRC electronic mail to NextEra Energy Point Beach, LLC, dated November 2, 2009, Point Beach Nuclear Plant, Units 1 and 2 - Request for Additional Information from Instrumentation and Control Branch RE: Auxiliary Feedwater (ML093060166)

(2) FPL Energy Point Beach, LLC letter to NRC, dated April 7, 2009, License Amendment Request 261, Extended Power Uprate (ML091250564)

(3) NextEra Energy Point Beach, LLC letter to NRC, dated June 17, 2009, License Amendment Request 261 Supplement 1, Extended Power Uprate (ML091690090)

ENCLOSURE 2

NEXTERA ENERGY POINT BEACH, LLC
POINT BEACH NUCLEAR PLANT, UNITS 1 AND 2

LICENSE AMENDMENT REQUEST 261
EXTENDED POWER UPRATE
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

CALCULATION FOR AFW PUMP LOW SUCTION PRESSURE SETPOINT

87 pages follow

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1.0 BACKGROUND, PURPOSE, AND SCOPE OF CALCULATION

1.1 Background

ECs 13400 through 13407 installs new MDAFW pumps, modifies controls for the existing TDAFW pumps and converts the existing MDAFW pumps to Standby Steam Generator (SSG) feed pumps. The SSG feed pumps are used in normal startup and shutdowns, receive no automatic start signals and are tripped on signals that would automatically initiate AFW flow.

The new MDAFW pumps will have their own connection to the Condensate Storage Tanks. This connection will be separate from the TDAFW pumps connection to the Condensate Storage Tank.

The Auxiliary Feedwater (AF) System automatically supplies feedwater to the steam generators to remove decay heat from the Reactor Coolant System upon a loss of normal feedwater supply. The AF system consists of two independent pump systems per unit; Motor Driven (MD) AFPs (1P-53 and 2P-53, and steam turbine-driven (TD) AFPs (1P-29 and 2P-29).

The normal source of water for the AFP is the Condensate Storage Tank (CST), and the safety-related supply is the Service Water (SW). The switch from the normal suction supply to the safety related supply is done automatically or manually.

A pressure transmitter is installed on the suction side of each AF pump that monitors AFP suction pressure. This pressure transmitter will initiate the switch to the safety related supply and trip of the pump on low suction pressure if the switchover was not successful to prevent pump damage. Additionally, an alarm before trip function provides annunciation prior to a trip and in the main control room.

The low-low suction SW switchover/pump trip and low suction alarm functions associated with each AFP are provided by a setpoint controlled bistable unit downstream of the Low Suction Pressure Transmitter, which provides a switchover/trip and alarm output. The outputs of each bistable unit are connected to a Time Delay Relay (TDR). The output of the bistable is delayed in order to minimize spurious switchovers/trips caused by normal transient drops in suction pressure during plant startup. The time delay function for the low suction pressure switchover/trip is evaluated in Calculation 97-0211, "AFW Pump Low Suction Pressure Trip Time Delay Relay Uncertainty Calculation".

The AF pump low suction pressure trip is a safety-related function per Passport equipment search.

1.2 Purpose

The purpose of this minor revision is to determine the instrument uncertainties, TDAFW Pump Low Suction Pressure Alarm Setpoint, and Low Suction Pressure Switchover/Pump Trip Setpoint associated with the Turbine-Driven Auxiliary Feedwater Pump (AFP) Low Suction Pressure Switchover/Trip instrument loop.

A subsequent minor revision will be prepared to evaluate the MDAFW pump low suction pressure switchover/trip and alarm uncertainties and setpoints

The low suction pressure trip circuits for the Standby Steam Generator (SSG) pumps are not modified. Uncertainties and setpoints for these circuits determined in revision 2 of this calculation remain valid.

Because the Low Suction Pressure Switchover/Trip is a safety-related function and is required to operate during/after a design basis event, this calculation will determine uncertainties for accident environmental conditions.

The results of this calculation, along with the results of I&C Calculations 97-0211 and PBNP-IC-42, are used as input to Calculation 97-0215 to ensure that sufficient water (including water pumped during the switchover/trip time delay) is available to supply the AFPs to allow an orderly switchover to the safety related supply or automatically trip if the switchover is unsuccessful following a loss of CSTs, thus preventing damage to the pump. (See Section 10.0).

1.3 Purpose of This Revision

This minor revision supports the modifications to the TDAFW low suction pressure switchover/trip circuits in EC-13407. The existing trip/alarm and indication will split into two loops:

1. SW Switchover/Pump Trip and alarm scaled from 0-30 psig (Sections 5.1.5 and 9.4.6).
2. Suction pressure indication scaled from 0-100 psig (Sections 5.1.5 and 9.4.6).

Since the suction pressure indication loops are not Reg. Guide 1.97 Cat 1 Type A variables and since they are no longer a part of the suction pressure trip alarms circuits, their uncertainties and setting tolerances are not addressed in this minor revision. Moreover, the parallel instrumentation legs fed by the pressure transmitters (e.g. control board indication and PPCS input) were not addressed in previous revisions of this calculation.

This minor revision creates imposed conditions of the design of EC-13407

1.4 Scope

The scope of this calculation is listed below:

- Determine uncertainties for the AFP Suction Pressure Switchover/Trip Instrumentation (excluding Time Delay Relay).

- Evaluate the Low Suction Pressure Alarm setpoint and the Low-low Suction Pressure Switchover/Trip Setpoint for the AFP.

- Determine Acceptable As-Found / As-Left Calibration Tolerances for AFP Suction Pressure Instrumentation.

1.5 Instrumentation Evaluated

This calculation evaluates the plant equipment listed in the table below (with the exception of the pumps). See Sections 6.2, 6.3 and 6.4 of this calculation for instrument specifications, parameters, ranges and loop configurations.

Table 1.5-1: Instrumentation List

Pump	Pressure Transmitter	Current-to-Voltage Converter	Voltage-to-Current Converter	Switchover & Trip / Alarm Bistable
1P-29 Steam driven	1PT-4044A	1PQ-4044	1PM-4044-3	1PC-4044-L 1PC-4044-LL
2P-29 Steam driven	2PT-4044A	2PQ-4044	2PM-4044-3	2PC-4044-L 2PC-4044-LL

1.6 Superseded Station Calculations

None

2.0 ACCEPTANCE CRITERIA

This calculation determines the following:

- The adequacy of Limiting Trip Setpoints (LTSP) for the TDAF Low-Low Suction Pressure Pump Switchover/Trip as added by the Extended Power Uprate

  The LTSP is acceptable if the following criteria are met:

  The calculated setpoint (SP) is established to ensure that the instrument channel pump trip initiation, i.e., actuation of the Time Delay Relay (see Calculation 97-0211) occurs before the AL is reached. The SP will be compared to the LTSP to ensure that the LTSP ≤ SP (for increasing process) or the LTSP ≥ SP (for decreasing process).

- The adequacy of existing Field Trip Setpoints (FTSP) for the TDAF Low-Low Suction Pressure Pump Switchover/Trip as added by the Extended Power Uprate

  The FTSP is acceptable if the following criteria are met:

  The calculated setpoint (SP) is established to ensure that the instrument channel pump trip initiation, i.e., actuation of the Time Delay Relay (see Calculation 97-0211) occurs before the AL is reached. The SP will be compared to the FTSP to ensure that the FTSP ≤ SP (for increasing process) or the FTSP ≥ SP (for decreasing process). In addition, the FTSP must provide sufficient margin to ensure that the LTSP is protected.

- The adequacy of existing Field Trip Setpoints (FTSP) for Low Suction Pressure Pump Alarm

  The FTSP is acceptable if the following criteria are met:

  1) The SP will be compared to the FTSP to ensure that the FTSP ≤ SP (for increasing process) or the FTSP ≥ SP (for decreasing process).

  2) The FTSP is 0.5 psig above the AFP Low-Low Suction Pressure Switchover/Trip Setpoint

- Uncertainties for the AFP Suction Pressure Instrumentation

  All uncertainty results are deemed acceptable so long as they are calculated in accordance with Point Beach Nuclear Plant's Instrument Setpoint Methodology (Ref. G.1). Any deviations from this methodology are noted where applicable.

3.0 ABBREVIATIONS

3.1	AL	Analytical Limit
3.2	AF	Auxiliary Feedwater
3.3	AFP	Auxiliary Feedwater Pump
3.4	AV	Allowable Value
3.5	BAF	Bistable As-Found Tolerance
3.6	BAL	Bistable As-Left Tolerance
3.7	COT	Channel Operational Test
3.8	CST	Condensate Storage Tank
3.9	EOP	Emergency Operating Procedures
3.10	FSAR	Final Safety Analysis Report
3.11	FTSP	Field Trip Setpoint
3.12	IVAF	Current-to-Voltage Converter As-Found Tolerance
3.13	IVAL	Current-to-Voltage Converter As-Left Tolerance
3.14	LSSS	Limiting Safety System Setting
3.15	LTSP	Limiting Trip Setpoint
3.16	M&TE	Measurement and Test Equipment
3.17	NPSH	Net Positive Suction Head
3.18	PBNP	Point Beach Nuclear Plant
3.19	PL	Process Limit
3.20	PS	Process Span
3.21	PT	Pressure Transmitter (Section 6.6) /Pressure Tester (remainder of calc)
3.22	RAD	Radiation Absorbed Dose
3.23	SAF	Sensor As-Found Tolerance
3.24	SAL	Sensor As-Left Tolerance
3.25	SP	Calculated Setpoint
3.26	SW	Service Water
3.27	SRSS	Square Root of the Sum of the Squares
3.28	SSG	Standy Steam Generator
3.29	TLE	Total Loop Error
3.30	URL	Upper Range Limit
3.31	VIAF	Voltage-to-Current Converter As-Found Tolerance
3.32	VIAL	Voltage-to-Current Converter As-Left Tolerance

4.0 REFERENCES

The revisions and/or dates of the References per this section are current as of 5/24/2009.

4.1 General

G.1 Point Beach Nuclear Plant Design & Installation Guidelines Manual DG-I01, "Instrument Setpoint Methodology", Rev. 4

G.2 Bechtel Corporation Specification No. 6118-M-40, Rev. 1, "Specification for Heating, Ventilating, and Air Conditioning Controls."

G.3 WCAP-8587, Rev. 6-A, "Methodology for Qualifying Westinghouse WRD Supplied NSSS Safety Related Electrical Equipment", dated March 1983

G.4 Point Beach Nuclear Plant FSAR:

- Section 9.8.1 (dated 2008)
- Section 9.5 (dated 2008)
- Section 11.6.2 (dated 2008)

G.5 Not used.

G.6 Walkdown, Pressure Transmitter Elevation and Pressure Tap Elevation (Attachment A)

G.7 ASME Steam Tables for Industrial Use (Version 1997), Copyright 2000.

G.8 PBF-2032, Rev. 90, "Operations Daily Logsheet"

G.9 WE Letter NPC-28077 to NRC, "Response to NUREG-0737", dated 9/14/81

G.10 Letter NRC 200-0030, dated April 7,2009, "License Amendment 261, Extended Power Uprate"

G.11 Walkdown, ICTI-621 and ICTI-797 Readability (Attachment C)

4.2 Drawings

D.1 Bechtel 6118, Dwg. M-217, Sht. 1, Rev. 84, "P&ID Auxiliary Feedwater System", Point Beach N.P., Unit 1&2

D.2 Bechtel 6118, Dwg. M-217, Sht. 2, Rev. 22, "P&ID Auxiliary Feedwater System", Point Beach N.P., Unit 1&2

D.3 Foxboro 62550, Dwg. CD1-15-1, Rev. 0, "Point Beach N.P., Unit 1 Connection Diagram – Rack 1C171B-F/1C197"

D.4 Foxboro 62550, Dwg. CD2-15-1, Rev. 1, "Point Beach N.P., Unit 2 Connection Diagram – Rack 2C173B-F/2C-197"

D.5 Not Used.
D.6 Not Used.

D.7 977-82, Sheet 10, Rev. 9, "Cable Spreader Room Air Conditioning System Rack C58" (available in Passport as 0082).

4.3 Procedures

P.1 1ICP 04.003-5, Rev. 12, "Auxiliary Feedwater Flow and Pressure Instruments Outage Calibration", 8/30/05

P.2 2ICP 04.003-5, Rev. 13, "Auxiliary Feedwater Flow and Pressure Instruments Outage Calibration", 8/30/05

P.3 1ICP 04.032-1, Rev. 15, "Auxiliary Feedwater System and Charging Flow Electronic Outage Calibration", 11/15/05

P.4 2ICP 04.032-1, Rev. 13, "Auxiliary Feedwater System and Charging Flow Electronic Outage Calibration", 11/15/05

P.5 Not Used.

P.6 Not Used.

P.7 ICI 12, Rev. 8, "Selection of M&TE for Field Calibrations"

4.4 Vendor

V.1 Not Used.

V.2 Foxboro Spec 200 Composite Manual, PBNP VTM # 00580, Rev. 8, Foxboro Technical Information, TI 2AI-130, dated October 1977, "Current-to-Voltage Converters"

V.3 Foxboro Spec 200 Composite Manual, PBNP VTM # 00580, Rev. 8, Foxboro Technical Information, TI 2A0-130, dated October 1977, "Voltage-to-Current Converters, Model 2AO-VAI, Isolated, 4 to 20 mAdc, Adjustable Span & Zero"

V.4 Foxboro Spec 200 Composite Manual, PBNP VTM # 00580, Rev. 8, Foxboro Technical Information, TI 2AP-100, dated March 1977, "Spec 200 Nest Alarms"

V.5 Johnson Controls Temperature Composite Book 2, VTM # 00309B, Rev. 5, dated 8/15/94 – T-4000 Series Pneumatic Room Thermostats (Tab – Thermostats & Thermometers).

V.6 User Guide HP 34401A Multimeter, VTM 01692, Rev. 0

V.7 Rosemount Model 3051N Smart Pressure Transmitter for Nuclear Service, Reference Manual 00809-0100-4808, Rev. CA, June 2008, PBNP VTM # 01826.

4.5 Calculations

C.1 Calculation 97-0172, Rev. 2, "Available Water in Volume of Piping to the Auxiliary Feedwater Pumps Following Pipe Break at Elevation 25-6"

C.2 Calculation 2003-0062, Rev. 2, "AFW Pump NPSH Calculation and Condensate Storage Tank Required Fluid to Prevent Vortexing.", including 2003-0062-002-A and 2003-0062-002-B.

C.3 Calculation No. M-8992-02.TM, "Thermal Modes Evaluation Report for Point Beach-Units 1&2", Appendix L, Rev. 1

5.0 ASSUMPTIONS

5.1 Validated Assumptions

5.1.1 It is assumed that the environmental conditions in the Auxiliary Feedwater Pump Room (in the Control Building) are similar to the conditions inside the Auxiliary Building.

Basis: Section 2.1 of Bechtel Specification 6118-M-40 (Ref. G.2) does not specifically identify environmental conditions for the Auxiliary Feedwater Pump Room. Descriptions of the various plant HVAC systems and their controls are provided in Section 3.0 of Ref. G.2. A comparison of the description of the AF Pump Room ventilation to that of the areas listed in Section 2.1 indicates that the air conditioning features make this area comparable to the Auxiliary Building. Also, a review of PBF-2032 Daily Logsheet, page 59, (Ref. G.8) verifies that the maximum temperature inside the Auxiliary Feedwater Pump Room is the same as the maximum temperature inside the Auxiliary Building.

5.1.2 It is assumed that the maximum temperature (for accident conditions) in the Auxiliary Feedwater Pump Cubicle Area is 120 °F.

Basis: Table 6-1 of WCAP-8587 (Reference G.3) states that "abnormal operating parameters" apply to areas outside of containment when the HVAC System is non-safety related, resulting in a maximum temperature of 120 °F and humidity of 95%.

The Auxiliary Feedwater Pump Area HVAC system is non-safety related (Per Section 9.5 of Ref. G.4). Therefore, 120 °F is used as the maximum operating temperature in the Auxiliary Feedwater Pump Cubicle Area.

5.1.3 It is assumed that the maximum environmental temperature of the Control Room and Computer Room instrumentation is 120 °F.

Basis: Table 6-1 of WCAP-8587 (Reference G.3) states that when the HVAC is non-safety related, a temperature of 120 °F (loss of chiller) should be used. Since the Control Room and Computer Room HVAC System chiller is not powered from an essential power bus, the Control Room and Computer Room HVAC System is considered a non-safety related system.

5.1.4 It is assumed that the As-Left setting tolerances for the instruments evaluated in this calculation are as indicated in the tables below:

Steam Driven Pump Suction Pressure Instrumentation				
Pressure Transmitters 1(2)PT-4044A	**I/V Converters 1(2)PQ-4044**	**V/I Converters 1(2)PM-4044-3**	**Switchover & Trip / Alarm Bistable Units**	
			1(2)PC-4044-LL (Switchover / Trip)	**1(2)PC-4044-L (Alarm)**
± 0.04 mAdc	± 0.050 Vdc	± 0.08 mAdc	± 0.020 Vdc	± 0.03 mAdc

Basis: These As-Left setting tolerance values have historically provided acceptable instrument performance and consistency in the calibration program for similar instruments installed throughout the plant. These values are routinely achievable for the installed instruments, and are consistent with safety limits and test equipment capability. They are currently used in practice at the station, and implemented by calibration procedures P.1 – P.4. As-Found setting tolerances are to be determined in this calculation (see Section 8.5).

5.1.5 It is assumed that documents P.1, P.2, P.3, P.4, D.2, D.3, D.4 and all impacted equipment will be modified to incorporate the changes per EC-13407 and minor revisions of this calculation.

Basis: This minor revision creates an imposed condition for EC 13407 to install the pressure transmitters 1PT-4044A and 2PT-4044A which will function as the switchover/pump trip/alarm pressure transmitters. The transmitters installed by EC 13407 replace the pump trip and alarm functionality of existing transmitters (1PT-4044 and 2PT-4044) ranged from 0 - 100 psig with transmitters ranged from 0-30 psig to recapture uncertainty in order to provide the required CST level and have significant margin in the water volume. The existing transmitters 1PT-4044 and 2PT-4044 are required to provide indication. The results of this calculation are only valid upon installation of the steam driven pump suction pressure instrumentation according to the changes documented in EC 13407 and this minor revision.

5.2 Unvalidated Assumptions

5.2.1 This calculation creates an imposed condition requiring transmitters 1PT-4044A and 2PT-4044A to be installed at an elevation 12.08' or higher and orientation such that the Analytical Limit calculated in Section 6.6 is conservative and remains valid.

6.0 DESIGN INPUTS

6.1 Loop Definitions

The AFP Suction Pressure Instrumentation Loops that are analyzed in this calculation are shown in block diagram format in the figures (below), and are explained in more detail in Sections 6.2 and 6.3.

6.2 Loop Block Diagram

The block diagram below (Fig. 6.2-1) shows the component configuration for the AF loops addressed in this calculation. The block diagram below (Fig. 6.2-2) shows the component configuration for the AF loops in the previous revisions of this calculation.

Although not addressed in this calculation, the time delay relay that succeeds the SW switchover suction pressure bistable in each loop is shown for completeness (these time delay relays are addressed in 97-0211, "AFW Pump Low Suction Pressure Trip Time Delay Relay Uncertainty Calculation"). Other parallel instrumentation legs fed by the pressure transmitters (e.g. control board indication and PPCS input) are not shown, as they are not involved in the Low Suction Pressure Switchover/Alarm/Trip functions addressed in this calculation.

Figure 6.2-1
Steam Driven AF Pump Low Suction Pressure Instrumentation Post EC 13407

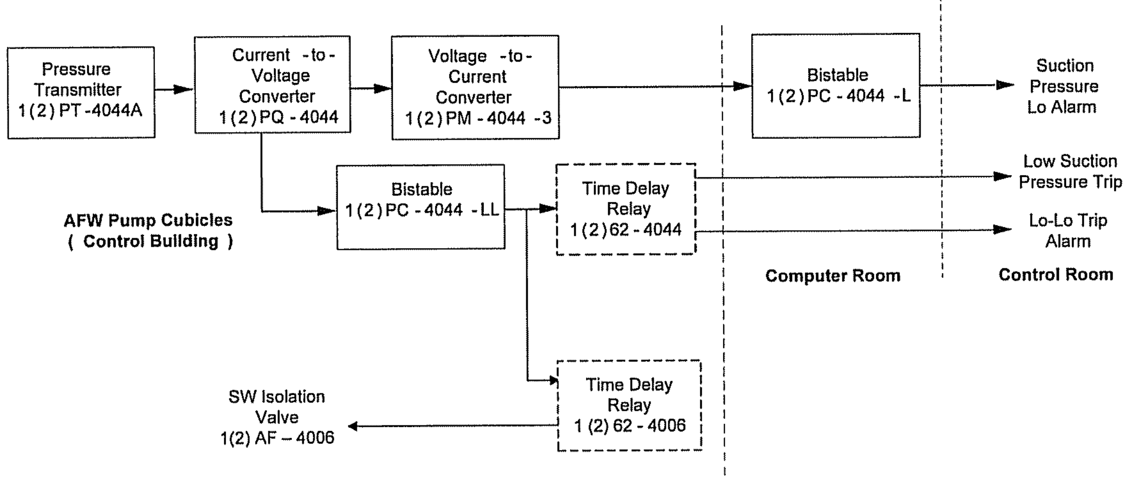
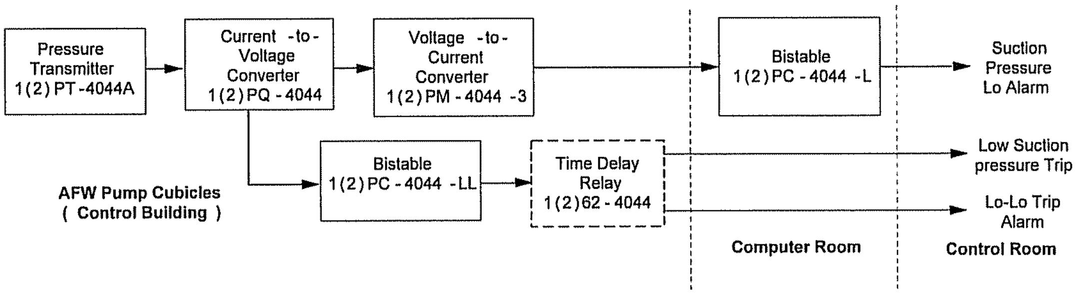


Figure 6.2-2
Steam Driven AF Pump Low Suction Pressure Instrumentation Prior to EC 13407



6.3 Component Models and Tag Numbers

The following table identifies each component shown in Figures 6.2-1 for the AFW Pump Low Suction Pressure Switchover/Trip instrument loops, and provides the associated equipment information for use throughout this calculation.

Table 6.3-1: Steam Driven AF Pump Suction Pressure Instrumentation

Component	Model	Equipment Tag Number	Reference(s)
Transmitter	Rosemount 3051NG3A02A1JH2B2	1(2)PT-4044A	V.7, D.3, D.4
Loop Power Supply / Current-to-Voltage Converter	Foxboro N-2AI-I2V	1(2)PQ-4044	D.3, D.4
Voltage-to-Current Converter	Foxboro N-2AO-VAI	1(2)PM-4044-3	D.3, D.4
Bistable Units	Foxboro N-2AP+ALM-AR	1(2)PC-4044-L	D.3, D.4
		1(2)PC-4044-LL	

6.4 Transmitter Operating Spans

The calibrated transmitter range is 0 - 30 psig (Sections 5.1.5 and 9.4.6). The output is a 4-20 mAdc signal (References P.1 and P.2). The Upper Range Limit (URL) is 1000 inH2O (Ref. V.7). The conversion factor from psig to inH2O is determined at 68 °F and 14.7 psia. This is consistent with the standard temperature and pressure used for calibration. Converting the URL from inH2O to psig:

Where 1 psig = 27.729 inH2O

URL = 1000 inH2O * (1 psig / 27.729 inH2O)

URL = 36.063 psig

6.5 Environmental Considerations

Per Ref. G.9, the AF Pump Suction Pressure Trip instrumentation loops are required to trip the corresponding AF Pump when suction pressure is inadequate. This is a pump protection feature used to control switchover from the normal AFP Supply (Condensate Storage Tank) to the alternative supply (Service Water). This function is safety related. The associated Low Suction Pressure Alarm function is not safety related. However, this calculation conservatively treats this function as safety related also.

6.5.1 Control Building (Auxiliary Feed Pump Room)

As shown in Figure 6.2-1 (and per References P.1 – P.4), the Steam Driven Pump Suction Pressure transmitters and rack components (except for 1(2)PC-4044-L) are located in the AF Pump Cubicles in the Control Building.

<u>Accident Conditions</u>

The minimum design temperature for the Auxiliary Building HVAC system (per Section 3.9.h of Ref. G.2) is 60 °F during winter. Therefore, per Assumption 5.1.1, 60 °F is taken as the minimum temperature for the Control Building Aux. Feed Pump Cubicle area.

Per Assumption 5.1.2, accident conditions in the Aux. Feed Pump Cubicle area will not exceed a temperature range of 120 °F, and a maximum relative humidity of 95%. Therefore, a maximum temperature of 120 °F and a maximum humidity of 95% are used for accident environmental conditions in this area.

While the Aux. Feed Pump Cubicle area is subject to the accident conditions described in the previous paragraph, these accident conditions do not include elevated radiation levels, as this area is not part of the Radiologically Controlled Area (RCA) at the station. Therefore, the 40-Year Dose of less than 400 RADs - taken for Normal Conditions - is also applicable to accident environmental conditions for the Aux. Feed Pump Cubicle area.

Table 6.5-1: Aux. Feed Pump Cubicle Area Environmental Conditions

Conditions	Minimum Temp. (°F)	Maximum Temperature (°F)	Humidity (%)	Radiation (RADs)
Accident	60	120	95	Less than 400 (40-year dose)

6.5.2 Main Control Room /Computer Room

The AFP Suction Pressure Instrument rack components for the Low Pressure Alarm Bistable (1(2)PC-4044-L) for the Steam Driven Pumps is located in the Computer Room (Per References P.3 – P.4).

The Control Room HVAC System controls the temperature of the Control Room and the Computer Room at 75 °F per Ref. G.2. Per Reference G.4, the temperature can vary +/-10 °F, resulting in a minimum temperature of 65 °F. This temperature variation is supported by the fact that the Johnson Controls T-4002-202 thermostat (Ref. D.7) in the Control Room is capable of controlling the room temperature (Ref. V.5) within these bounds. In accordance with Section 3.3.4.7 of Reference G.1, a minimum temperature of 65 °F is chosen for the components in the Main Control Room and Computer Room.

Per Assumption 5.1.3, a maximum Control Room /Computer Room temperature of 120 °F is chosen for the subject instrument loops. This maximum temperature corresponds to environmental conditions associated with a loss of the Control Room HVAC cooling unit. The choice of this maximum temperature is justified by the intended function of the AF Pump Suction Pressure Switchover/Trip (i.e. this function is safety related, and is required to operate correctly under compromised environmental conditions caused by a loss of the HVAC cooling unit).

The Control Room humidity of 95 % (95% R.H. due to loss of HVAC chiller) is documented in Table 6-1 of Ref. G.3.

FSAR Section 11.6.2 (fifth paragraph) (Ref. G.4) states that the Control Room is in Zone I and Table 11.6-1 states the maximum dose rate in Zone I is 1.0 mrem/hr.

Table 6.5-2: Control Room Environmental Conditions

Safety Related	Min. Temperature (°F)	Max. Temperature (°F)	Humidity (%)	Radiation (mrem/hr)
	65	120	95	1.0

6.6 Analytical Limit

The elevation in the Auxiliary Feedwater (AF) pump suction pipe at which the low suction pressure alarm /switchover/trip initiation will occur, i.e., actuation of the Time Delay Relay (see Calculation 97-0211) can be determined by the following equation:

EL Trip = (P Trip * CF) + EL PT

where:

EL Trip	= Elevation in the AF pump suction piping where switchover/trip initiation must occur.
P Trip	= Corresponding AF pump low suction switchover/trip initiation pressure.
CF	= Conversion factor from fluid height (ft) to pressure (psig).
EL PT	= Elevation of the AF pump suction pressure transmitters.

The Analytical Limit (AL) is the minimum pressure at which the switchover/trip initiation (actuation of the Time Delay Relay) must occur. This value is also considered P Trip. Therefore, rearranging the above formula to solve for the pressure trip setpoint (P Trip) determines the Analytical Limit:

AL = P Trip = (EL Trip – EL PT) / CF; where $CF = v_{(40^\circ F)} \cdot \frac{144\text{in.}^2}{\text{ft}^2}$

Note: The conversion factor (CF) from fluid height to pressure is determined at 40 °F and 14.696 psia. This will result in the most conservative (higher) trip pressure setpoint (Reference G.7).

The AF Pump low suction pressure switchover/trip performs two functions:

1) To protect the pump from low NPSH conditions, and
2) To protect the pump from a loss of suction.

Calculation 2003-0062 (Reference C.2) determines that the lowest possible water level (NPSH) for the AF system is El. 19.8 feet. This height can be considered as the elevation at which the pump protection trip must occur, or EL Trip, to protect the pump from low NPSH conditions.

Calculation 97-0172 (Reference C.1) determines that, in the case of a seismic or tornado induced failure of the suction pipe, a minimum volume of 512 gallons in the protected piping (corresponding to El. 24.17 feet) is available to maintain protection to the AF pumps. This elevation in the AF piping is selected as the point where the switchover/trip initiation must occur. The minimum volume in the protected piping corresponding to EL 24.17 ft is used as an input to Calculation 97-0215 for ensuring that sufficient water (including water pumped during the associated switchover and trip time delays) is available to supply the AFPs until they automatically switchover/trip, thus preventing damage to the pump (See Section 10.0).

The bounding analytical limit for the pump suction switchover/trip initiation is:

EL Trip = 24.17 ft

Per Reference G.6:

EL 1PT 4044 = 12.08 ft.
EL 2PT 4044 = 12.46 ft.

Note: Because the elevation of the pressure transmitter (EL PT) is subtracted from the elevation of the switchover/trip (EL Trip), and instrument loop instantiates action on decreasing signal (pressure),selecting the lowest elevation will result in a larger difference in height, thus generating a larger pressure value thereby ensuring a more conservative value . Therefore, the Analytical Limit is calculated only for the height of 12.08 ft. The generated value is conservatively utilized for all transmitters. Also, friction drop associated with the Analytical Limit creates a conservative (early) switchover/trip initiation and is therefore ignored in this calculation.

Substituting from above:

P Trip = (EL Trip – EL PT) / CF; $CF = 0.016019\,ft^3/lb \cdot \frac{144 in^2}{ft^2}$ (Reference G.7)

P Trip = (24.17 ft – 12.08 ft) / (CF); $CF = 2.30674\ ft \cdot in^2/lb$

P Trip = (12.09 ft) / (2.30674 ft/psig) CF = 2.30674 ft/psig

P Trip = 5.241 psig

From above, P Trip is equal to the Analytical Limit. Therefore:

AL = 5.241 psig

7.0 METHODOLOGY

7.1 Uncertainty Determination

The uncertainties and loop errors are calculated in accordance with Point Beach Nuclear Plant's Instrument Setpoint Methodology, DG-I01 (Ref. G.1). This methodology uses the square root of the sum of the squares (SRSS) method to combine random and independent errors, and algebraic addition of non-random or bias errors. Clarifications to this methodology are noted below:

A) Treatment of 95/95 and 75/75 Values

The use of 95/95 values versus 75/75 values is dependent upon the instrument loop's "category" as defined by Section 3.1 of Ref. G.1. Per Section 3.1 of Reference G.1, the devices evaluated in this calculation are classified as Category A - "RPS / ESF Technical Specification Setpoint Instrument loops and RG 1. 97 Type A". This classification corresponds to a loop uncertainty expressed as a 95/95 value (95% probability at a 95% confidence level).

Based on the Category A classification (and based on the significance of the suction pressure switchover/trip function), the total loop uncertainty will be reported as a 95/95 value.

B) Treatment of Significant Digits and Rounding

This uncertainty calculation will adhere to the rules given below for the treatment of numerical results.

1. For values less than 10^2, the rounding of discrete calculated instrument uncertainties (e.g. reference accuracy, temperature effect, etc.) should be performed such that the numerical value is restricted to three (3) or less digits shown to the right of the decimal point.

   For example, an uncertainty calculated as 0.6847661 should be listed (and carried through the remainder of the calculation) as 0.685.

   An uncertainty calculated as 53.235487 should be listed (and carried through the remainder of the calculation) as 53.235.

2. For values less than 10^3, but greater than or equal to 10^2, the rounding of discrete calculated instrument uncertainties (e.g. reference accuracy, temperature effect, etc.) should be performed such that the numerical value is restricted to two (2) or less digits shown to the right of the decimal point.

   For example, an uncertainty calculated as 131.6539 should be listed (and carried through the remainder of the calculation) as 131.65.

3. For values greater than or equal to 10^3, the rounding of discrete calculated instrument uncertainties (e.g. reference accuracy, temperature effect, etc.) should be performed such that the numerical value is restricted to one (1) or less digits shown to the right of the decimal point.

   For example, an uncertainty calculated as 2251.4533 should be listed (and carried through the remainder of the calculation) as 2251.5.

4. For Total Loop Uncertainties, the calculated result should be rounded to the numerical precision that is readable on the associated loop indication or recorder. If the loop of interest does not have an indicator, the Total Loop Error should be rounded to the numerical precision currently used in the associated calibration procedure for the end device in that loop (e.g. trip unit or alarm unit).

5. For calibration tolerances, the calculated result should be rounded to the numerical precision currently used in the associated calibration procedure.

   These rules are intended to preserve a value's accuracy, while minimizing the retention of insignificant or meaningless digits. In all cases, the calculation preparer shall exercise judgment when rounding and carrying numerical values, to ensure that the values are kept practical with respect to the application of interest.

C) Seismic Considerations (Seismic versus Harsh Environment)

Per Reference C.1, the AF Pump Suction Pressure Transmitters are designed to detect a loss of pump supply water source due to a piping failure, caused by a seismic or tornadic event. Therefore, this calculation considers seismic plant conditions.

Per Reference G.1, Section 3.3.3.10, harsh environments associated with accident / post-accident conditions are not considered coincident to a seismic or tornado event. However, in the case of the AF Pump Suction Pressure Instrument loop, a pump trip protects a safety-related function from a non-safety related piping failure. Since the non-safety related section of AF piping cannot be relied upon to function in the event of an accident, it is reasonable to consider a non-safety related piping failure during or after an accident.

Therefore, this calculation takes exception to Section 3.3.3.10 of Reference G.1 and considers harsh environmental conditions coincidental to a seismic or tornado event.

7.1.1 Sources of Uncertainty

Per Reference G.1, the device uncertainties to be considered for accident and adverse (seismic event) environmental conditions include the following:

Sensor Accuracy	(Sa)
Sensor Drift	(Sd)
Sensor M&TE	(Sm)
Sensor Setting Tolerance	(Sv)
Sensor Power Supply Effect	(Sp)
Sensor Temperature Effect	(St)
Sensor Humidity Effect	(Sh)
Sensor Radiation Effect	(Sr)
Sensor Seismic Effect	(Ss)
Sensor Static Pressure Effect	(Sspe)
Sensor Overpressure Effect	(Sope)
Current-to-Voltage Converter Accuracy	(IVa)
Current-to-Voltage Converter Drift	(IVd)
Current-to-Voltage Converter M&TE	(IVm)
Current-to-Voltage Converter Setting Tolerance	(IVv)
Current-to-Voltage Converter Power Supply Effect	(IVp)
Current-to-Voltage Converter Temperature Effect	(IVt)
Current-to-Voltage Converter Humidity Effect	(IVh)
Current-to-Voltage Converter Radiation Effect	(IVr)
Current-to-Voltage Converter Seismic Effect	(IVs)
Voltage-to-Current Converter Accuracy	(VIa)
Voltage-to-Current Converter Drift	(VId)
Voltage-to-Current Converter M&TE	(VIm)
Voltage-to-Current Converter Setting Tolerance	(VIv)
Voltage-to-Current Converter Power Supply Effect	(VIp)
Voltage-to-Current Converter Temperature Effect	(VIt)
Voltage-to-Current Converter Humidity Effect	(VIh)
Voltage-to-Current Converter Radiation Effect	(VIr)
Voltage-to-Current Converter Seismic Effect	(VIs)
Bistable Accuracy	(Ba)
Bistable Drift	(Bd)
Bistable M&TE	(Bm)
Bistable Setting Tolerance	(Bv)
Bistable Power Supply Effect	(Bp)
Bistable Temperature Effect	(Bt)
Bistable Humidity Effect	(Bh)
Bistable Radiation Effect	(Br)
Bistable Seismic Effect	(Bs)
Process Error	(PE)
Bias Terms	(Bias)

Per Section 3.3.3.13 of Reference G.1, the uncertainties listed above are considered 2 sigma (95% probability/95% confidence) unless otherwise specified.

7.1.2 Total Loop Error Equation Summary (TLE)

The general equation for total instrument loop error is found in Ref. G.1. This methodology uses the square root of the sum of the squares (SRSS) method to combine the applicable random and independent errors, and algebraic addition of non-random or bias errors (of like sign).

7.1.2.1 Steam Driven Pump Switchover/Trip Total Loop Error ($TLE_{SWITCHOVER/TRIP-STEAM}$)

Per Figure 6.2-1, the total loop error for the steam driven pump suction pressure switchover/trip function contains the uncertainties for the Sensor, Current-to-Voltage Converter, and Bistable:

$$TLE_{SWITCHOVER/TRIP-STEAM} = \pm\sqrt{\begin{aligned}&Sa^2 + IVa^2 + Ba^2 + Sd^2 + IVd^2 + Bd^2 + Sm^2 + VIm^2 + Bm^2 + Sv^2\\ &+ VIv^2 + Bv^2 + Sp^2 + IVp^2 + Bp^2 + St^2 + IVt^2 + Bt^2 + Sh^2 + IVh^2\\ &+ Bh^2 + Sr^2 + IVr^2 + Br^2 + Ss^2 + IVs^2 + Bs^2 + Sspe^2 + Sope^2\end{aligned}} \pm Bias$$

7.1.2.2 Steam Driven Pump Alarm Total Loop Error ($TLE_{ALARM-STEAM}$)

Per Figure 6.2-1, the total loop error for the steam driven pump low suction pressure alarm function contains the uncertainties for the Sensor, Current-to-Voltage Converter, Voltage-to-Current Converter, and Bistable:

$$TLE_{ALARM-STEAM} = \pm\sqrt{\begin{aligned}&Sa^2 + IVa^2 + VIa^2 + Ba^2 + Sd^2 + IVd^2 + VId^2 + Bd^2 + Sm^2 + IVm^2\\ &+ VIm^2 + Bm^2 + Sv^2 + IVv^2 + VIv^2 + Bv^2 + Sp^2 + IVp^2 + VIp^2 + Bp^2\\ &+ St^2 + IVt^2 + VIt^2 + Bt^2 + Sh^2 + IVh^2 + VIh^2 + Bh^2 + Sr^2 + IVr^2\\ &+ VIr^2 + Br^2 + Ss^2 + IVs^2 + VIs^2 + Bs^2 + Sspe^2 + Sope^2\end{aligned}} \pm Bias$$

7.2 As-Found Tolerance Equation Summary

As-Found Tolerances are calculated independently for each of the loop components. The equations shown are adapted from Section 3.3.8.6 of Reference G.1 for use in this calculation.

7.2.1 Sensor As-Found Tolerance (SAF)

The acceptable As-Found Tolerance for the Sensor (SAF) is calculated using the following equation:

$$SAF = \pm \sqrt{Sv^2 + Sd^2 + Sm^2}$$

where:

Sv = Sensor Setting Tolerance

Sd = Sensor Drift

Sm = Sensor M&TE error

7.2.2 Current-to-Voltage As-Found Tolerance (IVAF)

The acceptable As-Found Tolerance for the Current-to-Voltage Converter (IVAF) is calculated using the following equation:

$$IVAF = \pm \sqrt{IVv^2 + IVd^2 + IVm^2}$$

where:

IVv = Current-to-Voltage Converter Setting Tolerance

IVd = Current-to-Voltage Converter Drift

IVm = Current-to-Voltage Converter M&TE error

7.2.3 Voltage-to-Current As-Found Tolerance (VIAF)

The acceptable As-Found Tolerance for the Voltage-to-Current Converter (VIAF) is calculated using the following equation:

$$VIAF = \pm \sqrt{VIv^2 + VId^2 + VIm^2}$$

where:

VIv = Voltage-to-Current Converter Setting Tolerance

VId = Voltage-to-Current Converter Drift

VIm = Voltage-to-Current Converter M&TE error

7.2.4 Bistable As-Found Tolerance (BAF)

The acceptable As-Found Tolerance for the Bistable (BAF) is calculated using the following equation:

$$BAF = \pm \sqrt{Bv^2 + Bd^2 + Bm^2}$$

where:

Bv = Bistable Setting Tolerance

Bd = Bistable Drift

Bm = Bistable M&TE error

7.3 As-Left Tolerance Equation Summary

As-Left Tolerances are calculated independently for each of the loop components. The equations shown are adapted from Section 3.3.8.6 of Reference G.1 for use in this calculation.

7.3.1 Sensor As-Left Tolerance (SAL)

The As-Left Tolerance for the Sensor (SAL) is equal to its setting tolerance:

SAL = ± Sv

Where:

Sv = Sensor Setting Tolerance

7.3.2 Current-to-Voltage Converter As-Left Tolerance (IVAL)

The As-Left Tolerance for the Current-to-Voltage Converter (IVAL) is equal to its setting tolerance:

IVAL = ± IVv

Where:

IVv = Current-to-Voltage Converter Setting Tolerance

7.3.3 Voltage-to-Current Converter As-Left Tolerance (VIAL)

The As-Left Tolerance for the Voltage-to-Current Converter (VIAL) is equal to its setting tolerance:

VIAL = ± VIv

Where:

VIv = Voltage-to-Current Converter Setting Tolerance

7.3.4 Bistable As-Left Tolerance (BAL)

The As-Left Tolerance for the Bistable (BAL) is equal to its setting tolerance:

BAL = ± Bv

Where:

Bv = Bistable Setting Tolerance

7.4 Calculated Setpoint (SP) Equation Summary

Per Section 3.3.8.4 of Reference G.1, when a setpoint is approached from one direction and the uncertainties are normally distributed, a reduction factor of 1.645/1.96 = 0.839 may be applied to a 95/95 (95% probability at a 95% confidence level) TLE. The reduction factor should only be applied to the random portion of the TLE that has been statistically derived using the SRSS method. Therefore, this calculation expands upon the methodology of DG-I01 (Reference G.1), and separates the TLE into random and bias terms in order to apply the reduction factor solely to the random portion of the TLE.

For a process increasing toward the analytical limit, the calculated Setpoint is as follows:

$SP\uparrow = AL + [(0.839)^* TLE_{rdm}^{-} + TLE_{bias}^{-}]PS$ (Eq. 7.4-1)

For a process decreasing from normal operation toward the analytical limit, the calculated Limiting Trip Setpoint is determined as follows:

$SP\downarrow = AL + [(0.839)^* TLE_{rdm}^{+} + TLE_{bias}^{+}]PS$ (Eq. 7.4-2)

Using the setpoint acceptance criteria prescribed in Section 2.0 for a decreasing setpoint.

$LTSP \geq SP$

The FTSP including the required margin to protect the LTSP is determined as follows:

$Margin = LTSP - FTSP$ (Eq. 7.4-3)

8.0 BODY OF CALCULATION

8.1 Device Uncertainty Analysis

This section will determine all applicable uncertainties for the devices that comprise the AF Pump Suction Pressure Alarm/ Switchover/Trip functions shown in Figures 6.2-1 and 6.2-2.

Per References P.1 through P.4, all components in the loop are separately calibrated.

8.1.1 Sensor Accuracy (Sa)

Per Reference V.7, the reference accuracy of the transmitter is ± 0.075 % calibrated span from 1:1 to 10:1 Range Down Factor. This includes combined effects of terminal-based linearity, hysteresis and repeatability.

Sa = ± 0.075 % span

8.1.2 Sensor Drift (Sd)

Per Reference V.7, the drift value for the transmitters is ± 0.2 % URL for 30 months. Per References P.1 and P.2 the transmitters are calibrated every 18 months (or 22.5 months based on 25% extension). As such, the vendor specified thirty month drift value bounds the calibration frequency. Per Section 6.4, the calibrated span is 0 – 30 psig and the URL is 36.063 psig. As such, the drift value in terms of span is calculated below.

Sd = (± 0.20 % * URL) / span

Sd =(± 0.20% * 36.063 psig) / 30 psig

Sd = ± 0.240 % span

8.1.3 Sensor M&TE (Sm)

Per References P.1 and P.2, the transmitters are calibrated with the "Fluke Model 45, HP 34401A, or equivalent multimeter approved for current use on a 10.0 – 50 mAdc per ICI 12, Selection of M&TE for Field Calibrations." References P.1 and P.2 do not provide a required tolerance for a pressure tester with a range of 0 – 30 psig. Therefore, the ICI 12 Microsoft Access Data Base has been reviewed for an appropriate device per the requirements of References P.7 and G.1. M&TE uncertainties are calculated separately for the multimeter and pressure tester, and combined to find the total M&TE uncertainty associated with the calibration of the pressure transmitters.

Per References P.1 and P.2, either the Fluke Model 45, HP 34401A or an approved equivalent multimeter shall be used for calibration. Therefore, the uncertainties calculated for the Fluke Model 45 and HP 34401A will envelope the uncertainties of any other multimeter permitted for use under References P.1 and P.2. Per ICI 12 ("Selection of M&TE for Field Calibrations"- Ref. P.7). There are 2 devices suited for use as a pressure tester with a range comparable to the instrument tested.

Per P.7 the accuracy of the Aschcroft and McDaniels gauges are ± 0.25 % Full Scale and ± 0.25 % Full Scale, respectively. Per G.11, the least significant digit of ICTI-621 is 3 digits to the right of the decimal. Therefore, the readability is + 0.001 psig. Per G.1 Section 3.3.4.4, the reading error associated with M&TE that employs an analog (graduated) scale, the associated uncertainty in this reading is ± ¼ of the smallest division. Per G.1 Section 3.3.5.3 is divisions are more closely spaced, ± 50% of the difference between divisions may be more appropriate. Per G.11, the minor division of the McDaniels gauge is 0.1 psig and should be considered closely spaced. Due to the close spacing ± 50% of the difference between divisions will be used to calculate the readability which is conservative, and therefore acceptable.

Per G.1 Section 3.3.4.4 of Reference G.1 based on the practices observed by the station, Calibration Standard Error (RAstd) is considered negligible.

Each of the equipment device uncertainties is calculated below:

Multimeter (Output M&TE):

For the Fluke 45 multimeter (30 mA range, 5 digit display):

RA_{mtc} = uncertainty * maximum reading
RA_{mtc} = ± 0.05 % reading * 20 mAdc
RA_{mtc} = ± 0.01 mAdc

RA_{std} = 0

RD_{mtc} = ± 3 DGTS * 0.001 mAdc
RD_{mtc} = ± 0.003 mAdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mtc} + RA^2{}_{std} + RD^2{}_{mtc}}$$

$$Sm_{MM\text{-}45} = \pm\sqrt{0.01^2 + 0^2 + 0.003^2} = \pm 0.0104 \text{ mAdc}$$

HP 34401A multimeter (6.5 digit display, 100 mAdc range) (Ref. V.6)

RA_{mtc} = ± (0.050 % reading + 0.005 % range)
RA_{mtc} = ± [0.050 % (20 mAdc) + 0.005 % (100 mAdc)]

RA_{mtc} $= \pm 0.015$ mAdc

RA_{std} $= 0$

RD_{mtc} $= \pm 0.0001$ mAdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mtc} + RA^2{}_{std} + RD^2{}_{mtc}}$$

$$Sm_{HP} = \pm\sqrt{0.015^2 + 0^2 + 0.0001^2} = \pm 0.015 \text{ mAdc}$$

The worst case and bounding output M&TE error is $Sm_{HP} = \pm 0.015$ mAdc.

Converting to % span:

Sm_{HP} $= \pm 0.015$ mAdc * (100 % span / 16 mAdc)

Sm_{HP} $= \pm 0.094$ % span

Pressure Testers (Input M&TE):

For the Ashcroft 452074SD02L 30 psig digital gauge

RA_{mtc} = uncertainty * instrument range
RA_{mtc} $= \pm 0.25$ % full scale * 30 psig
RA_{mtc} $= \pm 0.075$ psig

RA_{std} $= 0$

RD_{mtc} $= \pm 0.001$ psig

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$Sm_{PT\text{-}Ashcroft} = \pm\sqrt{0.075^2 + 0^2 + 0.001^2} = \pm 0.075 \text{ psig}$$

For the McDaniels 30 psig gauge

RA_{mtc} = uncertainty * instrument range
RA_{mtc} $= \pm 0.5$ % full scale * 30 psig
RA_{mtc} $= \pm 0.15$ psig

RA_{std} $= 0$

RD_{mte} = ± 50% of the difference between divisions
RD_{mte} = ±0.5*0.1 psig
RD_{mte} = ± 0.05 psig

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$Sm_{PT\text{-}Ashcroft} = \pm\sqrt{0.15^2 + 0^2 + 0.05^2} = \pm 0.158 \text{ psig}$$

The worst case and bounding input M&TE error is $Sm_{MCDaniels}$ = ± 0.158 psig.

Converting to % span:

Sm_{PT} = ± 0.158 psig * (100 % span / 30 psig)

Sm_{PT} = ± 0.527 % span

The total M&TE uncertainty for the calibration of the pressure transmitter is calculated using the multiple M&TE equation given in Section 3.3.4.4 of Reference G.1:

$$Sm = \pm\sqrt{Sm_{HP}^2 + Sm_{PT}^2}$$

$$Sm = \pm\sqrt{0.094^2 + 0.527^2}$$

Sm = ± 0.535 % span

8.1.4 Sensor Setting Tolerance (Sv)

Per Assumption 5.1.4, pressure transmitters 1PT-4044A and 2PT-4044A have a setting tolerance of ± 0.04 mAdc.

<u>For 1(2)PT-4044A</u>:

Sv_{steam} = ± 0.04 mAdc * (100 % span / 16 mAdc)

Sv_{steam} = ± 0.25 % span

8.1.5 Sensor Power Supply Effect (Sp)

Per Reference V.2, the Current-to-Voltage Converters provide +24 Vdc to the transmitters via an internal dc-to-dc converter, which is supplied from the Spec

200 system 30 Vdc nest field bus. The rack power supply is a regulated ± 15 Vdc ± 5% power supply with an output voltage variation of:

(± 5% * 30 Vdc / 100 %) = ± 1.5 Vdc

Per Reference V.7, the transmitter has a power supply effect of less than ± 0.005% span per voltage change.

Sp = ± (0.005 % span / voltage change) * 1.5 Vdc

Sp = ± 0.0075 % span

8.1.6 Sensor Temperature Effect (St)

Per Reference V.7, the transmitter has a temperature effect of ± (0.0125 % URL + 0.0625 % span) from 1:1 to 5:1 per 50 °F (28 °C) ambient temperature change.

Per Section 6.5.1, the temperature range in the Auxiliary Feedwater Pump Cubicles (Control Building) is 60 °F to 120 °F. Therefore, the maximum temperature change for accident conditions is 60 °F.

St = ± [(0.0125 % * (36.063 psig / 30 psig) + (0.0625 %)] * (60 °F / 100 °F)

St = ± 0.047 % span

8.1.7 Sensor Humidity Effect (Sh)

Per Ref. V.7, the Rosemount 3051N will function correctly under 0 % - 100% relative humidity.

Per Section 6.5.1, the humidity in the Auxiliary Feedwater Pump Cubicles (Control Building) is 95%. This humidity is bounded by the humidity range specified by the vendor. Therefore,

Sh = ± 0.0 % span

8.1.8 Sensor Radiation Effect (Sr)

Per Section 6.5.1, the AF Pump Cubicle Area is outside the Radiologically Controlled Area (RCA), and is not subject to high radiation levels during accident conditions. Further, per Section 3.3.3.21 of Ref. G.1, radiation errors are typically small when compared with other instrument uncertainties, and are adjusted out at every instrument calibration. Therefore,

Sr = ± 0.0 % span

8.1.9 Sensor Seismic Effect (Ss)

Per Section 7.1.C, seismic uncertainties must be considered in this calculation. Reference V.7 indicates a seismic effect for the transmitter of ± 0.75 % URL during and ± 0.25 % of the span after seismic event. Per Section 6.4, the transmitter URL is 36.063 psig and the calibrated span is 30 psig. The uncertainty is calculated using the value during a seismic event to achieve a conservative result.

Ss = ± (0.75 % * 36.063 psig) * (100 % span / 30 psig)

Ss = ± 0.902 % span

8.1.10 Sensor Static Pressure Effect (Sspe)

Per Reference G.1, Section 3.3.4.11, static pressure effects due to change in process pressure only apply to differential pressure instruments in direct contact with the process. Therefore,

Sspe = ± 0.0 % span

8.1.11 Sensor Overpressure Effect (Sope)

The normal supply to the AF pumps is the CSTs which are vented tanks (Reference D.1). If the supply is switched to Service Water (due to a seismic event), the suction pressure would be 120 psig (Reference C.3). Per Reference V.7, the overpressure limit is 3626 psig and when exceed will cause a zero shift of ± 0.25 % URL for the Rosemount 3051N range code 3 transmitters. Since the pressure of the normal and alternate AF pump water sources is well below the maximum overpressure rating, the transmitter overpressure effect is considered to be negligible.

Sope = ± 0.0 % span

8.1.12 Current-to-Voltage Converter Accuracy (IVa)

Per Reference V.2, the Current-to-Voltage Converter Accuracy is ± 0.25 % of the output span.

IVa = ± 0.25 % span

8.1.13 Current-to-Voltage Converter Drift (IVd)

Per Reference V.2, the vendor does not specify a drift value for the IV converter. Per Section 3.3.3.15 of Ref. G.1, in the absence of an appropriate drift analysis and when drift is unspecified by the vendor, the instrument's accuracy is used as the instrument drift over the entire calibration period.

IVd **= ± 0.25 % span**

8.1.14 Current-to-Voltage Converter M&TE (IVm)

Per References P.3 through P.4, the Current-to-Voltage Converter is calibrated with a multimeter capable of measuring 0-10 Vdc (output M&TE) and 4-20 mAdc (input M&TE). Therefore, M&TE uncertainties are calculated separately for each of the multimeters, and combined to find the total M&TE uncertainty associated with the calibration of the IV converter.

Per G.1 Section 3.3.4.4 of Reference G.1 based on the practices observed by the station, Calibration Standard Error (RAstd) is considered negligible.

Per ICI 12 ("Selection of M&TE for Field Calibrations"- Ref. P.7), there are 2 devices that meet the required criteria for the output M&TE, and 2 devices that meet the required criteria for the input M&TE. Each of the equipment device uncertainties is calculated below:

Multimeter (Output M&TE):

<u>HP 34401A multimeter (6.5 digit display, 10.0 Vdc range) (Ref. V.6)</u>

RA_{mte} = ± (0.0035 % reading + 0.0005 % range)
RA_{mte} = ± [0.0035 % (10 Vdc) + 0.0005 % (10 Vdc)]
RA_{mte} = ± 0.0004 Vdc

RA_{std} = 0

RD_{mte} = ± 0.00001 Vdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mte} + RA^2{}_{std} + RD^2{}_{mte}}$$

$$IVm_{HP} = \pm\sqrt{0.0004^2 + 0^2 + 0.00001^2} = \pm 0.0004\ \text{Vdc}$$

<u>Fluke 45 multimeter (5 digit display, 10 Vdc range)</u>

RA_{mte} = ± 0.025% reading
RA_{mte} = ± 0.025% reading * 10 Vdc
RA_{mte} = ± 0.0025 Vdc

RA_{std} = 0

RD_{mte} = ± 6 DG * 0.001 Vdc

RD_{mte} $= \pm 0.006$ Vdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mte} + RA^2{}_{std} + RD^2{}_{mte}}$$

$$IVm_{45} = \pm\sqrt{0.0025^2 + 0^2 + 0.006^2} = \pm 0.0065\,\text{Vdc}$$

The worst case and bounding output M&TE error is $IVm_{45} = \pm 0.0065$ Vdc.

Converting to % span:

IVm_{45} $= \pm 0.0065$ Vdc * (100 % span / 10 Vdc)

IVm_{45} $= \pm 0.065$ % span

Multimeter (Input M&TE):

For the Fluke 45 multimeter (30 mA range, 5 digit display):

RA_{mte} = uncertainty * maximum reading
RA_{mte} $= \pm 0.05$ % reading * 20 mAdc
RA_{mte} $= \pm 0.01$ mAdc

RA_{std} $= 0$

RD_{mte} $= \pm 3$ DGTS * 0.001 mAdc
RD_{mte} $= \pm 0.003$ mAdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mte} + RA^2{}_{std} + RD^2{}_{mte}}$$

$$IVm_{45} = \pm\sqrt{0.01^2 + 0^2 + 0.003^2} = \pm 0.0104\text{ mAdc}$$

HP 34401A multimeter (6.5 digit display, 100 mAdc range) (Ref. V.6)

RA_{mte} $= \pm$ (0.050 % reading + 0.005 % range)
RA_{mte} $= \pm$ [0.050 % (20 mAdc) + 0.005 % (100 mAdc)]
RA_{mte} $= \pm 0.015$ mAdc

RA_{std} $= 0$

RD_{mte} $= \pm 0.0001$ mAdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mtc} + RA^2{}_{std} + RD^2{}_{mtc}}$$

$$IVm_{HP} = \pm\sqrt{0.015^2 + 0^2 + 0.0001^2} = \pm 0.015 \text{ mAdc}$$

The worst case and bounding output M&TE error is $IVm_{HP} = \pm 0.015$ mAdc.

Converting to % span:

IVm_{HP} = ± 0.015 mAdc * (100 % span / 16 mAdc)

IVm_{HP} = ± 0.094 % span

The total M&TE uncertainty for the calibration of the current-to-voltage converter is calculated using the multiple M&TE equation given in Section 3.3.4.4 of Reference G.1:

$$IVm = \pm\sqrt{IVm_{45}{}^2 + IVm_{HP}{}^2}$$

$$IVm = \pm\sqrt{0.065^2 + 0.094^2}$$

IVm = ± 0.114 % span

8.1.15 Current-to-Voltage Converter Setting Tolerance (IVv)

Per Assumption 5.1.4 and References P.3 through P.4, the Current-to-Voltage Converter Setting Tolerance is ± 0.05 Vdc.

IVv = calibration tolerance * (100% span / calibrated span)
IVv = ± 0.05 Vdc * (100% span /10 Vdc)

IVv = ± 0.5 % span

8.1.16 Current-to-Voltage Converter Power Supply Effect (IVp)

Per Reference V.2, the Current-to-Voltage Converter has a supply voltage effect of ± 0.2 % of span for a ± 5 % change in input voltage. As noted in Section 8.1.5, a ± 5% Vdc power supply change is considered. Therefore,

IVp = ± 0.2 % span

8.1.17 Current-to-Voltage Converter Temperature Effect (IVt)

Per Reference V.2, the Current-to-Voltage Converter Temperature Effect is ± 0.5 % of output span maximum for a 50 °F change within normal operating limits of 40 °F to 120 °F.

Per Section 6.5.1, the Current-to-Voltage converters employed in the Steam Driven AF Pump Suction Pressure Switchover/Trip/Alarm loops are located in the AF Pump Cubicles (Control Building).

Steam Driven Loop IV Converters (IVt_{steam})

Per Section 6.5.1, the temperature range in the Auxiliary Feedwater Pump Cubicles (Control Building) is 60 °F to 120 °F. Therefore, the maximum temperature change for accident conditions is 60 °F.

$IVt_{steam} = \pm (0.5\ \% * 10\ \text{Vdc}) * (60\ ^\circ\text{F} / 50\ ^\circ\text{F})$
$IVt_{steam} = \pm (0.05\ \text{Vdc}) * (1.2)$
$IVt_{steam} = \pm 0.06\ \text{Vdc}$

Converting to % span:

$IVt_{steam} = \pm 0.06\ \text{Vdc} * (100\ \%\ \text{span} / 10\ \text{Vdc})$

$\mathbf{IVt_{steam} = \pm 0.6\ \%\ span}$

8.1.18 Current-to-Voltage Converter Humidity Effect (IVh)

Per Section 6.5.1, the Current-to-Voltage converters employed in the Steam Driven AF Pump Suction Pressure Switchover/Trip/Alarm loops are located in the AF Pump Cubicles (Control Building).

Per Section 3.3.3.20 of Ref. G.1, humidity effects should be incorporated when provided by the vendor. Otherwise, changes in humidity are assumed to have a negligible effect on the instrument uncertainty.

Per Ref. V.2, the vendor does not specify a humidity effect for the IV converters. Therefore,

IVh = ± 0.0 % span

8.1.19 Current-to-Voltage Converter Radiation Effect (IVr)

Per Section 6.5.1, the Current-to-Voltage converters employed in the Steam Driven AF Pump Suction Pressure Switchover/Trip/Alarm loops are located in the AF Pump Cubicles (Control Building).

<u>Steam Driven Loop IV Converters (IVr_{steam})</u>

Per Section 6.5.1, the radiation level in the Auxiliary Feedwater Pump Cubicles (Control Building) 400 RADs (40 year dose).

Per Section 6.5.1, the AF Pump Cubicle Area is outside the Radiologically Controlled Area (RCA), and is not subject to high radiation levels during accident conditions. Further, per Section 3.3.3.21 of Ref. G.1, radiation errors are typically small when compared with other instrument uncertainties, and are adjusted out at every instrument calibration. Therefore,

$IVr_{steam} = \pm 0.0$ % span

8.1.20 Current-to-Voltage Converter Seismic Effect (IVs)

Per Section 3.3.4.10 of Reference G.1, the effects of seismic or vibration events for non-mechanical instrumentation are considered zero unless vendor or industry experience indicates otherwise.

The vendor does not report a seismic effect for the Current-to-Voltage Converter (Reference V.2). Therefore,

IVs $= \pm 0.0$ % span

8.1.21 Voltage-to-Current Converter Accuracy (VIa)

Per Reference V.3, the Voltage-to-Current Converter Accuracy is ± 0.5 % of output span.

VIa $= \pm 0.5$ % span

8.1.22 Voltage-to-Current Converter Drift (VId)

Per Reference V.3, the vendor does not specify a drift value for the V/I converter. Per Section 3.3.3.15 of Ref. G.1, in the absence of an appropriate drift analysis and when drift is unspecified by the vendor, the instrument's accuracy is used as the instrument drift over the entire calibration period.

VId $= \pm 0.5$ % span

8.1.23 Voltage-to-Current Converter M&TE (VIm)

Per Reference P.3 – P.4, the Voltage-to-Current Converter is calibrated with a multimeter capable of measuring 4-20 mAdc (output M&TE) and 0-10 Vdc (input M&TE). Therefore, M&TE uncertainties are calculated separately for each of the multimeters, and combined to find the total M&TE uncertainty associated with the calibration of the VI converter.

Per G.1 Section 3.3.4.4 of Reference G.1 based on the practices observed by the station, Calibration Standard Error (RAstd) is considered negligible.

Per ICI 12 ("Selection of M&TE for Field Calibrations"- Ref. P.7), there are 2 devices that meet the required criteria for the output M&TE, and 2 devices that meet the required criteria for the input M&TE. Each of the equipment device uncertainties is calculated below:

Multimeter (Output M&TE):

For the Fluke 45 multimeter (30 mA range, 5 digit display):

RA_{mte} = uncertainty * maximum reading
RA_{mte} $= \pm 0.05$ % reading * 20 mAdc
RA_{mte} $= \pm 0.01$ mAdc

RA_{std} $= 0$

RD_{mte} $= \pm 3$ DGTS * 0.001 mAdc
RD_{mte} $= \pm 0.003$ mAdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mte} + RA^2{}_{std} + RD^2{}_{mte}}$$

$$VIm_{MM\text{-}45} = \pm\sqrt{0.01^2 + 0^2 + 0.003^2} = \pm 0.0104 \text{ mAdc}$$

HP 34401A multimeter (6.5 digit display, 100 mAdc range) (Ref. V.6)

RA_{mte} $= \pm$ (0.050 % reading + 0.005 % range)
RA_{mte} $= \pm$ [0.050 % (20 mAdc) + 0.005 % (100 mAdc)]
RA_{mte} $= \pm 0.015$ mAdc

RA_{std} $= 0$

RD_{mte} $= \pm 0.0001$ mAdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mte} + RA^2{}_{std} + RD^2{}_{mte}}$$

$$VIm_{HP} = \pm\sqrt{0.015^2 + 0^2 + 0.0001^2} = \pm 0.015 \text{ mAdc}$$

The worst case and bounding output M&TE error is VIm_{HP} = ±0.015 mAdc.

Converting to % span:

VIm_{HP} = ± 0.015 mAdc * (100 % span / 16 mAdc)

VIm_{HP} = ± 0.094 % span

Multimeter (Input M&TE):

<u>HP 34401A multimeter (6.5 digit display, 10.0 Vdc range) (Ref. V.6)</u>

RA_{mte} = ± (0.0035 % reading + 0.0005 % range)
RA_{mte} = ± [0.0035 % (10 Vdc) + 0.0005 % (10 Vdc)]
RA_{mte} = ± 0.0004 Vdc

RA_{std} = 0

RD_{mte} = ± 0.00001 Vdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mte} + RA^2{}_{std} + RD^2{}_{mte}}$$

$$VIm_{HP} = \pm\sqrt{0.0004^2 + 0^2 + 0.00001^2} = \pm 0.0004 \text{ Vdc}$$

<u>Fluke 45 multimeter (5 digit display, 10 Vdc range)</u>

RA_{mte} = ± 0.025% reading
RA_{mte} = ± 0.025% reading * 10 Vdc
RA_{mte} = ± 0.0025 Vdc

RA_{std} = 0

RD_{mte} = ± 6 DG * 0.001 Vdc
RD_{mte} = ± 0.006 Vdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mte} + RA^2{}_{std} + RD^2{}_{mte}}$$

$$VIm_{45} = \pm\sqrt{0.0025^2 + 0^2 + 0.006^2} = \pm 0.0065 \text{ Vdc}$$

The worst case and bounding input M&TE error is $VIm_{45} = \pm 0.0065$ Vdc.

Converting to % span:

$VIm_{45} = \pm 0.0065$ Vdc * (100 % span / 10 Vdc)

$VIm_{45} = \pm 0.065$ % span

The total M&TE uncertainty for the calibration of the current-to-voltage converter is calculated using the multiple M&TE equation given in Section 3.3.4.4 of Reference G.1:

$$VIm = \pm\sqrt{VIm_{45}^2 + VIm_{HP}^2}$$

$$VIm = \pm\sqrt{0.065^2 + 0.094^2}$$

$VIm = \pm 0.114$ % span

8.1.24 Voltage-to-Current Converter Setting Tolerance (VIv)

Per Assumption 5.1.4 and References P.3 – P.4, the Voltage-to-Current Converter Setting Tolerance is ± 0.08 mAdc.

VIv = setting tolerance * (100% span / calibrated span)
VIv = ± 0.08 mAdc * (100% span /16 mAdc)

VIv = ± 0.5 % span

8.1.25 Voltage-to-Current Converter Power Supply Effect (VIp)

Per Reference V.3, the Voltage-to-Current Converter has a supply voltage effect of ± 0.5 % of output span for a ± 5% change in input voltage. As noted in Section 8.1.5, a ± 5% Vdc power supply change is considered. Therefore,

VIp = ± 0.5 % span

8.1.26 Voltage-to-Current Converter Temperature Effect (VIt)

Per Reference V.3, the Voltage-to-Current Converter Temperature Effect is ± 0.5 % of output span maximum for a 50 °F change within normal operating limits of 40 °F to 120 °F.

Per Section 6.5.1, the Voltage-to-Current converters employed in the Steam Driven AF Pump Suction Pressure Switchover/Trip/Alarm loops are located in the AF Pump Cubicles (Control Building).

Per Section 6.5.1, the temperature range in the Auxiliary Feedwater Pump Cubicles (Control Building) is 60 °F to 120 °F. Therefore, the maximum temperature change is 60 °F.

VIt = ± (0.5 % * 16 mAdc) * (60 °F / 50 °F)
VIt = ± (0.08 mAdc) * (1.2)
VIt = ± 0.096 mAdc

Converting to % span:

VIt = ± 0.096 mAdc * (100 % span / 16 mAdc)

VIt = ± 0.6 % span

8.1.27 Voltage-to-Current Converter Humidity Effect (VIh)

Per Section 6.5.1, the Voltage-to-Converter converters employed in the Steam Driven AF Pump Suction Pressure Alarm loop is located in the AF Pump Cubicles (Control Building).

Per Section 3.3.3.20 of Ref. G.1, humidity effects should be incorporated when provided by the vendor. Otherwise, changes in humidity are assumed to have a negligible effect on the instrument uncertainty.

Per Ref. V.3, the vendor does not specify a humidity effect for the VI converters. Therefore,

VIh = ± 0.0 % span

8.1.28 Voltage-to-Current Converter Radiation Effect (VIr)

Per Section 6.5.1, the Voltage-to-Current converters employed in the Steam Driven AF Pump Suction Pressure Alarm loop is located in the AF Pump Cubicles (Control Building).

Per Section 6.5.1, the radiation level in the Auxiliary Feedwater Pump Cubicles (Control Building) is 400 RADs (40 year dose).

Per Section 6.5.1, the AF Pump Cubicle Area is outside the Radiologically Controlled Area (RCA), and is not subject to high radiation levels during accident conditions. Further, per Section 3.3.3.21 of Ref. G.1, radiation errors are typically small when compared with other instrument uncertainties, and are adjusted out at every instrument calibration. Therefore,

VIr = ± 0.0 % span

8.1.29 Voltage-to-Current Converter Seismic Effect (VIs)

Per Section 3.3.4.10 of Reference G.1, the effects of seismic or vibration events for non-mechanical instrumentation are considered zero unless vendor or industry experience indicates otherwise.

The vendor does not report a seismic effect for the Voltage-to-Current Converter (Reference V.3). Therefore,

VIs = ± 0.0 % span

8.1.30 Bistable Accuracy (Ba)

Per Reference V.4, the Bistable has a ± 0.5 % setpoint repeatability.

Ba = ± 0.5 % span

8.1.31 Bistable Drift (Bd)

Per Reference V.4, the vendor does not specify a drift value for the bistable unit. Per Section 3.3.3.15 of Ref. G.1, in the absence of an appropriate drift analysis and when drift is unspecified by the vendor, the instrument's accuracy is used as the instrument drift over the entire calibration period.

Bd = ± 0.5 % span

8.1.32 Bistable M&TE Effect (Bm)

M&TE Effect for 1(2)PC-4044-LL (switchover/trip), PC-4042L/LL, and PC-4043L/LL

Per Reference P.3 through P.4, these bistable units are calibrated by applying a voltage signal into the bistable unit, measuring the input signal via a multimeter capable of measuring 0-10 Vdc, and confirming a relay output on the bistable unit (at the desired setpoint).

Per G.1 Section 3.3.4.4 of Reference G.1 based on the practices observed by the station, Calibration Standard Error (RAstd) is considered negligible.

Per ICI 12 ("Selection of M&TE for Field Calibrations"- Ref. P.7), there are 2 devices that meet the required criteria for the M&TE. Each of the equipment device uncertainties is calculated below:

HP 34401A multimeter (6.5 digit display, 10.0 Vdc range) (Ref. V.6)

RA_{mtc} = ± (0.0035 % reading + 0.0005 % range)
RA_{mtc} = ± [0.0035 % (10 Vdc) + 0.0005 % (10 Vdc)]
RA_{mtc} = ± 0.0004 Vdc

RA_{std} = 0

RD_{mtc} = ± 0.00001 Vdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2_{mtc} + RA^2_{std} + RD^2_{mtc}}$$

$$Bm_{HP} = \pm\sqrt{0.0004^2 + 0^2 + 0.00001^2} = \pm 0.0004 \text{ Vdc}$$

<u>Fluke 45 multimeter (5 digit display, 10 Vdc range)</u>

RA_{mtc} = ± 0.025% reading
RA_{mtc} = ± 0.025% reading * 10 Vdc
RA_{mtc} = ± 0.0025 Vdc

RA_{std} = 0

RD_{mtc} = ± 6 DG * 0.001 Vdc
RD_{mtc} = ± 0.006 Vdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2_{mtc} + RA^2_{std} + RD^2_{mtc}}$$

$$Bm_{45} = \pm\sqrt{0.0025^2 + 0^2 + 0.006^2} = \pm 0.0065 \text{Vdc}$$

The worst case and bounding M&TE error is Bm_{45} = ±0.0065 Vdc.

Converting to % span:

Bm_{45} = ± 0.0065 Vdc * (100 % span / 10 Vdc)

Bm_{45} = ± 0.065 % span

<u>**M&TE Effect for 1(2)PC-4044-L (alarm)**</u>

Per Reference P.3 – P.4, these bistable units are calibrated by injecting a current signal into the bistable unit (over a 500 Ω resistor connected across the calibration point per Ref. D.3 – D.4), measuring the input signal via a multimeter capable of measuring 4-20 mAdc, and confirming a relay output on the bistable unit (at the desired setpoint). This calculation does not consider any uncertainty value associated with the 500 Ω resistor because effects are calibrated out during calibration.

Per G.1 Section 3.3.4.4 of Reference G.1 based on the practices observed by the station, Calibration Standard Error (RAstd) is considered negligible.

Per ICI 12 ("Selection of M&TE for Field Calibrations"- Ref. P.7), there are 2 devices that meet the required criteria for the M&TE. Each of the equipment device uncertainties is calculated below:

For the Fluke 45 multimeter (30 mA range, 5 digit display):

RA_{mtc} = uncertainty * maximum reading
RA_{mtc} $= \pm 0.05$ % reading * 20 mAdc
RA_{mtc} $= \pm 0.01$ mAdc

RA_{std} $= 0$
RD_{mtc} $= \pm 3$ DGTS * 0.001 mAdc
RD_{mtc} $= \pm 0.003$ mAdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mtc} + RA^2{}_{std} + RD^2{}_{mtc}}$$

$$Bm_{45} = \pm\sqrt{0.01^2 + 0^2 + 0.003^2} = \pm 0.0104 \text{ mAdc}$$

HP 34401A multimeter (6.5 digit display, 100 mAdc range) (Ref. V.6)

RA_{mtc} $= \pm$ (0.050 % reading + 0.005 % range)
RA_{mtc} $= \pm$ [0.050 % (20 mAdc) + 0.005 % (100 mAdc)]
RA_{mtc} $= \pm 0.015$ mAdc

RA_{std} $= 0$

RD_{mtc} $= \pm 0.0001$ mAdc

From Section 3.3.4.4 of Reference G.1, M&TE uncertainty is calculated using the following equation:

$$m = \pm\sqrt{RA^2{}_{mtc} + RA^2{}_{std} + RD^2{}_{mtc}}$$

$$Bm_{HP} = \pm\sqrt{0.015^2 + 0^2 + 0.0001^2} = \pm 0.015 \text{ mAdc}$$

The worst case and bounding M&TE error $Bm_{HP} = \pm 0.015$ mAdc.

Converting to % span:

Bm_{HP} = ± 0.015 mAdc * (100 % span / 16 mAdc)

Bm_{HP} = ± 0.094 % span

8.1.33 Bistable Setting Tolerance (Bv)

Per Assumption 5.1.4 and References P.3 and P.4, bistables 1(2)PC-4044-LL (switchover/trip) have a setting tolerance of ± 0.020 Vdc. Note that this bistable is configured for single setpoint action (switchover/trip function).

Per Assumption 5.1.4 and References P.3 and P.4, bistables 1(2)PC-4044-L (alarm) have a setting tolerance of ± 0.03 mAdc (due to a 500 Ω resistor connected across the calibration point per Ref. D.3 – D.4). Note that this bistable is configured for single setpoint action (alarm function).

Steam Driven Loop Bistable (Switchover / Trip) Setting Tolerance ($Bv_{steam-LL}$)

$Bv_{steam-LL}$ = ± 0.020 Vdc * (100 % span / 10 Vdc)

$Bv_{steam-LL}$ = ± 0.2 % span

Steam Driven Loop Bistable (Alarm) Setting Tolerance ($Bv_{steam-L}$)

$Bv_{steam-L}$ = ± 0.03 mAdc * (100 % span / 16 mAdc)

$Bv_{steam-L}$ = ± 0.1875 % span

8.1.34 Bistable Power Supply Effect (Bp)

Per Reference V.4, the Bistable has a power supply effect of ± 0.25 % for a 5 % change in supply voltage. As noted in Section 8.1.5, a ± 5% Vdc power supply change is considered. Therefore,

Bp = ± 0.25 % span

8.1.35 Bistable Temperature Effect (Bt)

Per Reference V.4, the Bistable Unit Temperature Effect is ± 0.5 % of input span maximum for a 50 °F change within normal operating limits of 40 °F to 120 °F.

Per Section 6.5.1, the bistable unit employed in the Steam Driven AF Pump Suction Pressure Switchover / Trip is located in the AF Pump Cubicles (Control

Building). The bistable unit employed in the Steam Driven AF Pump Suction Pressure Alarm is located in the Computer Room.

Switchover/Trip Bistable Temperature Effect ($Bt_{steam-LL}$)

Per Section 6.5.1, the temperatures in the Auxiliary Feedwater Pump Cubicles (Control Building) are range from 60 °F to 120 °F. Therefore, the maximum temperature change is 60 °F.

$Bt_{steam-LL}$ = ± (0.5 % * 10 Vdc) * (60 °F / 50 °F)
$Bt_{steam-LL}$ = ± (0.05 Vdc) * (1.2)
$Bt_{steam-LL}$ = ± 0.06 Vdc

Converting to % span:

$Bt_{steam-LL}$ = ± 0.06 Vdc * (100 % span / 10 Vdc)

$Bt_{steam-LL}$ = ± 0.6 % span

Alarm Bistable Temperature Effect ($Bt_{steam-L}$)

Per Section 6.5.2, the temperatures in the computer room range from 65 °F to 120 °F (due to a loss of the non-safety related HVAC cooling unit). Therefore, the maximum temperature change is 55 °F.

$Bt_{steam-L}$ = ± (0.5 % * 16 mAdc) * (55 °F / 50 °F)
$Bt_{steam-L}$ = ± (0.08 mAdc) * (1.1)
$Bt_{steam-L}$ = ± 0.088 mAdc

Converting to % span:

$Bt_{steam-L}$ = ± 0.088 mAdc * (100 % span / 16 mAdc)

$Bt_{steam-L}$ = ± 0.55 % span

8.1.36 Bistable Humidity Effect (Bh)

Per Section 6.5.1, the bistable units employed in the Steam Driven AF Pump Suction Pressure Switchover/Trip loop is located in the AF Pump Cubicles (Control Building). Per Section 6.5.2, the bistable units employed in the Steam Driven AF Pump Suction Pressure Alarm loop are located in the Computer Room.

Per Section 3.3.3.20 of Ref. G.1, humidity effects should be incorporated when provided by the vendor. Otherwise, changes in humidity are assumed to have a negligible effect on the instrument uncertainty.

Per Ref. V.4, the vendor does not specify a humidity effect for the bistable units.

Bh = ± 0.0 % span

8.1.37 Bistable Radiation Effect (Br)

Per Section 6.5.1, the bistable unit employed in the Steam Driven AF Pump Suction Pressure Switchover/Trip is located in the AF Pump Cubicles (Control Building). The bistable unit employed in the Steam Driven AF Pump Suction Pressure Alarm is located in the Computer Room. Per Sections 6.5.1 and 6.5.2, the AF Pump Cubicles (Control Building) environmental conditions are harsher than in the Computer Room. As such, for simplicity purposes, all Steam Driven AF Pump Suction Bistables are conservatively evaluated under the AF Pump Cubicles (Control Building) environmental conditions.

Steam Driven Loop Bistable Units (Br_{steam})

Per Section 6.5.1, the radiation levels in the Auxiliary Feedwater Pump Cubicles (Control Building) is 400 RADs.

Per Section 6.5.1, the AF Pump Cubicle Area is outside the Radiologically Controlled Area (RCA), and is not subject to high radiation levels during accident conditions. Further, per Section 3.3.3.21 of Ref. G.1, radiation errors are typically small when compared with other instrument uncertainties, and are adjusted out at every instrument calibration. Therefore,

Br_{steam} = ± 0.0 % span

8.1.38 Bistable Seismic Effect (Bs)

Per Section 3.3.4.10 of Reference G.1, the effects of seismic or vibration events for non-mechanical instrumentation are considered zero unless vendor or industry experience indicates otherwise.

The vendor does not report a seismic effect for the bistable units (Reference V.4).

Bs = ± 0.0 % span

8.2 Process Error (PE)

The normal source of the Auxiliary Feedwater Pumps is the Condensate Storage Tanks. As pump suction pressure lowers to a predetermined value, the pressure instrument loops alarm and switchover/trip in order to prevent damage to the AF pumps. Since these pressure sensors (transmitters) are located in a location where environmental conditions, such as temperature, may vary, Process Error must be evaluated.

However, Section 6.6 utilized a temperature of 40 °F to determine the minimum pressure at which a switchover/trip initiation must occur to protect the AF pumps. This temperature is considered conservative because it provides the largest possible density of water in the AF piping, thus providing the highest possible minimum pressure. An increase or decrease in temperature (from 40 °F) will create a lower density of water, causing the transmitter to receive a lower pressure and consequently cause an early switchover/trip initiation. Therefore, process errors, due to changes in temperature, are accounted for in determining the conservative analytical limit (AL) value.

PE = ± 0.0 % span

8.3 Device Uncertainty Summary

8.3.1 Sensor Uncertainties

Parameter	Uncertainty (% span)	Ref. Section
Sensor Accuracy (Sa)	± 0.075 %	8.1.1
Sensor Drift (Sd)	± 0.240%	8.1.2
Sensor M&TE (Sm)	± 0.535 %	8.1.3
Sensor Setting Tolerance (Sv)	= ± 0.25 %	8.1.4
Sensor Power Supply Effect (Sp)	± 0.0075 %	8.1.5
Sensor Temperature Effect (St)	± 0.047 %	8.1.6
Sensor Humidity Effect (Sh)	± 0.0 %	8.1.7
Sensor Radiation Effect (Sr)	± 0.0 %	8.1.8
Sensor Seismic Effect (Ss)	± 0.902 %	8.1.9
Sensor Static Pressure Effect (Sspe)	± 0.0 %	8.1.10
Sensor Overpressure Effect (Sope)	± 0.0 %	8.1.11

8.3.2 Current-to-Voltage Converter Uncertainties

Parameter	Uncertainty (% span)	Ref. Section
Current-to-Voltage Converter Accuracy (IVa)	± 0.25 %	8.1.12
Current-to-Voltage Converter Drift (IVd)	± 0.25 %	8.1.13
Current-to-Voltage Converter M&TE (IVm)	± 0.114 %	8.1.14
Current-to-Voltage Converter Setting Tolerance (IVv)	± 0.5 %	8.1.15
Current-to-Voltage Converter Power Supply Effect (IVp)	± 0.2 %	8.1.16
Current-to-Voltage Converter Temperature Effect (IVt)	= ± 0.6%	8.1.17
Current-to-Voltage Converter Humidity Effect (IVh)	± 0.0 %	8.1.18
Current-to-Voltage Converter Radiation Effect (IVr)	± 0.0 %	8.1.19
Current-to-Voltage Converter Seismic Effect (IVs)	± 0.0 %	8.1.20

8.3.3 Voltage-to-Current Converter Uncertainties

Parameter	Uncertainty (% span)	Ref. Section
Voltage-to-Current Converter Accuracy (VIa)	± 0.5 %	8.1.21
Voltage-to-Current Converter Drift (VId)	± 0.5 %	8.1.22
Voltage-to-Current Converter M&TE (VIm)	± 0.114 %	8.1.23
Voltage-to-Current Converter Setting Tolerance (VIv)	± 0.5 %	8.1.24
Voltage-to-Current Converter Power Supply Effect (VIp)	± 0.5 %	8.1.25
Voltage-to-Current Converter Temperature Effect (VIt)	± 0.6%	8.1.26
Voltage-to-Current Converter Humidity Effect (VIh)	± 0.0 %	8.1.27
Voltage-to-Current Converter Radiation Effect (VIr)	± 0.0 %	8.1.28
Voltage-to-Current Converter Seismic Effect (VIs)	± 0.0 %	8.1.29

8.3.4 Bistable Uncertainties

Parameter	Uncertainty (% span)	Ref. Section
Bistable Accuracy (Ba)	± 0.5 %	8.1.30
Bistable Drift (Bd)	± 0.5 %	8.1.31
Bistable M&TE (Bm)	Bm_{45} = ± 0.065 % Bm_{HP} = ± 0.094 %	8.1.32
Bistable Setting Tolerance (Bv)	$Bv_{steam\text{-}LL}$ = ± 0.2 % $Bv_{steam\text{-}L}$ = ± 0.1875 %	8.1.33
Bistable Power Supply Effect (Bp)	± 0.25 %	8.1.34
Bistable Temperature Effect (Bt)	$Bt_{steam\text{-}LL}$ = ± 0.6 % $Bt_{steam\text{-}L}$ = ± 0.55%	8.1.35
Bistable Humidity Effect (Bh)	± 0.0 %	8.1.36
Bistable Radiation Effect (Br)	± 0.0 %	8.1.37
Bistable Seismic Effect (Bs)	± 0.0 %	8.1.38

8.3.5 Process Considerations and Bias Terms

Parameter	Uncertainty (% span)	Ref. Section
Process Error (PE)	± 0.0 %	8.2
Bias Terms (Bias)	± 0.0 %	8.1.1 – 8.1.38

8.4 Total Loop Error

Per Section 7.1.2, the Total Loop Error is determined as follows:

8.4.1 Steam Driven Pump Switchover/Trip Total Loop Error ($TLE_{SWITCHOVER/TRIP-STEAM}$)

Per Section 7.1.2.1, the AFP Low Suction Pressure Switchover/Trip Function for the steam driven pumps (1P-29 and 2P-29) contains uncertainties from the Sensor, Current-to-Voltage Converter and Bistable.

The TLE Equation from Section 7.1.2.1 is adapted for the specific instrument uncertainties and shown below:

$$TLE_{SWITCHOVER/TRIP-STEAM} = \pm\sqrt{\begin{array}{l} Sa^2 + IVa^2 + Ba^2 + Sd^2 + IVd^2 + Bd^2 + Sm^2 + IVm^2 + Bm_{45}{}^2 + Sv_{steam}{}^2 \\ + IVv^2 + Bv_{steam\text{-}LL}{}^2 + Sp^2 + IVp^2 + Bp^2 + St^2 + IVt_{steam}{}^2 + Bt_{steam\text{-}LL}{}^2 + Sh^2 \\ + IVh^2 + Bh^2 + Sr^2 + IVr^2 + Br^2 + Ss^2 + IVs^2 + Bs^2 + Sspe^2 + Sope^2 \end{array}} \pm Bias$$

Substituting from the uncertainty tables in Sections 8.3.1, 8.3.2, 8.3.4 and 8.3.5, the Allowances are calculated as follows:

$$TLE_{SWITCHOVER/TRIP-STEAM} = \pm\sqrt{\begin{array}{l} 0.075^2 + 0.25^2 + 0.5^2 + 0.240^2 + 0.25^2 + 0.5^2 + 0.535^2 + 0.114^2 + 0.065^2 + 0.25^2 \\ + 0.5^2 + 0.2^2 + 0.0075^2 + 0.2^2 + 0.25^2 + 0.047^2 + 0.6^2 + 0.6^2 + 0.0^2 \\ + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.902^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 \end{array}} \pm 0.0$$

$TLE_{SWITCHOVER/TRIP-STEAM}$ $= \pm$ 1.727% span

Per Section 7.4, a reduction factor of (1.645 / 1.96) is utilized when calculating setpoints approached from a single direction. Therefore,

$TLE_{SWITCHOVER/TRIP-STEAM}$ $= \pm$ 1.727 % * (1.645 / 1.96)

TLE $_{SWITCHOVER/TRIP-STEAM}$ **= ± 1.450 % span** *
(30 psig / 100 % span)

TLE $_{SWITCHOVER/TRIP-STEAM}$ **= ± 0.435 psig**

8.4.2 Steam Driven Pump Alarm Total Loop Error ($TLE_{ALARM\text{-}STEAM}$)

Per Section 7.1.2.2, the AFP Low Suction Pressure Alarm Function for the steam driven pumps (1P-29 and 2P-29) contains uncertainties from the Sensor, Current-to-Voltage Converter, Voltage-to-Current Converter and the Bistable.

The TLE Equation from Section 7.1.2.2 is adapted for the specific instrument uncertainties and shown below:

$$TLE_{ALARM\text{-}STEAM} = \pm\sqrt{\begin{array}{l} Sa^2 + IVa^2 + VIa^2 + Ba^2 + Sd^2 + IVd^2 + VId^2 + Bd^2 + Sm^2 + IVm^2 \\ + VIm^2 + Bm_{HP}{}^2 + Sv_{steam}{}^2 + IVv^2 + VIv^2 + Bv_{steam\text{-}L}{}^2 + Sp^2 + IVp^2 + VIp^2 \\ + Bp^2 + St^2 + IVt_{steam}{}^2 + VIt^2 + Bt_{steam\text{-}L}{}^2 + Sh^2 + IVh^2 + VIh^2 + Bh^2 \\ + Sr^2 + IVr^2 + VIr^2 + Br^2 + Ss^2 + IVs^2 + VIs^2 + Bs^2 + Sspe^2 + Sope^2 \end{array}} \pm Bias$$

Substituting from the uncertainty tables in Sections 8.3.1 – 8.3.5, the Allowances are calculated as follows:

$$TLE_{ALARM\text{-}STEAM} = \pm\sqrt{\begin{array}{l} 0.075^2 + 0.25^2 + 0.5^2 + 0.5^2 + 0.240^2 + 0.25^2 + 0.5^2 + 0.5^2 + 0.535^2 + 0.114^2 \\ + 0.114^2 + 0.094^2 + 0.25^2 + 0.5^2 + 0.5^2 + 0.1875^2 + 0.0075^2 + 0.2^2 + 0.5^2 \\ + 0.25^2 + 0.047^2 + 0.6^2 + 0.6^2 + 0.55^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 \\ + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.902^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 \end{array}} \pm 0.0$$

$TLE_{ALARM\text{-}STEAM}$ $= \pm 2.073$ % span

Per Section 7.4, a reduction factor of (1.645 / 1.96) is utilized when calculatingsetpoints approached from a single direction. Therefore,

$TLE_{ALARM\text{-}STEAM}$ $= \pm 2.073 * (1.645 / 1.96)$

$TLE_{ALARM\text{-}STEAM}$ **$= \pm$ 1.740 % span** * (30 psig / 100 % span)
$TLE_{ALARM\text{-}STEAM}$ **$= \pm$ 0.522 psig**

8.5 Acceptable As-Found and As-Left Calibration Tolerances

8.5.1 Acceptable As-Found Calibration Tolerances

Per Section 3.3.8.6 of Reference G.1, the As-Found Tolerances are determined using the equations shown in Section 7.2 of this calculation.

Reference P.1 through P.4 shows a separate calibration for the Sensor, Current-to-Voltage Converter, Voltage-to-Current Converter, and Bistable. Therefore, the As-Found Tolerance for each device is calculated independently.

8.5.1.1 Sensor As-Found Tolerance (SAF)

Steam Driven Pump Suction Pressure Transmitter AFT (SAF_{Steam})

The equation from Section 7.2.1 is adapted for the specific instrument uncertainties and shown below:

$$SAF_{Steam} = \pm\sqrt{Sv_{Steam}{}^2 + Sd^2 + Sm^2}$$

where:

Sv_{Steam}	$= \pm\, 0.25$ % span	Section 8.1.4
Sd	$= \pm\, 0.240$ % span	Section 8.1.2
Sm	$= \pm\, 0.535$ % span	Section 8.1.3

$$SAF_{Steam} = \pm\sqrt{0.25^2 + 0.240^2 + 0.535^2}$$

$$SAF_{Steam} = \pm\, 0.6374 \text{ \% span}$$

Converting from % span to mA:

$$SAF_{Steam} = \pm\, 0.6378 \text{ \% span} * (16 \text{ mA} / 100 \text{ \% span})$$

$$\mathbf{SAF_{Steam} = \pm\, 0.10\ mA}$$

The resulting As-Found Tolerance is rounded to the precision of the associated calibration procedure (Ref. P.1 – P.2).

8.5.1.2 Current-to-Voltage Converter As-Found Tolerance (IVAF)

The equation from Section 7.2.2 is adapted for the specific instrument uncertainties and shown below:

$$IVAF = \pm \sqrt{IVv^2 + IVd^2 + IVm^2}$$

where:

$IVv = \pm 0.5$ % span	Section 8.1.15
$IVd = \pm 0.25$ % span	Section 8.1.13
$IVm = \pm 0.114$ % span	Section 8.1.14

$$IVAF = \pm \sqrt{0.5^2 + 0.25^2 + 0.114^2}$$

$IVAF = \pm 0.5705$ % span

Converting from % span to mA:

$IVAF = \pm 0.5705$ % span * (10 Vdc / 100 % span)

IVAF = ± 0.057 Vdc

The resulting As-Found Tolerance is rounded to the precision of the associated calibration procedure (Ref. P.3 – P.4).

8.5.1.3 Voltage-to-Current Converter As-Found Tolerance (VIAF)

The equation from Section 7.2.3 is adapted for the specific instrument uncertainties and shown below:

$$VIAF = \pm \sqrt{VIv^2 + VId^2 + VIm^2}$$

where:

$VIv = \pm 0.5$ % span	Section 8.1.24
$VId = \pm 0.5$ % span	Section 8.1.22
$VIm = \pm 0.114$ % span	Section 8.1.23

$$VIAF = \pm \sqrt{0.5^2 + 0.5^2 + 0.114^2}$$

$VIAF = \pm 0.7162$ % span

Converting from % span to mA:

VIAF = ± 0.7162 % span * (16 mA / 100 % span)

VIAF = ± 0.11 mA

The resulting As-Found Tolerance is rounded to the precision of the associated calibration procedure (Ref. P.3 – P.4).

8.5.1.4 Bistable As-Found Tolerance (BAF)

Steam Driven Pump Suction Pressure Switchover/Trip Bistable AFT ($BAF_{Steam-LL}$)

The equation from Section 7.2.4 is adapted for the specific instrument uncertainties and shown below:

$$BAF_{Steam-LL} = \pm\sqrt{Bv_{Steam-LL}^2 + Bd^2 + Bm_{45}^2}$$

where:

$Bv_{Steam-LL}$	= ± 0.2 % span	Section 8.1.33
Bd	= ± 0.5 % span	Section 8.1.31
Bm_{45}	= ± 0.065 % span	Section 8.1.32

$$BAF_{Steam-LL} = \pm\sqrt{0.2^2 + 0.5^2 + 0.065^2}$$

$$BAF_{Steam-LL} = \pm 0.5424 \text{ \% span}$$

Converting from % span to Vdc:

$BAF_{Steam-LL}$ = ± 0.5424 % span * (10 Vdc / 100 % span)

$BAF_{Steam-LL}$ = ± 0.054 Vdc

The resulting As-Found Tolerance is rounded to the precision of the associated calibration procedure (Ref. P.3 – P.4).

Steam Driven Pump Suction Pressure Alarm Bistable AFT ($BAF_{Steam-L}$)

The equation from Section 7.2.4 is adapted for the specific instrument uncertainties and shown below:

$$BAF_{Steam-L} = \pm \sqrt{Bv_{Steam-L}{}^2 + Bd^2 + Bm_{HP}{}^2}$$

where:

$Bv_{Steam-L}$	$= \pm\, 0.1875$ % span	Section 8.1.33
Bd	$= \pm\, 0.5$ % span	Section 8.1.31
Bm_{HP}	$= \pm\, 0.094$ % span	Section 8.1.32

$$BAF_{Steam-L} = \pm \sqrt{0.1875^2 + 0.5^2 + 0.094^2}$$

$BAF_{Steam-L}$ $= \pm\, 0.5422$ % span

Converting from % span to mAdc:

$BAF_{Steam-L}$ $= \pm\, 0.5422$ % span * (16 mAdc / 100 % span)

$BAF_{Steam-L}$ $= \pm\, 0.08$ mA

The resulting As-Found Tolerance is rounded to the precision of the associated calibration procedure (Ref. P.3 – P.4).

8.5.2 Acceptable As-Left Calibration Tolerances

Per Section 3.3.8.6 of Reference G.1, the As-Left Tolerance is determined using the equations shown in Section 7.3 of this calculation.

Reference P.1 through P.4 shows a separate calibration for the Sensor, Current-to-Voltage Converter, Voltage-to-Current Converter and Bistable. Therefore, the As-Left Tolerance for each device is calculated independently.

8.5.2.1 Sensor As-Left Tolerance (SAL)

Steam Driven Pump Suction Pressure Transmitter ALT (SAL_{Steam})

Using the equation from Section 7.3.1:

$SAL_{Steam} = \pm Sv_{Steam}$

$SAL_{Steam} = \pm 0.25$ %Span Section 8.1.4

Converting from % span to mAdc:

$SAL_{Steam} = \pm 0.25$ % span * (16 mAdc / 100 % span)

$SAL_{Steam} = \pm 0.04$ mAdc

8.5.2.2 Current-to-Voltage Converter As-Left Tolerance (IVAL)

Using the equation from Section 7.3.2:

$IVAL = \pm IVv$

$IVAL = \pm 0.5$% span Section 8.1.15

Converting from % span to Vdc:

$IVAL = \pm 0.5$ % span * (10 Vdc / 100 % span)

$IVAL = \pm 0.050$ Vdc

8.5.2.3 Voltage-to-Current Converter As-Left Tolerance (VIAL)

Using the equation from Section 7.3.3:

$VIAL = \pm VIv$

$VIAL = \pm 0.5$% span Section 8.1.24

Converting from % span to mAdc:

VIAL = ± 0.5 % span * (16 mAdc / 100 % span)

VIAL = ± 0.08 mAdc

8.5.2.4 Bistable As-Left Tolerance (BAL)

Steam Driven Pump Suction Pressure Switchover/Trip Bistable ALT ($BAL_{Steam-LL}$)

Using the equation from Section 7.3.4:

$BAL_{Steam-LL} = \pm Bv_{Steam-LL}$

$BAL_{Steam-LL} = \pm 0.2$ % span   Section 8.1.33

Converting from % span to Vdc:

$BAL_{Steam-LL} = \pm 0.2$ % span * (10 Vdc / 100 % span)

$BAL_{Steam-LL} = \pm 0.020$ Vdc

Steam Driven Pump Suction Pressure Alarm Bistable ALT ($BAL_{Steam-L}$)

Using the equation from Section 7.3.4:

$BAL_{Steam-L} = \pm Bv_{Steam-L}$

$BAL_{Steam-L} = \pm 0.1875$ % span   Section 8.1.33

Converting from % span to mAdc:

$BAL_{Steam-L} = \pm 0.1875$ % span * (16 mAdc / 100 % span)

$BAL_{Steam-L} = \pm 0.03$ mAdc

8.6 Setpoint Evaluation

Per Section 7.4, for a process decreasing from normal operation toward the analytical limit, the calculated limiting trip setpoint is determined as follows:

$SP\downarrow \quad = AL + [(0.839)^* \; TLE_{rdm}{}^{+} + TLE_{bias}{}^{+}]PS$

Per Section 7.4, the LTSP used to determine the margin compared to the existing FTSP as follows:

$$\text{Margin} = \text{LTSP} - \text{FTSP}$$

These equations are used throughout this section for the evaluation of the AFP Suction Pressure Switchover/Trip/Alarm Setpoints.

8.6.1 Steam Driven Pump 1(2)P-29 Low-Low Suction Pressure Switchover/Trip Setpoint

Per Section 6.6, the Analytical Limit for the AF Low Pressure Suction Stitchover/Trip is 5.241 psig. The random component of $TLE_{\text{SWITCHOVER/TRIP-STEAM}}$ was converted (for a single-sided approach) from 1.727 %Span to 1.450 % span in Section 8.4.1.

Substituting:

$SP_{\text{SWITCHOVER/TRIP-Steam}} \quad = 5.241 \text{ psig} + (1.450 \% * 30 \text{ psig})$

$SP_{\text{SWITCHOVER/TRIP-Steam}} \quad = 5.241 \text{ psig} + 0.435 \text{ psig}$

$\mathbf{SP_{\text{SWITCHOVER/TRIP-Steam}} \quad = 5.676 \text{ psig}}$

Using the setpoint acceptance criteria prescribed in Section 2.0 for a decreasing setpoint.

$LTSP \geq SP$

$5.7 \text{ psig} \geq 5.676 \text{ psig}$

The newly recommended limiting trip setpoint of 5.7 psig is acceptable. Therefore,

$\mathbf{LTSP_{\text{SWITCHOVER/TRIP-Steam-new}} = 5.7 \text{ psig}}$

To protect the LTSP the FTSP has been select such that additional margin is provided between LTSP and FTSP. Therefore a value of 6.0 psig has been selected for the FTSP.

$\mathbf{FTSP_{\text{SWITCHOVER/TRIP-Steam-new}} = 6.0 \text{ psig}}$

Per References P.3 and P.4, the existing 1(2)P-29 AF Pump Lo-Lo Suction Pressure Trip Setpoint (FTSP) is 6.6 psig (decreasing). Per Section 2.0, the existing trip setpoint (FTSP) is revised to reflect the lower span of the new switchover/trip loop.

FTSP ≥ SP

The existing Lo-Lo Suction Pressure Trip Setpoint (FTSP) is not acceptable, and will be revised to 6.0 psig.

Again, using the setpoint acceptance criteria prescribed in Section 2.0,

FTSP ≥ SP

6.0 psig ≥ 5.676 psig

Where additional margin is provided to protect the LTSP.

$\text{Margin}_{\text{SWITCHOVER/TRIP-Steam}} = \text{LTSP}_{\text{SWITCHOVER/TRIP-Steam}} - \text{FTSP}_{\text{SWITCHOVER/TRIP-Steam}}$

Substituting:

$\text{Margin}_{\text{SWITCHOVER/TRIP-Steam}} = |\ 5.7\text{ psig} - 6.0\text{ psig}\ |$

$\text{Margin}_{\text{SWITCHOVER/TRIP-Steam}} = 0.3\text{ psig}$

Moreover, margin is required to be provided for Rack Error (RE) for the tested portion of the trip channel during normal operation. This includes the Current-to-Voltage Converter and Bistable As-Found Tolerance. Per Section 8.5.1.2 and 8.5.1.4 the uncertainty associated with the Current-to-Voltage Converter and Switchover/Trip Bistable are used to determine the RE as follows:

$$RE = \pm\sqrt{IVv^2 + IVd^2 + IVm^2 + {Bv_{Steam\text{-}LL}}^2 + Bd^2 + {Bm_{45}}^2}$$

Where:

IVv	= ± 0.5 % span	Section 8.1.15
IVd	= ± 0.25 % span	Section 8.1.13
IVm	= ± 0.114 % span	Section 8.1.14
$Bv_{Steam\text{-}LL}$	= ± 0.2 % span	Section 8.1.33
Bd	= ± 0.5 % span	Section 8.1.31
Bm_{45}	= ± 0.065 % span	Section 8.1.32

$$RE_{as\text{-}found} = \pm\sqrt{0.5^2 + 0.25^2 + 0.114^2 + 0.2^2 + 0.5^2 + 0.065^2}$$

$RE_{as\text{-}found} = \pm\ 0.7872\ \%\text{ span}$

Converting from % span to Vdc:

$RE_{as\text{-}found} = \pm\ 0.7872\ \%\ span * (10\ Vdc / 100\ \%\ span)$
$RE_{as\text{-}found} = \pm\ 0.079\ Vdc$

Converting from % span to psig:

$RE_{as\text{-}found} = \pm\ 0.\ 7872\%\ span * (30\ psig / 100\ \%\ span)$
$RE_{as\text{-}found} =$ **0.236 psig**

The Rack Error (RE) for the Current-to-Voltage Converter and Bistable As-Left Tolerance. Per Section 8.5.2.2 and 8.6.2.4 the uncertainty associated with the Current-to-Voltage Converter and Switchover/Trip Bistable are used to determine the RE as follows:

$$RE = \pm\ \sqrt{IVv^2 + Bv_{Steam\text{-}LL}{}^2}$$

Where:

IVv	$= \pm\ 0.5\ \%$ span	Section 8.1.15
$Bv_{Steam\text{-}LL}$	$= \pm\ 0.2\ \%$ span	Section 8.1.33

$$RE_{as\text{-}left} = \pm\ \sqrt{0.5^2 + 0.2^2}$$

$RE_{as\text{-}left} = \pm\ 0.5385\ \%\ span$

Converting from % span to Vdc:

$RE_{as\text{-}left} = \pm\ 0.5385\ \%\ span * (10\ Vdc / 100\ \%\ span)$
$RE_{as\text{-}left} = \pm$ **0.054 Vdc**

Converting from % span to psig:

$RE_{as\text{-}found} = \pm\ 0.\ 5385\%\ span * (30\ psig / 100\ \%\ span)$
$RE_{as\text{-}found} =$ **0.162 psig**

$Margin_{SWITCHOVER/TRIP\text{-}Steam\ As\text{-}Found}{}^{-} = (LTSP_{SWITCHOVER/TRIP\text{-}Steam} + RE_{as\text{-}found}{}^{+}) - FTSP_{SWITCHOVER/TRIP\text{-}Steam}$

Substituting:

$Margin_{SWITCHOVER/TRIP\text{-}Steam\ As\text{-}Found}{}^{-} = |\ (5.7\ psig + 0.236\ psig) - 6.0\ psig\ |$

$Margin_{SWITCHOVER/TRIP\text{-}Steam\ As\text{-}Found}{}^{-}$ = 0.064 psig

The newly recommended switchover/trip setpoint of 6.0 psig is acceptable. Therefore,

$FTSP_{SWITCHOVER/TRIP\text{-}Steam\text{-}new}$ = 6.0 psig

Converting from psig to Vdc and conservatively rounding up to the precision of the setpoint:

$FTSP_{SWITCHOVER/TRIP\text{-}Steam\text{-}new}$ = 6.0 psig * (10 Vdc / 30 psig)

$FTSP_{SWITCHOVER/TRIP\text{-}Steam\text{-}new}$ = 2.000 Vdc

8.6.2 Steam Driven Pump 1(2)P-29 Low Suction Pressure Alarm Setpoint

Per Section 6.6, the Analytical Limit for the AF Low Pressure Suction Switchover/Trip is 5.241 psig. This analytical limit will also be used to evaluate the Lo Suction Pressure Alarm.

The random component of $TLE_{ALARM\text{-}STEAM}$ was converted (for a single-sided approach) from 2.073 % span to 1.740 % span in Section 8.4.2.

Substituting:

$SP_{ALARM\text{-}Steam}$ = 5.241 psig + (1.740 % * 30 psig)

$SP_{ALARM\text{-}Steam}$ = 5.241 psig + 0.522 psig

$SP_{ALARM\text{-}Steam}$ = 5.763 psig

Per Reference P.3 and P.4, the existing 1(2)P-29 AF Pump Lo Suction Pressure Alarm Setpoint (FTSP) is 7.1 psig (decreasing). Per Section 2.0, the existing alarm setpoint (FTSP) is acceptable if it is:

1) Greater than (or equal to) the setpoint calculated in this section (SP)
2) 0.5 psig above the AFP Low-Low Suction Pressure Switchover/Trip Setpoint.

$FTSP \geq SP$

7.0 psig is greater than or equal to 5.763 psig.

Although the existing FTSP is greater than (or equal to) the setpoint calculated in this section (SP), it is much greater than 0.5 psig above the AFP Low-Low Suction Pressure Switchover/Trip Setpoint (based on the switchover/trip setpoint change prescribed in Section 8.6.1 of this calculation).

As such, the existing alarm setpoint of 7.1 psig will be changed to 6.5 psig to preserve the existing 0.5 psig increment between the switchover/trip and alarm setpoints and meet the alarm setpoint acceptance criteria.

Therefore, the newly recommended Lo Suction Pressure Alarm setpoint is:

$FTSP_{ALARM\text{-}Steam\text{-}new}$ = 6.5 psig

Converting from psig to mAdc and conservatively rounding up to the precision of the setpoint:

$FTSP_{ALARM\text{-}Steam\text{-}new} = 6.5 \text{ psig} * [(20 \text{ mAdc} - 4 \text{ mAdc}) / 30 \text{ psig})] + 4 \text{ mAdc}$

$\mathbf{FTSP_{ALARM\text{-}Steam\text{-}new} = 7.47\ mAdc}$

9.0 RESULTS AND CONCLUSIONS, WITH LIMITATIONS

9.1 Loop Uncertainties

The Seismic loop uncertainties (concurrent with accident environments) for Auxiliary Feedwater Pump Low Suction Pressure are summarized below.

95% / 95% Confidence	Seismic Conditions (concurrent with accident environments)		Reference
	% span	psig	
$TLE_{SWITCHOVER / TRIP-STEAM}$	± 1.450	± 0.435	8.4.1
$TLE_{ALARM-STEAM}$	± 1.740	± 0.522	8.4.2

9.2 Field Switchover/Trip Setpoint (FTSP) and Calculated Switchover/Trip Setpoint (SP)

This calculation has determined that the existing Field Trip Setpoints (FTSP) for Auxiliary Feedwater Low Suction Pressure Alarm and Low-Low Suction Pressure Trip should be revised to meet the setpoint acceptance criteria prescribed in Section 2.0 of this calculation. The setpoint summary is shown in the table below.

Setpoint Function	Calculated SP	Existing FTSP		Newly Recommended FTSP		Reference
1(2)P-29 Steam Driven AFP Low-Low Suction Pressure Switchover/Trip	5.676 psig	6.6 psig	0.660 Vdc	6.0 psig	2.000 Vdc	8.6.1, P.3, P.4
1(2)P-29 Steam Driven AFP Lo Suction Pressure Alarm	5.763psig	7.1 psig	5.14 mAdc	6.5 psig	7.47mAdc	8.6.2, P.3, P.4

9.3 Acceptable As-Left and As-Found Tolerances

This calculation has determined the Acceptable As-Found and As-Left Tolerances for the instruments listed in Section 1.5. The values are rounded to the precision of the calibration procedures. The new As-Found and As-Left Tolerances should be incorporated into the affected calibration procedures identified in Section 10.0.

Refer to Section 8.5.1 for As-Found Tolerances and Section 8.5.2 for As-Left Tolerances.

Table 9.3-1

Steam Driven Pump Suction Pressure Instrumentation As-Left/As-Found Values

	Pressure Transmitters 1(2)PT-4044A	I/V Converters 1(2)PQ-4044	V/I Converters 1(2)PM-4044-3	Switchover/ Trip & Alarm Bistable Units	
				1(2)PC-4044-LL (Switchover/ Trip)	1(2)PC-4044-L (Alarm)
As-Left	± 0.04 mAdc	± 0.050 Vdc	± 0.08 mAdc	± 0.020 Vdc	± 0.03 mAdc
As-Found	±0.10mAdc	± 0.057 Vdc	± 0.11 mAdc	± 0.054 Vdc	± 0.08 mAdc

Table 9.3-2

Steam Driven Pump Suction Pressure Instrumentation Channel Operability Testing Rack Error As-Found Values

	Rack Error – Channel Operability Testing
As-Left	± 0.054 Vdc
As-Found	± 0.079 Vdc

9.4 Limitations

9.4.1 Aux. Feed Pump Cubicle Area Environmental Limitations

The results of this calculation are valid only if the temperature inside of the AFP Cubicle Cabinets (1(2)C-197) does not exceed 120 °F. AR 524983, Action Item #2, (previously CA 028602) has been generated to track this limitation.

9.4.2 Computer Room Temperature Limitations

The results of this calculation are valid only if the temperature inside of the Computer Room instrumentation panels does not exceed 120 °F. GAR 01031656 has been generated to track this limitation.

9.4.3 M&TE Limitations

To preserve the validity of this calculation's results, this calculation requires that all future calibrations of the equipment (addressed in this calculation) be performed using the M&TE mentioned below (or better).

M&TE	Range	Accuracy	Readability	Reference
Fluke 45	0-10 Vdc	0.025 % reading	0.006 Vdc	8.1.14, 8.1.23, 8.1.32
Fluke 45	0-30 mA	0.05 % reading	0.003 mA	8.1.3, 8.1.14, 8.1.23, 8.1.32
HP 34401A	0-10 Vdc	0.0035 % reading + 0.0005 % range	0.00001 Vdc	8.1.14, 8.1.23, 8.1.32
HP 34401A	0-100 mAdc	0.050 % reading + 0.005 % range	0.0001 mAdc	8.1.3, 8.1.14, 8.1.23, 8.1.32
Ashcroft 452074SD02L	30 psig	+0.25 % FS	0.001 psig	8.1.3
McDaniels	30 psig	+0.50 % FS	0.05 psig	8.1.3

9.4.4 Not Used.

9.4.5 Not Used.

9.4.6 Implementation of EC-13407

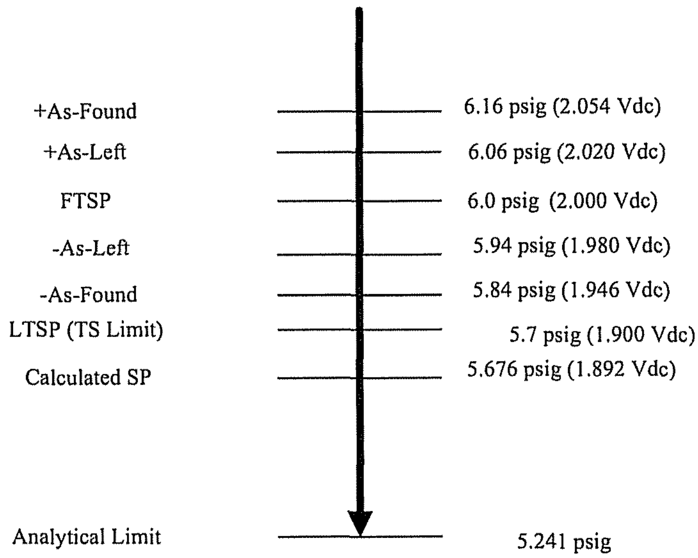
This calculation has an imposed condition requiring documents P.1, P.2, P.3, P.4, D.2, D.3, D.4 and all impacted equipment to be modified to incorporate the changes per EC-13407 and minor revisions of this calculation.

This calculation creates an imposed condition requiring transmitters 1PT-4044A and 2PT-4044A be installed at an elevation 12.08' or higher and orientation such that the Analytical Limit calculated in Section 6.6 is conservative and remains valid.

9.5 Graphical Representation of Revised Setpoints and Tolerances

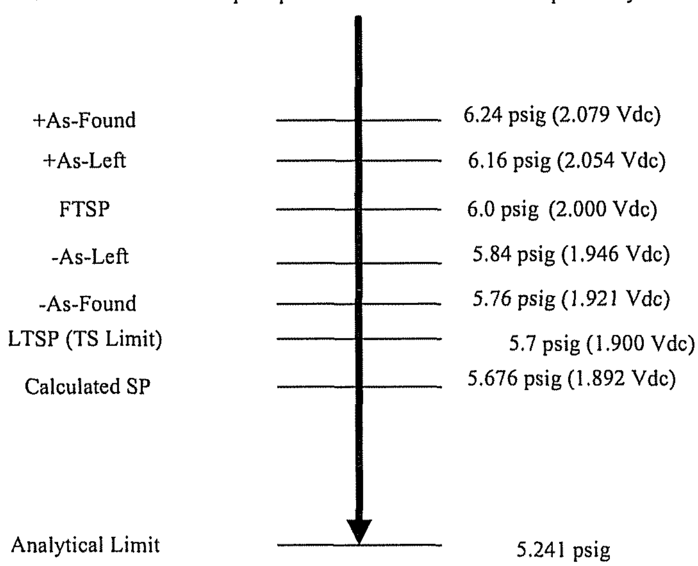
9.5.1 Steam Driven Low-Low Suction Pressure Trip (Bistable Only)

Steam Driven Pump Low-Low Suction Pressure Switchover / Trip Setpoint



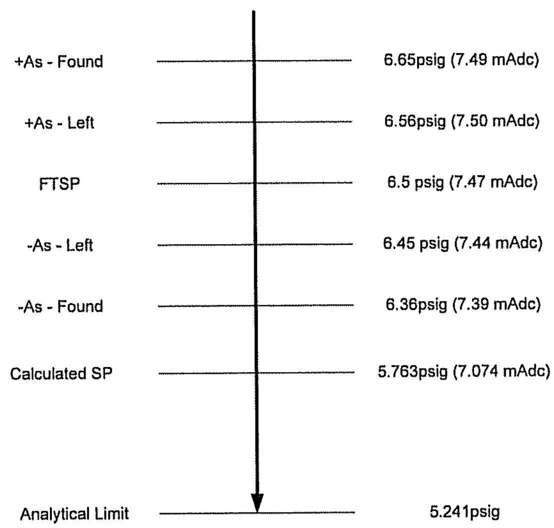
9.5.2 Steam Driven Low-Low Suction Pressure Trip Rack Error – Channel Operability Testing

Steam Driven Pump Low-Low Suction
Pressure Switchover / Trip Setpoint Rack Error – Channel Operability Testing



9.5.3 Steam Driven Low Suction Pressure Alarm

Steam Driven Pump Lo Suction Pressure Alarm Setpoint



9.5.4 Technical Specification Value

The requirement for the Limiting Safety System Setting (LSSS) to be in the Technical Specification is met by specifying a value in the Specifications that is the least conservative value that the LTSP can have during testing along with requiring that the LTSP and methodology for determining the LPST must be in a document controlled under 10 CFR 50.59.

Using the setpoint acceptance criteria prescribed in Section 2.0 for a decreasing setpoint Section 8.6.1 determined the LTSP to be as follows:

$LTSP_{SWITCHOVER/TRIP\text{-}Steam\text{-}new} = 5.7$ psig

The LTSP provided in this calculation is based upon the design of the new unitized Auxiliary Feedwater System to be installed as part of the extended power uprate (EPU) at Point Beach Nuclear Plant Units 1 and 2. The LTST provides the information for Technical Specification Table 3.3.2-1, Engineered Safety Feature Actuation System Instrumentation, .Function Item 6.e for AFW Pump Suction Transfer on Suction Pressure Low. The LSSS for Function 6.e. is proposed to be 5.7 psig.

It is noted that the Technical Specification value is taken based on the LTSP. Exception has been taken to Reference G.1 Section 3.3.8.4.3 which calculates the Allowable Value under Method 3 of ISA 67.04.02 and, as such is not take as the Technical Specifications value.

10.0 IMPACT ON PLANT DOCUMENTS

Note: Passport Engineering Change (EC) Number for Calculation 97-0231 is 14048.

- PBNP-IC-42, Rev. 1, "Condensate Storage Tank Water Level Instrument Loop Uncertainty/ Setpoint Calculation"

  The AFP Pressure Switchover/Trip setpoint per this calculation is input to PBNP-IC-42 for determining the CST water level instrument loop uncertainties and the adequacy of CST water level setpoints.

- 97-0215-002-A, Rev. 5, "Water Volume Swept by all four AFW Pumps following a Seismic /Tornado Event affecting both Units."

  To ensure that this trip initiation provides protection for the AFW pumps, the minimum volume of 512 gallons in the protected piping (corresponding to EL. 24.17 feet) must be used in Calculation 97-0215 for ensuring that sufficient water (including water pumped during the associated trip time delay) is available to supply the AFPs until they automatically trip, thus preventing damage to the pump.

- 1ICP 04.003-5, Rev. 12, "Auxiliary Feedwater Flow and Pressure Instruments Outage Calibration"

  - Revise procedure to include the new pressure transmitter 1PT-4044A.

- 2ICP 04.003-5, Rev. 13, "Auxiliary Feedwater Flow and Pressure Instruments Outage Calibration"

  Revise procedure to include the new pressure transmitter 2PT-4044A.

- 1ICP 04.032-1, Rev. 15, "Auxiliary Feedwater System and Charging Flow Electronic Outage Calibration"

  Revise procedure to include the new pressure transmitter 1PT-4044A. New As-Found Tolerances for the Steam Driven Suction Pressure Rack Components need to be incorporated. New Switchover/Trip and Alarm setpoints for the Suction Pressure Bistable units need to be incorporated.

- 2ICP 04.032-1, Rev. 13, "Auxiliary Feedwater System and Charging Flow Electronic Outage Calibration"

  Revise procedure to include the new pressure transmitter 2PT-4044A. New As-Found Tolerances for the Steam Driven Suction Pressure Rack Components need to be incorporated. New Switchover/Trip and Alarm setpoints for the Suction Pressure Bistable units need to be incorporated.

- STPT 14.11, Rev. 20, "Auxiliary Feedwater"

  New Switchover/Trip and Alarm setpoints for the Suction Pressure Bistable unit need to be incorporated.

11.0 ATTACHMENT LIST

Attachment A (Ref. G.6), Walkdown, Pressure Transmitter Elevation and Pressure Tap Elevation (6 pages).

Attachment B, Instrument Scaling (5 pages).

Attachment C (Ref. G.11), Walkdown, ICTI-621 and ICTI-797 Readability (3 pages)

ATTACHMENT A

PART 1 - WALKDOWN REQUEST FORM

Calculation No. 97-0231

Walkdown Location (Bldg/Elev/Room/Column Lines)
Control Building / Elevation 8' / Auxiliary Feedwater Pump Rooms

Scope
Determine the distance between transmitters PT-4042, PT-4043, 1PT-4044 and 2PT-4044 and their corresponding pipe centerline.

Also, determine the distance between the transmitters listed above and their corresponding pressure tap.

References:

Data Tolerance Requirements

S&L Lead W. Barasa Signature W A Barasa Date 8-10-05

ATTACHMENT A

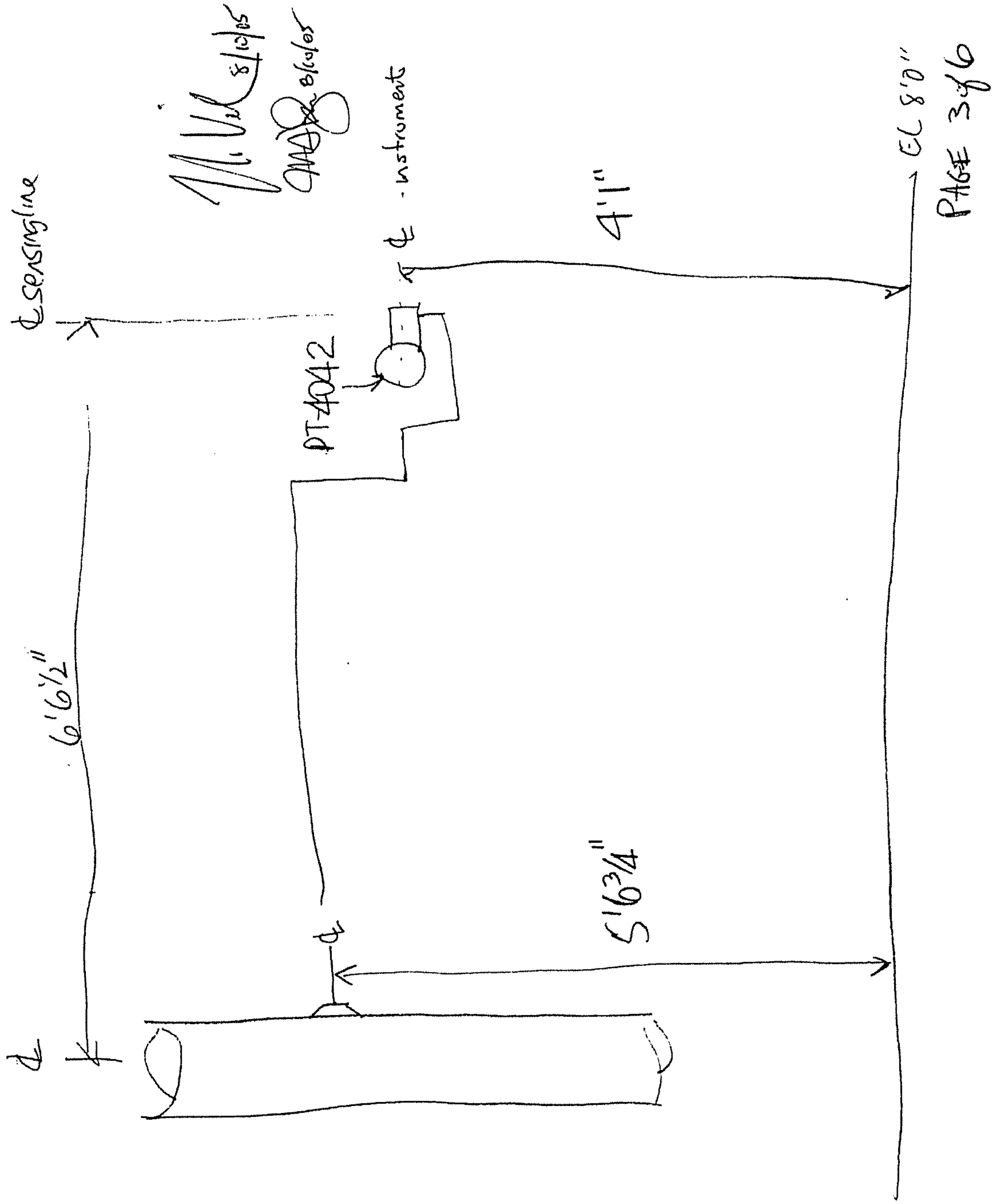
PART 2 - WALKDOWN DATA COLLECTION FORM

Results

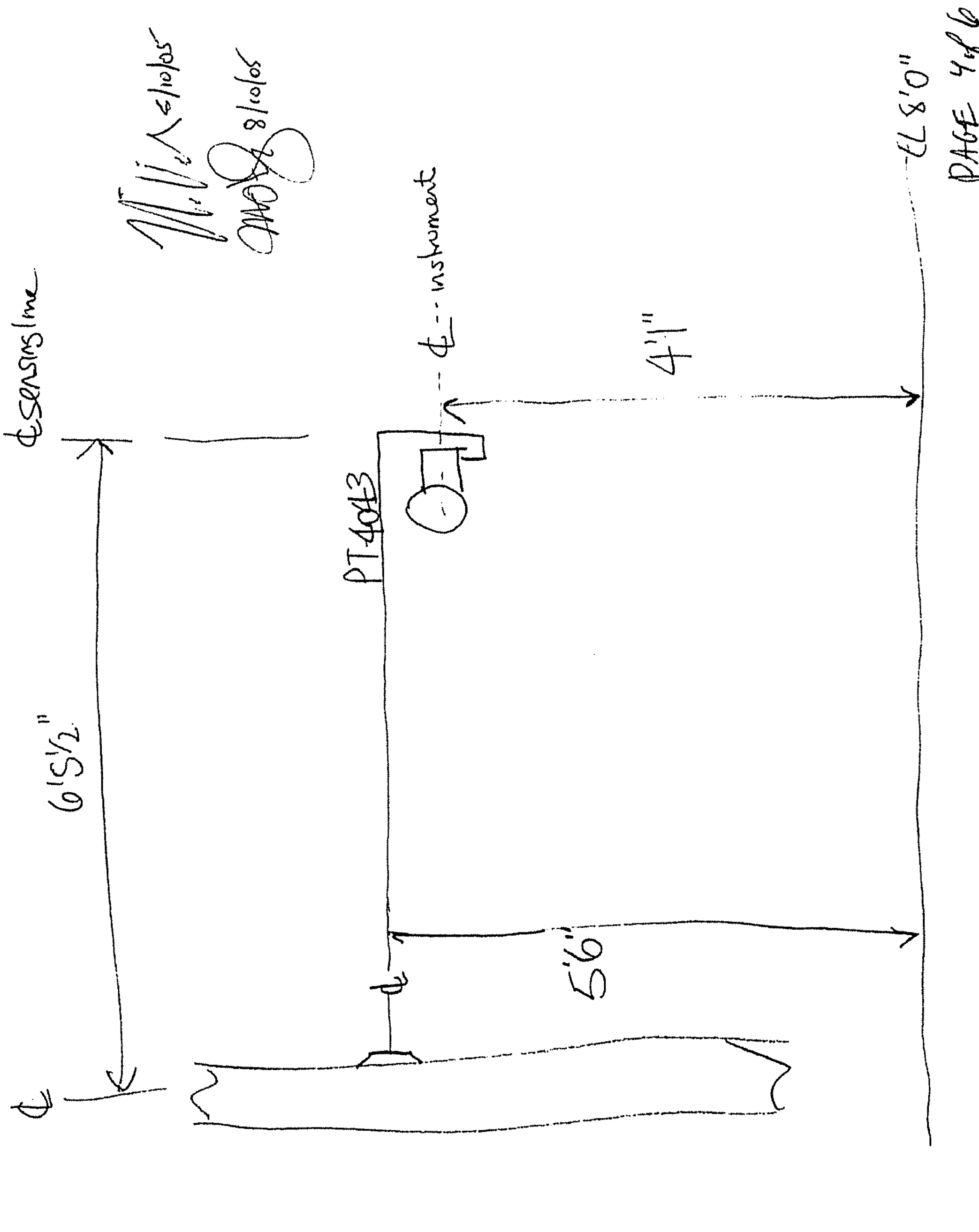
See attached diagram for each pressure transmitter (4 pages total).

NICK VILLONE	N. Vl	8/10/05
Data Taker Name	Signature	Date
MG	M G Flynn	8/10/05
Independent Verifier Name	Signature	Date

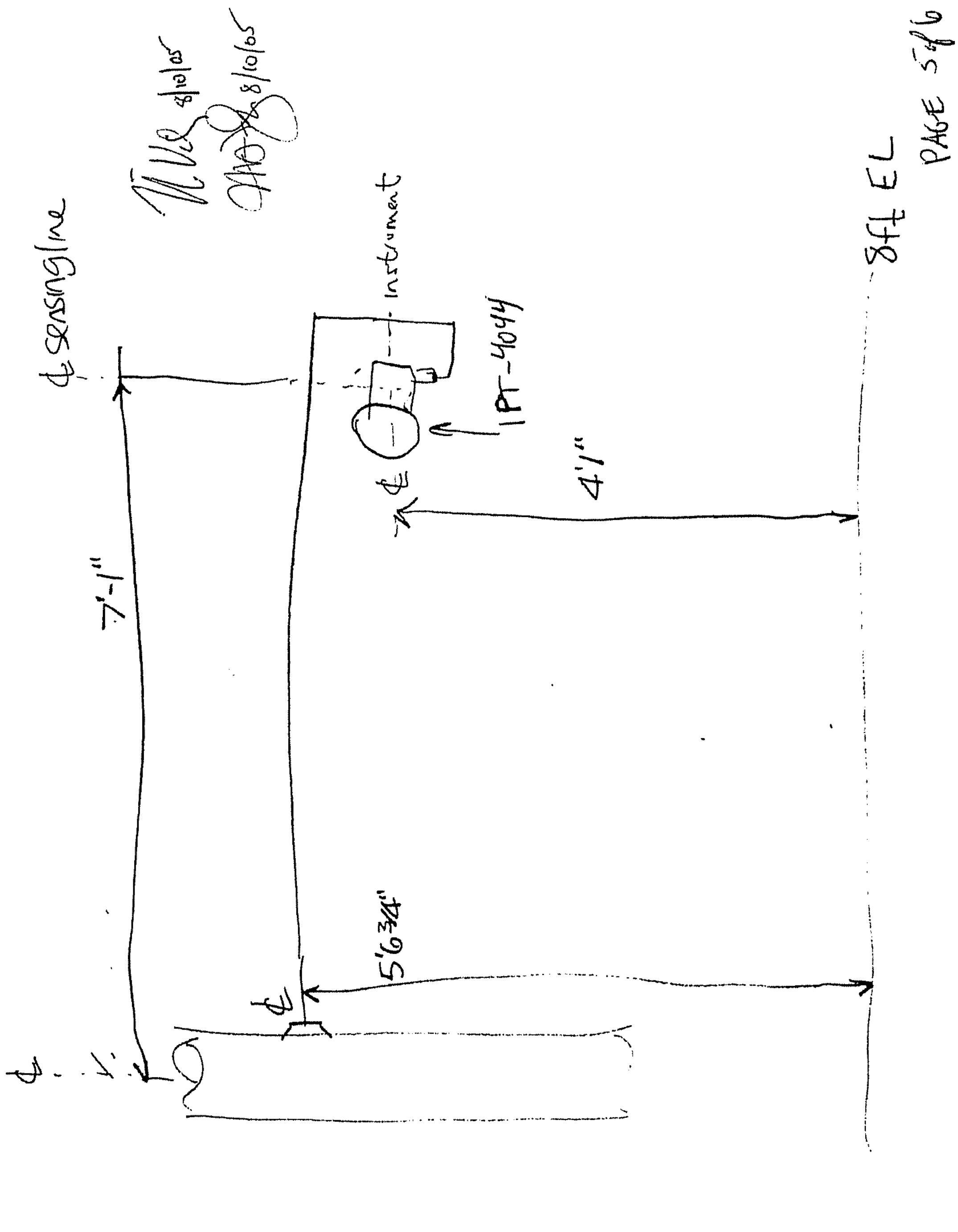
ATTACHMENT A



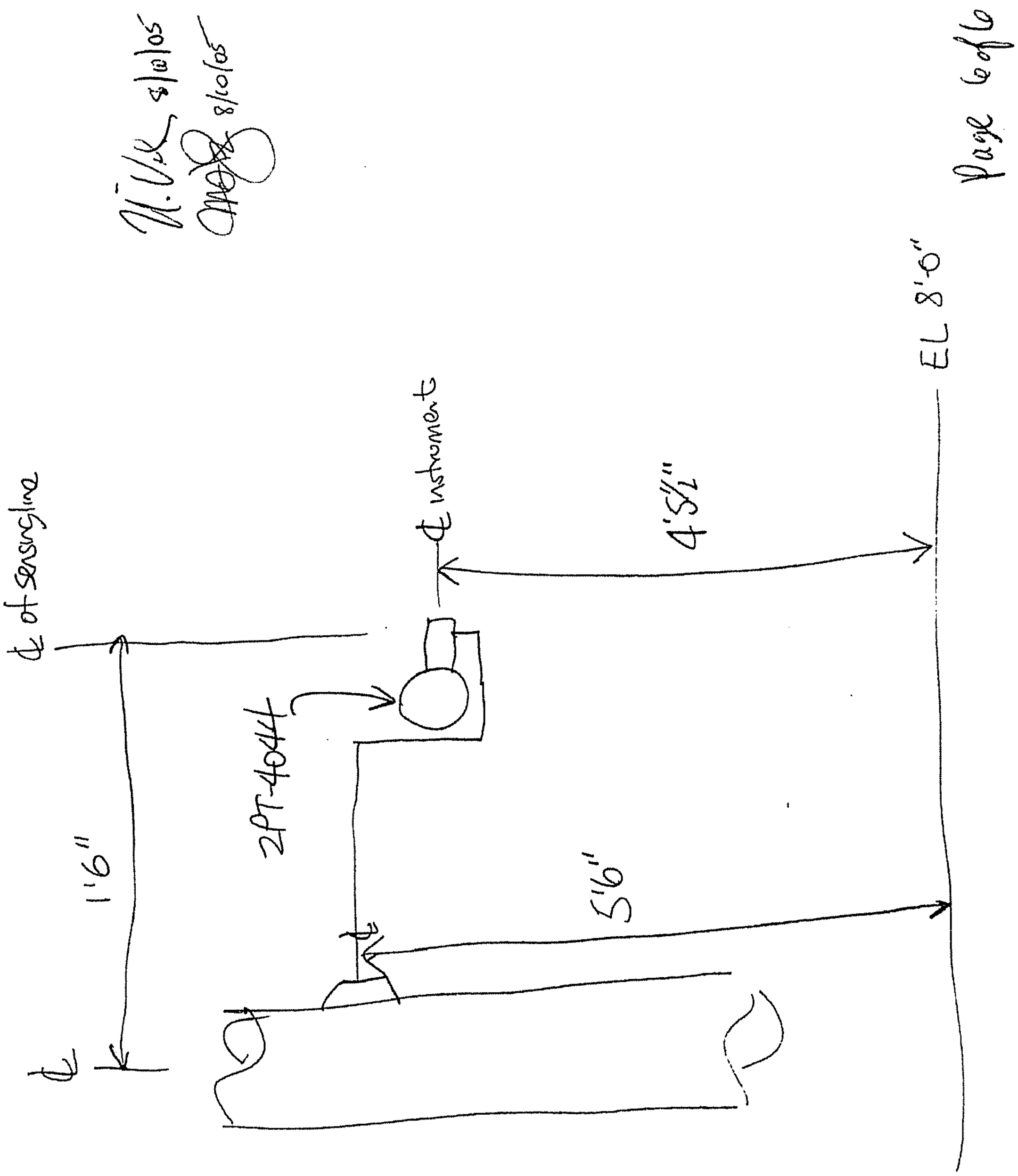
ATTACHMENT A



ATTACHMENT A



ATTACHMENT A



ATTACHMENT B

Instrument Scaling

This calculation has determined Acceptable As-Found Tolerances for all instruments identified in Section 1.5 in addition to new setpoint values and new Acceptable As-Left Tolerances for PT-4042 and PT-4043. The following tables illustrate the necessary modifications to calibration procedures P.1 through P.4 to account for these new tolerance values. The boxed-in fields represent the necessary changes; all other fields are provided for completeness only.

For 1ICP 04.003-5:

EQUIPMENT ID: 1PT-4044A				MANUFACTURER: Rosemount			
DESCRIPTION: P-29 AFP Suction Pressure				MODEL NUMBER: 3051NG3A02A1JH2B2			
SCALING: 0.0 – 30 psig / 4.00 – 20.00 mAdc				LOCATION: El. 8', CB, AFP RM 1P-29 CUB			
INPUT	OUTPUT			LIMITS			
				As-Found		As-Left	
psig	IDEAL mAdc	AS FOUND mAdc	AS LEFT mAdc	Low mAdc	High mAdc	Low mAdc	High mAdc
0	4.00			3.9	4.1	3.96	4.04
7.5	8.00			7.9	8.1	7.96	8.04
15	12.00			11.9	12.1	11.96	12.04
22.5	16.00			15.9	16.1	15.96	16.04
30	20.00			19.9	20.1	19.96	20.04
22.5	16.00			15.9	16.1	15.96	16.04
15	12.00			11.9	12.1	11.96	12.04
7.5	8.00			7.9	8.1	7.96	8.04
0	4.00			3.9	4.1	3.96	4.04

ATTACHMENT B

For 2ICP 04.003-5:

EQUIPMENT ID: 2PT-4044A	MANUFACTURER: Rosemount
DESCRIPTION: P-29 AFP Suction Pressure	MODEL NUMBER: 3051NG3A02A1JH2B2
SCALING: 0.0 – 30 psig / 4.00 – 20.00 mAdc	LOCATION: El. 8', CB, AFP RM 2P-29 CUB

INPUT	OUTPUT			LIMITS			
				As-Found		As-Left	
psig	IDEAL mAdc	AS FOUND mAdc	AS LEFT mAdc	Low mAdc	High mAdc	Low mAdc	High mAdc
0	4.00			3.9	4.1	3.96	4.04
7.5	8.00			7.9	8.1	7.96	8.04
15	12.00			11.9	12.1	11.96	12.04
22.5	16.00			15.9	16.1	15.96	16.04
30	20.00			19.9	20.1	19.96	20.04
22.5	16.00			15.9	16.1	15.96	16.04
15	12.00			11.9	12.1	11.96	12.04
7.5	8.00			7.9	8.1	7.96	8.04
0	4.00			3.9	4.1	3.96	4.04

ATTACHMENT B

For 1ICP 04.032-1 (Data Sheet 5):

EQUIPMENT ID: 1PC-4044-LL				MANUFACTURER: Foxboro			
DESCRIPTION: 1P-29 AFP Suction Header Pressure Bistable				MODEL NUMBER: 2AP+ALM-AR			
SCALING: 0.0 – 30.0 psig				LOCATION: Rack: 1C-197; N1, S4			
PROCESS SETPOINT	INPUT Vdc	OUTPUT					
PSIG	Setpoint Vdc	As-Found Limits (Vdc)		As-Found (Vdc)	As-Left Limits (Vdc)		As-Left (Vdc)
		Low	High		Low	High	
6.0 ↓	1.2.000 ↓	1.946	2.054		1.980	2.020	
REMARKS							

EQUIPMENT ID: 1PC-4044-L				MANUFACTURER: Foxboro			
DESCRIPTION: 1P-29 AFP Suction Header Pressure Bistable				MODEL NUMBER: 2AP+ALM-AR			
SCALING: 4.0 – 20.00 mAdc / 0 – 30.0 psig				LOCATION: Rack: 1C-171B-F; N5, S3			
PROCESS SETPOINT	*INPUT mAdc	OUTPUT					
PSIG	Setpoint mAdc	As-Found Limits (mAdc)		As-Found (mAdc)	As-Left Limits (mAdc)		As-Left (mAdc)
		Low	High		Low	High	
6.5 ↓	7.47 ↓	7.39	7.55		7.44	7.50	
Annunciator Check	C01 A, Annunciator 4-9, "AUX FEED PUMP SUCTION PRESSURE LOW"						INITIALS ______
REMARKS	* 4 – 20 mADC is input at 1C171A-R, TB-3, terminals 33 (+) and 34 (-). Field wire lifted and input current leads across resistor						

For 2ICP 04.032-1 (Data Sheet 5):

EQUIPMENT ID: 2PC-4044-LL					MANUFACTURER: Foxboro			
DESCRIPTION: 2P-29 AFP Suction Header Pressure Bistable					MODEL NUMBER: 2AP+ALM-AR			
SCALING: 0.0 – 30.0 psig					LOCATION: Rack: 2C-197; N1, S4			
PROCESS SETPOINT	INPUT Vdc	OUTPUT						
PSIG	Setpoint Vdc	As-Found Limits (Vdc)		As-Found (Vdc)	As-Left Limits (Vdc)		As-Left (Vdc)	
		Low	High		Low	High		
6.0 ↓	2.000 ↓	1.946	2.054		1.980	2.020		
REMARKS								

EQUIPMENT ID: 2PC-4044-L					MANUFACTURER: Foxboro			
DESCRIPTION: 2P-29 AFP Suction Header Pressure Bistable					MODEL NUMBER: 2AP+ALM-AR			
SCALING: 4.0 – 20.00 mAdc / 0 – 30.0 psig					LOCATION: Rack: 2C-173B-F; N3, S8			
PROCESS SETPOINT	*INPUT mAdc	OUTPUT						
PSIG	Setpoint mAdc	As-Found Limits (mAdc)		As-Found (mAdc)	As-Left Limits (mAdc)		As-Left (mAdc)	
		Low	High		Low	High		
6.5 ↓	7.47 ↓	7.39	7.55		7.44	7.50		
Annunciator Check	C01 A, Annunciator 4-9, "AUX FEED PUMP SUCTION PRESSURE LOW"							INITIALS
REMARKS	* 4 – 20 mADC is input at 2C173A-R, TB-3, terminals 83 (+) and 84 (-). Field wire lifted and input current leads across resistor							

ATTACHMENT B

Per Section 9.4, to preserve the validity of this calculation's results, this calculation requires that all future calibrations of the equipment (addressed in this calculation) be performed using the M&TE mentioned below (or better). This table needs to be implemented in calibration procedures 1(2)ICP 04.003-5 and 1(2)ICP 04.032-1 to provide the calibrator with a list of acceptable M&TE equipment.

M&TE	Range	Accuracy	Readability
Fluke 45	0-10 Vdc	0.025 % reading	0.006 Vdc
Fluke 45	0-30 mA	0.05 % reading	0.003 mA
HP 34401A	0-10 Vdc	0.0035 % reading + 0.0005 % range	0.00001 Vdc
HP 34401A	0-100 mAdc	0.050 % reading + 0.005 % range	0.0001 mAdc
Ashcroft 452074SD02L	30 psig	+0.25 % FS	0.001 psig
McDaniels	30 psig	+0.50 % FS	0.05 psig

ATTACHMENT C

PART 1 - WALKDOWN REQUEST FORM

Calculation 97-0231-002-B

Walkdown Location (Bldg/Elev/Room/Column Lines)

Scope

The purpose of this walk down is to provide input to Calc. 97-0231-002-B for the readability of the following M&TE equipment:

- ICTI-621 : Ashcroft 452074SD02L 30 psi Digital Gauge
- ICTI-797 : McDaniels 30 psi gauge

Documentation will be provided via photographs.

References: ICI 12

Data Tolerance Requirements

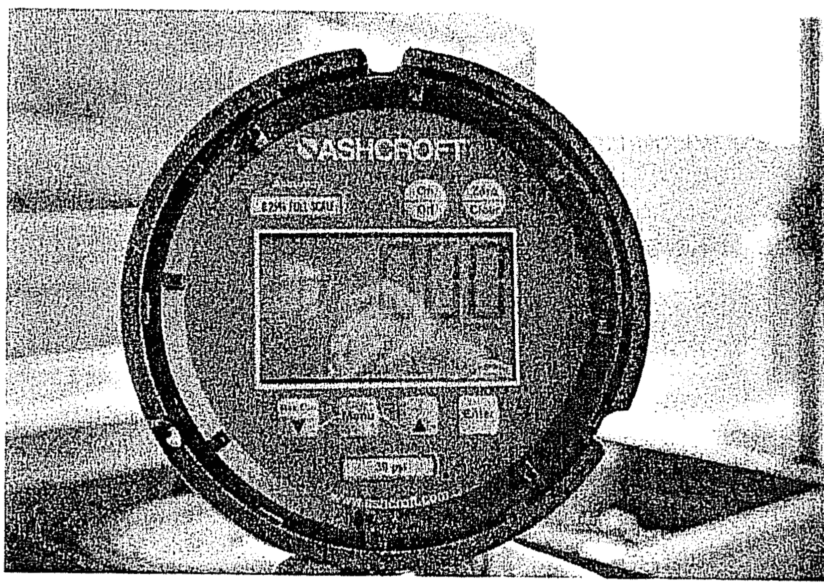
S&L Lead Nicholas Vilione Signature [signature] Date 5/28/2009

ATTACHMENT C

PART 2 - WALKDOWN DATA COLLECTION FORM

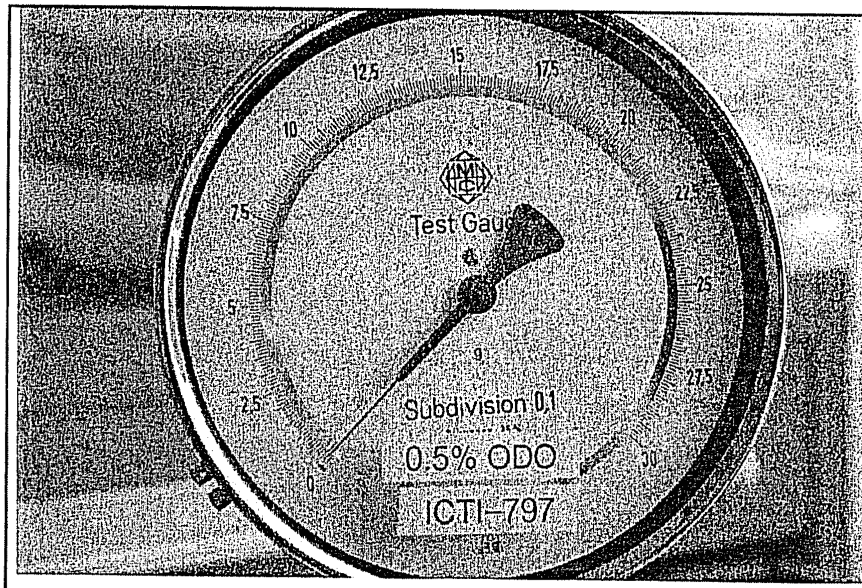
Results

See photographs.



The least significant digit of ICTI-621 is 3 digits to the right of the decimal.

ATTACHMENT C



The subdivisions of ICTI-797 are 0.1psi.

Nicholas Vilione	[signature]	5-28-09
Data Taker Name	Signature	Date
Steven Barwin	[signature]	
Independent Verifier Name	Signature	Date