NEXTera ENERGY POINT BEACH

July 21, 2010

NRC 2010-0113
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
Transmittal of Sample Reactor Protection System / Engineered Safety Features Actuation System Instrumentation Setpoint Calculations

References:
(1) FPL Energy Point Beach, LLC letter to NRC, dated April 7, 2009, License Amendment Request 261, Extended Power Uprate (ML091250564)
(2) NextEra Energy Point Beach, LLC, Letter to NRC, dated December 8, 2009, License Amendment Request 261 Supplement 3, Extended Power Uprate (ML093430114)
(3) 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 Instrument and Control Branch RE: Non-conservative Technical Specifications (ML093060170)
(4) NextEra Energy Point Beach, LLC letter to NRC, dated November 30, 2009, License Amendment Request 261, Extended Power Uprate, Response to Request for Additional Information (ML093360143)
(5) NRC electronic mail to NextEra Energy point Beach, LLC, dated March 25, 2010, DRAFT - Request for Additional Information from Instrument and Control Branch RE: EPU (ML100840783)
(6) NextEra Energy Point Beach, LLC letter to NRC, dated April 30, 2010, License Amendment Request 261, Extended Power Uprate, Response to Request for Additional Information (ML101200544)

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 (TS) to support operation at the increased thermal power level.

Supplement 3 to LAR 261 (Reference 2) was submitted to the NRC to provide revised proposed changes for the reactor protection system (RPS) Instrumentation TS Table 3.3.1-1 and engineered safety features actuation system (ESFAS) Instrumentation TS Table 3.3.2-1. The proposed changes provided in Reference (2) included both extended power uprate (EPU) related and non-EPU related changes. The proposed changes also included the addition of a new column, Nominal Trip Setpoint. This column was added in order to be consistent with the TS Table format in NUREG 1431, Standard Technical Specifications - Westinghouse Plants, and Technical Specification Task Force (TSTF)-493, Revision 4, Clarify the Application of Setpoint Methodology for Limiting Safety System Setting (LSSS) functions.

Via electronic mail dated November 2, 2009 (Reference 3), the NRC requested additional information to support its review of the RPS/ESFAS TS changes. Reference (4) provided NextEra's response to the NRC request and included four sample uncertainty calculations for RPS/ESFAS setpoints to support the response to RAI EICB-RAI-2. Via electronic mail dated March 25, 2010 (Reference 5), additional calculations were requested to support the response to RAI EICB-RAI-2. Reference (6) provided two additional sample calculations for RPS/ESFAS setpoints affected by EPU.

Per telecon on May 6, 2010, the NRC staff notified NextEra that determining LSSSs using single-sided random uncertainties was not acceptable and that the RPS/ESFAS calculations that used single sided uncertainty factors would have to be revised. As a result, NextEra revised the RPS/ESFAS instrumentation uncertainty/setpoint calculations to eliminate the use of a single-sided reduction factor in the total loop error determination for LSSSs. The revised calculations require changes to some TS allowable values and nominal trip setpoints previously provided in References (4) and (6). These changes are being submitted to the NRC under separate correspondence.

It was requested that the revisions to the sample calculations eliminating the single-sided reduction factor be submitted. Five of the six sample calculations previously submitted were revised to eliminate the single-sided reduction factor. Calc 2007-0001, Turbine Impulse Pressure Low Power Permissive P-7 Instrument Scaling and Uncertainty, did not include single-sided uncertainties, and as a result does not require revision or resubmittal. The remaining five calculations have minor revisions that eliminate the single-sided reduction factor and supplement the full calculations that were previously sent to NRC. The uncertainty/setpoint calculations with minor revisions are listed below and are Attachments 1 through 5 to Enclosure 1 as follows:

These minor revisions convert the uncertainties to double-sided.

Attachment 1	2009-0001-000-A	Pressurizer Pressure Instrument Loop Uncertainty/Setpoint Calculation
Attachment 2	2009-0002-000-A	Power Range Nuclear Instrumentation Uncertainty/Setpoint Calculation
Attachment 3	PBNP-IC-17-003-A	Low Range Containment Pressure Uncertainty/Setpoint Calculation

Attachment 4	PBNP-IC-39-004-A	Steam Line Pressure Instrument Loop Uncertainty/Setpoint Calculation
Attachment 5	97-0231-002-C	Auxiliary Feedwater Pumps Low Suction Pressure SW Switchover Uncertainty/Setpoint Calculation

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

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 July 21, 2010.

Very truly yours,

NextEra Energy Point Beach, LLC

Larry Meyer
Site Vice President

Enclosure

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
TRANSMITTAL OF SAMPLE CALCULATIONS FOR
REACTOR PROTECTION SYSTEM / ENGINEERED SAFETY FEATURES
ACTUATION SYSTEM INSTRUMENTATION SETPOINT CALCUATIONS

178 pages follow

ENCLOSURE 1

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

LICENSE AMENDMENT REQUEST 261, EXTENDED POWER UPRATE
TRANSMITTAL OF SAMPLE CALCULATIONS FOR
REACTOR PROTECTION SYSTEM / ENGINEERED SAFETY FEATURES
ACTUATION SYSTEM INSTRUMENTATION SETPOINT CALCUATIONS

ATTACHMENT 1

PRESSURIZER PRESSURE INSTRUMENT LOOP
UNCERTAINTY/SETPOINT CALCULATION

33 pages to follow

KCI ENGINEERING CONSULTANTS

CALCULATION TITLE PAGE

Project Number:	441-005	**Client or Station:**	Point Beach Nuclear Station		
Calculation Number:	2009-0001	**Revision Number:**	000-A	**Total Number of Pages:**	33
Title:	Pressurizer Pressure Instrument Loop Uncertainty/Setpoint Calculation.				

☐ **Original Calculation** ☒ **Revised Calculation** ☐ **Cancelled**

☐ **Supersedes Calculation:** ______________________

Nuclear Safety Related:	☒YES ☐NO	**QA Scope:**	☒YES ☐NO
System:	RP/ESF		
Date of Issue:	See Approval Date		

SIGNATURES AND DATES

Preparer	Reviewer	Discipline	Name	Signature	Date
☒	☐		Aijaz Ahmed	[signature]	6/25/10
☐	☒		for Anup Behera	[signature]	6/25/10
☐	☐				
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Approver: **Name:** Badar Hussain

Signature: [signature]

Date: 6/25/10

REVISION SUMMARY SHEET

Revision No.	Description of the Revision
000-A	This minor revision eliminates single-sided uncertainties and instead incorporates double-sided random uncertainties in the TLE term to calculate the Limiting Trip Setpoints (LTSP). In addition, separate markups of calibration procedures (ICPs) are included in Attachment A for Current and EPU conditions. All the changes made in this minor revision are identified by revision bars.

CALCULATION TABLE OF CONTENTS

SECTION **PAGE**

1.0 BACKGROUND, PURPOSE, AND SCOPE OF CALCULATION

1.1 Background

Same as Revision 000 of calculation 2009-0001.

1.2 Purpose

Same as Revision 000 of calculation 2009-0001.

1.3 Purpose of this Minor Revision

The purpose of this minor revision is to calculate the Limiting Trip Setpoints (LTSP) by applying double-sided random uncertainties to the random portion of the Total Loop Error (TLE). This resolves the concern raised in CAP 01173082.

1.4 Scope

The scope of base calculation remains unaffected except to:

- Determine the Limiting Trip Setpoints (LTSP) for the reactor trip and ESFAS functions taking into consideration the double-sided random uncertainties in the Total Loop Error (TLE)

1.5 Instrumentation Evaluated

Same as Revision 000 of calculation 2009-0001.

2.0 ACCEPTANCE CRITERIA

Same as Revision 000 of calculation 2009-0001.

3.0 ABBREVIATIONS

Same as Revision 000 of calculation 2009-0001.

4.0 REFERENCES

Same as Revision 000 of calculation 2009-0001.

5.0 ASSUMPTIONS

Same as Revision 000 of calculation 2009-0001.

6.0 DESIGN INPUTS

Same as Revision 000 of calculation 2009-0001.

7.0 METHODOLOGY

7.1 Uncertainty Determination

Same as Revision 000 of calculation 2009-0001 except for Section 7.1.5.

7.1.5 Limiting Trip Setpoint (LTSP) Equation summary

The LTSP is determined by applying the Total Loop Error (TLE) to the AL or PL. The TLE consists of the combination of 95/95 double-sided random uncertainties and bias uncertainties. The TLE based on a double-sided distribution is larger than the TLE based on a single-sided distribution. Therefore, including double-sided random uncertainties in the TLE is an acceptable, conservative deviation from the guidance in DG-I01 (Section 3.3.8.4, Reference G.1 of the base calculation), which permits smaller single-sided random uncertainties.

In 2010, NRC advised Point Beach that the NRC would no longer accept the use of single-sided random uncertainties for determining Limiting Safety System Settings (LSSS) in the plant Technical Specifications. Double-sided uncertainties in the random portion of the TLE term yields a more conservative LTSP value than an LTSP based on single-sided uncertainties. Therefore, a TLE based on double-sided uncertainties is appropriate and acceptable for LSSS values.

For a process increasing toward the analytical limit (AL), the calculated Limiting Trip Setpoint is as follows:

$$LTSP\uparrow = AL + [TLE_{rdm}^{-} + TLE_{bias}^{-}]PS \quad \text{(Eq. 7.1.5-1)}$$

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

$$LTSP\downarrow = AL + [TLE_{rdm}^{+} + TLE_{bias}^{+}]PS \quad \text{(Eq. 7.1.5-2)}$$

Per Section 3.3.8.4 of Reference G.1, for backup and anticipatory trips that lack an analytical limit, the setpoint is determined by subtracting (or adding for a decreasing setpoint) the total loop error from a Process Limit (PL) established either by system design requirements or using an instrument span limit. For these functions, the calculated setpoint (SP) is as follows:

Increasing Setpoints $SP\uparrow = PL + (TLE_{rdm}^{-} + TLE_{bias}^{-})* PS$ (Eq. 7.1.5-3)

Decreasing Setpoints $SP\downarrow = PL + (TLE_{rdm}^{+} + TLE_{bias}^{+})* PS$ (Eq. 7.1.5-4)

7.2 Drift Considerations

Same as Revision 000 of calculation 2009-0001.

7.3 Multiple Analytical Limits Considerations

Same as Revision 000 of calculation 2009-0001.

7.4 Margin-to-Trip Evaluation

Same as Revision 000 of calculation 2009-0001.

8.0 BODY OF CALCULATIONS

8.1 Device Uncertainty Analysis

Same as Revision 000 of calculation 2009-0001.

8.2 Device Uncertainty Summary

Same as Revision 000 of calculation 2009-0001.

8.3 Total Loop Errors

Same as Revision 000 of calculation 2009-0001.

8.4 Setpoint Evaluations

8.4.1 High PZR Pressure Reactor Trip Setpoint Evaluation – Current Power Level

For an increasing setpoint towards the Analytical Limit, Equation 7.1.5-1 is used.

$$LTSP_{H\text{-}RPS}\uparrow = AL_{H\text{-}RPS} + [TLE_{H\text{-}RPS\text{-}rdm}^{-} + TLE_{H\text{-}RPS\text{-}bias}^{-}]PS$$

Where:

$AL_{H\text{-}RPS}$	= 2410 psig	Section 6.5
$TLE_{H\text{-}RPS\text{-}rdm}^{-}$	= - 2.166 % span	Section 8.3.1
$TLE_{H\text{-}RPS\text{-}bias}^{-}$	= - 0.092 % span	Section 8.3.1
PS	= 800 psi	Section 6.9

Substituting,

$$TLE_{H\text{-}RPS\text{-}total} = (-2.166\% - 0.092\%) = -2.258\ \%\ span$$

$$LTSP_{H\text{-}RPS} = 2410psig + \frac{-2.258\% * 800psi}{100\%}$$

$LTSP_{H\text{-}RPS}$ = 2391.9 psig **(95/95)**

From Section 6.5, the Field Trip Setpoint ($FTSP_{H\text{-}RPS}$) for High PZR Pressure Reactor Trip is 2365.0 psig. The $FTSP_{H\text{-}RPS}$ is less than the calculated $LTSP_{H\text{-}RPS}$. Per Section 2.0, the $FTSP_{H\text{-}RPS}$ is conservative and is acceptable.

Margin-to-Trip Evaluation

Per Attachment E, the Margin-to-Trip should remain above the peak process parameter of 2351 psia under normal operating conditions. Using Equation 7.4-1,

$$\text{Margin-to-Trip} = FTSP - (TLE*PS)$$

$$= 2365\ psig + \frac{-2.258\% * 800\ psi}{100\%}$$

= 2346.9 psig or 2361.6 psia

Therefore, since the Margin-to-Trip (2361.6 psia) is greater than the Peak Process Parameter (2351 psia), the Field Trip Setpoint ($FTSP_{H\text{-}RPS}$) is acceptable.

The margin between $LTSP_{H\text{-}RPS}$ and $FTSP_{H\text{-}RPS}$ is calculated in accordance with Section 3.3.8.5 of Reference G.1:

$$Margin = LTSP_{H\text{-}RPS} - FTSP_{H\text{-}RPS}$$

Where:

$LTSP_{H\text{-}RPS}$ = 2391.9 psig

$FTSP_{H\text{-}RPS}$ = 2365.0 psig — Section 6.5

Substituting,

$$Margin = 2391.9\ psig - 2365.0\ psig$$

Margin = 26.9 psi

8.4.2 High PZR Pressure Reactor Trip Setpoint Evaluation - EPU

For an increasing setpoint towards the Analytical Limit, Equation 7.1.5-1 is used.

$$LTSP_{H\text{-}RPS}\uparrow = AL_{H\text{-}RPS} + [TLE_{H\text{-}RPS\text{-}rdm}^{-} + TLE_{H\text{-}RPS\text{-}bias}^{-}]PS$$

Where:

$AL_{H\text{-}RPS}$ = 2403 psig — Section 6.5

$TLE_{H\text{-}RPS\text{-}rdm}^{-}$ = - 2.166 % span — Section 8.3.1

$TLE_{H\text{-}RPS\text{-}bias}^{-}$ = - 0.092 % span — Section 8.3.1

PS = 800 psi — Section 6.9

Substituting,

$$TLE_{H\text{-}RPS\text{-}total} = (-2.166\% - 0.092\%) = -2.258\ \%\ span$$

$$LTSP_{H\text{-}RPS} = 2403\text{ psig} + \frac{-2.258\% * 800\text{psi}}{100\%}$$

$LTSP_{H\text{-}RPS}$ = 2384.9 psig **(95/95)**

From Section 6.5, the Field Trip Setpoint ($FTSP_{H\text{-}RPS}$) for High PZR Pressure Reactor Trip is 2365.0 psig. The $FTSP_{H\text{-}RPS}$ is less than the calculated $LTSP_{H\text{-}RPS}$. Per Section 2.0, the $FTSP_{H\text{-}RPS}$ is conservative and is acceptable.

Margin-to-Trip Evaluation

Per Attachment E, the Margin-to-Trip should remain above the peak process parameter of 2351 psia under normal operating conditions. Using Equation 7.4-1,

Margin-to-Trip = FTSP – (TLE*PS)

$$= 2365\text{ psig} + \frac{-2.258\% * 800\text{ psi}}{100\%}$$

= 2346.9 psig or 2361.6 psia

Therefore, since the Margin-to-Trip (2361.6 psia) is greater than the Peak Process Parameter (2351 psia), the Field Trip Setpoint ($FTSP_{H\text{-}RPS}$) is acceptable.

The margin between $LTSP_{H\text{-}RPS}$ and $FTSP_{H\text{-}RPS}$ is calculated in accordance with Section 3.3.8.5 of Reference G.1:

Margin= $LTSP_{H\text{-}RPS} - FTSP_{H\text{-}RPS}$

Where:

$LTSP_{H\text{-}RPS}$ = 2384.9 psig

$FTSP_{H\text{-}RPS}$ = 2365.0 psig Section 6.5

Substituting,

Margin= 2384.9 psig – 2365.0 psig

Margin = 19.9 psi

8.4.3 Low PZR Pressure Reactor Trip Setpoint Evaluation – Current Power Level

Low PZR Pressure Reactor Trip – Dropped Rod

For a decreasing setpoint towards the Analytical Limit, Equation 7.1.5-2 is used.

$$LTSP_{L\text{-}RPS\text{-}ROD}\downarrow = AL_{L\text{-}RPS\text{-}ROD} + [TLE_{L\text{-}RPS\text{-}ROD\text{-}rdm}^{+} + TLE_{L\text{-}RPS\text{-}ROD\text{-}bias}^{+}]PS$$

Where:

$AL_{L\text{-}RPS\text{-}ROD}$	= 1815 psig	Section 6.5
$TLE_{L\text{-}RPS\text{-}ROD\text{-}rdm}^{+}$	= + 2.334 % span	Section 8.3.2
$TLE_{L\text{-}RPS\text{-}ROD\text{-}bias}^{+}$	= + 0.000 % span	Section 8.3.2
PS	= 800 psi	Section 6.9

Substituting,

$$TLE_{L\text{-}RPS\text{-}ROD\text{-}total} = (2.334\% + 0.000\%) = 2.334\ \%\ span$$

$$LTSP_{L\text{-}RPS\text{-}ROD}\downarrow = 1815psig + \frac{2.334\% * 800psi}{100\%}$$

$LTSP_{L\text{-}RPS\text{-}ROD}\downarrow$ = 1833.7 psig (95/95)

Low PZR Pressure Reactor Trip – SBLOCA

For a decreasing setpoint towards the Analytical Limit, Equation 7.1.5-2 is used.

$$LTSP_{L\text{-}RPS\text{-}LOCA}\downarrow = AL_{L\text{-}RPS\text{-}LOCA} + [TLE_{L\text{-}RPS\text{-}LOCA\text{-}rdm}^{+} + TLE_{L\text{-}RPS\text{-}LOCA\text{-}bias}^{+}]PS$$

Where:

$AL_{L\text{-}RPS\text{-}LOCA}$	= 1648 psig	Section 6.5
$TLE_{L\text{-}RPS\text{-}LOCA\text{-}rdm}^{+}$	= + 3.515 % span	Section 8.3.3
$TLE_{L\text{-}RPS\text{-}LOCA\text{-}bias}^{+}$	= + 0.000 % span	Section 8.3.3
PS	= 800 psi	Section 6.9

Per Section 6.7.1, the Low PZR Pressure Reactor Trip (SBLOCA) analytical limit is lower than the calibrated span of the transmitter and should be replaced in the setpoint evaluation by the lower span limit of the transmitter.

$$LTSP_{L\text{-}RPS\text{-}LOCA}\downarrow = 1700psig + \frac{(3.515\% + 0.000\%) * 800psi}{100\%}$$

$$\mathbf{LTSP_{L\text{-}RPS\text{-}LOCA}\downarrow = 1728.1\ psig} \quad \mathbf{(95/95)}$$

The LTSP for the Low PZR Pressure Reactor Trip is taken to be the most conservative of the LTSPs calculated above. Therefore,

$$\mathbf{LTSP_{L\text{-}RPS} = 1833.7\ psig}$$

From Section 6.5, the Field Trip Setpoint ($FTSP_{L\text{-}RPS}$) for Low PZR Pressure Reactor Trip is 1925.0 psig. The $FTSP_{L\text{-}RPS}$ is greater than the calculated $LTSP_{L\text{-}RPS}$. Per Section 2.1, the $FTSP_{L\text{-}RPS}$ is conservative and is acceptable.

<u>Margin-to-Trip Evaluation</u>

Per Attachment E, the Margin-to-Trip should remain below the peak process parameter of 2136 psia under normal operating conditions. The loop uncertainty for normal environmental conditions is for the dropped rod case. Using Equation 7.4-2,

Margin-to-Trip = FTSP + (TLE*PS)

$$= 1925\ psig + \frac{2.334\% * 800psi}{100\%}$$

= 1943.7 psig or 1958.4 psia

Therefore, since the Margin-to-Trip (1958.4 psia) is less than the Peak Process Parameter (2136 psia), the Field Trip Setpoint ($FTSP_{L\text{-}RPS}$) is acceptable.

The worst-case margin between $LTSP_{L\text{-}RPS}$ and $FTSP_{L\text{-}RPS}$ is calculated in accordance with Section 3.3.8.5 of Reference G.1, based on the dropped rod event:

Margin= $FTSP_{L\text{-}RPS} - LTSP_{L\text{-}RPS}$

Where:

$LTSP_{L\text{-}RPS}$ = 1833.7 psig

$FTSP_{L\text{-}RPS}$ = 1925.0 psig Section 6.5

Substituting,

Margin = 1925.0 psig – 1833.7psig

Margin = 91.3 psi

8.4.4 Low PZR Pressure Reactor Trip Setpoint Evaluation - EPU

Low PZR Pressure Reactor Trip – OPTOAX

For a decreasing setpoint towards the Analytical Limit, Equation 7.1.5-2 is used. As discussed in Appendix E, the containment environment is normal for the accidents analyzed under OPTOAX. Therefore, the same random and bias TLE terms used for a rod drop accident LTSP calculation in 8.4.3 above are applied to this LTSP calculation.

$$LTSP_{L\text{-}RPS\text{-}OPTOAX}\downarrow = AL_{L\text{-}RPS\text{-}OPTOAX} + [TLE_{L\text{-}RPS\text{-}ROD\text{-}rdm}^{+} + TLE_{L\text{-}RPS\text{-}ROD\text{-}bias}^{+}]PS$$

Where:

$AL_{L\text{-}RPS\text{-}OPTOAX}$	= 1840 psig	Section 6.5
$TLE_{L\text{-}RPS\text{-}ROD\text{-}rdm}^{+}$	= + 2.334 % span	Section 8.3.2
$TLE_{L\text{-}RPS\text{-}ROD\text{-}bias}^{+}$	= + 0.000 % span	Section 8.3.2
PS	= 800 psi	Section 6.9

Substituting,

$$TLE_{L\text{-}RPS\text{-}ROD\text{-}total} = (2.334\% + 0.000\%) = 1.958\ \%\ \text{span}$$

$$LTSP_{L\text{-}RPS\text{-}OPTOAX} = 1840\ \text{psig} + \frac{2.334\% * 800\text{psi}}{100\%}$$

$LTSP_{L\text{-}RPS\text{-}OPTOAX}$ **= 1858.7 psig** **(95/95)**

The LTSP for the Low PZR Pressure Reactor Trip for Extended Power Uprate is the LTSP calculated above. Therefore,

$LTSP_{L\text{-}RPS}$ = 1858.7 psig

From Section 6.5, the Field Trip Setpoint ($FTSP_{L\text{-}RPS}$) for Low PZR Pressure Reactor Trip is 1925.0 psig. The $FTSP_{L\text{-}RPS}$ is greater than the calculated

$LTSP_{L\text{-}RPS}$. Per Section 2.1, the $FTSP_{L\text{-}RPS}$ is conservative and is acceptable.

Margin-to-Trip Evaluation

Per Attachment E, the Margin-to-Trip should remain below the peak process parameter of 2136 psia under normal operating conditions. The loop uncertainty for normal environmental conditions is for the dropped rod case. Using Equation 7.4-2,

Margin-to-Trip = FTSP + (TLE*PS)

$$= 1925 \text{ psig} + \frac{2.334\% * 800\text{psi}}{100\%}$$

= 1943.7 psig or 1958.4 psia

Therefore, since the Margin-to-Trip (1958.4 psia) is less than the Peak Process Parameter (2136 psia), the Field Trip Setpoint ($FTSP_{L\text{-}RPS}$) is acceptable.

The worst-case margin between $LTSP_{L\text{-}RPS}$ and $FTSP_{L\text{-}RPS}$ is calculated in accordance with Section 3.3.8.5 of Reference G.1, based on the dropped rod event:

Margin= $FTSP_{L\text{-}RPS} - LTSP_{L\text{-}RPS}$

Where:

$LTSP_{L\text{-}RPS}$ = 1858.7 psig

$FTSP_{L\text{-}RPS}$ = 1925.0 psig — Section 6.5

Substituting,

Margin= 1925.0 psig – 1858.7psig

Margin = 66.3 psi

8.4.5 Low PZR Pressure SI Actuation Setpoint Evaluation

For a decreasing setpoint towards the Analytical Limit, Equation 7.1.5-2 is used.

$$LTSP_{L\text{-}SI}\downarrow = AL_{L\text{-}SI} + [TLE_{L\text{-}SI\text{-}rdm}^{+} + TLE_{L\text{-}SI\text{-}bias}^{+}]PS$$

Where:

$AL_{L\text{-}SI}$	= 1625 psig or 1648 psig	Section 6.5
$TLE_{L\text{-}SI\text{-}rdm}^{+}$	= + 3.406 % span	Section 8.3.4
$TLE_{L\text{-}SI\text{-}bias}^{+}$	= + 0.000 % span	Section 8.3.4
PS	= 800 psi	Section 6.9

Per Section 6.7.3, the SI Actuation analytical limit is lower than the lower span limit of the transmitter and should be replaced in the setpoint evaluation by the lower span limit.

$$LTSP_{L\text{-}SI}\downarrow = 1700\text{psig} + \frac{(3.406\% + 0.000\%) * 800\text{psi}}{100\%}$$

$LTSP_{L\text{-}SI}\downarrow$ = 1727.2 psig **(95/95)**

From Section 6.5, the Field Trip Setpoint ($FTSP_{L\text{-}SI}$) for Low PZR Pressure SI Actuation is 1735.0 psig. The $FTSP_{L\text{-}SI}$ is greater than the calculated $LTSP_{L\text{-}SI}$. Per Section 2.1, the $FTSP_{L\text{-}SI}$ is conservative and is acceptable.

Per Attachment E and Section 2.3, the Low PZR Pressure SI Actuation FTSP must be no lower than 1715 psig. The FTSP is 1735.0 psig, which is greater than 1715 psig, and therefore, acceptable.

The worst-case margin between $LTSP_{L\text{-}SI}$ and $FTSP_{L\text{-}SI}$ is calculated in accordance with Section 3.3.8.5 of Reference G.1:

$$\text{Margin} = FTSP_{L\text{-}SI} - LTSP_{L\text{-}SI}$$

Where:

$LTSP_{L\text{-}SI}$	= 1727.2 psig	
$FTSP_{L\text{-}SI}$	= 1735.0 psig	Section 6.5

Substituting,

Margin = 1735.0 psig – 1727.2 psig

Margin = 7.8 psi

8.4.6 PZR Pressure SI Unblock Setpoint Evaluation (Proposed Setpoint)

Same as Revision 000 of calculation 2009-0001.

8.4.7 PZR Pressure SI Block Setpoint Evaluation (Proposed Setpoint)

Same as Revision 000 of calculation 2009-0001.

8.5 Operability Limit Determination

8.5.1 High PZR Pressure Reactor Trip Operability Limit

Changes in this section are indicated by a revision bar shown below.

From Section 8.4.2, the post EPU Limiting Trip Setpoint for the high Pressurizer Pressure Reactor Trip is 2384.9 psig. For this increasing trip, the OL^+ value of 2370 psig is more conservative (i.e., restrictive) than the LTSP. Per Section 2.4, the OL^+ value is acceptable to use for channel operability determination during COT.

8.5.2 Low PZR Pressure Reactor Trip Operability Limit

Changes in this section are indicated by a revision bar shown below.

From Section 8.4.4, the post EPU Limiting Trip Setpoint for the low Pressurizer Pressure Reactor Trip is 1858.7 psig. For this decreasing trip, the OL^- value of 1920 psig is more conservative (i.e., restrictive) than the LTSP. Per Section 2.4, the OL^- value is acceptable to use for channel operability determination during COT.

8.5.3 Low PZR Pressure SI Actuation Operability Limit

Changes in this section are indicated by a revision bar shown below.

From Section 8.4.5, the Limiting Trip Setpoint for the low Pressurizer Pressure SI Actuation is 1727.2 psig. For this decreasing trip, the OL^- value of 1730 psig is more conservative (i.e., restrictive) than the LTSP. Per Section 2.4, the OL^- value is acceptable to use for channel operability determination during COT.

8.5.4 PZR Pressure SI Unblock Operability Limit (Existing)

Same as Revision 000 of calculation 2009-0001.

8.5.5 PZR Pressure SI Unblock Operability Limit (Proposed)

Same as Revision 000 of calculation 2009-0001.

8.6 Acceptable As-Left and As-Found Calibration Tolerances

Same as Revision 000 of calculation 2009-0001.

8.7 Channel Check Tolerances

Same as Revision 000 of calculation 2009-0001.

8.8 Scaling

Same as Revision 000 of calculation 2009-0001.

9.0 RESULTS AND CONCLUSIONS, WITH LIMITATIONS

9.1 Analytical Limits (AL)

Same as Revision 000 of calculation 2009-0001.

9.2 Limiting Trip Setpoints, Operability Limits (OL), and Recommended Tech Spec Changes

Changes in this section are indicated by a revision bar shown below.

To make the Technical Specification Allowable Values easier to remember, it is recommended that the LTSP values be rounded (in the conservative direction) to the nearest 5 psig. For example, the LTSP for the high pressurizer pressure reactor trip for EPU is 2384.9 psig. For use in Technical Specification 3.3.1, the Allowable Value should be rounded down to 2380 psig.

9.3 Calculated Limiting Trip Setpoints (LTSP) and Existing Field Trip Setpoints (FTSP)

Changes in this section are indicated by a revision bar shown below.

Table 9.3-1 Calculated Limiting Trip Setpoints/Existing Field Trip Setpoints

Function	Calculated LTSP	Recommended TS AV	Existing FTSP	Margin	Reference
High PZR Pressure Reactor Trip – Current Power Level	**2391.9 psig**	**≤ 2390 psig**	**2365 psig**	**26.9 psi**	**Section 8.4.1**
High PZR Pressure Reactor Trip – Extended Power Level	**2384.9 psig**	**≤ 2380 psig**	**2365 psig**	**19.9 psi**	**Section 8.4.2**
Low PZR Pressure Reactor Trip – Current Power Level	**1833.7 psig**	**≥ 1835 psig**	**1925 psig**	**91.3 psi**	**Section 8.4.3**
Low PZR Pressure Reactor Trip – Extended Power Level	**1858.7 psig**	**≥ 1860 psig**	**1925 psig**	**66.3 psi**	**Section 8.4.4**
Low PZR Pressure SI Actuation	**1727.2 psig**	**≥ 1730 psig**	**1735 psig**	**7.8 psi**	**Section 8.4.5**

For the High PZR Pressure Reactor Trip and the Low PZR Pressure Reactor Trip, the Margin-to-Trip values (>2361.6 psia and <1958.4 psia, respectively) are conservative with respect to the peak process parameter values (>2351 psia and <2136 psia, respectively), per Sections 8.4.1 and 8.4.3. Therefore, the existing FTSPs for these functions may be retained.

Revision 0 of this calculation also recommended changes to the existing Field Trip Setpoints (FTSP) for the PZR Pressure SI Block Enable and SI Unblock functions, to return these two setpoints to the correct values for an RCS operating pressure of 2250 psia, as follows:

Table 9.3-2 Recommended Field Trip Setpoint Changes

Function	Existing FTSP	Recommended FTSP	Reference
PZR Pressure SI Unblock	**1775 psig↑**	**2000 psig↑**	**Section 8.4.6**
PZR Pressure SI Block Enable	**1765 psig↓**	**1990 psig↓**	**Section 8.4.7**

9.4 Tech Spec Surveillance

Same as Revision 000 of calculation 2009-0001.

9.5 Channel Check Tolerances

Same as Revision 000 of calculation 2009-0001.

9.6 Acceptable As-Left and As-found Tolerances

Same as Revision 000 of calculation 2009-0001.

9.7 Scaling

Same as Revision 000 of calculation 2009-0001.

9.8 Limitations

Same as Revision 000 of calculation 2009-0001.

9.9 Graphical Representation of Setpoint Parameters

Changes in figures 9.9.1a, 9.9.1b, 9.9.2a, 9.9.2b, and 9.9.3 have been indicated by a revision bar shown below, which needs to be incorporated in the next major revision.

9.9.1 High PZR Pressure Reactor Trip Setpoint

Figure 9.9.1a

High PZR Pressure Reactor Trip Function – Current Power Level
(PC-429A, 430A, 431A)

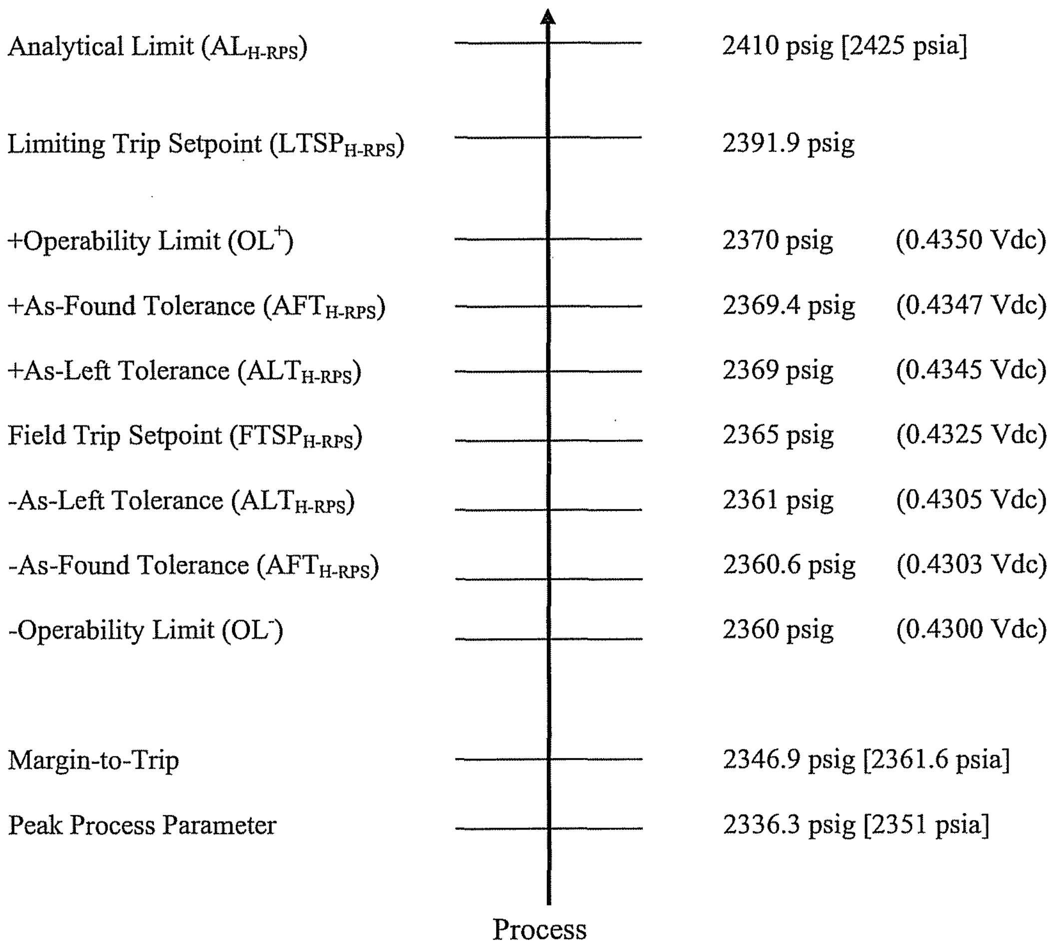
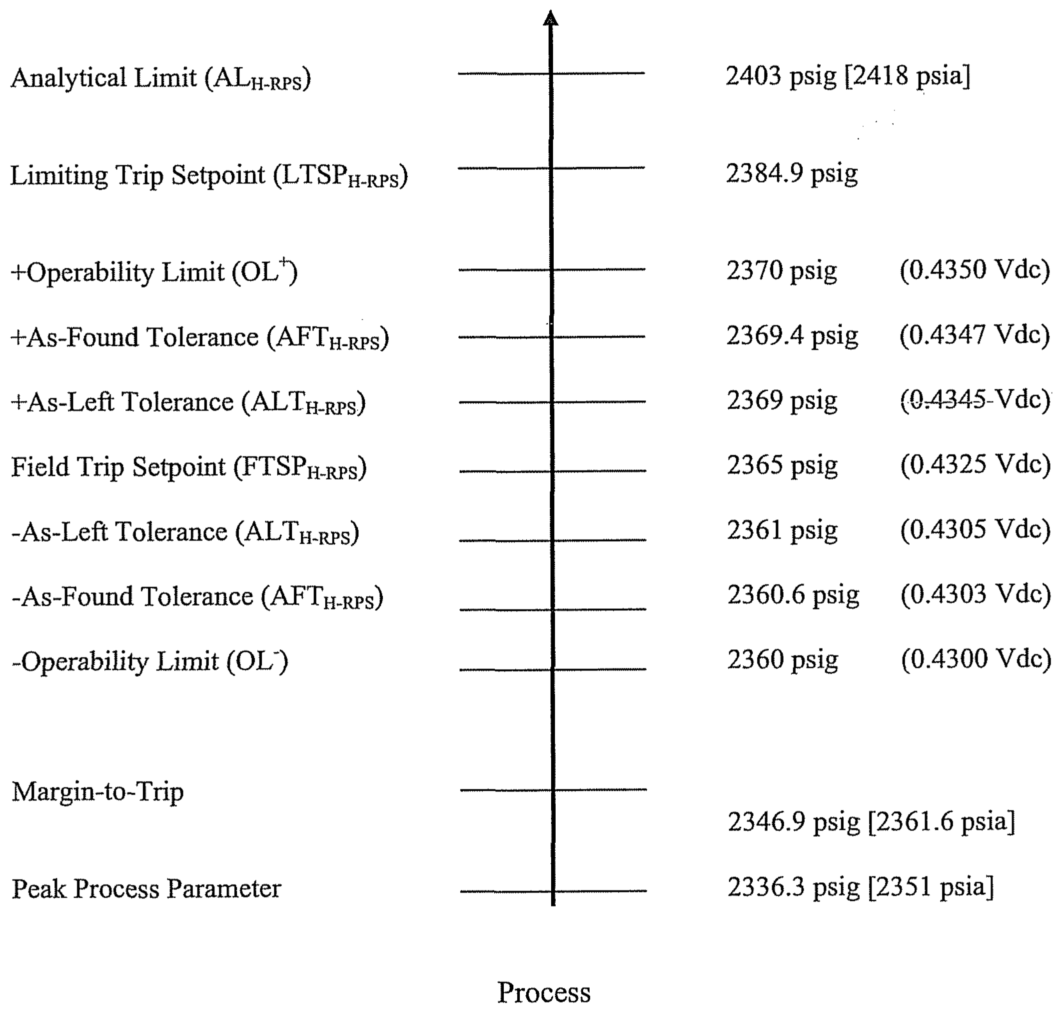


Figure 9.9.1b

High PZR Pressure Reactor Trip Function – EPU
(PC-429A, 430A, 431A)



9.9.2 Low PZR Pressure Reactor Trip Setpoint

Figure 9.9.2a

Low PZR Pressure Reactor Trip Bistable – Current Power Level
(PC-429E, 430H, 431J, 449A)

Process

Peak Process Parameter	2121.3 psig [2136 psia]	
Margin-to-Trip	1943.7 psig [1958.4 psia]	
+Operability Limit (OL^+)	1930 psig	(0.2150 Vdc)
+As-Found Tolerance ($AFT_{L\text{-}RPS}$)	1929.4 psig	(0.2147 Vdc)
+As-Left Tolerance ($ALT_{L\text{-}RPS}$)	1929 psig	(0.2145 Vdc)
Field Trip Setpoint ($FTSP_{L\text{-}RPS}$)	1925 psig	(0.2125 Vdc)
-As-Left Tolerance ($ALT_{L\text{-}RPS}$)	1921 psig	(0.2105 Vdc)
-As-Found Tolerance ($AFT_{L\text{-}RPS}$)	1920.6 psig	(0.2103 Vdc)
-Operability Limit (OL^-)	1920 psig	(0.2100 Vdc)
Limiting Trip Setpoint ($LTSP_{L\text{-}RPS}$)	1833.7 psig	
Analytical Limit ($AL_{L\text{-}RPS\text{-}ROD}$)	1815 psig [1829.7 psia]	
Limiting Trip Setpoint ($LTSP_{L\text{-}RPS\text{-}LOCA}$)	1728.1 psig	
Setpoint Evaluation Starting Limit	1700 psig	
Analytical Limit ($AL_{L\text{-}RPS\text{-}LOCA}$)	1648.0 psig	

Figure 9.9.2b

Low PZR Pressure Reactor Trip Bistable – EPU
(PC-429E, 430H, 431J, 449A)

Process

Peak Process Parameter	2121.3 psig [2136 psia]	
Margin-to-Trip	1943.7 psig [1958.4 psia]	
+Operability Limit (OL^{+})	1930 psig	(0.2150 Vdc)
+As-Found Tolerance ($AFT_{L\text{-}RPS}$)	1929.4 psig	(0.2147 Vdc)
+As-Left Tolerance ($ALT_{L\text{-}RPS}$)	1929 psig	(0.2145 Vdc)
Field Trip Setpoint ($FTSP_{L\text{-}RPS}$)	1925 psig	(0.2125 Vdc)
-As-Left Tolerance ($ALT_{L\text{-}RPS}$)	1921 psig	(0.2105 Vdc)
-As-Found Tolerance ($AFT_{L\text{-}RPS}$)	1920.6 psig	(0.2103 Vdc)
-Operability Limit (OL^{-})	1920 psig	(0.2100 Vdc)
Limiting Trip Setpoint ($LTSP_{L\text{-}RPS}$)	1858.7 psig	
Analytical Limit ($AL_{L\text{-}RPS\text{-}OTPOAX}$)	1840 psig [1854.7 psia]	

9.9.3 Low PZR Pressure SI Actuation Setpoint

Figure 9.9.3

Low PZR Pressure SI Actuation Bistable
(PC-429C, 430E, 431G)

Process

+Operability Limit (OL^+)	1740 psig	(0.1200 Vdc)
+As-Found Tolerance (AFT_{L-SI})	1739.4 psig	(0.1197 Vdc)
+As-Left Tolerance (ALT_{L-SI})	1739 psig	(0.1195 Vdc)
Field Trip Setpoint ($FTSP_{L-SI}$)	1735 psig	(0.1175 Vdc)
-As-Left Tolerance (ALT_{L-SI})	1731 psig	(0.1155 Vdc)
-As-Found Tolerance (AFT_{L-SI})	1730.6 psig	(0.1153 Vdc)
-Operability Limit (OL^-)	1730 psig	(0.1150 Vdc)
Limiting Trip Setpoint ($LTSP_{L-SI}$)	1727.2 psig [1741.9 psia]	
Transmitter Minimum Range Limit	1700 psig [1714.7 psia]	
Analytical Limit ($AL_{L-SI-SLB}$)	1648.3 psig [1663 psia]	
Analytical Limit ($AL_{L-SI-LOCA}$)	1625 psig [1639.7 psia]	

10.0 IMPACT ON PLANT DOCUMENTS

As a result of this minor revision, the following plant documents should be revised as follows:

- 1ICP 02.001RD, "Reactor Protection and Engineered Safety Features Red Channel Analog 92 Day Surveillance Test" (See Attachment A for changes).
- 2ICP 02.001RD, "Reactor Protection and Engineered Safety Features Red Channel Analog 92 Day Surveillance Test" (See Attachment A for changes).
- 1ICP 02.001BL, "Reactor Protection and Engineered Safety Features Blue Channel Analog 92 Day Surveillance Test" (See Attachment A for changes).
- 2ICP 02.001BL, "Reactor Protection and Engineered Safety Features Blue Channel Analog 92 Day Surveillance Test" (See Attachment A for changes).
- 1ICP 02.001WH, "Reactor Protection and Engineered Safety Features White Channel Analog 92 Day Surveillance Test" (See Attachment A for changes).
- 2ICP 02.001WH, "Reactor Protection and Engineered Safety Features White Channel Analog 92 Day Surveillance Test" (See Attachment A for changes).
- 1ICP-02.001YL, "Reactor Protection and Engineered Safety Features Yellow Channel Analog 92 Day Surveillance Test" (See Attachment A for changes).
- 2ICP 02.001YL, Rev. 13, "Reactor Protection and Engineered Safety Features Yellow Channel Analog 92 Day Surveillance Test" (See Attachment A for changes).
- 1ICP 02.020RD, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test" (See Attachment A for changes).
- 2ICP 02.020RD, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test" (See Attachment A for changes).
- 1ICP 02.020BL, "Post-Refueling Pre-Startup RPS and ESF Blue Channel Analog Surveillance Test" (See Attachment A for changes).
- 2ICP 02.020BL, "Post-Refueling Pre-Startup RPS and ESF Blue Channel Analog Surveillance Test" (See Attachment A for changes).
- 1ICP 02.020WH, "Post-Refueling Pre-Startup RPS and ESF White Channel Analog Surveillance Test" (See Attachment A for changes).
- 2ICP 02.020WH, "Post-Refueling Pre-Startup RPS and ESF White Channel Analog Surveillance Test" (See Attachment A for changes).
- 1ICP 02.020YL, "Post-Refueling Pre-Startup RPS and ESF Yellow Channel Analog Surveillance Test" (See Attachment A for changes).
- 2ICP 02.020YL, "Post-Refueling Pre-Startup RPS and ESF Yellow Channel Analog Surveillance Test" (See Attachment A for changes).

- Tech Spec 3.3.1, Table 3.3.1-1, Functions 7.a and 7.b

  After EPU license amendment 261 is approved to make the change, revise the "Pressurizer Pressure – Low" and "Pressurizer Pressure – High" reactor trip Allowable Values to ≥ 1860 psig and ≤ 2380 psig, respectively, and eliminate Notes (h) and (i) in Table 3.3.1-1.

- Tech Spec 3.3.2, Table 3.3.2-1, Function 1d.

  After EPU license amendment 261 is approved to make the change, revise the Safety Injection – Pressurizer Pressure Low Allowable Value from ≥ 1715 psig to ≥ 1730 psig.

- Tech Spec 3.3.2, Table 3.3.2-1, Function 8

  After EPU license amendment 261 is approved to make the change, revise the "SI Unblock – Pressurizer Pressure" Allowable Value from ≤ 1800 psig to ≤ 2005 psig.

- DBD-25 Section A, Revision 3, Figure A.2.2-1 needs to be revised to change the High and Low Pressurizer Pressure Reactor Trip Tech Spec Values to their post-EPU values.

- DBD-27 Revision 5, Table 2-2 needs to be revised to change the High and Low Pressurizer Pressure Reactor Trip Tech Spec Values to their post-EPU values.

11.0 ATTACHMENT LIST

Same as Revision 000 of calculation 2009-0001 except for Attachment A. Revised pages A3, A4, A5 and A6. Added pages A7, A8, A9 and A10. Re-numbered page A7 (original) to A11.

12.0 10CFR 50.59 REVIEW

Same as Revision 000 of calculation 2009-0001. No separate 10CFR50.59 screening is required as a result of this minor revision.

ATTACHMENT A (Page A3)

Section 5.18.1 of 1(2) ICP 02.001BL (Ref. P.2 and P.7) and Section 5.12.1 of 1(2) ICP 02.020BL (Ref. P.24 and P.28). **[CURRENT]**

Pressurizer Pressure	Bistable Light	Process Setpoint psig	Output (PZR Press)			As-Left Limits		As-Found Limits		Operability Limits	
			Setpoint Vdc	As-Found Vdc	As-Left Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
1(2)-PC-431A	High Press Trip	2365	0.4325↑			0.4305	0.4345	0.4303	0.4347	0.4300	0.4350
1(2)-PC-431I/G	SI G I	1735	0.1175↓			0.1155	0.1195	0.1153	0.1197	0.1150	0.1200
1(2)-PC-431I/G	Unblock SI I (G)	1775	0.1375↑			0.1355	0.1395	0.1353	0.1397	0.1350	0.1400
1(2)-PC-431I/G SI Block Enable	Unblock SI I (G) (Light ON)	1765	0.1325↓			0.1305	0.1345	0.1303	0.1347	None	None
			Output (Comp Press)								
1(2)-PC-431J	Low Press Trip	1925	0.2125↓			0.2105	0.2145	0.2103	0.2147	0.2100	0.2150

- High PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-431A ≤ 0.4450 Vdc (≤2390 psig) (Ref: Calculation 2009-0001 Rev 0)
- Low PZR Pressure SI Actuation Function Technical Specification Limit • 1(2)-PC-431G ≥ 0.1150 Vdc (≥ 1730 psig) (Ref: Calculation 2009-0001 Rev. 0A)
- Unblock SI Function Technical Specification Limit • 1(2)-PC-431I ≤ 0.1500 Vdc (≤ 1800 psig) (Ref: Calculation 2009-0001 Rev. 0)
- Low PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-431J ≥ 0.1675 Vdc (≥ 1835 psig) (Ref: Calculation 2009-0001 Rev. 0)

ATTACHMENT A (Page A4)

Section 5.18.1 of 1(2) ICP 02.001RD (Ref. P.3 and P.8) and Section 5.13.1 of 1(2) ICP 02.020RD (Ref. P.25 and P.29). **[CURRENT]**

Pressurizer Pressure	Bistable Light	Process Setpoint psig	Output (PZR Press)			As-Left Limits		As-Found Limits		Operability Limits	
			Setpoint Vdc	As-Found Vdc	As-Left Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
1(2)-PC-429A	High Press Trip	2365	0.4325↑			0.4305	0.4345	0.4303	0.4347	0.4300	0.4350
1(2)-PC-429C/D	SI C ®	1735	0.1175↓			0.1155	0.1195	0.1153	0.1197	0.1150	0.1200
1(2)-PC-429C/D	Unblock SI D (G)	1775	0.1375↑			0.1355	0.1395	0.1353	0.1397	0.1350	0.1400
1(2)-PC-429C/D SI Block Enable	Unblock SI D (G) (Light ON)	1765	0.1325↓			0.1305	0.1345	0.1303	0.1347	None	None
			Output (Comp Press)								
1(2)-PC-429E	Low Press Trip	1925	0.2125↓			0.2105	0.2145	0.2103	0.2147	0.2100	0.2150

- High PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-429A ≤ 0.4450 Vdc (≤ 2390 psig) (Ref: Calculation 2009-0001 Rev 0)
- Low PZR Pressure SI Actuation Function Technical Specification Limit • 1(2)-PC-429C ≥ 0.1150 Vdc (≥ 1730 psig) (Ref: Calculation 2009-0001 Rev. 0A)
- Unblock SI Function Technical Specification Limit • 1(2)-PC-429D ≤ 0.1500 Vdc (≤ 1800 psig) (Ref: Calculation 2009-0001 Rev. 0)
- Low PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-429E ≥ 0.1675 Vdc (≥ 1835 psig) (Ref: Calculation 2009-0001 Rev. 0)

ATTACHMENT A (Page A5)

Section 5.18.1 of 1(2) ICP 02.001WH (Ref. P.4 and P.9) and Section 5.12.1 of 1(2) ICP 02.020WH (Ref. P.26 and P.30). **[CURRENT]**

Pressurizer Pressure	Bistable Light	Process Setpoint psig	Output (PZR Press) Setpoint Vdc	Output (PZR Press) As-Found Vdc	Output (PZR Press) As-Left Vdc	As-Left Limits Low Vdc	As-Left Limits High Vdc	As-Found Limits Low Vdc	As-Found Limits High Vdc	Operability Limits Low Vdc	Operability Limits High Vdc
1(2)-PC-430A	High Press Trip	2365	0.4325↑			0.4305	0.4345	0.4303	0.4347	0.4300	0.4350
1(2)-PC-430E/F	SI E (R)	1735	0.1175↓			0.1155	0.1195	0.1153	0.1197	0.1150	0.1200
1(2)-PC-430E/F	Unblock SI F (G)	1775	0.1375↑			0.1355	0.1395	0.1353	0.1397	0.1350	0.1400
1(2)-PC-430E/F SI Block Enable	Unblock SI F (G) (Light ON)	1765	0.1325↓			0.1305	0.1345	0.1303	0.1347	None	None
			Output (Comp Press)								
1(2)-PC-430H	Low Press Trip	1925	0.2125↓			0.2105	0.2145	0.2103	0.2147	0.2100	0.2150

- High PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-430A ≤ 0.4450 Vdc (≤ 2390 psig) (Ref: Calculation 2009-0001 Rev. 0)
- Low PZR Pressure SI Actuation Function Technical Specification Limit • 1(2)-PC-430E ≥ 0.1150 Vdc (≥ 1730 psig) (Ref: Calculation 2009-0001 Rev. 0A)
- Unblock SI Function Technical Specification Limit • 1(2)-PC-430F ≤ 0.1500 Vdc (≤ 1800 psig) (Ref: Calculation 2009-0001 Rev. 0)
- Low PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-430H ≥ 0.1675 Vdc (≥ 1835 psig) (Ref: Calculation 2009-0001 Rev. 0)

ATTACHMENT A (Page A6)

Section 5.16.1 of 1(2) ICP 02.001YL (Ref. P.5 and P.10) and Section 5.11.1 of 1(2) ICP 02.020YL (Ref. P.27 and P.31). **[CURRENT]**

Pressurizer Pressure	Bistable Light	Process Setpoint psig	Output (PZR Press)			As-Left Limits		As-Found Limits		Operability Limits	
			Setpoint Vdc	As-Found Vdc	As-Left Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
1(2)-PC-449A	Low Press Trip	1925	0..2125↓			0.2105	0.2145	0.2103	0.2147	0.2100	0.2150

- Low Pressurizer Trip Function Technical Specification Limit 1(2)-PC-449A ≥ 0.1675 Vdc (≥ 1835 psig) (Ref: Calculation 2009-0001 Rev. 0)

ATTACHMENT A (Page A7)

Section 5.18.1 of 1(2) ICP 02.001BL (Ref. P.2 and P.7) and Section 5.12.1 of 1(2) ICP 02.020BL (Ref. P.24 and P.28). **[EPU]**

Pressurizer Pressure	Bistable Light	Process Setpoint psig	Output (PZR Press)			As-Left Limits		As-Found Limits		Operability Limits	
			Setpoint Vdc	As-Found Vdc	As-Left Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
1(2)-PC-431A	High Press Trip	2365	0.4325↑			0.4305	0.4345	0.4303	0.4347	0.4300	0.4350
1(2)-PC-431I/G	SI G (R)	1735	0.1175↓			0.1155	0.1195	0.1153	0.1197	0.1150	0.1200
1(2)-PC-431I/G	Unblock SI I (G)	2000	0.2500↑			0.2480	0.2520	0.2478	0.2522	0.2475	0.2525
1(2)-PC-431I/G SI Block Enable	Unblock SI I (G) (Light ON)	1990	0.2450↓			0.2430	0.2470	0.2428	0.2472	None	None
			Output (Comp Press)								
1(2)-PC-431J	Low Press Trip	1925	0.2125↓			0.2105	0.2145	0.2103	0.2147	0.2100	0.2150

- High PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-431A ≤ 0.4400 Vdc (≤ 2380 psig) (Ref: Calculation 2009-0001 Rev 0A)
- Low PZR Pressure SI Actuation Function Technical Specification Limit • 1(2)-PC-431G ≥ 0.1150 Vdc (≥ 1730 psig) (Ref: Calculation 2009-0001 Rev 0A)
- Unblock SI Function Technical Specification Limit • 1(2)-PC-431I ≤ 0.2525 Vdc (≤ 2005 psig) (Ref: Calculation 2009-0001 Rev 0A)
- Low PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-431J ≥ 0.1800 Vdc (≥ 1860 psig) (Ref: Calculation 2009-0001 Rev 0)

ATTACHMENT A (Page A8)

Section 5.18.1 of 1(2) ICP 02.001RD (Ref. P.3 and P.8) and Section 5.13.1 of 1(2) ICP 02.020RD (Ref. P.25 and P.29). [EPU]

Pressurizer Pressure	Bistable Light	Process Setpoint psig	Output (PZR Press)			As-Left Limits		As-Found Limits		Operability Limits	
			Setpoint Vdc	As-Found Vdc	As-Left Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
1(2)-PC-429A	High Press Trip	2365	0.4325↑			0.4305	0.4345	0.4303	0.4347	0.4300	0.4350
1(2)-PC-429C/D	SI C (R)	1735	0.1175↓			0.1155	0.1195	0.1153	0.1197	0.1150	0.1200
1(2)-PC-429C/D	Unblock SI D (G)	2000	0.2500↑			0.2480	0.2520	0.2478	0.2522	0.2475	0.2525
1(2)-PC-429C/D SI Block Enable	Unblock SI D (G) (Light ON)	1990	0.2450↓			0.2430	0.2470	0.2428	0.2472	None	None
			Output (Comp Press)								
1(2)-PC-429E	Low Press Trip	1925	0.2125↓			0.2105	0.2145	0.2103	0.2147	0.2100	0.2150

- High PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-429A ≤ 0.4400 Vdc (≤ 2380 psig) (Ref: Calculation 2009-0001 Rev 0A)
- Low PZR Pressure SI Actuation Function Technical Specification Limit • 1(2)-PC-429C ≥ 0.1150 Vdc (≥ 1730 psig) (Ref: Calculation 2009-0001 Rev 0A)
- Unblock SI Function Technical Specification Limit • 1(2)-PC-429D ≤ 0.2525 Vdc (≤ 2005 psig) (Ref: Calculation 2009-0001 Rev 0A)
- Low PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-429E ≥ 0.1800 Vdc (≥ 1860 psig) (Ref: Calculation 2009-0001 Rev 0)

ATTACHMENT A (Page A9)

Section 5.18.1 of 1(2) ICP 02.001WH (Ref. P.4 and P.9) and Section 5.12.1 of 1(2) ICP 02.020WH (Ref. P.26 and P.30). **[EPU]**

Pressurizer Pressure	Bistable Light	Process Setpoint Psig	Output (PZR Press)			As-Left Limits		As-Found Limits		Operability Limits	
			Setpoint Vdc	As-Found Vdc	As-Left Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
1(2)-PC-430A	High Press Trip	2365	0.4325↑			0.4305	0.4345	0.4303	0.4347	0.4300	0.4350
1(2)-PC-430E/F	SI E (R)	1735	0.1175↓			0.1155	0.1195	0.1153	0.1197	0.1150	0.1200
1(2)-PC-430E/F	Unblock SI F (G)	2000	0.2500↑			0.2480	0.2520	0.2478	0.2522	0.2475	0.2525
1(2)-PC-430E/F SI Block Enable	Unblock SI F (G) (Light ON)	1990	0.2450↓			0.2430	0.2470	0.2428	0.2472	None	None
			Output (Comp Press)								
1(2)-PC-430H	Low Press Trip	1925	0.2125↓			0.2105	0.2145	0.2103	0.2147	0.2100	0.2150

- High PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-430A ≤ 0.4400 Vdc (≤ 2380 psig) (Ref: Calculation 2009-0001 Rev 0A)
- Low PZR Pressure SI Actuation Function Technical Specification Limit • 1(2)-PC-430E 0.1150 Vdc (≥ 1730 psig) (Ref: Calculation 2009-0001 Rev 0A)
- Unblock SI Function Technical Specification Limit • 1(2)-PC-430F ≤ 0.2525 Vdc (≤ 2005psig) (Ref: Calculation 2009-0001 Rev 0A)
- Low PZR Pressure Trip Function Technical Specification Limit • 1(2)-PC-430H ≥ 0.1800 Vdc (≥ 1860 psig) (Ref: Calculation 2009-0001 Rev 0)

Attachment A (Page A10)

Section 5.16.1 of 1(2) ICP 02.001YL (Ref. P.5 and P.10) and Section 5.11.1 of 1 (2) ICP 02.020YL (Ref. P.27and P.31). **[EPU]**

Pressurizer Pressure	Bistable Light	Process Setpoint psig	Output (PZR Press)			As-Left Limits		As-Found Limits		Operability Limits	
			Setpoint Vdc	As-Found Vdc	As-Left Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
1(2)-PC-449A	Low Press Trip	1925	0..2125↓			0.2105	0.2145	0.2103	0.2147	0.2100	0.2150

- Low Pressurizer Trip Function Technical Specification Limit, 1(2)-PC-449A ≥ 0.1800 Vdc (≥ 1860 psig) (Ref: Calculation 2009-0001 Rev. 0)

ENCLOSURE 1

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

LICENSE AMENDMENT REQUEST 261, EXTENDED POWER UPRATE
TRANSMITTAL OF SAMPLE CALCULATIONS FOR
REACTOR PROTECTION SYSTEM / ENGINEERED SAFETY FEATURES
ACTUATION SYSTEM INSTRUMENTATION SETPOINT CALCUATIONS

ATTACHMENT 2

POWER RANGE NUCLEAR INSTRUMENTATION
UNCERTAINTY/SETPOINT CALCULATION

19 pages follow

KCI ENGINEERING CONSULTANTS

CALCULATION TITLE PAGE

Project Number:	441-005	**Client or Station:**	Point Beach Nuclear Station		
Calculation Number:	2009-0002	**Revision Number:**	000-A	**Total Number of Pages:**	19
Title:	Power Range Nuclear Instrumentation Uncertainty/Setpoint Calculation				

☐ **Original Calculation** ☒ **Revised Calculation** ☐ **Cancelled**

☐ **Supersedes Calculation:** ____________________

Nuclear Safety Related:	☒YES ☐NO	**QA Scope:**	☒YES ☐NO
System:	RP		
Date of Issue:	See Approval Date		

SIGNATURES AND DATES

Preparer	Reviewer	Discipline	Name	Signature	Date
☒	☐	I&C	Aijaz Ahmed	[signature]	6/25/10
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☐	☐				

Approver: **Name:** Badar Hussain

Signature: [signature]

Date: 6/25/10

REVISION SUMMARY SHEET

Revision No.	Description of the Revision
000-A	This minor revision incorporates double sided random uncertainties to calculate Limiting Trip Setpoints (LTSP) and revises Field Trip Setpoint (FTSP) for the High Range – High Flux Reactor Trip Setpoint for the EPU condition. All the alpha-numeric changes in this minor revision are marked up revision bars.

CALCULATION TABLE OF CONTENTS

SECTION **PAGE**

1.0 PURPOSE

The purpose of this minor revision is to calculate the Limiting Trip Setpoint (LTSP) for the High/Low – Range – High Flux Reactor Trip Setpoint by applying double sided random uncertainties to the random portion of the Total Loop Error (TLE). This resolves the concern in CAP 01173082.

In addition, as a result of calculating the LTSP for the High Range – High Flux Reactor Trip for EPU, this minor revision also recommends changing the EPU Field Trip Setpoint (FTSP), to avoid the FTSP as-found tolerance from overlapping the LTSP (and corresponding TS Allowable Value). This will allow the LTSP to be rounded to the new TS Allowable Value without the normal as-found tolerance for the field setpoint violating the TS AV.

2.0 ACCEPTANCE CRITERIA

Same as Revision 0 of Calculation 2009-0002.

3.0 ABBREVIATIONS

Same as Revision 0 of Calculation 2009-0002.

4.0 REFERENCES

Same as Revision 0 of Calculation 2009-0002.

5.0 ASSUMPTIONS

Same as Revision 0 of Calculation 2009-0002.

6.0 DESIGN INPUTS

Same as Revision 0 of Calculation 2009-0002.

7.0 METHODOLOGY

Same as Revision 0 of Calculation 2009-0002 except for section 7.2.

7.2 Limiting Trip Setpoint (LTSP) Equation Summary

For setpoints that are based on an Analytical Limit (AL) or Process Limit (PL), a Limiting Trip Setpoint (LTSP) shall be calculated. The LTSP represents the most limiting value a channel trip setpoint can have that will ensure the AL or PL is not exceeded, considering all credible instrument channel errors that can exist between successive calibrations. The LTSP provides the basis for establishing an Allowable Value (AV) in the Technical Specifications.

The LTSP is determined by applying the Total Loop Error (TLE) to the AL or PL. The TLE consists of the combination of 95/95 double-sided random uncertainties and bias uncertainties. The uncertainty value associate with the double-sided distributions is larger than the value associated with the single-sided distributions. Therefore, including double-sided random uncertainties in the TLE is an acceptable, conservative deviation from the guidance in DG-I01 (Reference G.1), which permits smaller single-sided random uncertainties. In 2010, NRC advised Point Beach that the NRC would no longer accept the use of single-sided random uncertainties for determining Limiting Safety System Settings (LSSS) in the plant Technical Specifications. Double-sided uncertainties in the random portion of the TLE term yields a more conservative LTSP value than an LTSP based on single-sided uncertainties. Therefore, a TLE based on double-sided uncertainties is appropriate and acceptable for LSSS values.

Consistent with the methodology of Reference G.1, random and bias portions of the TLE are calculated separately and are then combined using an appropriate sign convention based on the direction that the process variable approaches the setpoint.

For a process variable increasing toward the AL (or PL), the calculated LTSP is as follows:

$$LTSP\uparrow = AL + [\, TLE_{rdm}^{-} + TLE_{bias}^{-} \,] * PS \qquad \text{(Eq. 7.2-1)}$$

For a process variable decreasing towards the AL (or PL), the calculated LTSP is as follows

$$LTSP\downarrow = AL + [\, TLE_{rdm}^{+} + TLE_{bias}^{+} \,] * PS \qquad \text{(Eq. 7.2-2)}$$

8.0 BODY OF CALCULATIONS

Sections, 8.1, 8.2, and 8.3 of the base calculation pertaining to Device Uncertainty Analysis, Device Uncertainty Summary, and Total Loop Errors are not affected by this minor revision.

8.4 Setpoint Evaluations

8.4.1 Power Range High Range High Flux Reactor Trip Setpoint Evaluation - Current Power Level

For an increasing setpoint towards the Analytical Limit, Eq. 7.2-1 is used.

$$LTSP_{HR} = AL + [TLE_{TRIP\text{-}rdm}^{-} + TLE_{TRIP\text{-}bias}^{-}]*PS$$

where,

AL	= 118% RTP	Section 6.5
$TLE_{TRIP\text{-}rdm}^{-}$	= -6.342% span	Section 8.3.1
$TLE_{TRIP\text{-}bias}^{-}$	= 0.000% span	Section 8.3.1
PS	= 120% RTP	

Substituting,

$$LTSP_{HR} = 118\% \text{ RTP} + [-6.342\% \text{ span} + 0.000\% \text{ span}]*120\% \text{ RTP}$$

$LTSP_{HR}$ = 110.4% RTP **(95/95)**

The margin between LTSP and FTSP is calculated as follows:

Margin= LTSP – FTSP

where,

LTSP	= 110.4% RTP	
FTSP	= 107% RTP	Section 6.5

Substituting,

Margin= 110.4% RTP – 107% RTP

Margin = 3.4% RTP

8.4.2 Power Range High Range High Flux Reactor Trip Setpoint Evaluation – EPU

For an increasing setpoint towards the Analytical Limit, Eq. 7.2-1 is used.

$$LTSP_{HR} = AL_{EPU} + [TLE_{TRIP\text{-}rdm}^{-} + TLE_{TRIP\text{-}bias}^{-}]*PS$$

where,

AL_{EPU}	= 116% RTP	Section 6.5
$TLE_{TRIP\text{-}rdm}^{-}$	= -6.342% span	Section 8.3.1

$TLE_{TRIP\text{-}bias}^{-}$ = 0.000% span Section 8.3.1
PS = 120% RTP

Substituting,

$LTSP_{HR}$ = 116% RTP + [-6.342% span + 0.000% span]*120% RTP

$LTSP_{HR}$ = 108.4% RTP **(95/95)**

From Section 6.5, the existing Field Trip Setpoint (FTSP) for High Range High Flux Reactor Trip Setpoint is 107% RTP. The existing FTSP value is conservative to the calculated LTSP value of 108.4% RTP; however, the upper As-Found value for an FTSP of 107% RTP would overlap the LTSP, making the LTSP unusable as the basis for the TS Allowable Value. Therefore, to prevent overlap between the new LTSP and the FTSP as-found tolerance, a lower FTSP of 106% RTP is recommended for EPU to meet the acceptance criteria outlined in Section 2.2 of the base calculation and to allow using the LTSP as the basis for the EPU TS Allowable Value.

The margin between LTSP and the recommended FTSP is calculated as follows:

Margin= LTSP – FTSP

where,

LTSP = 108.4% RTP
FTSP = 106% RTP (Recommended FTSP)

Substituting,

Margin = 108.4% RTP – 106% RTP

Margin = 2.4% RTP

8.4.3 Power Range Low Range High Flux Reactor Trip Setpoint Evaluation (For both Current Power Level and EPU)

For an increasing setpoint towards the Analytical Limit, Eq. 7.2-1 is used.

$LTSP_{LR}$ = AL + [$TLE_{TRIP\text{-}rdm}^{-}$ + $TLE_{TRIP\text{-}bias}^{-}$]*PS

where,

AL = 35% RTP Section 6.5
$TLE_{TRIP\text{-}rdm}^{-}$ = -6.342% span Section 8.3.1
$TLE_{TRIP\text{-}bias}^{-}$ = 0.000% span Section 8.3.1

PS = 120% RTP

Substituting,

$LTSP_{LR}$ = 35% RTP + [-6.342% span + 0.000% span]*120% RTP

$LTSP_{LR}$ = 27.4% RTP **(95/95)**

The margin between LTSP and FTSP is calculated as follows:

Margin = LTSP – FTSP

where,

LTSP = 27.4% RTP
FTSP = 20% RTP Section 6.5

Substituting,

Margin = 27.4% RTP – 20% RTP

Margin = 7.4% RTP

8.4.4 Permissive Setpoint Evaluation

The Permissive Setpoint Evaluation performed in the base calculation is not affected by this minor revision.

8.5 Operability Limit Determination

Same as Revision 0 of Calculation 2009-0002, except for sections 8.5.1 and 8.5.2.

8.5.1.1 High Range – High Flux Reactor Trip Operability Limit – Current Power Level

Same as Revision 0 of Calculation 2009-0002, except for following changes:

From Section 8.4.1, the Limiting Trip Setpoint for the High Range – High Flux Reactor Trip is **110.4% RTP**. For this increasing trip, the OL^+ value of 110% is more conservative (i.e., restrictive) than the LTSP. Per Section 2.2, with margin between the OL^+ value and the LTSP, the OL^+ value is acceptable to use for channel operability determination during COT.

8.5.1.2 High Range – High Flux Reactor Trip Operability Limit – EPU

Using Equation 7.1.5-3 to determine the COT 3σ drift value,

$Rd_{3\sigma} = (1.5)\, Rd_{2\sigma}$ (Eq. 7.1.5-3)

$Rd_{3\sigma} = (1.5)\, 2.0$ % span ($Dd_{2\sigma}$ from Section 8.1.11)

$Rd_{3\sigma} = \pm 3.0$ % span

The recommended FTSP for the high range - high flux trip of 106% (Section 8.4.2), expressed as percent span, is:

FTSP = 106 ÷ 120% = 88.33 % span

Using Equation 7.1.5-1, the OL^+ is determined as:

$OL^+ = FTSP + [RAL^2 + Rd_{3\sigma}{}^2]^{1/2}$ (Eq. 7.1.5-1)

$OL^+ = 88.33\,\% + (0.833^2 + 3.0^2)^{1/2}$ (RAL is Dv_2 from Section 8.1.13)
$OL^+ = 88.33\,\% + 3.11$
$OL^+ = 91.44$ % span

Expressed in % RTP, $OL^+ = (0.9144 * 120\%) = 109.72\%$

Note that the OL^+ value calculated above for the recommended FTSP of 106% RTP is greater than the LTSP value of 108.4 % RTP calculated in section 8.4.2. The LTSP will be conservatively rounded down to determine the TS Allowable Value. Because the TS AV must be used to determine operability of the channel when the calculated OL^+ exceeds the LTSP, a default OL^+ value to be used in the calibration procedures will be the TS AV, rather than the larger calculated OL^+.

For readability in the calibration procedures, the default OL^+ will be conservatively rounded down to the nearest whole percent. Therefore, the default OL^+ = **108%.**

Using Equation 7.1.5-2, the OL^- is determined as:

$OL^- = FTSP - [RAL^2 + Rd_{3\sigma}{}^2]^{1/2}$ (Eq. 7.1.5-2)

$OL^- = 88.33\,\% - (0.833^2 + 3.0^2)^{1/2}$
$OL^- = 88.33\,\% - 3.11$
$OL^- = 85.22$ % span

Expressed in % RTP, $OL^- = (0.8522 * 120\%) = 102.26\%$

For readability in the calibration procedures, the OL^- is conservatively rounded up to the nearest whole percent. Therefore, OL^- = **103%**.

Because the High Range – High Flux Reactor Trip is an increasing trip, the OL^+ value of 108% should be the limit compared to the COT as-found value to determine Technical Specification operability of the channel. However, an as-found value outside either the OL^+ or OL^- indicates that the channel is operating abnormally.

8.5.2 Low Range – High Flux Reactor Trip Operability Limit

Same as Revision 0 of Calculation 2009-0002, except for following changes:

From Section 8.4.3, the Limiting Trip Setpoint for the Low Range – High Flux Reactor Trip is **27.4% RTP**. For this increasing trip, the OL^+ value of 23% is more conservative (i.e., restrictive) than the LTSP. Per Section 2.2, with margin between the OL^+ value and the LTSP, the OL^+ value is acceptable to use for channel operability determination during COT.

9.0 RESULTS AND CONCLUSIONS WITH LIMITATIONS

9.1 Total Loop Error

Same as Revision 0 of Calculation 2009-0002.

9.2 Analytical Limits

Same as Revision 0 of Calculation 2009-0002.

9.3 Limiting Trip Setpoints, Operability Limits (OL), and Recommended Tech Spec Changes

Same as Revision 0 of Calculation 2009-0002, except Table 9.3-1

Table 9.3-1 Operability Limits

Function	FTSP	Recommended OL+ and OL-	Reference
High Range – High Flux Reactor Trip (Existing)	107%↑ RTP	OL+ 110% RTP OL- 104% RTP	**Section 8.5.1.1**
Low Range – High Flux Reactor Trip	20%↑ RTP	OL+ 23% RTP OL- 17% RTP	**Section 8.5.2**
Permissive P-7 Unblock	10%↑ RTP	OL+ 13% RTP OL- 7% RTP	**Section 8.5.3**
Permissive P-8 Unblock – for existing power level	50%↑ RTP	OL+ 53% RTP OL- 47% RTP	**Section 8.5.3**
Permissive P-9 Unblock – for existing power level	50%↑ RTP	OL+ 53% RTP OL- 47% RTP	**Section 8.5.3**
Permissive P-10 Unblock	9%↓ RTP	OL+ 12% RTP OL- 6% RTP	**Section 8.5.3**
EPU Changes:			
High Range – High Flux Reactor Trip (EPU)	106%↑ RTP	OL+ 108% RTP OL- 103% RTP	**Sections 8.4.2 and 8.5.1.2**
Permissive P-8 Unblock	35%↑ RTP	OL+ 38% RTP OL- 32% RTP	**Section 8.5.3**
Permissive P-9 Unblock – for Tavg < 572°F	35%↑ RTP	OL+ 38% RTP OL- 32% RTP	**Section 8.5.3**
Permissive P-9 Unblock – for Tavg ≥ 572°F	50%↑ RTP	OL+ 53% RTP OL- 47% RTP	**Section 8.5.3**

9.4 Set Point Evaluation

Same as Revision 0 of Calculation 2009-0002, except Table 9.4.1

Table 9.4.1, Trip Setpoints

Function	Limiting Trip Setpoint	Recommended TS Allowable Value	Existing/Recommended Field Trip Setpoint	Margin	Reference
High-Range – High Flux Trip @ Current Power Level	110.4% RTP	≤ 110% RTP	107%↑ RTP	3.4% RTP	Section 8.4.1
High-Range – High Flux Trip @ EPU level	108.4% RTP	≤ 108% RTP	106%↑ RTP (Recommended)	2.4% RTP	Section 8.4.2
Low Range – High Flux Trip	27.4% RTP	≤ 27% RTP	20%↑ RTP	7.4% RTP	Section 8.4.3
Rod Withdrawal Stop	N/A	N/A	105%↑ RTP	N/A	Section 8.4.5

9.5 Acceptable As-Left and As-Found Tolerances

Same as Revision 0 of Calculation 2009-0002.

9.6 Channel Check Tolerance

Same as Revision 0 of Calculation 2009-0002.

9.7 Limitations

Same as Revision 0 of Calculation 2009-0002.

9.8 Graphical Representation of Setpoints

Same as Revision 0 of Calculation 2009-0002, except for Figures 9.8.1, 9.8.2, and 9.8.3.

Figure 9.8.1, High Range - High Flux Reactor Trip Setpoint for Current Power Level

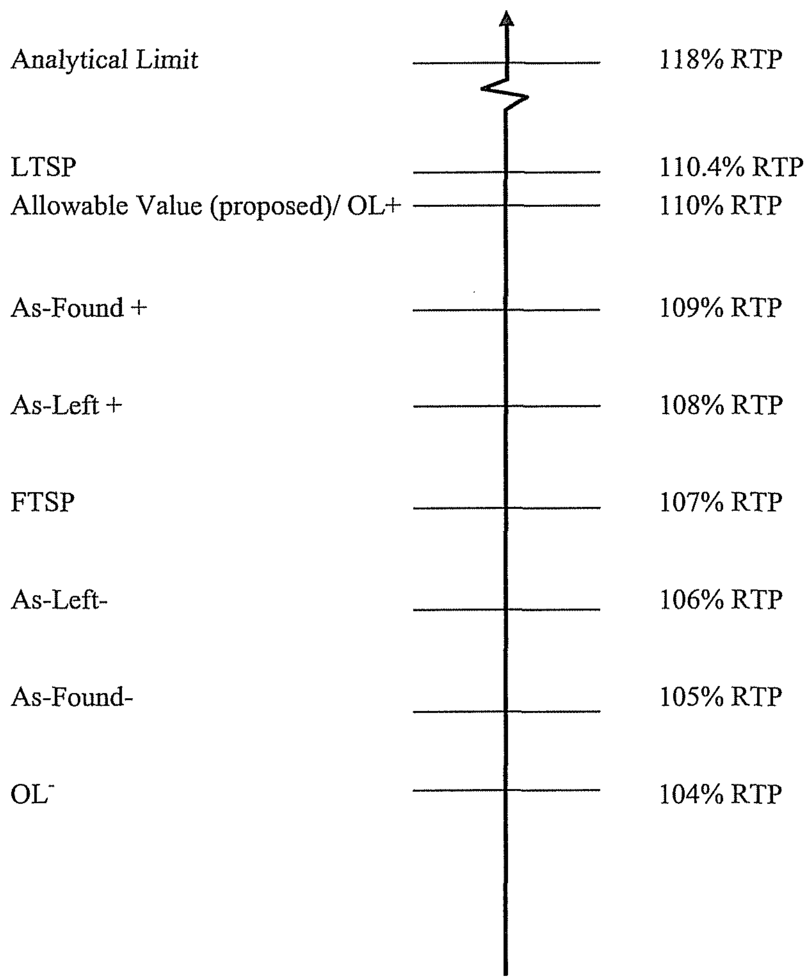


Figure 9.8.2, High Range - High Flux Reactor Trip Setpoint for Extended Power Uprate

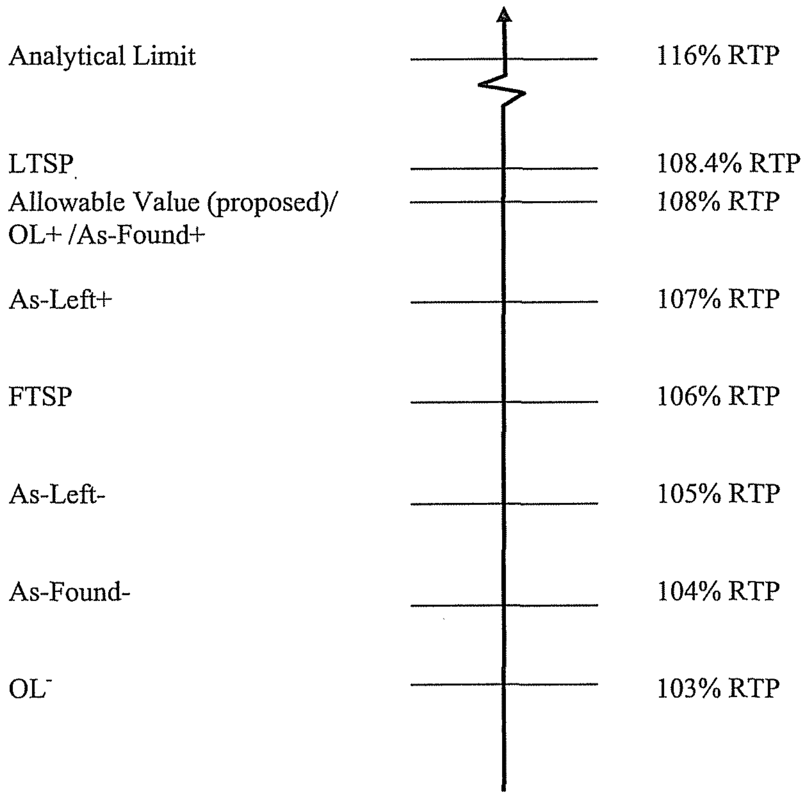
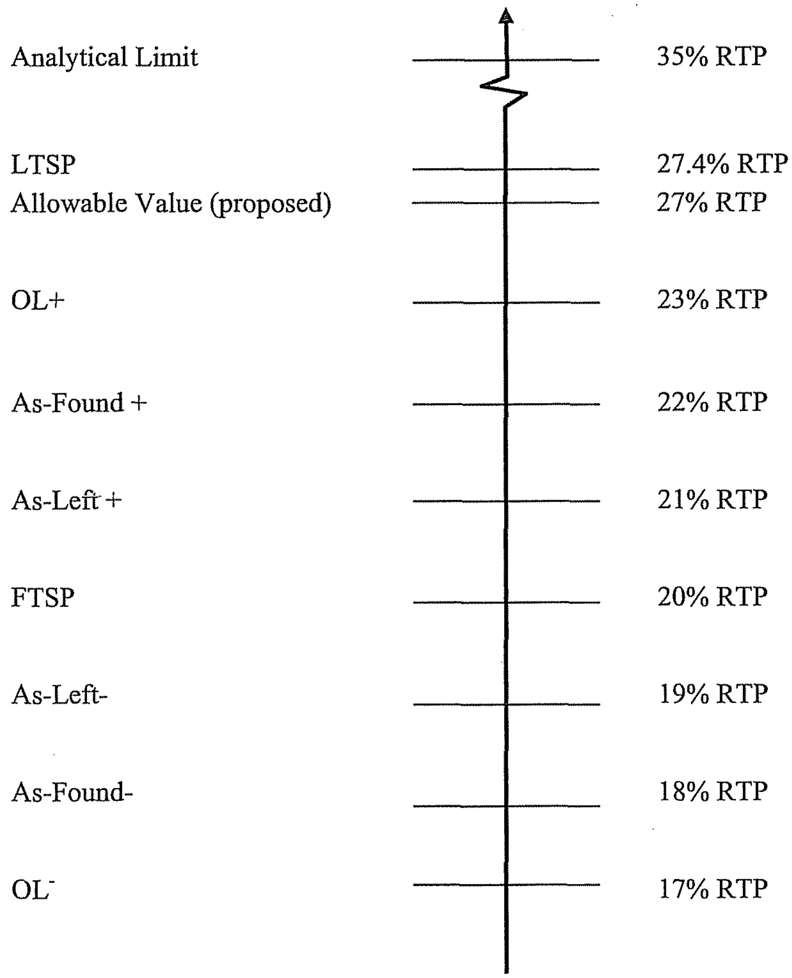


Figure 9.8.3, Low Range - High Flux Reactor Trip Setpoint



10.0 IMPACT ON PLANT DOCUMENTS

The following Plant documents are affected by this minor revision.

- Setpoint Document, STPT 1.1, "Reactor Trip NIS, Unit 1"

  For EPU, the High Range – High Flux setpoint should be changed per Section 9.4.

- Setpoint Document, STPT 1.1, "Reactor Trip NIS, Unit 2"

  For EPU, the High Range – High Flux setpoint should be changed per Section 9.4.

When EPU License Amendment 261 is approved, the following six ICPs need to be revised to incorporate the new EPU values for the TS Allowable Values, the new FTSP for the High Range – High Flux bistables for loops N-41 through N-44, and the corresponding as-left and as-found tolerances and Operability Limits. See Attachment B for marked up ICP data sheet changes.

- 1ICP 02.007, "Nuclear Instrumentation Power Range Channels 92 Day Channel Operational Test" (See Attachment B for changes).
- 2ICP 02.007, "Nuclear Instrumentation Power Range Channels 92 Day Channel Operational Test" (See Attachment B for changes).
- 1ICP 02.022, "Nuclear Instrumentation System Power Range Channels Shutdown operational Test" (See Attachment B for changes).
- 2ICP 02.022, "Nuclear Instrumentation System Power Range Channels Shutdown operational Test" (See Attachment B for changes).
- 1ICP 02.008-3, "Nuclear Instrumentation Power Range Channels Overpower Trip High Range Adjustment"
- 2ICP 02.008-3, "Nuclear Instrumentation Power Range Channels Overpower Trip High Range Adjustment"
- Technical Specification 3.3.1 "Reactor Protection System (RPS) Instrumentation" Table 3.3.1-1 Functions 2.a and 2.b.

  When EPU License Amendment 261 is approved, new Allowable Values for Low Range – High Flux, High Range – High Flux determined in this calculation should be incorporated in Table 3.3.1-1.

11.0 ATTACHMENT LIST

Same as Revision 0 of Calculation 2009-0002, except Attachment B. See the attached pages for the changes in Attachment B.

12.0 10CFR 50.59 REVIEW

10CFR 50.59 screening SCR 2007-0078-00 performed for the base calculation is also applicable to this minor revision. Therefore, no additional 50.59 screening is required.

Attachment B

Changes to Attachment B are as follows:

1(2) ICP 02.007 Series – Current Power Level
New limits for N-41 Red Channel I, N-42 White Channel II, N-43 Blue Channel III, and N-44 Yellow Channel IV

Bistable NC305	OUTPUT			LIMITS					
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %		Operability Limits %	
Overpower Low Setpoint Trip	20.0 ↑			18.0	22.0	19.0	21.0	17.0	23.0
• TECHNICAL SPECIFICATION LIMIT ≤ 27%									

1(2) ICP 02.007 Series – Extended Power Uprate Level
New limits for N-41 Red Channel I, N-42 White Channel II, N-43 Blue Channel III, and N-44 Yellow Channel IV

Bistable NC305	OUTPUT			LIMITS					
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %		Operability Limits %	
Overpower Low Setpoint Trip	20.0 ↑			18.0	22.0	19.0	21.0	17.0	23.0
• TECHNICAL SPECIFICATION LIMIT ≤ 27%									

Bistable NC306	OUTPUT			LIMITS					
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %		Operability Limits %	
Overpower High Setpoint Trip	106.0 ↑			104.0	108.0	105.0	107.0	103.0	108.0
• TECHNICAL SPECIFICATION LIMIT ≤ 108%									

Attachment B

1(2) ICP 02.022 Series – Current Power Level

New limits for N-41 Red Channel I, N-42 White Channel II, N-43 Blue Channel III, and N-44 Yellow Channel IV

Bistable NC305	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
Overpower Low Setpoint Trip	20.0% ↑			18.0%	22.0%	19.0%	21.0%	17.0%	23.0%
• TECHNICAL SPECIFICATION LIMIT ≤ 27%									

1(2) ICP 02.022 Series – Extended Power Uprate Level

New limits for N-41 Red Channel I, N-42 White Channel II, N-43 Blue Channel III, and N-44 Yellow Channel IV

Bistable NC305	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
Overpower Low Setpoint Trip	20.0% ↑			18.0%	22.0%	19.0%	21.0%	17.0%	23.0%
• TECHNICAL SPECIFICATION LIMIT ≤ 27%									

Bistable NC306	OUTPUT		LIMITS	
	SETPOINT	AS-FOUND	LOW	HIGH
*Overpower High Setpoint Trip	106.0% ↑		104.0%	108.0%
• TECHNICAL SPECIFICATION LIMIT ≤ 108%				

Bistable NC306	OUTPUT		LIMITS	
	SETPOINT	AS-LEFT	LOW	HIGH
*Overpower High Setpoint Trip	85.0% ↑		84.0%	86.0%
Reset	83.0% ↓		82.0%	83.0%
• TECHNICAL SPECIFICATION LIMIT ≤ 108%				

ENCLOSURE 1

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

LICENSE AMENDMENT REQUEST 261, EXTENDED POWER UPRATE TRANSMITTAL OF SAMPLE CALCULATIONS FOR REACTOR PROTECTION SYSTEM / ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION SETPOINT CALCUATIONS

ATTACHMENT 3

LOW RANGE CONTAINMENT PRESSURE UNCERTAINTY/SETPOINT CALCULATION

16 pages follow

KCI ENGINEERING CONSULTANTS

CALCULATION TITLE PAGE

Project Number:	441-005	Client or Station:	Point Beach Nuclear Station		
Calculation Number:	PBNP-IC-17	Revision Number:	003-A	Total Number of Pages:	16
Title:	Low Range Containment Pressure Instrument Uncertainty/Setpoint				

☐ Original Calculation ☒ Revised Calculation ☐ Cancelled

☐ Supersedes Calculation: ______________________

Nuclear Safety Related:	☒YES ☐NO	QA Scope:	☒YES ☐NO
System:	ESF		
Date of Issue:	See Approval Date		

SIGNATURES AND DATES

Preparer	Reviewer	Discipline	Name	Signature	Date
☒	☐	I&C	Aijaz Ahmed	[signature]	6/25/10
☐	☒	I&C	Saravanan Makayee	[signature]	6/25/10
☐	☐				
☐	☐				
☐	☐				
☐	☐				
☐	☐				

Approver: Name: Badar Hussain

Signature: [signature]

Date: 6/25/10

REVISION SUMMARY SHEET

Revision No.	Description of the Revision
003-A	This minor Revision incorporates double sided random uncertainties to calculate Limiting Trip Setpoints (LTSP) and revises the Field Trip Setpoint for the High Containment Pressure – SI Setpoint. All the alpha-numeric changes made in this minor revision are marked with revision bars.

CALCULATION TABLE OF CONTENTS

SECTION **PAGE**

1.0 PURPOSE

The purpose of this minor revision is to calculate the Limiting Trip Setpoint (LTSP) for the Low Range Containment Pressure trips by applying double sided random uncertainties to the random portion of the Total Loop Error (TLE). This resolves the concern raised in CAP 01173082.

2.0 ACCEPTANCE CRITERIA

Same as Revision 3 of Calculation PBNP-IC-17.

3.0 ABBREVIATIONS

Same as Revision 3 of Calculation PBNP-IC-17.

4.0 REFERENCES

Same as Revision 3 of Calculation PBNP-IC-17.

5.0 ASSUMPTIONS

Same as Revision 3 of Calculation PBNP-IC-17.

6.0 DESIGN INPUTS

Same as Revision 3 of Calculation PBNP-IC-17.

7.0 METHODOLOGY

7.1 Uncertainty Determination

Same as Revision 3 of Calculation PBNP-IC-17 except for section 7.1.6.

7.1.6 Limiting Trip Setpoint (LTSP) Equation summary

The LTSP is determined by applying the Total Loop Error (TLE) to the AL or PL. The TLE consists of the combination of 95/95 double-sided random uncertainties and bias uncertainties. The uncertainty value associated with the double-sided distributions is larger than the value associated with the single-sided distributions. Therefore, including double-sided random uncertainties in the TLE is an acceptable, conservative deviation from the guidance in DG-I01 (Reference G.1), which permits smaller single-sided random uncertainties.

In 2010, NRC advised Point Beach that the NRC would no longer accept the use of single-sided random uncertainties for determining Limiting Safety System Settings (LSSS) in the plant Technical Specifications. Double-sided uncertainties in the random portion of the TLE term yields a more conservative LTSP value than an LTSP based on single-sided uncertainties. Therefore, a TLE based on double-sided uncertainties is appropriate and acceptable for LSSS values.

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

$$LTSP\uparrow = AL + [TLE_{rdm}^{-} + TLE_{bias}^{-}]*PS \quad \text{(Eq. 7.1.6-1)}$$

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

$$LTSP\downarrow = AL + [TLE_{rdm}^{+} + TLE_{bias}^{+}]*PS \quad \text{(Eq. 7.1.6-2)}$$

7.2 Drift Consideration

Same as Revision 3 of Calculation PBNP-IC-17.

8.0 BODY OF CALCULATION

8.1 Determination of Process Error

Same as Revision 3 of Calculation PBNP-IC-17.

8.2 Device Uncertainty Analysis

Same as Revision 3 of Calculation PBNP-IC-17.

8.3 Device Uncertainty Summary

Same as Revision 3 of Calculation PBNP-IC-17.

8.4 Total Loop Errors

Same as Revision 3 of Calculation PBNP-IC-17.

8.5 Acceptable As -Left and As-Found Tolerances

Same as Revision 3 of Calculation PBNP-IC-17.

8.6 Setpoint Evaluations

8.6.1 High Containment Pressure – Safety Injection and Condensate Isolation Actuation Setpoint Evaluation

For an increasing setpoint towards Analytical Limit, Equation 7.1.6-1 is used.

$$LTSP = AL - TLE_{TRIP}$$

Where:

AL	= 6 psig	Section 6.5
TLE_{TRIP}	= ± 0.808 psi	Section 8.4.1

Substituting,

LTSP = 6 – 0.808 psi

LTSP = 5.192 psig **(95/95)**

From Section 6.5, the existing Field Trip Setpoint (FTSP) for High Containment Pressure – Safety Injection and High Containment Pressure – Condensate Isolation is 5 psig. While the existing FTSP is conservative compared to the calculated LTSP, it is non-conservative considering the Operability Limits (i.e., 5.24 psig from base calculation) based on the existing FTSP of 5 psig. Therefore, to prevent an overlap between the new LTSP and the OL values, a new FTSP of 4.8 psig is recommended in accordance with Section 2.0 for High Containment Pressure – Safety Injection and Condensate Isolation trip.

The margin between LTSP and the recommended FTSP is calculated as follows.

Margin = LTSP – FTSP

Where:

LTSP = 5.192 psig
FTSP = 4.8 psig

Substituting,

Margin = 5.192 psig – 4.8 psig

Margin = 0.392 psi

8.6.2 High-High Containment Pressure – Containment Spray Trip Setpoint Evaluation

For an increasing setpoint towards Analytical Limit, Equation 7.1.6-1 is used.

$LTSP = AL - TLE_{TRIP}$

Where:

AL = 30 psig — Section 6.5
TLE_{TRIP} = ± 0.808 psi — Section 8.4.1

Substituting,

LTSP = 30 – 0.808 psi

LTSP = 29.192 psig **(95/95)**

From Section 6.5, the Field Trip Setpoint (FTSP) for High-High Containment Pressure – Containment Spray Actuation setpoint is 25 psig. The FTSP is conservative compared to the calculated LTSP. Per Section 2.0, this setpoint is acceptable, and may be retained.

The margin between LTSP and FTSP is calculated as follows.

Margin = LTSP – FTSP

Where:

LTSP = 29.192 psig
FTSP = 25.0 psig Section 6.5

Substituting,

Margin = 29.192 psig – 25.0 psig

Margin = 4.192 psi

8.7 Operability Limit (OL) Evaluation

Same as Revision 3 of Calculation PBNP-IC-17 except section 8.7.1.

8.7.1 High containment Pressure – Safety Injection and Condensate Isolation Actuation Operability Limit Evaluation

Using Equation 7.1.7-3 to determine the bistable 3σ drift value,

$Rd_{3\sigma} = (1.5)\ Rd_{2\sigma}$ (Eq. 7.1.7-3)

$Rd_{3\sigma} = (1.5)\ 0.212$ % span ($Rd_{2\sigma}$ from Section 8.2.13)

$Rd_{3\sigma} = \pm\ 0.318$ % span

For the transmitter range of -6 psig to 54 psig, the recommended FTSP for the high containment pressure–safety injection and condensate isolation actuation of 4.8 psig, expressed as percent span is:

$FTSP = ([4.8 - (-6)] \div 60) * 100 = 18.0$ % span

Using Equation 7.1.7-1, the OL^+ is determined as:

$OL^+ = FTSP + [BAL^2 + Rd_{3\sigma}^2]^{1/2}$ (Eq. 7.1.7-1)
$OL^+ = 18.0\ \% + (0.250^2 + 0.318^2)^{1/2}$ (BAL from Section 8.5.1.2)
$OL^+ = 18.0\ \% + 0.405$
$OL^+ = 18.405\%$ span

Expressed in psig, $OL^+ = (0.18405 * 60) + (-6) =$ **5.04 psig**

Using Equation 7.1.7-2 the OL^- is determined as:

$OL^- = FTSP - [BAL^2 + Rd_{3\sigma}^2]^{½}$ (Eq. 7.1.7-2)
$OL^- = 18.0\% - (0.250^2 + 0.318^2)^{½}$ (BAL from Section 8.5.1.2)
$OL^- = 18.0\% - 0.405$
$OL^- = 17.595\%$ span

Expressed in psig, OL^- = (0.17928 * 60) + (-6) = **4.56 psig**

Because the High Containment Pressure – Safety Injection and Condensate Isolation actuation is an increasing trip, the positive OL^+ value of 5.04 psig should be the limit compared to the COT as-found value to determine Technical Specification operability of the channel. However, an as-found value found outside either the OL^+ or OL^- indicates that the channel is operating abnormally.

8.8 Channel Check Tolerances

Same as Revision 3 of Calculation PBNP-IC-17.

8.9 Scaling

Same as Revision 3 of Calculation PBNP-IC-17 except section 8.9.1.

8.9.1 High Containment Pressure – Safety Injection and Condensate Isolation FTSP and Operability Limits

From Table 6.3-1, the model number of the transmitters is Foxboro N-E11GM-HIB1-BEL/AEL. From Reference V.2, the transmitters have a 10 to 50 mAdc output range corresponding to an input of –6 to 54 psig (Ref. P.3 and P.4).

$m = (y_2 - y_1) / (x_2 - x_1)$ Equation 7.1.8-2

Where:

x_1 = -6 psig
x_2 = 54 psig
y_1 = 10 mAdc
y_2 = 50 mAdc

Substituting,

m = [(50 mAdc) - (10 mAdc)] / [(54 psig) - (-6 psig)]
m = 40 mAdc/ 60 psi

Solving for the equivalent signal in mAdc corresponding to the FTSP of 4.8 psig

$y = m*(x - x_1) + y_1$ Equation 7.1.8-3

Where:

x = 4.8 psig Section 8.6.1
x_1 = -6 psig
y = FTSP (mAdc)
y_1 = 10 mAdc

Substituting,

y = [(40 mAdc/ 60 psi) * (4.8 psig – (-6 psig))] + 10 mAdc

y = 17.20 mAdc

Converting to Vdc due to a 10 Ω resistor across the calibration point (Ref. D.12 through D.17)

y = 17.3 mAdc * 10 Ω / 1000 mVdc per Vdc

y = 0.172 Vdc

For an OL^+ of 5.04 psig (Section 8.7.1) the equivalent equation is:

$y = m * (x - x_1) + y_1$ Equation 7.1.8-3

Where:

x = 5.04 psig
x_1 = -6 psig
y = OL^+ (mAdc)
y_1 = 10 mAdc

Substituting,

y = [(40 mAdc/ 60 psi) * (5.04 psig – (-6 psig))] + 10 mAdc

y = 17.36 mAdc

Converting to Vdc due to a 10 Ω resistor across the calibration point (Ref. D.12 through D.17)

y = 17.36 mAdc * 10 Ω / 1000 mVdc per Vdc

y = 0.1736 Vdc

For an OL^- of 4.56 psig (Section 8.7.1) the equivalent equation is:

$y = m * (x - x_1) + y_1$ Equation 7.1.8-3

where:

$x = 4.56$ psig
$x_1 = -6$ psig
$y = OL^-$ (mAdc)
$y_1 = 10$ mAdc

Substituting,

$y = [(40 \text{ mAdc}/ 60 \text{ psi}) * (4.56 \text{ psig} - (-6 \text{ psig}))] + 10 \text{ mAdc}$

$y = 17.04$ mAdc

Converting to Vdc due to a 10 Ω resistor across the calibration point (Ref. D.12 through D.17)

$y = 17.04 \text{ mAdc} * 10\ \Omega / 1000 \text{ mVdc per Vdc}$

$y = 0.1704$ Vdc

Table 8.9-1

1(2)PC-945A/B, 947A/B, 949A/B – High Containment Pressure Bistable Calibration – Safety Injection and Condensate Isolation

Function	Input (psig)	Output (mAdc)	Output (Vdc)
OL+	5.04	17.36	0.1736
FTSP↑	4.8	17.20	0.1720
OL-	4.56	17.04	0.1704

9.0 RESULTS AND CONCLUSIONS, WITH LIMITATIONS

9.1 Analytical Limits (AL)

Same as Revision 3 of Calculation PBNP-IC-17.

9.2 Operability Limits (OL)

Same as Revision 3 of Calculation PBNP-IC-17, except for the following changes:

For recommended Technical Specification values for High Containment Pressure - Safety Injection/Condensate Isolation and Containment Spray, see Section 9.3.

Table 9.2-1 Operability Limits

Function	Calculated OL^+ and OL^-	Reference
High containment pressure – Safety Injection and Condensate Isolation Actuation	OL^+ 5.04 psig OL^- 4.56 psig	**Section 8.7.1**
High-High Containment Pressure – Containment Spray	OL^+ 25.24 psig OL^- 24.76 psig	**Section 8.7.2**

9.3 Limiting Trip Setpoints (LTSP) and Field Trip Setpoints (FTSP)

This calculation has determined a new Field Trip Setpoint (FTSP) for High Containment Pressure – Safety Injection and Condensate Isolation trip. PBNP should evaluate the proposed FTSP of 4.8 psig for adequacy.

This calculation has determined that the Field Trip Setpoint (FTSP) for High-High Containment Pressure – Containment Spray trip is conservative with respect to the calculated LTSP and may be retained.

Table 9.3-1 Limiting Trip Setpoints/Field Trip Setpoints

ESFAS Function	Calculated LTSP	FTSP	Margin	Reference
High Containment Pressure – Safety Injection and Condensate Isolation	**5.192 psig (†)**	**4.8 psig**	**0.392 psi**	**Section 8.6.1**
High-High Containment Pressure – Containment Spray	**29.192 psig (†)**	**25 psig**	**4.192 psi**	**Section 8.6.2**

Note †: Based on the calculated LTSPs, it is recommended that the Technical Specification 3.3.2 Allowable Values for High Containment Pressure – Safety Injection / Condensate Isolation and Containment Spray be rounded down from the LTSPs shown here.

9.4 Tech Surveillance

Same as Revision 3 of Calculation PBNP-IC-17.

9.5 EOP Inputs

Same as Revision 3 of Calculation PBNP-IC-17.

9.6 Channel Check Tolerances

Same as Revision 3 of Calculation PBNP-IC-17.

9.7 Acceptable As-Left And As Found Tolerances

Same as Revision 3 of Calculation PBNP-IC-17.

9.8 Scaling

Table 9.8-1 Scaling Values

Setpoints	Function	Input (psig)	Output (mAdc)	Output (Vdc)	Reference
High Containment Pressure – Safety Injection and Condensate Isolation	OL^+	5.04	17.36	0.1736	8.9.1
	As-Found	5.00	17.33	0.1733	8.5.2.2
	As-Left	4.95	17.30	0.1730	8.5.1.2
	FTSP↑	4.8	17.20	0.1720	8.6.1
	As-Left	4.65	17.10	0.1710	8.5.1.2
	As-Found	4.60	17.07	0.1707	8.5.2.2
	OL^-	4.56	17.04	0.1704	8.9.1
High-High Containment Pressure – Containment Spray	OL^+	25.24	30.83	0.3083	8.9.1
	As-Found	25.20	30.80	0.3080	8.5.2.2
	As-Left	25.15	30.77	0.3077	8.5.1.2
	FTSP↑	25	30.67	0.3067	6.5
	As-Left	24.85	30.57	0.3057	8.5.1.2
	As-Found	24.80	30.54	0.3054	8.5.2.2
	OL^-	24.76	30.51	0.3051	8.9.1

9.9 Limitations

Same as Revision 3 of Calculation PBNP-IC-17.

9.10 Graphical Representation of the Setpoints

9.10.1 High Containment Pressure – Safety Injection and Condensate Isolation Setpoints

Figure 9.10-1
High Containment Pressure – Safety Injection and Condensate Isolation Bistable
(PC-945A, 947A, 949A)

Analytical Limit (AL)	6.0 psig
Limiting Trip Setpoint (LTSP)	5.192 psig
+Operability Limit (OL^+)	5.04 psig (0.1736 Vdc)
+As-Found	5.0 psig (0.1733 Vdc)
+As-Left	4.95 psig (0.1730 Vdc)
Field Trip Setpoint (FTSP)	4.8 psig (0.1720 Vdc)
-As-Left	4.65 psig (0.1710 Vdc)
-As-Found	4.60 psig (0.1707 Vdc)
-Operability Limit (OL^-)	4.56 psig (0.1704 Vdc)

9.10.2 High-High Containment Pressure – Containment Spray Setpoint

Figure 9.10-2
High-High Containment Pressure – Containment Spray Bistable (PC-945B, 947B, 949B)

Analytical Limit (AL)	30.0 psig
Limiting Trip Setpoint (LTSP)	29.192 psig
+Operability Limit (OL^+)	25.24 psig (0.3083 Vdc)
+As-Found	25.20 psig (0.3080 Vdc)
+As-Left	25.15 psig (0.3077 Vdc)
Field Trip Setpoint (FTSP)	25.0 psig (0.3067 Vdc)
-As-Left	24.85 psig (0.3057 Vdc)
-As-Found	24.80 psig (0.3054 Vdc)
-Operability Limit (OL^-)	24.76 psig (0.3051 Vdc)

10.0 IMPACT ON PLANT DOCUMENTS

As a result of this minor revision, following documents need to be revised.

- 1ICP 02.001RD, "Reactor Protection and Engineered Safety Features Red Channel Analog 92 Day Surveillance Test". See Attachment A for changes.
- 2ICP 02.001RD, "Reactor Protection and Engineered Safety Features Red Channel Analog 92 Day Surveillance Test". See Attachment A for changes.
- 1ICP-02.001BL, "Reactor Protection and Engineered Safety Features Blue Channel Analog 92 Day Surveillance Test". See Attachment A for changes.
- 2ICP-02.001BL, "Reactor Protection and Engineered Safety Features Blue Channel Analog 92 Day Surveillance Test". See Attachment A for changes.
- 1ICP-02.001WH, "Reactor Protection and Engineered Safety Features White Channel Analog 92 Day Surveillance Test". See Attachment A for changes.
- 2ICP-02.001WH, "Reactor Protection and Engineered Safety Features White Channel Analog 92 Day Surveillance Test". See Attachment A for changes.
- 1ICP 02.020RD, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test". See Attachment A for changes.
- 2ICP 02.020RD, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test". See Attachment A for changes.
- 1ICP 02.020BL, "Post-Refueling Pre-Startup RPS and ESF Blue Channel Analog Surveillance Test". See Attachment A for changes.
- 2ICP 02.020BL, "Post-Refueling Pre-Startup RPS and ESF Blue Channel Analog Surveillance Test". See Attachment A for changes.
- 1ICP 02.020WH, "Post-Refueling Pre-Startup RPS and ESF White Channel Analog Surveillance Test". See Attachment A for changes.
- 2ICP 02.020WH, "Post-Refueling Pre-Startup RPS and ESF White Channel Analog Surveillance Test". See Attachment A for changes.
- STPT 2.1, "Setpoint Document – Safety Injection". New Tech Spec Allowable Value needs to be incorporated.
- STPT 2.3, "Setpoint Document – Containment Pressure and LTOP". New Tech Spec Allowable Value needs to be incorporated.
- DBD-30, "Containment Heating and Ventilation Systems". Revise section 2.2.3, page 2-16 to change the Containment High Pressure Setpoint from 5.0 psig to 4.8 psig.
- Technical Specifications 3.3.2 (ESFAS) to be revised after NRC approval of EPU License Amendment Request. Allowable Values for high and high-high containment pressure will be revised to rounded down values of the LTSP shown on Figures 9.10-1 and 9.10-2. The TRM may also be revised to include the operability limits shown on these diagrams.

11.0 ATTACHMENT LIST

Same as Revision 3 of Calculation PBNP-IC-17, except Attachment A.

12.0 10 CFR 50.59/72.48 REVIEW

The 10 CFR 50.59/72.48 review performed as part of base calculation is applicable to this minor revision. Hence, no separate 10 CFR 50.59/72.48 review is required.

ATTACHMENT A

Same as Revision 3 of Calculation PBNP-IC-17, except the following changes:

1(2)ICP 02.01RD, BL, WH and 1(2)ICP 02.020RD, BL, WH

1(2)PC-945A/B, 947A/B, 949A/B

Containment Pressure

Containment Pressure	Process Setpoint psig	Output (Containment Pressure)			As-Left Limits		As-Found Limits		Operability Limits	
		Setpoint Vdc	As-Found Vdc	As-Left Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Safety Injection	4.8	0.1720↑			0.1710	0.1730	0.1707	0.1733	0.1704	0.1736
Containment Spray Logic	25.0	0.3067↑			0.3057	0.3077	0.3054	0.3080	0.3051	0.3083

• Technical Specification Limit • 1(2)-PC-945A, 947A, 949A (To be specified by PBNP later)
(Ref: Calculation PBNP-IC-17)

• Technical Specification Limit • 1(2)-PC-945B, 947B, 949B (To be specified by PBNP later)
(Ref: Calculation PBNP-IC-17)

ENCLOSURE 1

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

LICENSE AMENDMENT REQUEST 261, EXTENDED POWER UPRATE
TRANSMITTAL OF SAMPLE CALCULATIONS FOR
REACTOR PROTECTION SYSTEM / ENGINEERED SAFETY FEATURES
ACTUATION SYSTEM INSTRUMENTATION SETPOINT CALCUATIONS

ATTACHMENT 4

STEAM LINE PRESSURE INSTRUMENT LOOP
UNCERTAINTY/SETPOINT CALCULATION

19 pages follow

KCI ENGINEERING CONSULTANTS

CALCULATION TITLE PAGE

Project Number:	**441-005**	**Client or Station:**	**Point Beach Nuclear Station**		
Calculation Number:	**PBNP-IC-39**	**Revision Number:**	**004-A**	**Total Number of Pages:**	**19**
Title:	**Steam Line Pressure Instrument Loop Uncertainty / Setpoint Calculation**				

☐ **Original Calculation** ☒ **Revised Calculation** ☐ **Cancelled**

☐ **Supersedes Calculation:** ____________________

Nuclear Safety Related:	☒**YES** ☐**NO**	**QA Scope:**	☒**YES** ☐**NO**
System:	**RP**		
Date of Issue:	**See Approval Date**		

SIGNATURES AND DATES

Preparer	Reviewer	Discipline	Name	Signature	Date
☒	☐	I&C	Saravanan Makayee	[signature]	6/22/10
☐	☒	I&C	Anup Behera	[signature]	6/22/10
☐	☐				
☐	☐				
☐	☐				
☐	☐				
☐	☐				

Approver: **Name:** Badar Hussain

Signature: [signature]

Date: 6/22/10

REVISION SUMMARY SHEET

Revision No.	Description of the Revision
004-A	This minor revision incorporates double-sided random uncertainties to calculate Limiting Trip Setpoint (LTSP) and revises the Field Trip Setpoint for the Low Steam Line Pressure Safety Injection trip for the EPU condition. All the alpha-numeric changes made in this minor revision are marked up revision bars.

CALCULATION TABLE OF CONTENTS

SECTION **PAGE**

1.0 PURPOSE

The purpose of this minor revision is to calculate the Limiting Trip Setpoint (LTSP) for Low Steam Line Pressure Safety Injection trip by applying double-sided random uncertainties to the random portion of the Total Loop Error (TLE). This resolves the concern raised in CAP 01173082.

2.0 ACCEPTANCE CRITERIA

Same as Revision 4 of calculation PBNP-IC-39.

3.0 ABBREVIATIONS

Same as Revision 4 of calculation PBNP-IC-39.

4.0 REFERENCES

Same as Revision 4 of calculation PBNP-IC-39.

5.0 ASSUMPTIONS

Same as Revision 4 of calculation PBNP-IC-39.

6.0 DESIGN INPUTS

Same as Revision 4 of calculation PBNP-IC-39.

7.0 METHODOLOGY

7.1 Uncertainty Determination

Same as Revision 4 of calculation PBNP-IC-39.

7.2 Drift Considerations

Same as Revision 4 of calculation PBNP-IC-39.

7.3 Channel Check Tolerance Equation Summary (CCT)

Same as Revision 4 of calculation PBNP-IC-39.

7.4 Setpoint Calculations

For setpoints that are based on an Analytical Limit (AL) or Process Limit (PL), a Limiting Trip Setpoint (LTSP) shall be calculated. The LTSP represents the most limiting value a channel trip setpoint can have that will ensure the AL or PL is not exceeded, considering all credible instrument channel errors that can exist between successive calibrations. The LTSP provides the basis for establishing an Allowable Value (AV) in the Technical Specifications.

The LTSP is determined by applying the Total Loop Error (TLE) to the AL or PL. The TLE consists of the combination of 95/95 double-sided random uncertainties and bias uncertainties. The uncertainty value associated with the double-sided distributions is larger than the value associated with the single-sided distributions. Therefore, including double-sided random uncertainties in the TLE is an acceptable, conservative deviation from the guidance in DG-I01 (Reference G.1), which permits smaller single-sided random uncertainties. In 2010, NRC advised Point Beach that the NRC would no longer accept the use of single-sided random uncertainties for determining Limiting Safety System Settings (LSSS) in the plant Technical Specifications. Double-sided uncertainties in the random portion of the TLE term yields a more conservative LTSP value than an LTSP based on single-sided uncertainties. Therefore, a TLE based on double-sided uncertainties is appropriate and acceptable for LSSS values.

Consistent with the methodology of Reference G.1, random and bias portions of the TLE are calculated separately and are then combined using an appropriate sign convention based on the direction that the process variable approaches the setpoint.

For a process increasing toward the Analytical Limit, the calculated Limiting Trip Setpoint is as follows:

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

For a process decreasing toward the Analytical Limit, the calculated Limiting Trip Setpoint is as follows:

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

7.5 Process Error Calculation

Same as Revision 4 of calculation PBNP-IC-39.

8.0 BODY OF CALCULATION

8.1 Device Uncertainty Analysis

Same as Revision 4 of calculation PBNP-IC-39.

8.2 Device Uncertainty Summary

Same as Revision 4 of calculation PBNP-IC-39.

8.3 Total Loop Error

Same as Revision 4 of calculation PBNP-IC-39.

8.4 Acceptable As-Found and As-Left Calibration Tolerance

Same as Revision 4 of calculation PBNP-IC-39.

8.5 Channel Check Tolerance

Same as Revision 4 of calculation PBNP-IC-39.

8.6 Low Steam Line Pressure Safety Injection Setpoint

According to Section 7.4, for decreasing setpoints:

$LTSP\downarrow = AL + [TLE_{1a\text{-}rdm}^{+} + TLE_{1a\text{-}bias}^{+}]*PS$

Where:

AL	= 320.3 psig (Existing); 395.3 psig (EPU)	(Section 6.7)
$TLE_{1a\text{-}rdm}^{+}$	= + 8.097 % span	(Section 8.3.1)
$TLE_{1a\text{-}bias}^{+}$	= + 1.808% span	(Section 8.3.1)
PS	= 1400 psi	

Combine TLE to be used in the LTSP equation:

$TLE_{1a} = 8.097\% + 1.808\%$

$\mathbf{TLE_{1a} = 9.905\%}$ **span**

Converting to process units,

$TLE_{1a} = 9.905\% * (1400 \text{ psi}/100\%)$

$TLE_{1a} = 138.67$ psi

Existing LTSP:

Substituting TLE_{1a} value in the LTSP equation:

LTSP = 320.3 psig + 138.67 psi

LTSP = 458.97 psig (Existing)

From Section 6.7, the actual Field Trip Setpoint (FTSP) for Low Steam Line Pressure Safety Injection is 530 psig. The FTSP is conservative for a decreasing setpoint compared to the calculated LTSP. Per Section 2.0, this setpoint is acceptable, and may be retained. In addition, per Section 6.7.4, the FTSP of 530 psig is not lower than the backup trip process limit of 500 psig and, therefore, may be retained.

EPU LTSP:

Substituting TLE_{1a} value in the LTSP equation:

LTSP = 395.3 psig + 138.67 psi

LTSP = 533.97 psig (EPU)

From Section 6.7, the existing Field Trip Setpoint (FTSP) for Low Steam Line Pressure Safety Injection is 530 psig. The FTSP is non-conservative for a decreasing setpoint compared to the calculated LTSP for EPU condition and hence, not acceptable. In accordance with the criteria outlined in Sections 2.0 and 6.7.4, a new Field Trip Setpoint of 545 psig is recommended for Low Steam Line Pressure Safety Injection trip. The recommended FTSP value of 545 psig for the EPU condition will provide sufficient margin such that the lower as-found value for the new FTSP will not overlap the recommended Allowable Value of 535 psig, which is the EPU LTSP conservatively rounded up (see Section 8.7).

Margin Between LTSP and FTSP:

The margin between LTSP and FTSP is calculated as follows:

Margin= FTSP – LTSP
Where:
LTSP = 458.97 psig (Existing); 533.97 psig (EPU)
FTSP (Existing) = 530 psig (Section 6.7)
FTSP (EPU) = 545 psig (Proposed)

Substituting this value,

Margin (Existing) = 530 psig – 458.97 psig
Margin (EPU) = 545 psig – 533.97 psig

Margin = 71.03 psi (Existing); 11.03 psi (EPU)

8.7 Allowable Value (AV) Evaluation

From Section 8.6, the Limiting Trip Setpoint (LTSP) is as follows:

LTSP = 458.97 psig (Existing)
LTSP = 533.97 psig (EPU)

Existing Condition:

From Section 6.7, the existing Tech Spec Allowable Value (AV) for Low Steam Line Pressure is ≥ 500 psig. The existing Tech Spec Allowable Value of 500 psig is conservative for a decreasing setpoint compared to the calculated LTSP (Existing) of 458.97 psig and hence, acceptable.

EPU Condition:

For EPU condition, based on the calculated value of LTSP (i.e., 533.97 psig), the EPU Tech Spec Allowable Value (AV) of ≥ 535 psig is recommended for Low Steam Line Pressure.

8.7.1 Low Steam Line Pressure Safety Injection Trip Operability Limit

Using Equation 7.1.6-3 to determine the bistable 3σ drift value,

$Rd_{3\sigma} = (1.5)\ Rd_{2\sigma}$ (Eq. 7.1.6-3)

$Rd_{3\sigma} = (1.5)\ 0.212\ \%\ span$ ($Rd_{2\sigma}$ from Section 8.1.31)

$Rd_{3\sigma} = \pm 0.318\ \%\ span$

Existing Condition:

The FTSP for the Low Steam Line Pressure Safety Injection Trip of 530 psig (Section 6.7), expressed as percent span, is:

$FTSP = ([530 - 0] \div 1400) * 100 = 37.86\ \%\ span$

Using Equation 7.1.6-1, the OL^+ is determined as:

$OL^+ = FTSP + [RAL^2 + Rd_{3\sigma}^2]^{1/2}$ (Eq. 7.1.6-1)
$OL^+ = 37.86\ \% + (0.500^2 + 0.318^2)^{1/2}$ (RAL is B_v from Section 8.1.33)
$OL^+ = 37.86\ \% + 0.593$
$OL^+ = 38.45\ \%\ span$

Expressed in psig, OL^+ = (0.3845 * 1400) + 0 = 538.3 psig; Rounded down to 538 psig for calibration.

Using Equation 7.1.6-2, the OL^- is determined as:

$OL^- = FTSP - [RAL^2 + Rd_{3\sigma}^2]^{½}$ (Eq. 7.1.6-2)
$OL^+ = 37.86\ \% - (0.500^2 + 0.318^2)^{½}$ (RAL is B_v from Section 8.1.33)
$OL^- = 37.86\ \% - 0.593$
$OL^- = 37.27\ \%$ span

Expressed in psig, OL^- = (0.3727 * 1400) + 0 = 521.8 psig; Rounded up to 522 psig for calibration.

Because the Low Steam Line Pressure Safety Injection Trip is a decreasing trip, the negative OL^- value of 522 psig should be the limit compared to the COT as-found value to determine Technical Specification operability of the channel for the existing plant condition. However, an as-found value found outside either the OL^+ or OL^- indicates that the channel is operating abnormally.

EPU Condition:

The proposed FTSP (EPU) for the Low Steam Line Pressure Safety Injection Trip of 545 psig (Section 8.6), expressed as percent span, is:

$FTSP = ([545 – 0] \div 1400) * 100 = 38.93\ \%$ span

Using Equation 7.1.6-1, the OL^+ is determined as:

$OL^+ = FTSP + [RAL^2 + Rd_{3\sigma}^2]^{½}$ (Eq. 7.1.6-1)
$OL^+ = 38.93\ \% + (0.500^2 + 0.318^2)^{½}$ (RAL is B_v from Section 8.1.33)
$OL^+ = 38.93\ \% + 0.593$
$OL^+ = 39.52\ \%$ span

Expressed in psig, OL^+ = (0.3952 * 1400) + 0 = 553.28 psig; Rounded down to 553 psig for calibration.

Using Equation 7.1.6-2, the OL^- is determined as:

$OL^- = FTSP - [RAL^2 + Rd_{3\sigma}^2]^{½}$ (Eq. 7.1.6-2)
$OL^- = 38.93\ \% - (0.500^2 + 0.318^2)^{½}$ (RAL is B_v from Section 8.1.33)
$OL^- = 38.93\ \% - 0.593$
$OL^- = 38.34\ \%$ span

Expressed in psig, OL^- = (0.3834 * 1400) + 0 = 536.76 psig; Rounded up to 537 psig for calibration.

Because the Low Steam Line Pressure Safety Injection Trip is a decreasing trip, the negative OL^- value of 537 psig should be the limit compared to the COT as-found value to determine Technical Specification operability of the channel during the EPU condition. However, an as-found value found outside either the OL^+ or OL^- indicates that the channel is operating abnormally.

8.7.2 Scaling (Existing & EPU) for Low Steam Line Pressure Safety Injection Trip FTSP and Operability Limits

The output signal corresponding to the process value variable is determined using Equation 7.1.7-3,

$y = m * (x - x_1) + y_1$

Where:

x = Process value (psig)
x_1 = 0 psig
y = Output signal (Vdc)
y_1 = 0.1 Vdc
$m = (y_2 - y_1) + (x_1 - x_1)$ (Eq. 7.1.7-2)

Where:

y_2 = 0.5 Vdc
y_1 = 0.1 Vdc
x_2 = 1400 psig
x_1 = 0 psig

Using the above equation, the output signal for various process value related to Low Steam Line Pressure Safety Injection Trip is summarized below:

Table 8.7-1: 1(2) PC-468, 469, 478, 479, 482, 483 Bistable Calibration

Existing Condition			Parameter	EPU Condition		
Section	Output (Vdc)	Process (Psig)		Process (Psig)	Output (Vdc)	Section
8.7.1	0.2537	538	OL+	553	0.2580	8.7.1
8.4.2.6	0.2536 †	537.6	AF+	552.6	0.2579 †	8.4.2.6
8.4.1.6	0.2534	537	AL+	552	0.2577	8.4.1.6
6.7	0.2514	530	FTSP	545	0.2557	8.6
8.4.1.6	0.2494	523	AL-	538	0.2537	8.4.1.6
8.4.2.6	0.2492	522.4	AF-	537.4	0.2535	8.4.2.6
8.7.1	0.2491	522	OL-	537	0.2534	8.7.1
8.7	0.2429	500	AV	535	0.2529	8.7

Note †:A sample output signal calculation corresponding to the existing and the EPU As-Found+ is shown below:

1) For the existing As-Found+ value of 537.6 psig (530 psig + 7.6 psi from Section 8.4.2.6), the output signal is calculated as follows:

   $y = [(0.4 \text{ Vdc}/ 1400 \text{ psig}) * (537.6 \text{ psig} - 0 \text{ psig})] + 0.1 \text{ Vdc}$

   $y = 0.2536 \text{ Vdc}$

2) For the EPU As-Found+ value of 552.6 psig (545 psig + 7.6 psi from Section 8.4.2.6), the output signal is calculated as follows:

   $y = [(0.4 \text{ Vdc}/ 1400 \text{ psig}) * (552.6 \text{ psig} - 0 \text{ psig})] + 0.1 \text{ Vdc}$

   $y = 0.2579 \text{ Vdc}$

8.8 Parametric Value Evaluation

Same as Revision 4 of calculation PBNP-IC-39.

9.0 RESULTS AND CONCLUSIONS

9.1 Total Loop Error

Same as Revision 4 of calculation PBNP-IC-39, except for Total Bistable Loop Error (TLE_{1a}).

	ACCIDENT 95/95		Ref. Section
	Span	psi	
Total Bistable Loop Error (TLE_{1a})	+9.905%	+138.67	8.6

9.2 Acceptable As-Left and As-Found Tolerances

Same as Revision 4 of calculation PBNP-IC-39.

9.3 Limiting Trip Setpoints, Operability Limits (OL), and Recommended Tech Spec Changes

AR 896611 determined that the Technical Specification Allowable Values for several protection system functions in TS 3.3.1 (RPS) and TS 3.3.2 (ESFAS) were non-conservative. As a result, the I&C calibration procedures were revised to install temporary administrative limits (termed Allowable Limits in the ICPs) on the trip bistable as-found values until a license amendment is approved to revise the TS sections.

The Limiting Trip Setpoints for primary trip functions determined in this calculation provide new Technical Specification limits (Allowable Values) for channel operability to protect the accident analyses Analytical Limits. The LTSPs also satisfy the definition of a Limiting Safety System Setting in 10CFR50.36. Backup trips and permissives do not have a LTSP that can be used as an Allowable Value in Tech Specs because there is no analytical limit to "anchor" the LTSP. Therefore, it is recommended that a conservatively rounded version of the LTSPs for the primary trip functions be included in a license amendment to revise RPS TS 3.3.1, Table 3.3.1-1 and ESFAS TS 3.3.2, Table 3.3.2-1 Allowable Values.

Operability Limits have been determined for all trip functions (primary trips, backup trips, and the SI Block/Unblock function). The OLs provide new limits to be applied in the I&C calibration procedures for establishing Technical Specification operability of the trip channels during Channel Operational Testing (COT).

It is recommended that the Operability Limits for both primary and backup trips be included in the Technical Requirements Manual (TRM) as limits (more restrictive than the LTSPs) for establishing channel operability during channel surveillance testing. The reason for including OLs in the TRM rather than the Technical Specifications is to allow the station flexibility to revise the field setpoint values, along with their as-left, as-found, and OL values, without requiring prior NRC approval. The LTSPs, which provide protection for the accident analyses, are the appropriate Allowable Values for the protection functions in the Specifications and would remain bounding limits for the primary trips (only).

For the results of Limiting Trip Setpoint (LTSP) and Tech Spec Allowable Value (AV), see Sections 9.5 and 9.6, respectively.

The following Operability Limits are proposed to be added to the bistable calibration procedures, as shown in the procedure markups in Attachment A.

Table 9.2-1: Operability Limits for Existing and EPU Conditions

Function	Existing Condition	Reference	EPU Condition	Reference
Low Steam Line Pressure Safety Injection Trip	OL^+ 538 psig OL^- 522 psig	Section 8.7.1	OL^+ 553 psig OL^- 537 psig	Section 8.7.1

9.4 Channel Check Tolerance

Same as Revision 4 of calculation PBNP-IC-39.

9.5 Setpoint Evaluations

The following LTSPs and FTSPs with associated Margins have been determined for Existing and EPU operations.

Table 9.4-1a: Setpoints (Existing)

Existing Limiting Trip Setpoints	Existing Field Trip Setpoint	Existing Margin	Reference
458.97 psig	530 psig	71.03 psi	Section 8.6

Table 9.4-1b: Setpoints (EPU)

EPU Limiting Trip Setpoints	Proposed EPU Field Trip Setpoint	EPU Margin	Reference
533.97 psig	545 psig (Note †)	11.03 psi	Section 8.6

Note †: This calculation has determined that the existing FTSP value of 530 psig for Low Steam Line Pressure Safety Injection is non-conservative compared to the calculated LTSP value of 533.97 psig for the EPU condition. Therefore, it is recommended that the FTSP value for Low Steam Line Pressure Safety Injection (EPU condition) be revised to 545 psig, such that the lower Operability Limit of the new FTSP will be greater than the proposed new Allowable Value of ≥ 535 psig (which is based on rounding up the calculated LTSP of 533.97 psig)..

9.6 Technical Specification Allowable Values

The following Technical Specification Allowable Values (AV) have been determined for Existing and EPU operations.

Table 9.5-1a: Allowable Values (Existing)

Existing Allowable Value	Reference
≥500 psig	Section 8.7

Table 9.5-1b: Allowable Values (EPU)

Proposed EPU Allowable Value	Reference
≥535 psig (Note †)	Section 8.7

Note †: This calculation has determined that the existing Tech Spec Allowable Value of 500 psig for Low Steam Line Pressure Safety Injection is non-conservative compared to the calculated LTSP value of 533.97 psig for the EPU condition. . Based on the calculated LTSP for the EPU condition, it is recommended that the Technical Specification Table 3.3.2-1 Allowable Value for Low Steam Line Pressure Safety Injection be revised to ≥ 535 psig, which is the LTSP value conservatively rounded up.

9.7 Parametric Value Evaluation

Same as Revision 4 of calculation PBNP-IC-39.

9.8 Limitations

Same as Revision 4 of calculation PBNP-IC-39.

9.9 Graphical Representation of Setpoints

Figure 9.8.1-1, Low Steam Line Pressure Safety Injection Setpoint (Existing)

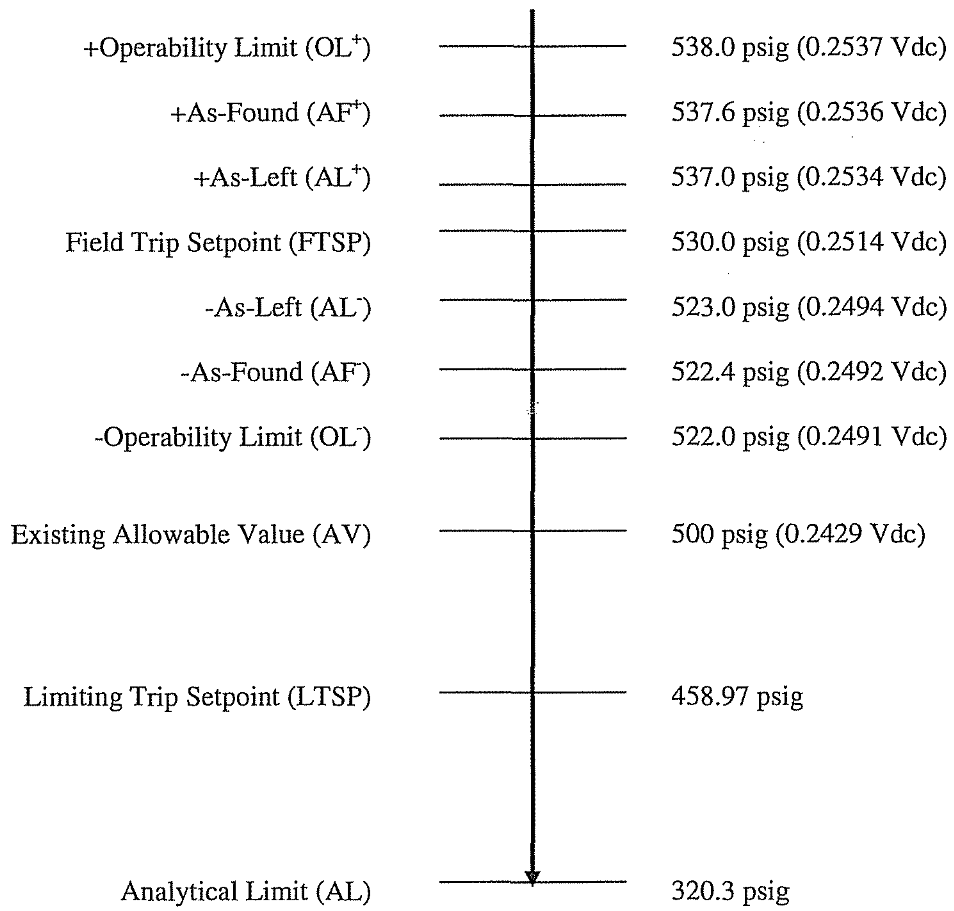


Figure 9.8.1-2, Low Steam Line Pressure Safety Injection Setpoint (EPU)

+Operability Limit (OL^+)	553.0 psig (0.2580 Vdc)
+As-Found (AF^+)	552.6 psig (0.2579 Vdc)
+As-Left (AL^+)	552.0 psig (0.2577 Vdc)
Recommended Field Trip Setpoint (FTSP)	545.0 psig (0.2557 Vdc) (Proposed)
-As-Left (AL^-)	538.0 psig (0.2537 Vdc)
-As-Found (AF^-)	537.4 psig (0.2535 Vdc)
-Operability Limit (OL^-)	537.0 psig (0.2534 Vdc)
Recommended Allowable Value (AV)	535.0 psig (0.2529 Vdc) (Proposed)
Limiting Trip Setpoint (LTSP)	533.97 psig
Analytical Limit (AL)	395.3 psig

10.0 IMPACT ON PLANT DOCUMENTS

As a result of this minor revision, the following plant documents should be revised as follows:

- 1ICP 02.001RD, "Reactor Protection and Engineered Safety Features Red Channel Analog 92 Day Surveillance Test" (See Attachment A for changes)
- 1ICP 02.001BL, "Reactor Protection and Engineered Safety Features Blue Channel Analog 92 Day Surveillance Test" (See Attachment A for changes)
- 1ICP 02.001WH, "Reactor Protection and Engineered Safety Features White Channel Analog 92 Day Surveillance Test" (See Attachment A for changes)
- 1ICP 02.001YL, "Reactor Protection and Engineered Safety Features Yellow Channel Analog 92 Day Surveillance Test" (See Attachment A for changes)
- 2ICP 02.001RD, "Reactor Protection and Engineered Safety Features Red Channel Analog 92 Day Surveillance Test" (See Attachment A for changes)
- 2ICP 02.001BL, "Reactor Protection and Engineered Safety Features Blue Channel Analog 92 Day Surveillance Test" (See Attachment A for changes)
- 2ICP 02.001WH, "Reactor Protection and Engineered Safety Features White Channel Analog 92 Day Surveillance Test" (See Attachment A for changes)
- 2ICP 02.001YL, "Reactor Protection and Engineered Safety Features Yellow Channel Analog 92 Day Surveillance Test" (See Attachment A for changes)
- 1ICP 02.020RD, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test" (See Attachment A for changes)
- 1ICP 02.020BL, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test" (See Attachment A for changes)
- 1ICP 02.020WH, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test" (See Attachment A for changes)
- 1ICP 02.020YL, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test" (See Attachment A for changes)
- 2ICP 02.020RD, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test" (See Attachment A for changes)
- 2ICP 02.020BL, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test" (See Attachment A for changes)
- 2ICP 02.020WH, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test" (See Attachment A for changes)
- 2ICP 02.020YL, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test" (See Attachment A for changes)
- Point Beach Nuclear Plant Technical Specifications, Section 3.3.2 and B3.3.2 For the EPU condition, change the Tech Spec Allowable Value to 535 psig in Table 3.3.2-1.

- PBNP Setpoint Document STPT 2.1, "Safety Injection", Rev. 2
  For the EPU condition, change the Low Steam Line Pressure setpoint and Tech Spec Allowable Value to 545 psig and 535 psig, respectively.

11.0 ATTACHMENT LIST

Same as Revision 4 of calculation PBNP-IC-39, except Attachment A (See the attached sheets for the changes).

12.0 10CFR50.59 REVIEW

As a result of this minor revision, there are no documentation changes due to the existing plant condition. Therefore, a 10CFR50.59 review is not required.

Due to EPU condition, the Field Trip Setpoint (FTSP), Operability Limit (OL) and Technical Specification Allowable Values (AV) associated with the Low Steam Line Pressure Safety Injection were changed in this minor revision. NRC prior approval is required in order to implement the revised Technical Specifications values. Since a license amendment is already acknowledged to be required, no separate 50.59 review is necessary for revising the Technical Specification values. The present intent is to include the Technical Specification changes, identified as EPU changes in this calculation, for RPS and ESFAS setpoints in the Extended Power Uprate License Amendment Request.

Note that the EPU implementation, after the EPU license amendment is received from NRC, will require separate screening and possibly a full 50.59 evaluation of individual changes being made. For future EPU implementation, a separate 50.59 screening number (SCR 2008-178) and a separate 50.59 evaluation number (SE 2008-014) have been reserved.

ATTACHMENT A

Same as Revision 4 of calculation PBNP-IC-39, except the following changes <u>due to **EPU** condition</u>:

For IDs 1(2) PC-468A/B and PC-483A/B: 1(2) ICP 02.001RD and 1(2) ICP 02.020RD
For IDs 1(2) PC-478A/B and PC-482A/B: 1(2) ICP 02.001BL and 1(2) ICP 02.020BL
For IDs 1(2) PC-469A/B: 1(2) ICP 02.001WH and 1(2) ICP 02.020WH
For IDs 1(2) PC-479A/B: 1(2) ICP 02.001YL and 1(2) ICP 02.020YL

STEAM GENERATOR PRESSURE 1-PC-4XXA/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
		SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
				Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Safety Injection	545.0	0.2557↓		0.2535	0.2579		0.2537	0.2577	0.2534	0.2580
•Technical Specification Limit •1-PC-4XXA ≥0.2529 Vdc (≥535.0 psig)										

ENCLOSURE 1

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

LICENSE AMENDMENT REQUEST 261, EXTENDED POWER UPRATE
TRANSMITTAL OF SAMPLE CALCULATIONS FOR
REACTOR PROTECTION SYSTEM / ENGINEERED SAFETY FEATURES
ACTUATION SYSTEM INSTRUMENTATION SETPOINT CALCUATIONS

ATTACHMENT 5

AUXILIARY FEEDWATER PUMPS LOW SUCTION PRESSURE SW SWITCHOVER
UNCERTAINTY/SETPOINT CALCULATION

86 pages follow

ISSUE SUMMARY
Form SOP-0402-07, Revision 8

DESIGN CONTROL SUMMARY

CLIENT: NextEra Energy Point Beach | UNIT NO.: 1, 2 | PAGE NO.: 1

PROJECT NAME: **EPU – AFW**

PROJECT NO.: 11165-145

CALC. NO..: 97-0231

S&L NUCLEAR QA PROGRAM APPLICABLE ☒ YES ☐ NO

TITLE: Auxiliary Feedwater Pump Low Suction Pressure SW Switch over and Pump Trip Instrument Loop Uncertainty / Setpoint Calculation

EQUIPMENT NO.: 1PT-4044A, 1PQ-4044, 1PM-4044-3, 1PC-4044-L, 1PC-4044-LL, 2PT-4044A, 2PQ-4044, 2PM-4044-3,

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

Minor revision to Calculation 97-0231 to support the changes to the TDAFW low suction pressure switchover/trip circuits in EC-13407.

INPUTS/ ASSUMPTIONS
☒ VERIFIED
☐ UNVERIFIED

REVIEW METHOD: | REV.: 2C

STATUS: ☒ APPROVED ☐ SUPERSEDED BY CALCULATION NO. ☐ VOID | DATE FOR REV.: 6/18/10

PREPARER: D. Peacock/N. Vilione [signatures] 6-18-10 | DATE: 6/18/10

REVIEWER: W. D. Crumpacker/M. Flynn (Sections 6.6, 8.2, 9.5.4) [signatures] | DATE: 6/18/10

APPROVER: [signature] | DATE: 6/18/10

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

INPUTS/ ASSUMPTIONS
☐ VERIFIED
☐ UNVERIFIED

REVIEW METHOD: | REV.:

STATUS: ☐ APPROVED ☐ SUPERSEDED BY CALCULATION NO. ☐ VOID. | DATE FOR REV.:

PREPARER: | DATE:

REVIEWER: | DATE:

APPROVER: | DATE:

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

INPUTS/ ASSUMPTIONS
☐ VERIFIED
☐ UNVERIFIED

REVIEW METHOD: | REV.:

STATUS: ☐ APPROVED ☐ SUPERSEDED BY CALCULATION NO. ☐ VOID | DATE FOR REV.:

PREPARER: | DATE:

REVIEWER: | DATE:

APPROVER: | DATE:

NOTE: PRINT AND SIGN IN THE SIGNATURE AREAS

Table of Contents

Table of Contents

1.0 BACKGROUND, PURPOSE, AND SCOPE OF CALCULATION

1.1 Background

ECs 13400 through 13407 install new MDAFW pumps, modify controls for the existing TDAFW pumps, and convert 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 AFPs 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 provide a signal that initiates the switch to the safety related supply, or subsequently, trips the pump on low suction pressure if the switchover was not successful. Additionally, an alarm will actuate prior to a trip/switchover to annunciate (in the Main Control Room) that the process is approaching a low suction pressure condition.

The low-low suction pressure switchover/pump trip and low suction alarm functions associated with each AFP are provided by setpoint-controlled bistable units downstream of the Low Suction Pressure Transmitter, which provide switchover/trip and alarm output. The output of the low-low switchover/trip bistable (but not the low alarm) is 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 low suction pressure supply switchover is a safety-related function.

1.2 Purpose

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

A separate minor revision (Revision 002-D) has been 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 (P38A/P38B) are not modified. Uncertainties and setpoints for these circuits determined in parent Revision 2 of this calculation remain valid until the system transition to SSG pumps in EC-13407.

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 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/ Revision History

Purpose of Minor Revision

This minor revision (-002C) supports the modifications to the TDAFW low suction pressure switchover/trip circuits in EC-13407.

The existing TDAFW trip/alarm and indication will split into two loops by EC 13407:

- Narrow-range Low Low SW Switchover/Pump Trip/Trip Alarm and Low Alarm scaled from 0-30 psig (Sections 5.1.5 and 9.4.6).

- 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, and therefore will not be addressed by this minor revision.

Revision History

Minor Revision -002B was originally issued during June of 2009 to support the EPU LAR Submittal. This minor revision determined the setpoint for "AFW Pump Suction Transfer on Suction Pressure Low", which was taken as input into EPU Tech Spec Section 3.3.2.

As with Minor Revision -002B, this minor revision (-002C) supports the modifications to the TDAFW low suction pressure switchover/trip circuits in EC-13407. However, this minor revision includes updates to correct the following:

- Eliminates the use of the uncertainty reduction factor for setpoints with a single side of interest. This change will result in a new Setpoint for "AFW Pump Suction Transfer on Suction Pressure Low", which must be incorporated in EPU Tech Spec Section 3.3.2.
- Incorporates lessons learned regarding M&TE accuracy for the Fluke 45 multimeter.

This minor revision supersedes minor revision -002B in its entirety.

1.4 Scope

The scope of this calculation is listed below:

- Determine uncertainties for the TDAFP 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 TDAFP (1(2)P-29).
- Determine Acceptable As-Found / As-Left Calibration Tolerances for TDAFP 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

This minor revision supersedes minor revision 97-0231-002-B in its entirety.

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.

Note: All setpoints in this calculation are for decreasing process values.

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 6/2/2010.

4.1 General

G.1 Point Beach Nuclear Plant Design & Installation Guidelines Manual DG-I01, "Instrument Setpoint Methodology", Rev. 5

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 2010)
- Section 9.5 (dated 2010)
- Section 11.6.2 (dated 2010)

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. 92, "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. 87, "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, Rev. 0, "Point Beach N.P., Unit 1 Connection Diagram – Rack 1C171B-F/1C197"

D.4 Foxboro 62550, Dwg. CD2-15, 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. 13, "Auxiliary Feedwater Flow and Pressure Instruments Outage Calibration", 8/30/05

P.2 2ICP 04.003-5, Rev. 15, "Auxiliary Feedwater Flow and Pressure Instruments Outage Calibration", 8/30/05

P.3 1ICP 04.032-1, Rev. 16, "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. 9, "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.

V.8 Fluke 45 Dual Display Meter User Manual, VTM 01425, Rev 1

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, (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 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 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 all impacted equipment will be created or 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 narrow-range low suction 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.

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

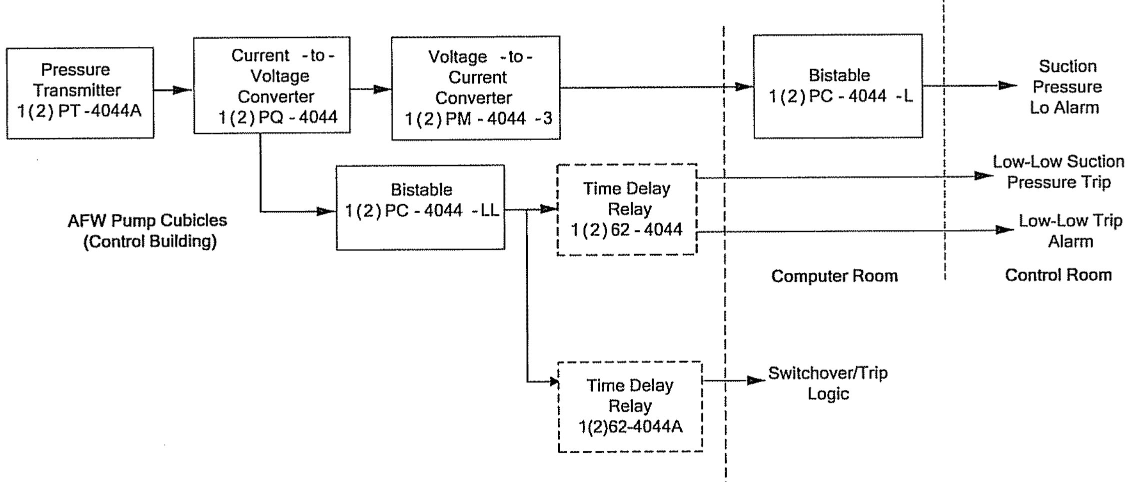
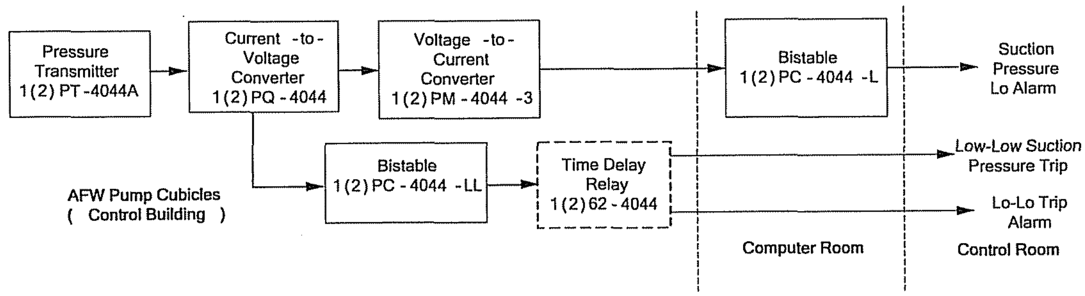


Figure 6.2-2
Steam Driven AF Pump Low Suction
Pressure Instrumentation Prior to EC 13407



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.

Accident Conditions

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 Foxboro Spec 200 rack that contains 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:

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

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

<u>Transmitter Elevation</u>

Per Reference G.6:

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

1(2)PT-4044A will be installed at the same elevation as existing transmitters 1(2)PT-4044 under ECN-15053 (EC 13403).

<u>Note:</u> Because the elevation of the pressure transmitter (EL PT) is subtracted from the elevation of the switchover/trip (EL Trip), and instrument loop initiates 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 low-low suction pressure switchover/trip function contains the uncertainties for the Sensor, Current-to-Voltage Converter, and Bistable:

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

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:

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

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:

$$SAL = \pm Sv$$

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:

$$IVAL = \pm IVv$$

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 3.3.8.5 of Reference G.1, for a process increasing toward the analytical limit, the calculated Setpoint is as follows:

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

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

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

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:

$$Margin = LTSP - FTSP \quad \text{(Eq. 7.4-3)}$$

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 4-20 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 ± 0.5 % 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, for 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 if 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 taken the readability.

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 (medium resolution, 30 mA range, 5 digit display) (Ref V8):

RA_{mte} = uncertainty * maximum reading
RA_{mte} = ± 0.05 % reading * 20 mAdc + 3 DGTS
RA_{mte} = ± 0.05 % reading * 20 mAdc + 3*(1 μA)
RA_{mte} = ± 0.05 % reading * 20 mAdc + 0.003 mA
RA_{mte} = ± 0.013 mAdc

RA_{std} = 0

The readability for digital indicators is defined as the least significant digit, per Ref G.1:

RD_{mte} = ± 0.001 mAdc

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

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

$$Sm_{MM\text{-}45} = \pm\sqrt{0.013^2 + 0^2 + 0.001^2} = \pm 0.013 \text{ mAdc}$$

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

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

RA_{std} = 0

RD_{mte} = ± 0.0001 mAdc

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

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

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

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

Converting to % span:

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

Sm_{HP} = ± 0.094 % span

Pressure Testers (Input M&TE):

For the Ashcroft 452074SD02L 30 psig digital gauge

RA_{mte} = uncertainty * instrument range
RA_{mte} = ± 0.25 % full scale * 30 psig
RA_{mte} = ± 0.075 psig

RA_{std} = 0

RD_{mte} = ± 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_{mte} = uncertainty * instrument range
RA_{mte} = ± 0.5 % full scale * 30 psig

RA_{mtc} = ± 0.15 psig

RA_{std} = 0

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

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

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

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.

For 1(2)PT-4044A:

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. In addition, the sensor would be recalibrated subsequent to a seismic event, so the during- and after-event values not considered random with respect to each other.

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 low suction pressure event), the suction pressure would be 120 psig (Reference C.3). Per Reference V.7, the overpressure limit is 3626 psig and when exceeded 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

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):

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

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

$RA_{std} = 0$

$RD_{mte} = \pm$ 0.00001 Vdc

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

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

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

Fluke 45 multimeter (slow resolution, 5 digit display, 10 Vdc range) (Ref V.8):

RA_{mtc} = ± 0.025% reading + 6*(100 μVdc)
RA_{mtc} = ± 0.025% reading + 0.0006 Vdc
RA_{mtc} = ± 0.025% reading * 10 Vdc + 0.0006 Vdc
RA_{mtc} = ± 0.0031 Vdc

RA_{std} = 0

The readability for digital indicators is defined as the least significant digit, per Ref G.1:

RD_{mtc} = ± 0.001 Vdc

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

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

$$IVm_{45} = \pm\sqrt{0.0031^2 + 0^2 + 0.001^2} = \pm 0.0033\,Vdc$$

The worst case and bounding output M&TE error is IVm_{45} = ±0.0033 Vdc.

Converting to % span:

IVm_{45} = ± 0.0033 Vdc * (100 % span / 10 Vdc)

IVm_{45} = ± 0.033 % span

Multimeter (Input M&TE):

For the Fluke 45 multimeter (medium resolution, 30 mA range, 5 digit display) (Ref V.8):

RA_{mtc} = uncertainty * maximum reading
RA_{mtc} = ± 0.05 % reading * 20 mAdc + 3 DGTS
RA_{mtc} = ± 0.05 % reading * 20 mAdc + 3*(1 μA)
RA_{mtc} = ± 0.05 % reading * 20 mAdc + 0.003 mA
RA_{mtc} = ± 0.013 mAdc

RA_{std} = 0

RD_{mtc} = ± 0.001 mAdc

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

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

$$Sm_{MM\text{-}45} = \pm\sqrt{0.013^2 + 0^2 + 0.001^2} = \pm\ 0.013 \text{ mAdc}$$

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

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

RA_{std} = 0

RD_{mte} = ± 0.0001 mAdc

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

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

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

The worst case and bounding output M&TE error is IVm_{HP} = ±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:

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

$$IVm = \pm\sqrt{0.0033^2 + 0.094^2}$$

IVm = ± 0.100 % 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} = ± (0.5 % * 10 Vdc) * (60 °F / 50 °F)
IVt_{steam} = ± (0.05 Vdc) * (1.2)
IVt_{steam} = ± 0.06 Vdc

Converting to % span:

IVt_{steam} = ± 0.06 Vdc * (100 % span / 10 Vdc)

IVt_{steam} = ± 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).

Steam Driven Loop IV Converters (IVr_{steam})

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} = ± 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 = ± 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 = ± 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 = ± 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):

<u>For the Fluke 45 multimeter (medium resolution, 30 mA range, 5 digit display) (Ref V.8)</u>:

RA_{mte} = uncertainty * maximum reading
RA_{mte} = ± 0.05 % reading * 20 mAdc + 3 DGTS
RA_{mte} = ± 0.05 % reading * 20 mAdc + 3*(1 μA)
RA_{mte} = ± 0.05 % reading * 20 mAdc + 0.003 mA
RA_{mte} = ± 0.013 mAdc

RA_{std} = 0

The readability for digital indicators is defined as the least significant digit, per Ref G.1:

RD_{mte} = ± 0.001 mAdc

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

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

$$Sm_{MM\text{-}45} = \pm\sqrt{0.013^2 + 0^2 + 0.001^2} = \pm 0.013 \text{ mAdc}$$

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

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

RA_{std} = 0

RD_{mte} = ± 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):

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

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:

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

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

Fluke 45 multimeter (slow resolution, 5 digit display, 10 Vdc range) (Ref V.8):

RA_{mte} = ± 0.025% reading + 6*(100 μVdc)
RA_{mte} = ± 0.025% reading + 0.0006 Vdc
RA_{mte} = ± 0.025% reading * 10 Vdc + 0.0006 Vdc
RA_{mte} = ± 0.0031 Vdc

RA_{std} = 0

The readability for digital indicators is defined as the least significant digit, per Ref G.1:

RD_{mte} = ± 0.001 Vdc

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

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

$$VIm_{45} = \pm\sqrt{0.0031^2 + 0^2 + 0.001^2} = \pm 0.0033 Vdc$$

The worst case and bounding input M&TE error is VIm_{45} = ±0.0033 Vdc.

Converting to % span:

VIm_{45} = ± 0.0033 Vdc * (100 % span / 10 Vdc)

VIm_{45} = ± 0.033 % 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:

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

$$VIm = \pm\sqrt{0.033^2 + 0.094^2}$$

VIm = ± 0.100 % 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)

<u>M&TE Effect for 1(2)PC-4044-LL (switchover/trip)</u>

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:

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

$RA_{mte} = \pm$ (0.0035 % reading + 0.0005 % range)
$RA_{mte} = \pm$ [0.0035 % (10 Vdc) + 0.0005 % (10 Vdc)]
$RA_{mte} = \pm$ 0.0004 Vdc
$RA_{std} = 0$

$RD_{mte} = \pm$ 0.00001 Vdc

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

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

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

<u>Fluke 45 multimeter (slow resolution, 5 digit display, 10 Vdc range) (Ref V.8):</u>

$RA_{mte} = \pm$ 0.025% reading + 6*(100 μVdc)
$RA_{mte} = \pm$ 0.025% reading + 0.0006 Vdc
$RA_{mte} = \pm$ 0.025% reading * 10 Vdc + 0.0006 Vdc
$RA_{mte} = \pm$ 0.0031 Vdc

$RA_{std} = 0$

The readability for digital indicators is defined as the least significant digit, per Ref G.1:

$RD_{mte} = \pm$ 0.001 Vdc

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

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

$$IVm_{45} = \pm\sqrt{0.0031^2 + 0^2 + 0.001^2} = \pm 0.0033\,\text{Vdc}$$

The worst case and bounding M&TE error is $Bm_{45} = \pm 0.0033$ Vdc.

Converting to % span:

Bm_{45} = ± 0.0033 Vdc * (100 % span / 10 Vdc)

Bm_{45} = ± 0.033 % span

M&TE Effect for 1(2)PC-4044-L (alarm)

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 (medium resolution, 30 mA range, 5 digit display) (Ref V.8):

RA_{mte} = uncertainty * maximum reading
RA_{mte} = ± 0.05 % reading * 20 mAdc + 3 DGTS
RA_{mte} = ± 0.05 % reading * 20 mAdc + 3*(1 μA)
RA_{mte} = ± 0.05 % reading * 20 mAdc + 0.003 mA
RA_{mte} = ± 0.013 mAdc

RA_{std} = 0

The readability for digital indicators is defined as the least significant digit, per Ref G.1:

RD_{mte} = ± 0.001 mAdc

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

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

$$Sm_{MM\text{-}45} = \pm\sqrt{0.013^2 + 0^2 + 0.001^2} = \pm 0.013 \text{ mAdc}$$

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:

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

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

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

Converting to % span:

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

Bm_{HP} $= \pm$ 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)	± 0.100 %	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)	± 0.100 %	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} = ± 0.033 % Bm_{HP} = ± 0.094 %	8.1.32
Bistable Setting Tolerance (Bv)	$Bv_{steam-LL}$ = ± 0.2 % $Bv_{steam-L}$ = ± 0.1875 %	8.1.33
Bistable Power Supply Effect (Bp)	± 0.25 %	8.1.34
Bistable Temperature Effect (Bt)	$Bt_{steam-LL}$ = ± 0.6 % $Bt_{steam-L}$ = ± 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 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:

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

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:

$$TLE_{SWITCHOVER/TRIP-STEAM} = \pm\sqrt{\begin{array}{l} 0.075^2 + 0.25^2 + 0.5^2 + 0.240^2 + 0.25^2 + 0.5^2 + 0.535^2 + 0.100^2 + 0.033^2 + 0.25^2 \\ + 0.5^2 + 0.2^2 + 0.0075^2 + 0.2^2 + 0.25^2 + 0.047^2 + 0.6^2 + 0.6^2 + 0.0^2 \\ + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.902^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 \end{array}} \pm 0.0$$

$TLE_{SWITCHOVER/TRIP-STEAM}$ = **± 1.725 % span** * (30 psig/100 % span)

$TLE_{SWITCHOVER/TRIP-STEAM}$ = **± 0.518 psig**

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

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:

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

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

$$TLE_{ALARM-STEAM} = \pm \sqrt{\begin{array}{l} 0.075^2 + 0.25^2 + 0.5^2 + 0.5^2 + 0.240^2 + 0.25^2 + 0.5^2 + 0.5^2 + 0.535^2 + 0.100^2 \\ + 0.100^2 + 0.094^2 + 0.25^2 + 0.5^2 + 0.5^2 + 0.1875^2 + 0.0075^2 + 0.2^2 + 0.5^2 \\ + 0.25^2 + 0.047^2 + 0.6^2 + 0.6^2 + 0.55^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 \\ + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.902^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 + 0.0^2 \end{array}} \pm 0.0$$

$TLE_{ALARM-STEAM}$ $= \pm$ **2.072 % span** * (30 psig/100 % span)

$TLE_{ALARM-STEAM}$ $= \pm$ **0.622 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 Narrow-Range 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 % span

Converting from % span to mA:

SAF_{Steam} $= \pm$ 0.6374 % span * (16 mA / 100 % span)

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 = ± 0.5 % span	Section 8.1.15
IVd = ± 0.25 % span	Section 8.1.13
IVm = ± 0.100 % span	Section 8.1.14

$$IVAF = \pm\sqrt{0.5^2 + 0.25^2 + 0.100^2}$$

IVAF = ± 0.5679 % span

Converting from % span to Vdc:

IVAF = ± 0.5679 % 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 = ± 0.5 % span	Section 8.1.24
VId = ± 0.5 % span	Section 8.1.22
VIm = ± 0.100 % span	Section 8.1.23

$$VIAF = \pm\sqrt{0.5^2 + 0.5^2 + 0.100^2}$$

VIAF = ± 0.7141 % span

Converting from % span to mA:

VIAF = ± 0.7141 % 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:

$Bv_{Steam-LL}$	$= \pm 0.2$ % span	Section 8.1.33
Bd	$= \pm 0.5$ % span	Section 8.1.31
Bm_{45}	$= \pm 0.033$ % span	Section 8.1.32

$$BAF_{Steam-LL} = \pm \sqrt{0.2^2 + 0.5^2 + 0.033^2}$$

$$BAF_{Steam-LL} = \pm 0.5395 \text{ \% span}$$

Converting from % span to Vdc:

$BAF_{Steam-LL} = \pm 0.5395$ % span * (10 Vdc / 100 % span)

$BAF_{Steam-LL} = \pm 0.054$ 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

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

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

Converting from % span to mAdc:

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

$BAF_{Steam-L}$ = ± 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} = ± Sv_{Steam}

SAL_{Steam} = ± 0.25 %Span Section 8.1.4

Converting from % span to mAdc:

SAL_{Steam} = ± 0.25 % span * (16 mAdc / 100 % span)

SAL_{Steam} = ± 0.04 mAdc

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

Using the equation from Section 7.3.2:

IVAL = ± IVv
IVAL = ± 0.5% span Section 8.1.15

Converting from % span to Vdc:

IVAL = ± 0.5 % span * (10 Vdc / 100 % span)
IVAL = ± 0.050 Vdc

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

Using the equation from Section 7.3.3:

VIAL = ± VIv

VIAL = ± 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:

$BAL_{Steam-LL}$ = ± $Bv_{Steam-LL}$

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

Converting from % span to Vdc:

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

$BAL_{Steam-LL}$ = ± 0.020 Vdc

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

Using the equation from Section 7.3.4:

$BAL_{Steam-L}$ = ± $Bv_{Steam-L}$

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

Converting from % span to mAdc:

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

$BAL_{Steam-L}$ = ± 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:

$SP\downarrow \quad = AL + [TLE_{rdm}^{+} + TLE_{bias}^{+}]PS$

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

Margin = LTSP – FTSP

These equations are used throughout this section for the evaluation of the TDAFP 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. Per Section 8.4.1, the random component of the TLE $_{SWITCHOVER/TRIP-STEAM}$ is 1.725 % span. There is no TLE bias component.

Substituting:

$SP_{SWITCHOVER/TRIP-Steam}$ = 5.241 psig + (1.725 % * 30 psig + 0)

$SP_{SWITCHOVER/TRIP-Steam}$ = 5.241 psig + 0.518 psig

$SP_{SWITCHOVER/TRIP-Steam}$ = 5.759 psig

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

$LTSP \geq SP$

The LTSP is chosen by conservatively rounding the SP to 5.8 psig.

5.8 psig ≥ 5.759 psig

The newly recommended limiting trip setpoint of 5.8 psig is acceptable. Therefore,

$LTSP_{SWITCHOVER/TRIP-Steam-new}$ = 5.8 psig

To protect the LTSP, the FTSP has been selected such that additional margin is provided between LTSP and FTSP. Therefore a value of 6.1 psig has been selected for the FTSP.

$FTSP_{SWITCHOVER/TRIP-Steam-new}$ = 6.1 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 6.1 psig.

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

FTSP ≥ SP

6.1 psig ≥ 5.759 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:

$$\text{Margin}_{\text{SWITCHOVER/TRIP-Steam}} = |\,5.8 \text{ psig} - 6.1 \text{ psig}\,|$$

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

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:

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

Where:

IVv	= ± 0.5 % span	Section 8.1.15
IVd	= ± 0.25 % span	Section 8.1.13
IVm	= ± 0.100 % span	Section 8.1.14
$Bv_{\text{Steam-LL}}$	= ± 0.2 % span	Section 8.1.33
Bd	= ± 0.5 % span	Section 8.1.31
Bm_{45}	= ± 0.033 % span	Section 8.1.32

$$RE_{\text{as-found}} = \pm\sqrt{0.5^2 + 0.25^2 + 0.100^2 + 0.2^2 + 0.5^2 + 0.033^2}$$

$$RE_{\text{as-found}} = \pm\, 0.7833\ \%\ \text{span}$$

Converting from % span to Vdc:

$RE_{as\text{-}found} = \pm 0.7833$ % span * (10 Vdc / 100 % span)
$RE_{as\text{-}found} = \pm 0.078$ Vdc

Converting from % span to psig:

$RE_{as\text{-}found} = \pm 0.7833$% span * (30 psig / 100 % span)
$RE_{as\text{-}found} =$ **0.235 psig**

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)
$RE_{as\text{-}left} =$ **± 0.054 Vdc**

Converting from % span to psig:

$RE_{as\text{-}left} = \pm 0.5385$% span * (30 psig / 100 % span)
$RE_{as\text{-}left} =$ **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:

$Margin_{SWITCHOVER/TRIP\text{-}Steam\ As\text{-}Found}{}^{-} = |(5.8\ psig + 0.235\ psig) - 6.1\ psig|$

$Margin_{SWITCHOVER/TRIP\text{-}Steam\ As\text{-}Found}{}^{-} = 0.065$ psig

The newly recommended switchover/trip setpoint of 6.1 psig is acceptable. Therefore,

$FTSP_{SWITCHOVER/TRIP\text{-}Steam\text{-}new}$ = 6.1 psig

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

$FTSP_{SWITCHOVER/TRIP\text{-}Steam\text{-}new}$ = 6.1 psig * (10 Vdc / 30 psig)

$FTSP_{SWITCHOVER/TRIP\text{-}Steam\text{-}new}$ = 2.033 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.

Substituting:

$SP_{ALARM\text{-}Steam}$ = 5.241 psig + (2.072 % * 30 psig)

$SP_{ALARM\text{-}Steam}$ = 5.241 psig + 0.622 psig

$SP_{ALARM\text{-}Steam}$ = 5.863 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 TDAFP Low-Low Suction Pressure Switchover/Trip Setpoint.

$FTSP \geq SP$

7.0 psig is greater than or equal to 5.863 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 TDAFP 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 6.6 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:

$FTSP_{ALARM\text{-}Steam\text{-}new}$ = 6.6 psig

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

$FTSP_{ALARM\text{- Steam-new}} = 6.6 \text{ psig} * [(20 \text{ mAdc} - 4 \text{ mAdc}) / 30 \text{ psig})] + 4 \text{ mAdc}$

$\mathbf{FTSP_{ALARM\text{- Steam-new}} = 7.52 \text{ mAdc}}$

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 $_{SWITCHOVER / TRIP-STEAM}$	± 1.725	± 0.518	8.4.1
TLE $_{ALARM-STEAM}$	± 2.072	± 0.622	8.4.2

9.2 Field and Calculated Switchover/Trip Setpoint (FTSP/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	5.759 psig	6.6 psig	0.660 Vdc	6.1 psig	2.033 Vdc	8.6.1, P.3, P.4
1(2)P-29 Steam Driven AFP Lo Suction Pressure Alarm	5.863 psig	7.1 psig	5.14 mAdc	6.6 psig	7.52mAdc	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	± 0.078 Vdc

9.4 Limitations

9.4.1 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.

9.4.2 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 (slow res.)	0-10 Vdc	0.025 % reading + 600 μV	0.001 Vdc	8.1.14, 8.1.23, 8.1.32
Fluke 45 (medium res.)	0-30 mA	0.05 % reading + 3 μA	0.001 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

9.4.3 Not Used.

9.4.4 Not Used.

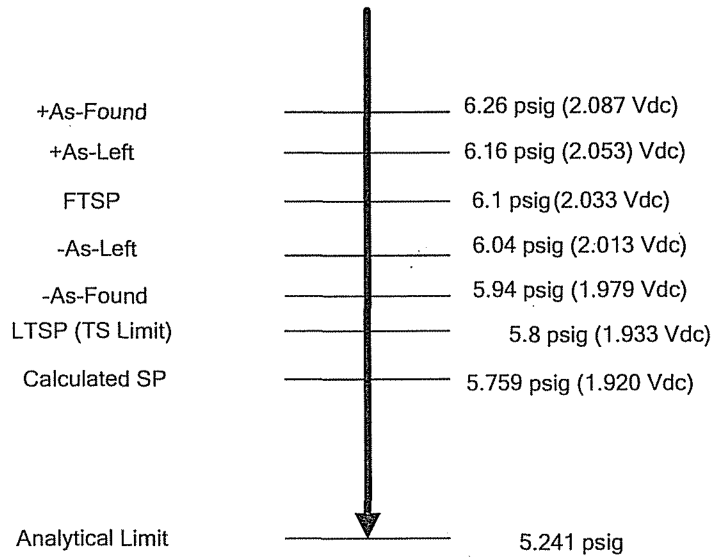
9.4.5 Implementation of EC-13407

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.

9.5 Graphical Representation of Revised Setpoints and Tolerances

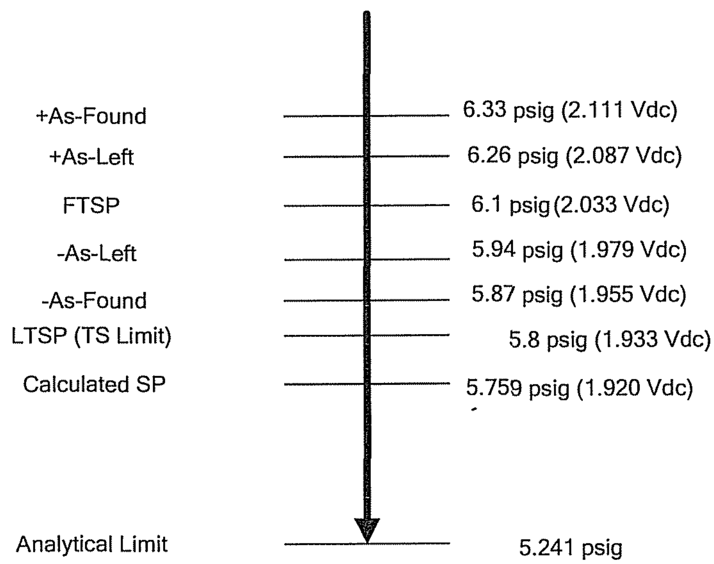
9.5.1 Steam Driven Low-Low Suction Pressure Trip (Bistable Only)

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



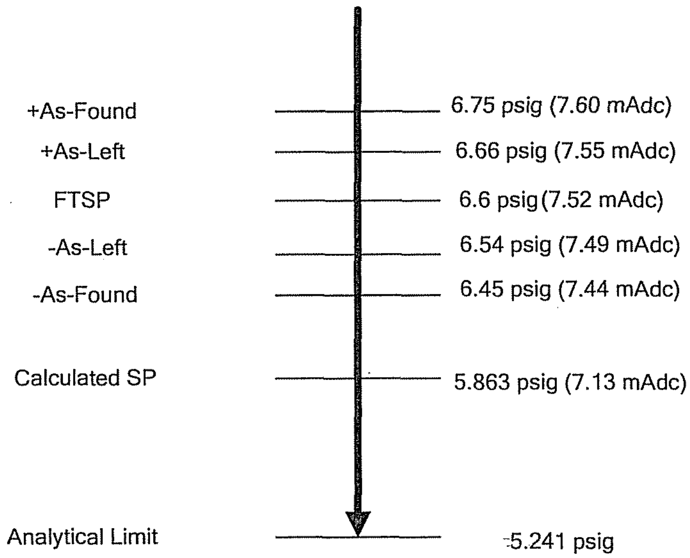
9.5.2 Steam Driven Low-Low Suction Pressure Trip Rack Error – Channel Operability Testing

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 Low 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 LTSP 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:

$LTSP_{SWITCHOVER/TRIP\text{-}Motor\text{-}new} = 5.8$ 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 LTSP provides the information for Technical Specification Table 3.3.2-1, Engineered Safety Feature Actuation System Instrumentation, Item 6.e for "AFW Pump Suction Transfer on Suction Pressure Low". The LSSS for Function 6.e. is proposed to be 5.8 psig.

EPU Tech Spec Table 3.3.2-1 Function 6. e. contains a single line that applies to both the turbine- and motor-driven AF pumps, this minor revision and minor revision 002-D must recommend the same setpoint values. This minor revision and minor revision 002-D recommend the same values for all setpoints for consistency.

Table 9.5-1: Input to EPU TS Table 3.3.2-1

Function	Allowable Value	Nominal Trip Setpoint
6. e. "AFW Pump Suction Transfer on Suction Pressure Low"	≥ 5.8 psig	6.1 psig

10.0 IMPACT ON PLANT DOCUMENTS

Note: Passport Engineering Change (EC) Number for Calculation 97-0231-002-C is 15802.

- 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 As-Found Tolerances for the Steam Driven Suction Pressure Rack Components. 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 As-Found Tolerances for the Steam Driven Suction Pressure Rack Components. 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)

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

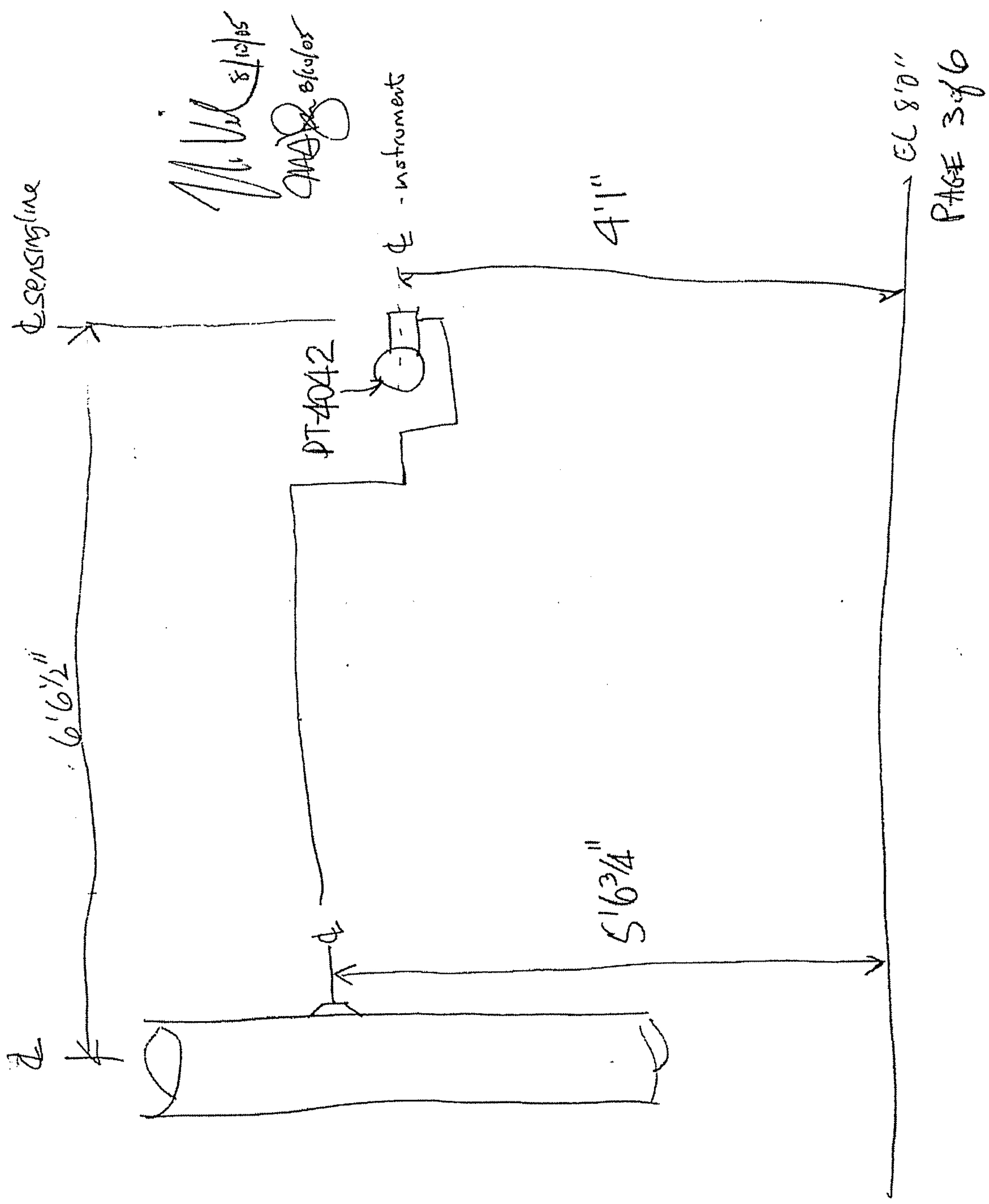
S&L Lead W. Barasa Signature [signature] Date 8-10-05

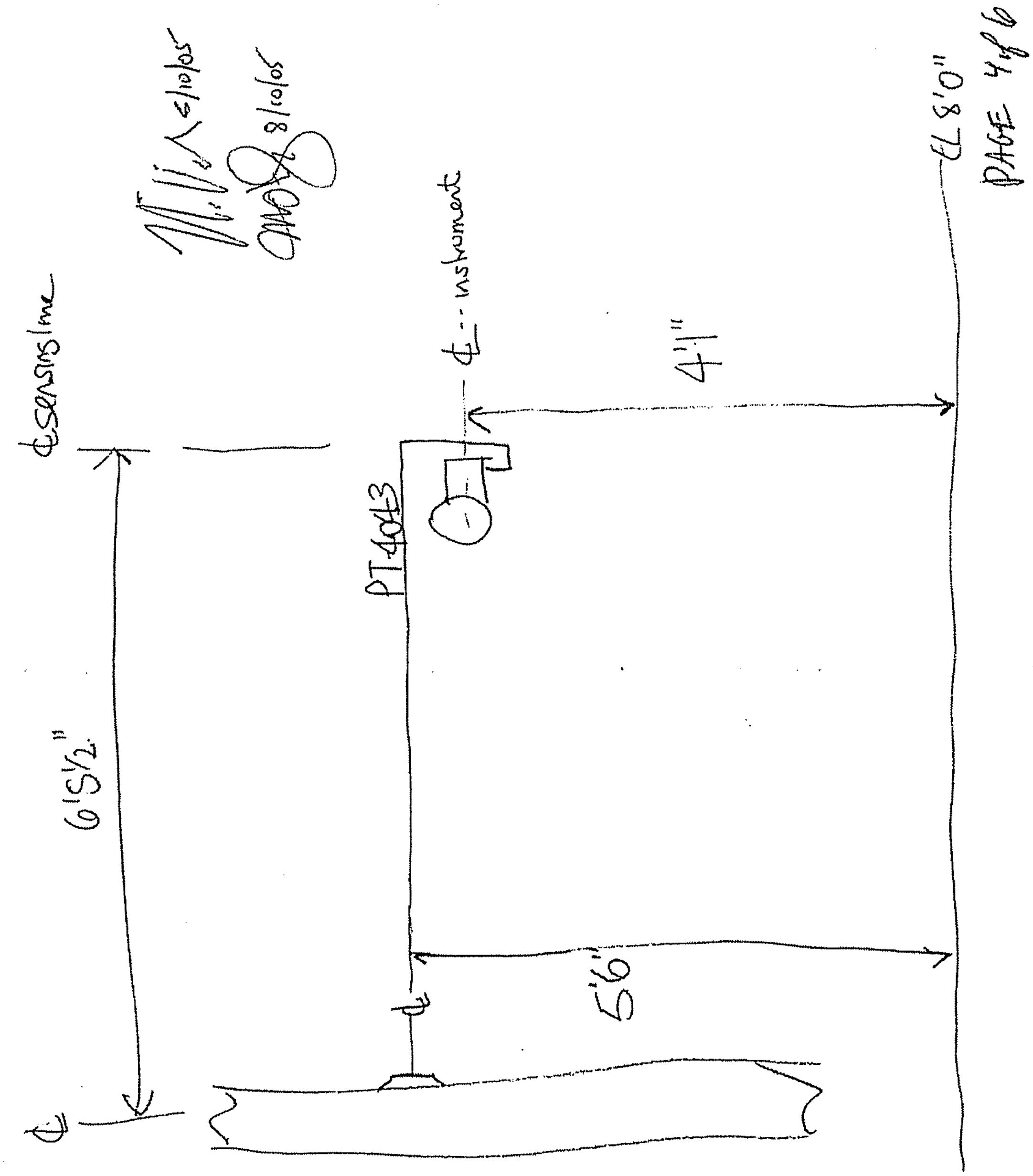
PART 2 - WALKDOWN DATA COLLECTION FORM

Results

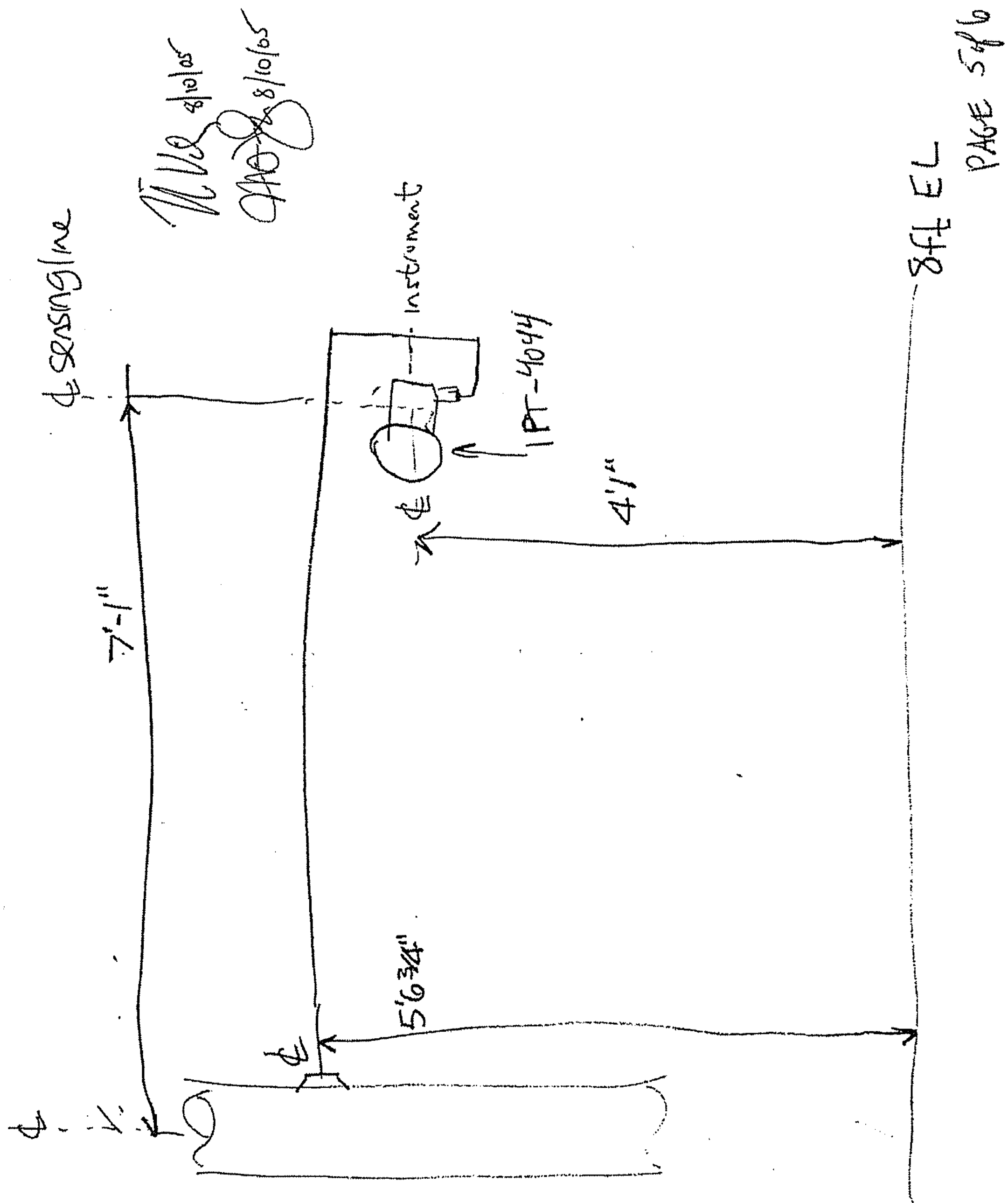
See attached diagram for each pressure transmitter (4 pages total).

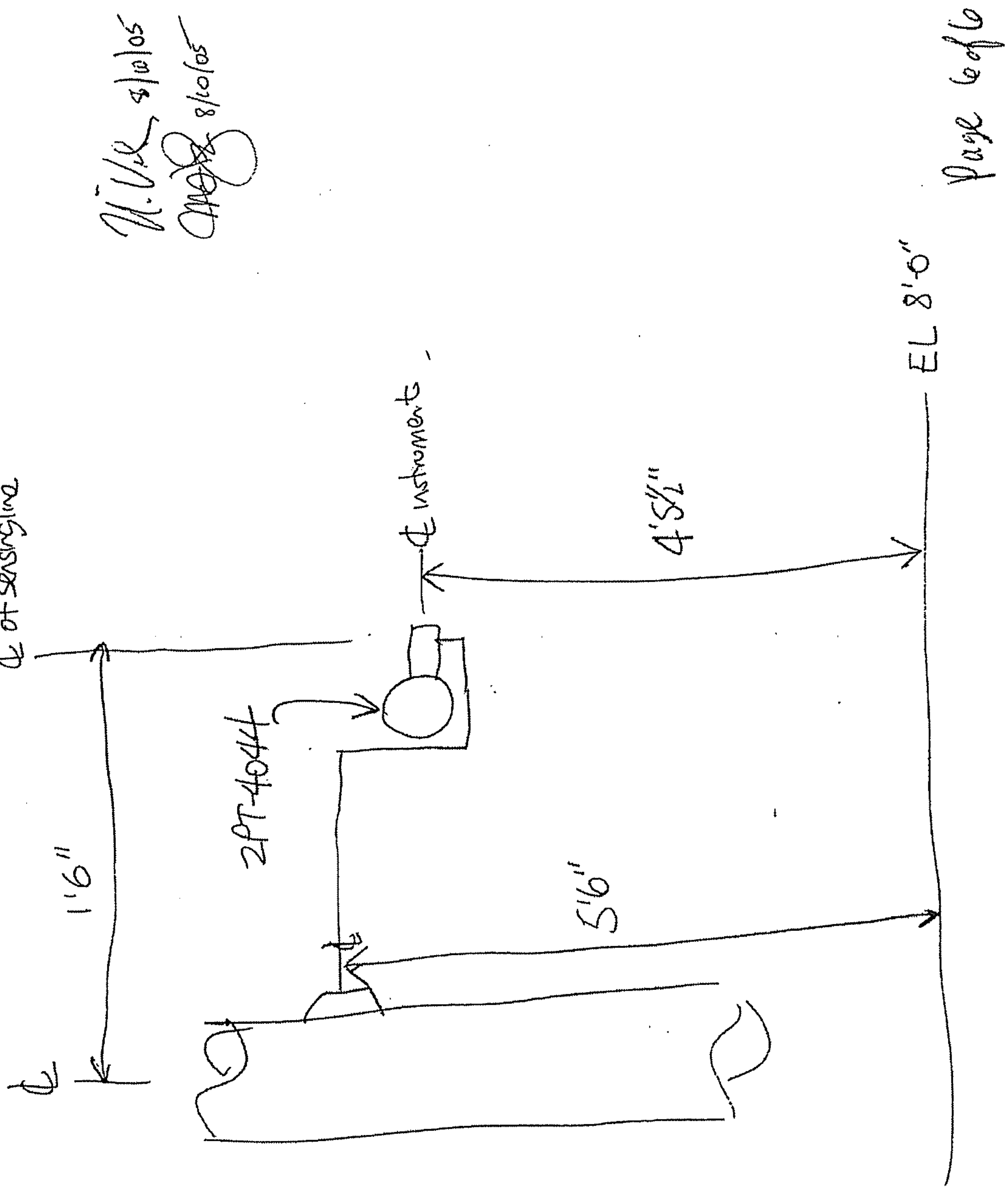
NICK VILLONE	N. V.	8/10/05
Data Taker Name	Signature	Date
[illegible]	H G Flynn	8/10/05
Independent Verifier Name	Signature	Date


℄ sensing line
6'6½"
PT-4042
℄ -instrument
4'1"
EL 8'0"
PAGE 3 of 6
5'6¾"
℄


8/10/05
8/10/05
EL 8'0"
PAGE 4 of 6
4'1"
6'5½"
5'6"

ATTACHMENT A




8/10/05
8/10/05
Page 6 of 6
EL 8'-0"
℄ instrument
4'5½"
℄ of sensing line
2PT-4044
1'6"
5'6"
℄

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 1PT-4044A and 2PT-4044A. 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

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

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		
6.1 ↓	2.033 ↓	1.955	2.111		1.979	2.087		
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	
6.6 ↓	7. 52↓	7.44	7.60		7.49	7.55	
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		
6.1 ↓	2.033 ↓	1.955	2.111		1.979	2.087		
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	
6.6 ↓	7.52 ↓	7.44	7.60		7.49	7.55	
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						

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 (slow res.)	0-10 Vdc	0.025 % reading + 600 μV	0.001 Vdc
Fluke 45 (medium res.)	0-30 mA	0.05 % reading + 3 μA	0.001 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

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

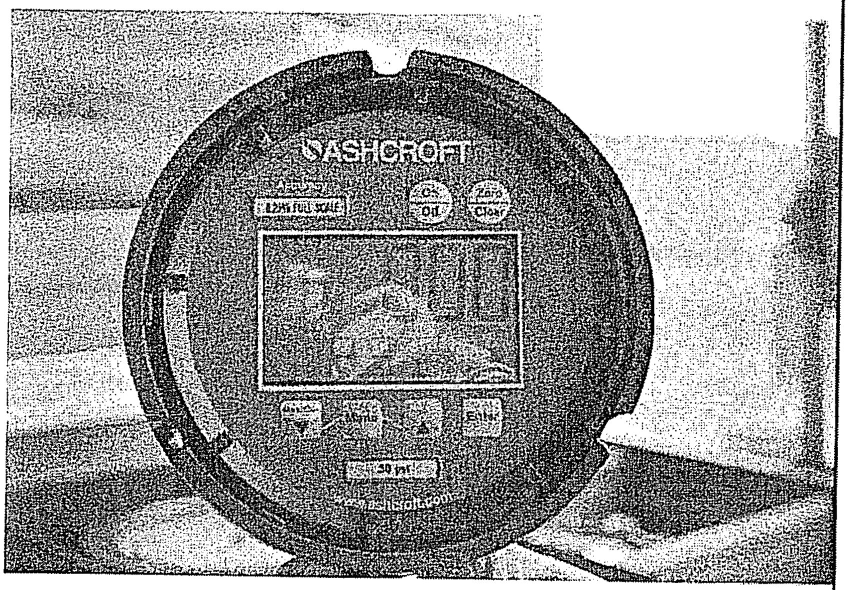
Data Tolerance Requirements

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

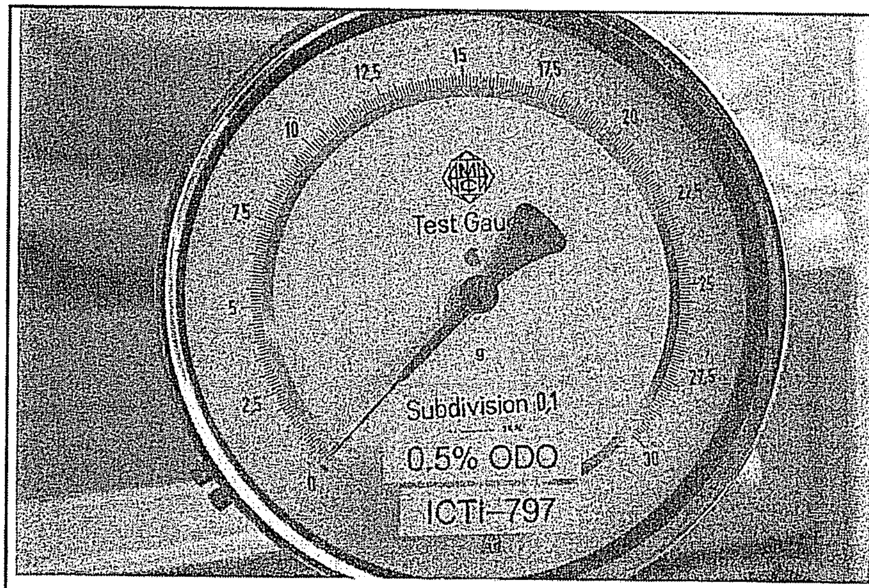
PART 2 - WALKDOWN DATA COLLECTION FORM

Results

See photographs.



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



The subdivisions of ICTI-797 are 0.1psi.

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