1717 Wakonade Drive
Welch, MN 55089

December 7, 2021

L-PI-21-047
10 CFR 50.90

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

Prairie Island Nuclear Generating Plant, Units 1 and 2
Docket Nos. 50-282 and 50-306
Renewed Facility Operating License Nos. DPR-42 and DPR-60

Response to Request for Additional Information RE: 24-Month Cycle Amendment Prairie Island Nuclear Generating Plant, Units 1 and 2

References: 1) Letter (L-PI-21-016) from NSPM to the NRC, "Application for License Amendment to Implement 24-Month Operating Cycle," dated August 6, 2021 (ADAMS Accession No. ML21218A093)

2) Email from the NRC to NSPM, "Requests for Additional Information 24-Month Cycle Amendment Prairie Island Nuclear Generating Plant, Units 1 and 2 Docket Nos. 50-282 And 50-306," dated November 10, 2021 (ADAMS Accession No. ML21321A045)

In Reference 1, Northern States Power Company, a Minnesota corporation, doing business as Xcel Energy (hereafter "NSPM"), submitted a request for approval for changes to the Prairie Island Nuclear Generating Plant (PINGP) licensing basis to implement a 24-month operating cycle for PINGP Units 1 and 2 and corresponding changes to the PINGP Technical Specifications (TS). The NRC identified the need for additional information and provided the Request for Additional Information (RAI) in Reference 2. The enclosure to this letter provides NSPM's response to the NRC RAI.

The information provided in this letter does not alter the evaluations performed in accordance with 10 CFR 50.92 in Reference 1.

NSPM is notifying the State of Minnesota of this request by transmitting a copy of this letter and enclosures to the designated State Official.

Please contact Mr. Jeff Kivi at (612) 330-5788 or Jeffrey.L.Kivi@xcelenergy.com if there are any questions or if additional information is needed.

Summary of Commitments

This letter makes no new commitments and no revisions to existing commitments.

I declare under penalty of perjury, that the foregoing is true and correct.
Executed on December 7, 2021.

for Harlan D. Hanson Jr. - Plant Mgr.

Christopher P. Domingos
Site Vice President, Prairie Island Nuclear Generating Plant
Northern States Power Company – Minnesota

Enclosures

cc: Administrator, Region III, USNRC
Project Manager, Prairie Island, USNRC
Resident Inspector, Prairie Island, USNRC
State of Minnesota

Response to Request for Additional Information RE:

24- Month Operating Cycle License Amendment Request Prairie Island Nuclear Generating Plant, Units 1 and 2

1.0 BACKGROUND

In Reference 1, Northern States Power Company, a Minnesota corporation, doing business as Xcel Energy (hereafter "NSPM"), submitted a request for approval for changes to the Prairie Island Nuclear Generating Plant (PINGP) licensing basis to implement a 24-month operating cycle for PINGP Units 1 and 2 and corresponding changes to the PINGP Technical Specifications (TS). The NRC identified the need for additional information and provided the Request for Additional Information (RAI) in Reference 2. The enclosure to this letter provides NSPM's response to the NRC RAI.

2.0 NRC REQUEST FOR ADDITIONAL INFORMATION AND NSPM RESPONSE

Regulatory Basis

Title 10 of the Code of Federal Regulations (10 CFR) Part 50 "Domestic Licensing of Production and Utilization Facilities," Section 50.36, "Technical specifications," paragraph (a)(1), states in part, "Each applicant for a license authorizing operation of a production or utilization facility shall include in his application proposed technical specifications (TSs) in accordance with the requirements of this section."

10 CFR Part 50.36(c)(1)(ii)(A) of 10 CFR, states that limiting safety system settings (LSSS) are settings for automatic protective devices related to those variables having significant safety functions. This clause requires, in part, that where a LSSS is specified for a variable on which a safety limit has been placed, the setting be chosen so that automatic protective action will correct the abnormal situation before a safety limit is exceeded.

10 CFR 50.36(c)(3) states that, "Surveillance requirements are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met."

Additionally, 10 CFR Part 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants, Criterion III, Design Criteria requires, in part, that "… The design control measures shall provide for verifying or checking the adequacy of design, such as by the performance of design reviews, by the use of alternate or simplified calculational methods, or by the performance of a suitable testing program."

In addition, Regulatory Guide (RG) 1.105, Revision 3, "Setpoints for Safety-Related Instrumentation," dated December 1999 (ADAMS Accession No. ML993560062), describes a method acceptable to the NRC staff for complying with the NRC's regulations for ensuring that setpoints for safety-related instrumentation are initially within and remain within the technical specification limits. This RG provides guidance on methods used to perform these calculations. Additionally, Branch Technical Position, 7-12, "Guidance on Establishing and Maintaining Instrument Setpoints" within Chapter 7, "Instrumentation and Controls" of the Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: Light Water Reactor Edition, NUREG 0800, provides guidance for the use of RG 1.105 when evaluating setpoints for safety-related instrumentation.

Background

Northern States Power Company (NSPM), a Minnesota corporation, submitted a LAR for changes to the Prairie Island Nuclear Generating Plant, Units 1 and 2 (Prairie Island), licensing bases to implement a 24-month operating cycle and corresponding changes to the Prairie Island TSs.

The LAR made multiple references to a "Summary Technical Specification Trip Setpoint Calculation." The LAR stated that "The Summary Technical Specification Trip Setpoint Calculation also assessed the availability of margin between the actual plant setting and Nominal Trip Setpoint as well as ensuring that the existing as-found setting tolerance specified in Surveillance Procedures does not challenge the Allowable Value from Technical Specifications."

Additionally, Enclosure 3 of the LAR provided a summary of the process undertaken by the licensee to determine the viability of maintaining or altering the affected devices setpoints to accommodate a 30-month calibration cycle. However, no summary of the actual implementation of the referenced process and resultant summary results for the impacted devices was provided in the LAR.

Request for Additional Information

Based upon a review of the information in the LAR, the summary calculations for the impacted instrumentation were not included. Therefore, provide a summary of the calculations that demonstrate and support the extension of the calibration periodicity.

NSPM Response to RAI

The Summary Technical Specification Trip Setpoint Calculation is included in Enclosure 2. The Summary Technical Specification Trip Setpoint Calculation was developed to support the license amendment request (Reference 1) that proposes to implement a 24-month operating cycle at PINGP that includes a 1.25 times grace for up to 30 months to complete TS Surveillance Requirements (SRs). The purpose of the calculation is to provide justification that the change in the surveillance interval from 24

to 30 months does not adversely impact the plant operation for instrument loops that perform trips listed in the Technical Specification with Allowable Values. The summary calculation documents the 30-month drift analysis which was used to determine the potential impact on the technical specification function trips by analyzing the effect of calculated instrument drift on the existing instrument setpoint calculation for a 30-month calibration interval. As noted in Reference 1, in one case, the Summary Technical Specification Trip Setpoint Calculation determined that one TS Allowable Value needed to be revised (see Attachment AA in the calculation included as Enclosure 2).

The Summary Technical Specification Trip Setpoint Calculation was specifically created to support Reference 1 and will not be maintained going forward. As stated in Reference 1, the setpoint calculations for the in-scope instruments in TS will be updated to support implementation of the amendment.

3.0 REFERENCES

1. Letter (L-PI-21-016) from NSPM to the NRC, "Application for License Amendment to Implement 24-Month Operating Cycle," dated August 6, 2021 (ADAMS Accession No. ML21218A093)

2. Email from the NRC to NSPM, "Requests for Additional Information 24-Month Cycle Amendment Prairie Island Nuclear Generating Plant, Units 1 and 2 Docket Nos. 50-282 And 50-306," dated November 10, 2021 (ADAMS Accession No. ML21321A045)

ENCLOSURE 2

Summary Technical Specification Trip Setpoint Calculation

NSPM Calculation No: SPC-AF-EA-RC-RP-001

461 pages follow

Xcel Energy	**Calculation Signature Sheet**

Approval: 602000009702

Document Information	
NSPM Calculation (Doc) No: SPC-AF-EA-RC-RP-001	Revision: 0
Title: Summary Technical Specification Trip Setpoint Calculation	
Facility: ☐ MT ☒ PI	Unit: ☒ 1 ☒ 2
Safety Class: ☒ SR ☐ Aug Q ☐ Non SR	
Type: **Calc** Sub-Type:	

NOTE:	**Print and sign name in signature blocks, as required.**

Major Revisions	☐ N/A
EC Number: 601000002918	☒ Vendor Calc: SPC-AF-EA-RC-RP-001
Vendor Name or Code: Sargent & Lundy	Vendor Doc No: N/A
Description of Revision: Original	
The following calculation and attachments have been reviewed and deemed acceptable as a legible QA record	☒
Prepared by: (sign) / (print) By Vendor	Date:
Reviewed by: (sign) Digitally signed by Nicholas J. Torres Date: 2021.07.15 14:37:11 -06'00' / (print) N. Torres	Date:
Type of Review: ☐ Design Verification ☐ Engr Review ☐ OAR ☒ EOC	
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by: (sign) See MOC Activity 600000886455 / (print) E. Watzl	Date:

Xcel Energy	**Calculation Signature Sheet**

Minor Revisions		☒ N/A
EC No:	☐ Vendor Calc:	
Minor Rev. No:		
Description of Change:		
Pages Affected:		
The following calculation and attachments have been reviewed and deemed acceptable as a legible QA record		☐
Prepared by: (sign) / (print)		Date:
Reviewed by: (sign) / (print)		Date:
Type of Review: ☐ Design Verification ☐ Engr Review ☐ OAR ☐ EOC		
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test		
Approved by: (sign) / (print)		Date:

Superseded Calculations:

Facility	Calc Document Number	Title

Summary of Verification

Does the Calculation:

☐ YES ☒ No Affect piping or supports? (If YES, Attach MT Form 3544.) MONTI ONLY

☐ YES ☒ No Require Fire Protection Review? (Using QF2900, Fire Protection Program Impact Screen, determine if a Fire Protection Review is required.) If YES, document the engineering review in the EC. If NO, then attach completed QF2900 to the associated EC.

Sargent & Lundy

ISSUE SUMMARY
Form SOP-0402-07, Revision 13

DESIGN CONTROL SUMMARY

CLIENT:	Northern States Power Company	UNIT NO.: 1 & 2	PAGE NO.: 1 of 7
PROJECT NAME:	**Prairie Island Nuclear Generating Plant**		
PROJECT NO.:	14385-034	S&L NUCLEAR QA PROGRAM	
CALC. NO..:	SPC-AF-EA-RC-RP-001	APPLICABLE ☒ YES ☐ NO	
TITLE:	Summary Technical Specification Trip Setpoint Calculation		
EQUIPMENT NO.:			

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

Initial Issue

INPUTS/ ASSUMPTIONS
☒ VERIFIED
☐ UNVERIFIED

REVIEW METHOD:	Detailed Review	REV.:	0
STATUS:	☒ APPROVED ☐ SUPERSEDED BY CALCULATION NO. ☐ VOID	DATE FOR REV.:	
ISSUE DESCRIPTION:	Initial Issue		
PREPARER:	Maarten Monster — Maarten T. Monster (Digitally signed by Maarten T. Monster Date: 2021.07.15 15:22:21 -04'00')	DATE:	
REVIEWER:	Dean Crumpacker — W. D. Crumpacker (Digitally signed by W. D. Crumpacker Date: 2021.07.15 14:27:35 -05'00')	DATE:	
APPROVER:	William A Barasa (Digitally signed by William A Barasa DN: cn=William A Barasa, o=Sargent & Lundy, ou, email=william.a.barasa@sargentlundy.com, c=US Date: 2021.07.15 14:42:36 -05'00')	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.:	
ISSUE DESCRIPTION:			
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.:	
ISSUE DESCRIPTION:			
PREPARER:		DATE:	
REVIEWER:		DATE:	
APPROVER:		DATE:	

Calculation Certification Page

Client: Northern States Power Company

Project Name: Prairie Island Nuclear Generating Plant

Calculation No.: SPC-AF-EA-RC-RP-001

Revision: 0

I certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.

Print Name: George Huber

Signature: George W Huber Jr

Digitally signed by George W Huber Jr
Date: 2021.07.15 15:29:12 -05'00'

Date: *(see signature above)* License No.: 53608

TABLE OF CONTENTS

LIST OF ATTACHMENTS

1.0 PURPOSE

The purpose of this calculation is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for instrument loops that perform trips listed in the Technical Specification with Allowable Values. This justification will provide input to the LAR being submitted to extend the surveillance intervals.

2.0 METHODOLOGY

The 30-month instrument drift is calculated from calibration data using the As-Found / As-Left (AFAL) methodology of EPRI Report TR-103335, Revision 2, “Guidelines for Instrument Calibration Extension/Reduction Programs,” (Reference 8.1) as implemented by EM 3.3.4.2 Revision 1, “The Analysis of Instrument Drift” (Reference 8.2).

The result of the 30-month drift analysis is used to determine the potential impact on the technical specification function trips by analyzing the effect of calculated instrument drift on the existing instrument setpoint calculation for a 30-month calibration interval. The calculated drift replaces three uncertainty terms in the instrument setpoint calculation: Reference Accuracy, Calibration Uncertainty, and time dependent drift for components included in the Total Loop Error (TLE) equation, described in EM 3.3.4.2 (Reference 8.2).

2.1 SETPOINT/UNCERTAINTY CALCULATIONS

This calculation will use the equations and methodology in EM 3.3.4.1, “Instrument Setpoint/Uncertainty Calculations,” (Reference 8.3) and from associated setpoint calculations.

The Total Loop Error (TLE) equation in the existing setpoint calculations will be used in this calculation. The calculated drift from As-Found / As-Left analysis will replace Instrument Reference Accuracy, calibration error and the time dependent error in the TLE equation as described in section 11.3 of TR-10335 (Reference 8.1). All the other values will remain the same and a new TLE will be calculated.

This new TLE will replace the TLE in the Nominal Trip Setpoint (NTSP) equation from the existing setpoint calculations. All other values unrelated to the calculated drift in this equation will remain the same and a new NTSP will be calculated.

The Actual Plant Setting (APS) and As-Found Tolerance (AFT) will be retrieved from the calibration procedure.

Loop Drift (LD) is used to calculate the Allowable Value (AV). For the instruments included in the analyzed loop, the calculated drift from the As-Found / As-Left data will replace the Instrument Reference Accuracy, the calibration error and the time dependent error in the LD equation. All other values used to calculate the LD will remain the same and a new AV will be calculated.

2.2 MISSING UNIT 2 CALCULATIONS

For functions that are missing Unit 2 calculations, the Unit 1 calculation will evaluate the configuration of the Unit 1 and the Unit 2 instrument loops. If the units are the same, the individual calculation will state that the Unit 1 calculation applies to Unit 2. If differences exist between the two units, separate computations will be performed for each unit following the methodology detailed in Section 2.1.

2.3 DISCRETIONARY SETPOINT MARGIN REDUCTION

The setpoint margin acceptance criteria given in section 3.1 is derived from ANSI/ISA-67.04.01 (Reference 8.4) which gives methodology to establish safety related instrument setpoints. Section 4.4 of Reference 8.4 shows that the NTSP includes discretionary margin. For the setpoint margin acceptance criteria given in section 3.1, this discretionary margin is conservatively assigned a default value equal to the As-Found Tolerance. When inclusion of this discretionary margin causes failure to meet the acceptance criteria, the as found tolerance will be decreased (to no less than zero) until the setpoint acceptance criteria is met; any remaining margin is calculated and documented as discretionary. Discussion will be included to identify where the As-Found Tolerance is decreased in this manner.

3.0 ACCEPTANCE CRITERIA

This section states the acceptance criteria for the setpoint analysis using the following terms:

$AV_{Tech\ Spec}$	AV in the Technical Specifications
AV_{calc}	AV determined in this calculation
NTSP	Nominal Trip Setpoint
APS	Actual Plant Setting
AFT	As-Found Tolerance

3.1 Setpoint Margin

For Increasing Setpoints:

NTSP ≥ APS + AFT

For Decreasing Setpoints:

NTSP ≤ APS – AFT

As described in section 2.3 the use of a revised As-Found Tolerance (AFT) greater than or equal to zero is acceptable to meet the setpoint margin acceptance criteria if required.

3.2 Allowable Value (AV)

For Increasing Setpoints:

$AV_{Tech\ Spec} \leq AV_{calc}$

For Decreasing Setpoints:

$AV_{Tech\ Spec} \geq AV_{calc}$

4.0 DESIGN INPUTS

4.1 DRIFT CALCULATIONS

Each Attachment evaluates a Technical Specification trip Function. For the drift calculations associated with the trip functions, see the attachment for that Technical Specification trip function.

4.2 SETPOINT/UNCERTAINTY CALCULATIONS

Each Attachment evaluates a Technical Specification trip Function. For the setpoint calculations associated with the trip functions, see the attachment for that Technical Specification trip function.

5.0 ASSUMPTIONS

See the attachment for each of the evaluated Technical Specification trip functions for any assumption associated with that function evaluation.

6.0 ANALYSIS

See the attachment for each of the evaluated Technical Specification trip functions for the analysis associated with that function evaluation.

7.0 CONCLUSIONS AND PLANT IMPACT

See the attachment for each of the evaluated Technical Specification trip functions for the conclusion and plant impact associated with that function evaluation. These attachments show sufficient margin exist for the extension to 30 months for all setpoints. All Allowable Value (AV) had sufficient margin with the exception of Attachment aa – “Safety Injection -Steam Line Low Pressure” which has the recommended change stated in the conclusion.

8.0 REFERENCES

8.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs."

8.2 EM 3.3.4.2 Revision 1, "The Analysis of Instrument Drift"

8.3 EM 3.3.4.1 Revision 2, "Instrument Setpoint/Uncertainty Calculations"

8.4 ANSI/ISA-67.04.01, "Setpoints for Nuclear Safety-Related Instrumentation" 12/8/2018

9.0 ATTACHMENTS

See the Table of Contents.

Prepared By:	Timothy Godsell	Timothy Godsell Digitally signed by Timothy Godsell DN: cn=Timothy Godsell, o=Sargent & Lundy, ou, email=timothy.a.godsell@sargentlundy.com, c=US Date: 2021.06.25 14:41:47 -05'00' (Signature)	(Date)
Reviewed By:	W. Dean Crumpacker	W. D. Crumpacker Digitally signed by W. D. Crumpacker Date: 2021.06.25 15:11:01 -05'00' (Signature)	(Date)

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1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Reactor Coolant Low Flow instrument loops which perform reactor trips. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1FC-411	NUS INSTRUMENTS LLC	SAM503-03
1FC-412	NUS INSTRUMENTS LLC	SAM503-03
1FC-413	NUS INSTRUMENTS LLC	SAM503-03
1FC-414	NUS INSTRUMENTS LLC	SAM503-03
1FC-415	NUS INSTRUMENTS LLC	SAM503-03
1FC-416	NUS INSTRUMENTS LLC	SAM503-03
1FT-411	FOXBORO	E13DH
1FT-412	FOXBORO	E13DH
1FT-413	FOXBORO	E13DH
1FT-414	FOXBORO	E13DH
1FT-415	FOXBORO	E13DH
1FT-416	FOXBORO	E13DH
2FC-411	NUS INSTRUMENTS LLC	SAM503-03
2FC-412	NUS INSTRUMENTS LLC	SAM503-03
2FC-413	NUS INSTRUMENTS LLC	SAM503-03
2FC-414	NUS INSTRUMENTS LLC	SAM503-03
2FC-415	NUS INSTRUMENTS LLC	SAM503-03
2FC-416	NUS INSTRUMENTS LLC	SAM503-03
2FT-411	FOXBORO	E13DH
2FT-412	FOXBORO	E13DH
2FT-413	FOXBORO	E13DH
2FT-414	FOXBORO	E13DH
2FT-415	FOXBORO	E13DH
2FT-416	FOXBORO	E13DH

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 1 and 2 setpoint calculations provided different values for temperature effect, radiation effect, and process element accuracy. The Unit whose variables provide the greatest total loop error will be used in this calculation to conservatively bound the worst case.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-008, "Drift Analysis of As-Found/As-Left Data for Foxboro Transmitter E13DH" (Reference 8.3.1) and SPC-DR-038, "Drift Analysis of As-Found/As-Left Data for NUS Bistable SAM503 (mA)" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-008

The Foxboro Transmitter E13DH was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{trans} = \pm 1.477\ \%\ Span$$

$$DA\_Ext\_Bias_{trans} = \pm 0\ \%\ Span$$

4.1.2 SPC-DR-038

The NUS Bistable SAM503 (mA) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.101\ \%\ Span$$

$$DA\_Ext\_Bias_{bistable} = \pm 0\ \%\ Span$$

4.2 Setpoint/Uncertainty Calculations

The reactor coolant low flow reactor trip setpoint is evaluated in two setpoint calculations: SPC-RP-023, "UNIT 1 REACTOR COOLANT LOW FLOW REACTOR TRIP" (Reference 8.4.1) and SPC-RP-024, "Unit 2 Reactor Coolant Low Flow Reactor Trip" (Reference 8.4.2). Pertinent information from each calculation for this evaluation is summarized below:

Form 1 of SPC-RP-023 (Reference 8.4.1) and SPC-RP-024 (Reference 8.4.2) provides the following information:

$$Process\ Span = 10\ to\ 50\ mA_{DC}$$

$$Analytical\ Limit\ (AL) = 35.02\ mA_{DC}$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS)\ =\ \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

After entering the data for Unit 1 (SPC-RP-023), the total loop error is calculated as:

$$TLE\ (SRSS) = \left[0.08\ (mA_{DC}{}^2) + 0.04538\ (mA_{DC}{}^2) + 0.17736\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0.04\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 4.0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + (2.0\ mA_{DC})^2 + (0\ mA_{DC})^2 + (0\ mA_{DC})^2\right]^{1/2} = \pm 2.8884\ mA_{DC}$$

$$Bias_{pos} = 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} = 0\ mA_{DC}$$

$$TLE_{pos} = 2.8884\ mA_{DC} + 0\ mA_{DC} = 2.8884\ mA_{DC}$$

After entering the data for Unit 2 (SPC-RP-024), the total loop error is calculated as:

$$TLE\ (SRSS) = \left[0.08\ (mA_{DC}{}^2) + 0.04538\ (mA_{DC}{}^2) + 0.17332\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0.03240\ (mA_{DC}{}^2) + 0.04\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 4.0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + (0.8\ mA_{DC})^2 + (0\ mA_{DC})^2 + (0\ mA_{DC})^2\right]^{1/2} = \pm 2.2385\ mA_{DC}$$

$$Bias_{pos} = 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} = 0\ mA_{DC}$$

$$TLE_{pos} = 2.2385\ mA_{DC} + 0\ mA_{DC} = 2.2385\ mA_{DC}$$

The Unit 1 variables provide the worst-case total loop error and will be used in Section 6 to calculate the new total loop error.

The nominal trip setpoint (NTSP) is calculated for a decreasing process using the following equation:

$$NTSP = AL + TLE_{pos}$$

The allowable value (AV) for a decreasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = D_{BN} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

4.3 Technical Specifications

The allowable value for the Reactor Coolant Flow – Low function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 91\%$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.2).

$$APS = 38.38\ mA_{DC}$$

$$AFT = \pm 0.2\ mA_{DC}$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Sections 4.2) below:

Foxboro Transmitter E13DH:

$$DA\_Ext\_Rand_{trans} = \pm 1.477\ \%\ Span\ = \pm 1.477\ \%\ Span \times \frac{40.0\ mA_{DC}}{100\ \%\ Span}\ = 0.5908\ mA_{DC}$$

NUS Bistable SAM503 (mA_{DC}):

$$DA\_Ext\_Rand_{bistable} = \pm 0.101\ \%\ Span\ = \pm 0.101\ \%\ Span \times \frac{40.0\ mA_{DC}}{100\ \%\ Span}\ = 0.0404\ mA_{DC}$$

6.2 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

$$TLE\ (SRSS) = \left[DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$TLE\ (SRSS) = \left[(0.5908\ mA_{DC})^2 + (0.0404\ mA_{DC})^2 + 0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0(mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0.04\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + 4.0\ (mA_{DC}{}^2) + 0\ (mA_{DC}{}^2) + (2.0\ mA_{DC})^2 + (0\ mA_{DC})^2 + (0\ mA_{DC})^2\right]^{1/2} = \pm 2.8967\ mA_{DC}$$

$$Bias_{pos} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} = 0\ mA_{DC}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLE_{pos} = 2.8967\ mA_{DC} + 0\ mA_{DC} = 2.8967\ mA_{DC}$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE_{pos} = 35.020\ mA_{DC} + 2.8967\ mA_{DC} = 37.917\ mA_{DC}$$

6.4 Allowable Value (AV)

The allowable value for Reactor Coolant Flow – Low is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBN}$$

$$AV = NTSP_{mA} - LD_R - LD_{BN\ mA}$$

$$LD_{R\ mA} = \sqrt{(0.5908\ mA_{DC})^2 + (0.0404\ mA_{DC})^2 + 0\left(mA_{DC}{}^2\right)} = 0.5922\ mA_{DC}$$

$$LD_{BN} = 0\ mA_{DC} + 0\ mA_{DC} + 0\ mA_{DC} = 0\ mA_{DC}$$

$$AV = 37.917\ mA_{DC} - 0.5922\ mA_{DC} - 0\ mA_{DC} = 37.325\ mA_{DC}$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values the setpoint margin is evaluated below:

$$Accetpance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

$$NTSP \leq APS - AFT$$

$$37.917\ mA_{DC} \leq 38.38\ mA_{DC} - 0.2\ mA_{DC}$$

$$37.917\ mA_{DC} \leq 38.18\ mA_{DC}$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2. First converting the calculated AV from Section 6.4 into percent process span, the AV is evaluated below:

$$Acceptance\ Criteria\ (Decreasing):\ AV_{Tech\ Spec} \geq AV_{Calc}$$

$$AV_{Calc} = \frac{(37.325\ mA_{DC} - 10\ mA_{DC})}{40.0\ mA_{DC}} \times 100\ \%\ Span = 68.31\%$$

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$91\% \geq 68.31\%$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-008 (Reference 8.3.1) and SPC-DR-038 (Reference 8.3.2), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Reactor Coolant Low Flow Function instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-008, Revision 0, "Drift Analysis of As-Found/As-Left Data for Foxboro Transmitter E13DH".

8.3.2 SPC-DR-038, Revision 0, "Drift Analysis of As-Found/As-Left Data for NUS Bistable SAM503 (mA)".

8.4 Setpoint Calculations:

8.4.1 SPC-RP-023, Revision 0C, "UNIT 1 REACTOR COOLANT LOW FLOW REACTOR TRIP".

8.4.2 SPC-RP-024, Revision 0, "Unit 2 Reactor Coolant Low Flow Reactor Trip".

8.5 Technical Specifications:

8.5.1 Unit 1, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE", Amendment 230.

8.5.2 Unit 2, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE", Amendment 218.

8.6 Surveillance Procedures:

8.6.1 SP 1002A, Revision 50, "Analog Protection System Calibration".

8.6.2 SP 2002A, Revision 51, "Analog Protection System Calibration".

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Reviewed By:	William G. Bloethe/ Leroy Stahl	William G. Bloethe Digitally signed by William G. Bloethe Date: 2021.07.06 10:04:15 -05'00' (Signature)	LeRoy Stahl Digitally signed by LeRoy Stahl Date: 2021.07.06 11:18:16 -04'00' (Date)

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1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Reactor Coolant Pump Underfrequency 4KV Buses 11 and 12 (21 and 22) setpoint. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
81A/B11	General Electric	SFF201B1A
81A/B12	General Electric	SFF201B1A
81A/B21	General Electric	SFF201B1A
81A/B22	General Electric	SFF201B1A
81B/B11	General Electric	SFF201B1A
81B/B12	General Electric	SFF201B1A
81B/B21	General Electric	SFF201B1A
81B/B22	General Electric	SFF201B1A

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-032, “Drift Analysis of As-Found/As-Left Data for General Electric Underfrequency Relay SFF201B1A” (Reference 8.3.1). This calculation evaluates the instrument drift of the instruments used in the setpoint calculations. The data taken from the calculation is summarized in the following sections:

4.1.1 SPC-DR-032

The General Electric Relay SFF201B1A was evaluated and the following values were calculated:

$$DA - Ext_{Rand} = \pm 0.0399\% \ calibrated\ span\ (95\%/95\%\ Factor)$$

$$DA_{Ext_{Bias}} = 0\% \ calibrated\ span$$

4.2 Setpoint/Uncertainty Calculations

The reactor coolant pump underfrequency relay setpoint is evaluated in two setpoint calculations: SPC-EA-009, "Unit 1 Reactor Coolant Pump Bus Underfrequency Setpoint" (Reference 8.4.1) and SPC-EA-010, "Unit 2 Reactor Coolant Pump Bus Underfrequency Setpoint" (Reference 8.4.2). Pertinent information from each calculation for this evaluation is summarized below:

SPC-EA-009 (Reference 8.4.1) and SPC-EA-010 (Reference 8.4.2) provides the following information:

Actual Trip Setpoint:

$$ATSP = 58.28\ Hz$$

Process Limit:

$$PL = 58.0\ Hz$$

Total loop error is calculated using the following equations:

$$TLE\ (SRSS)\ =\ [A^2 + D^2 + M\&TE^2 + PMA^2]^{1/2}$$

Total Loop Drift (LD) is calculated using the following equations:

$$LD\ =\ [A^2 + D^2 + M\&TE^2]^{1/2}$$

After entering the data for Unit 1 (SPC-EA-009), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.01^2 + 0.01^2 + 0.01^2 + 0.1^2]^{\frac{1}{2}} = 0.1015\ Hz$$

Total Loop Drift (LD) is calculated as:

$$LD = [0.01^2 + 0.01^2 + 0.01^2]^{\frac{1}{2}} = 0.017\ Hz$$

After entering the data for Unit 2 (SPC-EA-010), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.01^2 + 0.01^2 + 0.001^2 + 0.1^2]^{\frac{1}{2}} = 0.101\ Hz$$

Total Loop Drift (LD) is calculated as:

$$LD = [0.01^2 + 0.01^2 + 0.001^2]^{\frac{1}{2}} = 0.014\ Hz$$

The Unit 1 variables provide the worst-case total loop error and will be used in Section 6 to calculate the new total loop error.

The nominal trip setpoint (NTSP) is calculated for a decreasing process using the following equation:

$$NTSP = PL + TLE$$

The allowable value (AV) for a decreasing process is determined using the following equations:

$$AV = NTSP - LD$$

4.3 Technical Specifications

The allowable value for the Reactor Coolant Pump Underfrequency 4KV Buses is taken from the technical specification table 3.3.1-1 for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 58.2\ Hz$$

4.4 Calibration Procedures

The actual plant setting (ATSP) and as found tolerance (AFT) are taken from surveillance procedures SP 1014 (Reference 8.6.1) and SP 2014 (Reference 8.6.2).

$$ATSP = 58.28\ Hz$$

$$AFT = \pm 0.01\ Hz$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in Reference 8.3.1 using percent span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 7.3 of Reference 8.4.2) below:

General Electric Relay SFF201B1A:

$$DA\_Ext\_Rand_{trans} = \pm 0.0399\ \%Span\ = \pm 0.0399\%Span \times \frac{39.9\ Hz}{100\ \%Span} = 0.0159\ Hz$$

6.2 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$TLE\ (SRSS) = [0.00^2 + 0.0159^2 + 0.00^2 + 0.1^2]^{\frac{1}{2}} = 0.101\ Hz$$

Total Loop Drift (LD) is calculated as:

$$LD = [0.00^2 + 0.0159^2 + 0.00^2]^{\frac{1}{2}} = 0.0159\ Hz$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from section and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = PL + TLE = 58.0 + 0.101 = 58.101\ Hz$$

6.4 Allowable Value (AV)

The allowable value for the underfrequency relays is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$AV = NTSP - LD = 58.101 - 0.0159 = 58.09\ Hz$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and ATSP values the setpoint margin is evaluated below:

$$Accetpance\ Criteria\ (Decreasing): NTSP \leq ATSP - AFT$$

$$NTSP \leq ATSP - AFT$$

$$58.101\ Hz \leq 58.28\ Hz - 0.01\ Hz$$

$$58.101\ Hz \leq 58.27\ Hz$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$58.2\ Hz \geq 58.09\ Hz$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-032 (Reference 8.3.1), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Reactor Coolant Pump Underfrequency Buses Function instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, “Guidelines for Instrument Calibration Extension/Reduction Programs”.

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, “The Analysis of Instrument Drift”.

8.2.2 EM 3.3.4.1, Revision 2, “Instrument Setpoint/Uncertainty Calculations”.

8.3 Drift Calculations:

8.3.1 SPC-DR-032, Revision 0, “Drift Analysis of As-Found/As-Left Data for General Electric Underfrequency Relay SFF201B1A”.

8.4 Setpoint Calculations:

8.4.1 SPC-EA-009, Revision 0, “Unit 1 Reactor Coolant Pump Bus Underfrequency Setpoint”.

8.4.2 SPC-EA-010, Revision 0, “Unit 2 Reactor Coolant Pump Bus Underfrequency Setpoint”.

8.5 Technical Specifications:

8.5.1 Unit 1, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE (No. DPR-42), Amendment 230"

8.5.2 Unit 2, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE (No. DPR-60, Amendment 218"

8.6 Surveillance Procedures:

8.6.1 SP 1014, Revision 23, "Unit 1 4KV Voltage and Frequency Relay Calibration"

8.6.2 SP 2014, Revision 27, "Unit 2 4KV Voltage and Frequency Relay Calibration"

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Reviewed By:	William G. Bloethe/ Leroy Stahl	William G. Bloethe Digitally signed by William G. Bloethe Date: 2021.07.02 08:51:06 -05'00' (Signature)	LeRoy Stahl Digitally signed by LeRoy Stahl Date: 2021.07.02 10:11:00 -04'00' (Date)

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1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 Buses 11 and 12 and Unit 2 Buses 21 and 22 Undervoltage Relays which perform lockout 4.16KV Supply Breaker Trips, Reactor Coolant Pumps Trips, Feedwater Pump trips and possible reactor trips. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
27R/B11	ASCO	214A147
27R/B12	ASCO	214A147
27R/B21	ASCO	214A147
27R/B22	ASCO	214A147
27S/B11	ASCO	214A147
27S/B12	ASCO	214A147
27S/B21	ASCO	214A147
27S/B22	ASCO	214A147

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-030, “Drift Analysis of As-Found/As-Left Data for ASCO Valve Undervoltage Relay 214A147” (Reference 8.3.1). This calculation evaluates the instrument drift of the instruments used in the setpoint calculation. The data taken from the calculation is summarized in the following sections:

4.1.1 SPC-DR-030

The ASCO Relay 214A147 was evaluated and the following Drift Tolerance Interval value was calculated:

$$DA\_Ext\_Rand = \pm 1.07\ VAC$$

$$DA\_Ext\_Bias = 0\ VAC$$

Converting the drift into percent nominal voltage and squaring so that it can be applied in Section 6.0 as follows:

$$D = \left[\left(\frac{1.07}{120.09}\right)x100\right]^2 = 0.79\%$$

(120.09 is the nominal voltage seen by the undervoltage relay per reference 8.4.1 Section 4.1)

4.2 Setpoint/Uncertainty Calculations

The undervoltage relay trip setpoint for the 4.16KV, non-safeguards distribution buses is evaluated in setpoint calculation SPC-EA-0008, "4.16KV Non-Safeguards Buses 11, 12, 21 and 22 Undervoltage Relay Setpoint" (Reference 8.4.1). Pertinent information from this calculation for this evaluation is summarized below:

Sections 1.4.1 and 5.3 of SPC-EA-0008 (Reference 8.4.1) provides the following information:

$$Actual\ Trip\ Setpoint\ (ATSP) = 77.86\%\ (93.5\ VAC)$$

$$Analytical\ Limit\ (AL) = 75\%\ (90.07\ VAC)$$

Total loop error is calculated using the following equations (Reference 8.4.1 Section 5.2):

$$TLE\ (SRSS) = [A + D + M + SPE + R + T + H + P + PCR]^{\frac{1}{2}} + PCN$$

After entering the data for Unit 1 (SPC-EA-0008), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.09 + 0.839 + 0 + 0 + 0 + 0 + 0 + 0 + 0]^{\frac{1}{2}} + 0$$

$$TLE\ (SRSS) = 0.96\%$$

The accuracy allowance of 0.09 is the square of the potential transformer accuracy of ±0.3% (Reference 8.4.1 Section 5.1.1)

The nominal trip setpoint (NTSP) is calculated for the undervoltage relay using the following equation (Reference 8.4.1 Section 5.3):

$$NTSP = AL + TLE$$

The allowable value (AV) for the undervoltage relay is determined using the following equations (Reference 8.4.1 Section 5.2):

$$Loop\ Drift\ (LD) = \sqrt{A + D + M}$$

$$AV = NTSP - LD$$

4.3 Technical Specifications

The allowable value for the Undervoltage Relays on 4.16 KV Buses 11 and 12 (21 and 22) is taken from the technical specification table 3.3.1-1 for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 76\% \text{ rated bus voltage}$$

$$AV \geq 120.09\, VAC\ x\ 76\% = 91.27\, VAC$$

4.4 Calibration Procedures

The actual trip setpoint (ATSP) and as found tolerance (AFT) are taken from surveillance procedures SP 1014 (Reference 8.6.1) and SP 2014 (Reference 8.6.2).

$$ATSP = 77.86\%\ (93.5\, VAC)$$

$$AFT = \pm 0.83\%\ (\pm 1\, VAC)$$

5.0 Assumptions

5.1. Cable power losses for the instrument loops in question are negligible (Reference 8.4.1)

6.0 Analysis

6.1 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$TLE\ (SRSS) = [A + D + M + SPE + R + T + H + P + PCR]^{\frac{1}{2}} + PCN$$

$$TLE\ (SRSS) = [0.09 + 0.79 + 0 + 0 + 0 + 0 + 0 + 0 + 0]^{\frac{1}{2}} + 0$$

$$TLE\ (SRSS) = 0.94\%$$

$$TLE\ (SRSS) = 0.94\%\ X\ 120.09 = 1.13\, VAC$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE = 75\% + 0.94\% = 75.94\%\ (91.2\ VAC)$$

$$Margin = ASTP - NTSP = 77.86\% - 75.94\% = 1.92\%$$

A positive margin indicates that the existing ATSP is greater than the NTSP and is conservative.

6.4 Allowable Value (AV)

The allowable value for Undervoltage Relays is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$LD = [D]^{\frac{1}{2}}$$

$$LD = [0.79]^{\frac{1}{2}} = 0.89\%$$

$$AV = NTSP - LD$$

$$AV = 75.94\% - 0.89\% = 75.05\%$$

6.5 Setpoint Margin

Using the NTSP value calculated in Section 6.3 and the AFT and ATSP values the setpoint margin is evaluated below:

$$Accetpance\ Criteria: NTSP \leq ATSP - AFT$$

$$75.94\% \leq 77.86\% - 0.83\%$$

$$75.94\% \leq 77.03\%$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$76\% \geq 75.05\%$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-030 (Reference 8.3.1), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for Buses 11, 12, 21 and 22 Undervoltage Relays can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, “Guidelines for Instrument Calibration Extension/Reduction Programs”.

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, “The Analysis of Instrument Drift”.

8.2.2 EM 3.3.4.1, Revision 2, “Instrument Setpoint/Uncertainty Calculations”.

8.3 Drift Calculations:

8.3.1 SPC-DR-030, Revision 0, “Drift Analysis of As-Found/As-Left Data for ASCO Valve Undervoltage Relay 214A147”.

8.4 Setpoint Calculations:

8.4.1 SPC-EA-0008, Revision 0, “4.16KV Non-Safeguards Buses 11, 12, 21, and 22 Undervoltage Relay Setpoint”.

8.5 Technical Specifications:

8.5.1 Unit 1, “NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE (No. DPR-42), Amendment 230”

8.5.2 Unit 2, “NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE (No. DPR-60, Amendment 218”

8.6 Surveillance Procedures:

8.6.1 SP 1014, Revision 23, “Unit 1 4KV Voltage and Frequency Relay Calibration”

8.6.2 SP 2014, Revision 27, “Unit 2 4KV Voltage and Frequency Relay Calibration”

Prepared By:	Michael Elijah	Michael L Elijah Digitally signed by Michael L Elijah Date: 2021.07.01 16:58:27 -05'00' (Signature)	(Date)
Reviewed By:	Steve Vanderslice	Steve Vanderslice Digitally signed by Steve Vanderslice Date: 2021.07.02 09:09:47 -05'00' (Signature)	(Date)

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1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for Units 1 and 2 steam generator (SG) water level – low-low instrument loops which perform reactor trips. This justification will provide input into the License Amendment Request (LAR) being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table which are found in SP 1002A, SP 1002B.4, SP 2002A, SP 2002B.4 (References 8.6.1, 8.6.2, 8.6.3, and 8.6.4), SPC-DR-010 (Reference 8.3.1), and SPC-DR-022 (Reference 8.3.2):

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1LC-461B	NUS INSTRUMENTS	DAM503-03 (V)
1LC-462A	NUS INSTRUMENTS	DAM503-03 (V)
1LC-463C	NUS INSTRUMENTS	DAM503-03 (V)
1LC-471B	NUS INSTRUMENTS	DAM503-03 (V)
1LC-472A	NUS INSTRUMENTS	DAM503-03 (V)
1LC-473C	NUS INSTRUMENTS	DAM503-03 (V)
1LT-461	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-462	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-463	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-471	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-472	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-473	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
2LC-461B	NUS INSTRUMENTS	DAM503-03 (V)
2LC-462A	NUS INSTRUMENTS	DAM503-03 (V)
2LC-463C	NUS INSTRUMENTS	DAM503-03 (V)
2LC-471B	NUS INSTRUMENTS	DAM503-03 (V)
2LC-472A	NUS INSTRUMENTS	DAM503-03 (V)
2LC-473C	NUS INSTRUMENTS	DAM503-03 (V)
2LT-461	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-462	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-463	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-471	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-472	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-473	Rosemount	3152ND-2-A-2-F3-E-3-Q8-W2

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 1 and 2 setpoint calculations provided different values for measurement and test equipment allowance, temperature effect, static pressure effect span, seismic effect, primary element accuracy, process measurement accuracy, and other process considerations. The Unit which provides the greatest total loop error will be used in this calculation to conservatively bound the worst case.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-010, "Drift Analysis of As Found / As-Left Data for NUS Bistable DAM503-03 (V)" (Reference 8.3.1) and SPC-DR-022, "As-Found / As -Left Data for Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2 – Containment Building" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculation. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-010

The NUS Bistable DAM503-03 (VDC) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%\ Calibrated\ Span$$

4.1.2 SPC-DR-022

The Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2 was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{trans} = \pm 0.520\ \%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{trans} = -0.086\ \%\ Calibrated\ Span$$

4.2 Setpoint/Uncertainty Calculations

The SG water level – low-low reactor trip setpoint is evaluated in two setpoint calculations: SPC-RP-015, "Unit 1 Steam Generator Low-Low Level Reactor Trip" (Reference 8.4.1) and SPC-RP-016, "Unit 2 Steam Generator Low-Low Level Reactor Trip" (Reference 8.4.2). Pertinent information from this evaluation is summarized below:

Form 1 of SPC-RP-015 (Reference 8.4.1) and SPC-RP-016 (Reference 8.4.2) provides the following information:

$$Process\ Span = 0\ to\ 100\ PCT$$

$$Analytical\ Limit\ (AL) = 0\ \ PCT$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS)\ =\ \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

After entering the data for Unit 1 SPC-RP-015 (Reference 8.4.1), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.5\ (PCT^2) + 0.1458\ (PCT^2) + 1.2951\ (PCT^2) + 0\ (PCT^2) + 0.065\ (PCT^2) + 0.1319\ (PCT^2) + 0\ (PCT^2) + 0.332\ (PCT^2) + 0.345\ (PCT^2) + 0\ (PCT^2) + 5.5103\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT)^2 + 0\ (PCT)^2 + 0\ (PCT)^2]^{\frac{1}{2}} = \pm 2.8853\ PCT$$

$$Bias_{pos} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + .4394\ PCT + .37\ PCT + .43809\ PCT = 0.85321\ PCT$$

$$TLE_{pos} = 2.8853\ PCT + 0.85321\ PCT = 3.7385\ \ PCT$$

After entering the data for Unit 2 SPC-RP-016 (Reference 8.4.2), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.5\ (PCT^2) + 0.1458\ (PCT^2) + 1.2955\ (PCT^2) + 0\ (PCT^2) + 0.065\ (PCT^2) + 0.1321\ (PCT^2) + 0\ (PCT^2) + 0.2841\ (PCT^2) + 0.345\ (PCT^2) + 0\ (PCT^2) + 5.5206\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT)^2 + 0\ (PCT)^2 + 0\ (PCT)^2]^{\frac{1}{2}} = \pm 2.8789\ PCT$$

$$Bias_{pos} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + .47242\ PCT + .39\ PCT + .56404\ PCT = 1.4265\ PCT$$

$$TLE_{pos} = 2.8789\ PCT + 1.4265\ PCT = 4.3054\ PCT$$

The Unit 2 variables provide the worst-case total loop error and will be used for the remainder of this calculation to determine the bounding total loop error.

The nominal trip setpoint (NTSP) is calculated for a decreasing process using the following equation:

$$NTSP = AL + TLE_{pos}$$

$$NTSP = 0\ PCT + 4.3054\ PCT = 4.3054\ PCT$$

The allowable value (AV) for a decreasing process is determined using the following equations below.

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = D_{BN} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Substituting these values, the AV is calculated as:

$$LD_R = \sqrt{0.5\ (PCT^2) + 0.1458\ (PCT^2) + 1.2955\ (PCT^2) + 0.345\ (PCT^2)} = 1.5121\ PCT$$

$$LD_{BN} = 0\ PCT + 0\ PCT = 0\ PCT$$

$$AV = 4.3054\ PCT - 1.5121\ PCT - 0\ PCT = 2.7933\ PCT$$

4.3 Technical Specifications

The AV for the SG water level – low-low reactor trip setpoint from Table 3.3.1-1, Function 13 is taken from the technical specification for Units 1 and 2 (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 11.3\ \%$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.3).

$$APS = 0.1520\ \text{VDC}$$

$$AFT = \pm 0.002\ VDC$$

The actual plant setting (APS) for the 2LC-472A NUS Bistable DAM503-03 (VDC) from SP 2002A (Reference 8.6.3) is different from the other 11 NUS bistables.

$$APS_{2LC-472A} = 0.1540\ VDC$$

To interface with the equations, the AFT values are converted into process units using the input span taken from Form 2 of SPC-RP-015 (Reference 8.4.1) and SPC-RP-016 (Reference 8.4.2):

$$Input\ Span\ of\ Bistables = 0.1000\ to\ 0.5000\ VDC$$

$$APS = 0.1520\,VDC = \frac{(0.1520 - 0.1000)VDC}{.4000\,VDC} \times 100 = 13.0\,PCT$$

$$APS_{2LC-472A} = 0.1540\,VDC = \frac{(0.1540 - 0.1000)VDC}{.4000\,VDC} \times 100\,PCT = 13.5\,PCT$$

$$AFT = \frac{0.002\,VDC}{.4000\,VDC} \times 100 = 0.5\,PCT$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent (%) calibrated span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (see Section 4.2):

NUS Bistable DAM503-03 (VDC):

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%\ Calibrated\ Span$$
$$= \pm 0.1072\ \%\ Calibrated\ Span \times \frac{100.0\ PCT}{100\ \%\ Calibrated\ Span} = \pm 0.1072\ PCT$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%\ Calibrated\ Span$$
$$= +0.0095\ \%\ Calibrated\ Span \times \frac{100.0\ PCT}{100\ \%\ Calibrated\ Span} = +0.0095\ PCT$$

Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2:

$$DA\_Ext\_Rand_{trans} = \pm 0.520\ \%\ Calibrated\ Span$$
$$= \pm 0.520\ \%\ Calibrated\ Span \times \frac{100.0\ PCT}{100\ \%\ Calibrated\ Span} = \pm 0.520\ PCT$$

$$DA\_Ext\_Bias_{trans} = -0.086\ \%\ Calibrated\ Span$$
$$= -0.086\ \%\ Calibrated\ Span \times \frac{100.0\ PCT}{100\ \%\ Calibrated\ Span} = -0.086\ PCT$$

6.2 Total Loop Error (TLE)

Per Section 4.2, this attachment uses the Unit 2 data for substituting these values, since Unit 2 provides the worst-case total loop error. Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$(DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2) = A + D_R + M$$

New total loop error (TLE) under seismic event and potential loss of non-seismic HVAC for Unit 2 is calculated using the following equations:

$$TLE\ (SRSS) = \left[DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$TLE\ (SRSS) = [(0.520\ PCT)^2 + (0.1072\ PCT)^2 + 0\ (PCT^2) + 0.065\ (PCT^2) + 0.1321\ (PCT^2) + 0\ (PCT^2) + 0.2841\ (PCT^2) + 0.345\ (PCT^2) + 0\ (PCT^2) + 5.5206\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT)^2 + 0\ (PCT)^2 + 0\ (PCT)^2]^{1/2} = \pm 2.5746\ PCT$$

$$Bias_{pos} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ PCT + 0.0095\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0.47242\ PCT + 0.39\ PCT + 0.56404\ PCT = 1.43596\ PCT$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = (-0.086\ PCT) + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = -0.086\ PCT$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLE_{pos} = 2.5746\ PCT + 1.43596\ PCT = 4.0106\ PCT$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from Section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE_{pos} = 0\ PCT + 4.0106\ PCT = 4.0106\ PCT$$

6.4 Allowable Value (AV)

The AV for SG water level – low-low reactor trip setpoint is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Substituting these values, the AV is calculated as:

$$LD_R = \sqrt{(0.520\ PCT)^2 + (0.1072\ PCT)^2 + 0.345\ (PCT^2)} = 0.7918\ PCT$$

$$LD_{BN} = (-0.086\ PCT) + 0\ PCT + 0\ PCT = -0.086\ PCT$$

$$AV = 4.0106\ PCT - 0.7918\ PCT - (-0.086)\ PCT = 3.3048\ PCT$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values the setpoint margin is evaluated below for all bistables except for 2LC-472A:

$$Accetpance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

$$4.0106\ PCT \leq 13\ PCT - 0.5\ PCT$$

$$4.0106\ PCT \leq 12.5\ PCT$$

Using the APS and AFT values for the 2LC-472A NUS bistable from Section 4.4 and using the NTSP value calculated in Section 6.3, the setpoint margin is evaluated below.

$$Accetpance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

$$NTSP \leq APS - AFT$$

$$4.0106\ PCT \leq 13.5\ PCT - 0.5\ PCT$$

$$4.0106\ PCT \leq 13\ PCT$$

6.6 Allowable Value Acceptance

The AV acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

The AV taken from the Unit 1 and Unit 2 Technical Specifications is shown below:

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$11.3\ \% \geq 3.3048\ \%$$

7.0 Conclusions and Plant Impact

After calculating an updated TLE, NTSP, and AV using the new calculated drift values provided in drift calculations SPC-DR-010 (Reference 8.3.1) and SPC-DR-022 (Reference 8.3.2), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the SG water level – low-low reactor trip instruments can be extended to 30 months without impact to the subject setpoint and AV.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".
8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-010, Revision 0, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (V)".
8.3.2 SPC-DR-022, Revision 0, "As-Found / As -Left Data for Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2– Containment Building".

8.4 Setpoint Calculations:

8.4.1 SPC-RP-015, Revision 6, "Unit 1 Steam Generator Lo-Lo Level Reactor Trip".
8.4.2 SPC-RP-016, Revision 5, "Unit 2 Steam Generator Lo-Lo Level Reactor Trip".

8.5 Technical Specifications:

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42) Amendment 230.
8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60) Amendment 218.

8.6 Surveillance Procedures:

8.6.1 Surveillance Procedure SP 1002A, Rev. 50, "Analog Protection System Calibration".
8.6.2 Surveillance Procedure SP 1002B.4, Rev. 3, "Reactor Protection and Control Transmitter Calibration/Inspection Steam Generator Level".
8.6.3 Surveillance Procedure SP 2002A, Rev. 51, "Analog Protection System Calibration".
8.6.4 Surveillance Procedure SP 2002B.4, Rev. 6, "Reactor Protection and Control Transmitter Calibration/Inspection Steam Generator Level".

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Table of Contents

1.0 Purpose

The purpose of this calculation is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for instrument loops that perform trips listed in the Technical Specification with Allowable Values. This justification will provide input to the LAR being submitted to extend the surveillance intervals. This setpoint attachment considers the instruments listed in Table 1.1 below as referenced in surveillance procedures SP 1084 and SP 2084 (References 8.6.1 and 8.6.2).

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
16053	Mercoid	DA-23-127
16054	Mercoid	DA-23-127
16055	Mercoid	DA-23-127
16124	Mercoid	DA-23-127
16125	Mercoid	DA-23-127
16126	Mercoid	DA-23-127

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

This calculation applies to all three Unit 1 Turbine Auto Stop Oil Pressure Switches, 16053, 16054 and 16055 and all three Unit 2 Turbine Auto Stop Oil Pressure Switches, 16124, 16125 and 16126. Per Reference 8.7.1, all components in this evaluation are of the same make and model number (Mercoid, DA-23-127). Per References 8.6.1 and 8.6.2, the U1 and U2 Turbine Auto Stop Low Oil Pressure Turbine Trip function is calibrated with the same M&TE, are configured to the same actual plant setpoint and have the same as-found tolerances.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculation

This attachment uses data from drift calculation SPC-DR-009, "Drift Analysis of As-Found/As-Left Data for Mercoid Switch DA-23-127" (Reference 8.3.1). This calculation evaluates the instrument drift of the instruments used in the setpoint calculation.

In SPC-DR-009 (Reference 8.3.1) the Mercoid DA-23-127 pressure switch was evaluated and the following values were calculated:

$$\text{DA\_EXT\_RAND} = \pm 5.989 \text{ PSIG}$$

$$\text{DA\_EXT\_BIAS}_p = 0.000 \text{ PSIG}$$

$$\text{DA\_EXT\_}BIAS_n = -2.015 \text{ PSIG}$$

4.2 Setpoint/Uncertainty Calculation

The turbine auto stop low oil pressure setpoint is evaluated in setpoint calculation SPC-RP-079, "UNIT 1 TURBINE AUTO STOP OIL PRESSURE: LOW PRESSURE TURBINE TRIP REACTOR TRIP" (Reference 8.4.1). Pertinent information from this calculation is summarized below:

The term Analytical Limit (AL) applies to safety related calculations only. Process Limit (PL) is the equivalent term for non-safety related calculations. Form 1 of SPC-RP-079 (Reference 8.4.1) provides the following information:

$$Process\ Limit\ (PL) = 45.000\ PSIG$$

Total loop error under normal conditions is calculated using the following equations:

$$TLE\ (SRSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NR} + R_{NR} + H_{NR} + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NBp} + R_{NBp} + H_{NBp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

After entering the data for SPC-RP-079, the total loop error is calculated as:

$$TLE\ (SRSS) = [0.00\ (PSIG^2) + 9.4044\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} = \pm 3.0667\ PSIG$$

$$Bias_{pos} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{pos} = 3.0667\ PSIG + 0\ PSIG = 3.0667\ PSIG$$

The nominal trip setpoint (NTSP) is calculated for a decreasing process using the following equation:

$$NTSP = PL + TLE_{pos}$$

The allowable value (AV) for a decreasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = D_{BN} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

4.3 Technical Specifications

The allowable value for the Turbine Auto Stop Low Oil Pressure Turbine Trip function is taken from Table 3.3.1-1 Function 14.a of the technical specification for Units 1 and 2 (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 45\ PSIG$$

4.4 Calibration Procedures

The Actual Plant Setpoint (APS) and As-Found Tolerance for the Turbine Auto Stop Low Oil Pressure Turbine Trip function is taken from the Unit 1 and Unit 2 Calibration Procedures (References 8.6.1 and 8.6.2).

$$APS = 55\ PSIG$$

$$AFT = \pm 5.0\ PSIG$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Total Loop Error (TLE)

The total calculated drift tolerance interval for the instruments in this evaluation was calculated in SPC-DR-009 (Ref. 8.3.1). Instrument drift from the referenced drift calculation is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$DA\_Ext\_Rand^2 = A + D_R + M$$

$$\text{DA\_EXT\_RAND} = \pm 5.989 \text{ PSIG}$$

$$\text{DA\_EXT\_BIAS}_\text{p} = \ 0 \text{ PSIG}$$

$$\text{DA\_EXT\_BIAS}_\text{n} = \ -2.015 \text{ PSIG}$$

The updated total loop error (TLE) for Units 1 and 2 is calculated for normal conditions using the following equations:

$$TLE\ (SRSS) = \left[\text{DA\_EXT\_RAND}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NR} + R_{NR} + H_{NR} + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$TLE\ (SRSS) = [(5.989\ PSIG)^2 + 0\ (PSIG^2) + 0\ (PSIG^2) + 0(PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} = \pm 5.989\ PSIG$$

$$Bias_{pos} = \text{DA\_EXT\_}Bias_p + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NBp} + R_{NBp} + H_{NBp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{pos} = SRSSN + Bias_{pos}$$

$$TLE_{pos} = 5.989\ PSIG + 0\ PSIG = 5.989\ PSIG$$

6.2 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = PL + TLE_{pos}$$

$$NTSP = \ 45.000\ PSIG + 5.989\ PSIG\ =\ 50.989 PSIG$$

6.3 Allowable Value (AV)

The allowable value for the Turbine Auto Stop Low Oil Pressure function is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{\text{DA\_EXT\_RAND} + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = DA\_EXT\_BIAS_n + R_{NBP}$$

$$AV\ (Decreasing\ Process) = NTSP - LD_R - LD_{BN}$$

$$LD_R = \sqrt{(5.989\ PSIG)^2 + 0\ (PSIG^2)} = 5.989\ PSIG$$

$$LD_{BN} = 2.015\ PSIG + 0\ PSIG = 2.015\ PSIG$$

$$AV = 50.989\ \ PSIG - 5.989\ PSIG - 2.015\ PSIG = 42.985\ PSIG$$

6.4 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.2 and the AFT and APS values the setpoint margin is evaluated below:

$$Acceptance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

$$50.989\ \ PSIG \leq 55\ PSIG - 5\ PSIG$$

$$50.989\ \ PSIG \nleq 50.000\ PSIG$$

Sufficient margin does not exist between the calculated Nominal Trip Setpoint and the Actual Plant Setpoint. Per the Summary Setpoint Calculation Main Body, discretionary margin can be reduced to obtain acceptable setpoint margins. For the Turbine Auto Stop Low Oil Pressure function the discretionary margin will be reduced from the AFT value of 5 PSIG to 4 PSIG. The reduced margin is shown below:

$$50.989\ \ PSIG \leq 55\ PSIG - 4\ PSIG$$

$$50.989\ \ PSIG \leq 51.000\ PSIG$$

6.5 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2. The AV is evaluated below:

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

$$45\ PSIG \geq 42.985\ PSIG$$

7.0 Conclusions and Plant Impact

An updated total loop error, nominal trip setpoint and allowable value were calculated using the new calculated drift values provided in drift calculation SPC-DR-009 (Reference 8.3.1). After reducing the discretionary margin, the updated calculated allowable value and setpoint were found to be acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Turbine Auto Stop Low Oil Pressure instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, “Guidelines for Instrument Calibration Extension/Reduction Programs”.

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, “The Analysis of Instrument Drift”.

8.2.2 EM 3.3.4.1, Revision 2, “Instrument Setpoint/Uncertainty Calculations”.

8.3 Drift Calculations:

8.3.1 SPC-DR-009, Revision 0, “Drift Analysis of As-Found/As-Left Data for Mercoid Switch DA-23-127”.

8.4 Setpoint Calculations:

8.4.1 SPC-RP-079, Revision 0C, “UNIT 1 TURBINE AUTO STOP OIL PRESSURE: LOW PRESSURE TURBINE TRIP REACTOR TRIP”.

8.5 Technical Specifications:

8.5.1 Unit 1, “NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE”, Amendment 230.

8.5.2 Unit 2, “NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE”, Amendment 218.

8.6 Surveillance Procedures:

8.6.1 SP 1084, Revision 10, “TURBINE AUTO STOP OIL PRESSURE SWITCH CALIBRATION”

8.6.2 SP 2084, Revision 12, “TURBINE AUTO STOP OIL PRESSURE SWITCH CALIBRATION”

8.7 SAP Database

8.7.1 Data Pulled from Prairie Island’s SAP Database (January – February 2021).

Prepared By:	Giovanni Martinez	Giovanni Martinez (0U5393) Digitally signed by Giovanni Martinez (0U5393) Date: 2021.07.14 14:10:42 -05'00'	
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Table of Contents

1.0 Purpose

The purpose of this attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Low Power Reactor Trips Block, P-7 - Power Range Neutron Flux Reactor Trip Bistable channels. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment applies to all four Unit 1 and Unit 2 Power Range Neutron Flux instrumentation loops (i.e. channels N41, N42, N43, and N44). The power range instruments are listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1NE-41	Westinghouse	WL-23686
1NE-42	Westinghouse	WL-23686
1NE-43	Westinghouse	WL-23686
1NE-44	Westinghouse	WL-23686
2NE-41	Westinghouse	WL-23686
2NE-42	Westinghouse	WL-23686
2NE-43	Westinghouse	WL-23686
2NE-44	Westinghouse	WL-23686
1N41-NC308	Westinghouse	3359C39G01
1N42-NC308	Westinghouse	3359C39G01
1N43-NC308	Westinghouse	3359C39G01
1N44-NC308	Westinghouse	3359C39G01
2N41-NC308	Westinghouse	3359C39G01
2N42-NC308	Westinghouse	3359C39G01
2N43-NC308	Westinghouse	3359C39G01
2N44-NC308	Westinghouse	3359C39G01
1N41-NM310	Westinghouse	3359C48G01
1N42-NM310	Westinghouse	3359C48G01
1N43-NM310	Westinghouse	3359C48G01
1N44-NM310	Westinghouse	3359C48G01
2N41-NM310	Westinghouse	3359C48G01
2N42-NM310	Westinghouse	3359C48G01
2N43-NM310	Westinghouse	3359C48G01
2N44-NM310	Westinghouse	3359C48G01
1N41-NI301	Westinghouse	10072C10G01
1N42-NI301	Westinghouse	10072C10G01
1N43-NI301	Westinghouse	10072C10G01
1N44-NI301	Westinghouse	10072C10G01
2N41-NI301	Westinghouse	10072C10G01
2N42-NI301	Westinghouse	10072C10G01
2N43-NI301	Westinghouse	10072C10G01
2N44-NI301	Westinghouse	10072C10G01
1N41-NI302	Westinghouse	10072C10G01

1N42-NI302	Westinghouse	10072C10G01
1N43-NI302	Westinghouse	10072C10G01
1N44-NI302	Westinghouse	10072C10G01
2N41-NI302	Westinghouse	10072C10G01
2N42-NI302	Westinghouse	10072C10G01
2N43-NI302	Westinghouse	10072C10G01
2N44-NI302	Westinghouse	10072C10G01

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 2 setpoint calculation is not available. The Unit 1 and Unit 2 Nuclear Instrument Power Range drawer loop components are identical in design and qualification. The design source documents are identical between the two units, and the method of calibration is identical. Process Measurement Accuracy (PMA) and Process Considerations (PC) evaluated in SPC-RP-047 (Reference 8.4.1) have been reviewed and determined to be consistent between Unit 1 and Unit 2 for the purposes of drift and setpoint analysis. A deficiency in the base calculation was found where the Process Considerations (PC) which is used to calculate the Total Loop Error in section 4.3 of this Attachment is incorrectly taken as percentage of span instead of in Rated Thermal Power, this leads to unnecessary conservatism. This attachment will use the correct PC value of 5% Rated Thermal Power as seen in the assumptions section in SPC-RP-047 (Reference 8.4.1) to finalize the analysis section. Therefore, based on review, the Unit 1 setpoint calculation can be considered applicable to Unit 2 function and the Unit 1 setpoint calculation (Reference 8.4.1) is extended to Unit 2 by review.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 1.1 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 SPC-DR-026 Drift Calculation for NC308

This attachment uses data in the loop setpoint evaluation from drift calculation SPC-DR-026, "Drift Analysis of As-Found /As -Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables" (Reference 8.3.1). The data taken from the drift calculation is summarized below.

$$DA\_Ext\_Rand_{Bistable} = \pm 0.080\ \%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{Bistable} = \pm 0\ \%\ Calibrated\ Span$$

4.2 Input Data for the Power Range Detector, NI 301/302 and NM 310

4.2.1 Power Range Detector NE-41, NE-42, NE-43, and NE-44.

The Power Range Detectors are not calibrated instruments in a surveillance procedure that would provide As-Found (AF) and As-Left (AL) data for drift analysis. EM 3.3.4.2 (Reference 8.2.1) provides guidance for cases where there is not sufficient AF/AL drift data and specifies, in section 6.4.2, that vendor data can be used to establish drift data. The setpoint calculation SPC-RP-047, Unit 1 NIS Power Range P10 Input to P7 Interlock (Reference 8.4.1) evaluated the Power Range detector uncertainty from published vendor data, this method is consistent with EM 3.3.4.2 guidance. Therefore, this Attachment incorporates the vendor drift allowance from SPC-RP-047 as described in Section 4.2.4 and listed in Section 6.2.3.

4.2.2 NI 301/302

Per Design Equivalent Change 6EQVENG28491 (Reference 8.7.1) the Power Range Drawer B upper and lower detector digital current meters 1(2)N41-NI301(2), 1(2)N42-NI301(2), 1(2)N43-NI301(2), and 1(2)N44-NI301(2) were replaced with newly designed and qualified Digital Meter 2.0 assemblies per Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2 (Reference 8.7.2).

Review of Work Orders (Reference 8.8) indicated the new meter installations occurred in 2018 and 2019, limiting the number of available data points to less than required to have a statistically valid pool for drift analysis, as defined in EM 3.3.4.2 section 6.4.2 (Reference 8.2.2). As a result, no drift analysis was conducted for the power range upper and lower detector current meters. Therefore, this Attachment will use vendor data to establish drift data as described in section 6.4.2 of EM 3.3.4.2 (Reference 8.2.2) for conditions of insufficient drift data due to new or replaced components. The vendor data will be used to develop a drift allowance by evaluating the calibration interval and manufacture’s drift specification as described in section 4.2.4 below.

The vendor data for the Power Range Drawer B digital current meters is provided in Westinghouse design input document NIS Technical Manual Appendix Digital Meter 2.0 – Power Range A & B Section 1.3.1 Specification of Digital Meter (Reference 8.7.3) and as evaluated in Design Equivalent Change 6EQVENG28491 Section B.4 Design Evaluation (Reference 8.7.1).

Characteristic	Detail
Noise Rejection	Greater than 54 dB at 1 Hz ("SLOW" meter rate)
	Greater than 100 dB at 60 Hz ("SLOW" or "FAST" meter rate)
Conversion Rate	5 conversions per second
Accuracy	± 0.03% of reading (± 0.003%, meter alone)
Zero Stability	Auto-zero, ± 0.2 μV/ C (400.0 mV full scale input)
Display	4 digits, red LED, 0.43" high digits
Temperature Range	-10 to +50 degrees C Temperature
Coefficient	± 7 ppm of reading per degree C
Relative Humidity	0 to 90 %, non-condensing

Per References 8.4.1, 8.7.1 and 8.7.3 the current setpoint calculation evaluates meter accuracy as = 0.1% span, vendor drift allowance at 0 and drift time at 1.0 months. The meter accuracy value bounds the meter replacement specification as described in Reference 8.7.1 and represents worst case error. Vendor drift allowance and drift time are not specified in the referenced engineering change (Reference 8.7.1). However, the engineering change incorporates the Original Equipment Manufacturer approved equivalent replacement (Reference 8.7.3). As such, this Attachment will use the SPC-RP-047 (Reference 8.4.1) allowance for meter drift and drift time as bounding values in section 6 vendor drift analysis.

As described in Section 2.2.4.1 of Reference 8.7.4, "The current signals from the two detector sections are summed, then averaged by Summing and Level Amplifier NM310 to produce a single voltage which is proportional to average reactor output." The two detector sections are identical, each consisting of an upper (or lower) Power Range Detector and a Detector Current Meter. Per Reference 8.1.2, because these two input channels are averaged, their resulting uncertainties can be averaged. SPC-RP-047 (Reference 8.4.1) incorporated this method to average the two current inputs to the NM310 Summing and Level Amplifier channel uncertainties by including only one Power Range Detector and one Detector Current Meter in the instrument loop. This Attachment will evaluate loop uncertainty consistent with SPC-RP-047 (Reference 8.4.1) as described in 4.2.4.

4.2.3 Power Range Summing and Level Amplifier (NM 310)

Per SP 1005 (Reference 8.6.1) and Plant Technical Speciation Surveillance Requirements 3.3.1.2, 3.3.1.3, and 3.3.1.6 (References 8.5.1 and 8.5.2) the Power Range output current from the summing and level amplifier is normalized each day to heat balance results and quarterly to in core flux mapping. The adjustments occur throughout the fuel cycle and occur after the surveillance channel calibration has been performed. The Power Range current adjustments during the fuel cycle result in a change in the Summing and Level Amplifier (NM310) output, and it is likely that the As Found value for the next channel calibration will not correspond the As Left value from the previous calibration. The change is not exclusively instrument drift as it reflects adjustments made to align the summing and level amplifier output and Power Range drawer fuel cycle core measurement currents. On this basis the Power Range summing and Level amplifier data was excluded from drift analysis.

However, as previously described, EM 3.3.4.2 section 6.4.2 (Reference 8.2.2) provides guidance for cases where there is not sufficient drift data and specifies that vendor data can be used to establish drift data. Setpoint calculation SPC-RP-047 (Reference 8.4.1) developed a drift allowance consistent with EM 3.3.4.2 (Reference 8.2.2) and guidance from ISA-RP 67.04 (Reference 8.1.2) to characterize expected instrument drift by correlating Calibration Interval (CI) to performance predicted by the manufacture's drift specification. The Power Range Summing and Level amplifier daily drift allowance in this Attachment will be evaluated consistent with SPC-RP-047 (Reference 8.4.1) as described in 4.2.4.

Westinghouse Nuclear Instrumentation System Instruction Book XH-1-1931 (Reference 8.7.4), Section 1.4.3.1, states that the summing and level amplifier (Westinghouse model 3359C48G01) has a stability (i.e., drift) of 0.1 % per 100 hours. SPC-RP-047 (Reference 8.4.1) develops drift data using the vendor drift time (DT) as:

$$DT = \left(100\ hours \times \frac{1\ mont}{730\ hours}\right) = 0.1370 \text{ months.}$$

As described above the Power Range summing and level calibration interval (CI) is daily based on review of SP 1005 (Reference 8.6.1). SPC-RP-047 (Reference 8.4.1) develops the CI for daily calibration as:

$$CI = \left(1\ Day \times \frac{1\ year}{365\ days}\right) \times \left(\frac{12\ mont}{1\ year}\right) = 0.033\ months.$$

The setpoint calculation (Reference 8.4.1) allows for the surveillance to be performed up to 48 hours (two days) apart this results in CI_{calc}:

$$CI_{calc} = 2\ \times\ 0.033\ months = 0.066\ months$$

4.2.4 Calibration Interval and Manufacture's Drift Specification for the NIS Power Range detectors, NI 301/302 and NM 310

EM 3.3.4.1 (Reference 8.2.2) provides adequate guidance for conditions where drift is not defined or the drift analysis not acceptable. The guidance also includes instruction to adjust vendor drift to match the calibration period of an instrument when the vendor period does not agree with the calibration period of the instrument. Section 6.3.2 of EM 3.3.4.1 (Reference 8.2.2) provides the following equation to adjust drift to match the calibration period of an instrument "where drift is considered to be a linear condition over the entire period between calibrations." Reference 8.1.2 states that "in the absence of other data, it is considered reasonable, and perhaps conservative, to make this assumption" of linearity. The linear condition is chosen to match the method used for analysis in the setpoint calculation (Reference 8.4.1)

$$Instrument\ Drift\ (d) = \left(\frac{1.25 * tc}{td}\right)\left(\frac{vd}{cs}\right)$$

where:

vd = vendor's drift specification

td = vendor's time period for which drift specification is valid.

tc = instrument calibration period (months)
cs = instrument calibrated span
1.25 = maximum allowance on time requirements in technical specifications

The setpoint calculation SPC-RP-047, "Unit 1 NIS Power Range P10 Input to P7 Interlock" (Reference 8.4.1) developed a drift allowance consistent with guidance from ISA-RP 67.04 (References 8.1.2) to characterize expected instrument behavior by correlating Calibration Interval (CI) to performance predicted by the manufacturer. The calculation considered drift linear over time and calculated drift using the following equation:

SPC-RP-047 calculates drift as $Drift\ (d) = \left(\frac{CI}{DT}\right)(vd)\left(\frac{PS}{CS}\right)$
where:
vd = vendor's drift expression
CI = Calibration Interval
DT = Drift Time
PS = Process Span
CS = Calibrated Span

SPC-RP-047 (Reference 8.4.1) determines drift consistent with industry guidance (Reference 8.1.2). SPC-RP-029 is the calculation of record for the trip function. Therefore, the evaluation of the loop setpoint will incorporate manufacture's drift for the current meters (NI 301/302) and NM310 consistent with SPC-RP-047 (Reference 8.4.1).

4.3 Setpoint/Uncertainty Calculations

The Power Range Neutron Flux P-7 bistable is evaluated in setpoint calculation SPC-RP-047, (Reference 8.4.1). As described in section 2.0 Methodology the unit 1 calculation also applies to Unit 2. Pertinent information from the calculation for this evaluation is summarized below.

Form 1 of SPC-RP-047 (Reference 8.4.1) provides the following information:

$$Process\ Span = 0\ to\ 120\ PCT$$

$$Analytical\ Limit\ (AL) = 17.5\ PCT$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS)\ =\ \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-047), the total loop error is calculated as:

$$\begin{aligned} TLE\ (SRSS) = [&0.7488\ (PCT^2) + 0.16264\ (PCT^2) + 0.21879\ (PCT^2) + 0\ (PCT^2) \\ &+ 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) \\ &+ 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 5.76\ (PCT^2) + 36\ (PCT^2)]^{\frac{1}{2}} \\ = &\pm 6.5491\ PCT \end{aligned}$$

$$\begin{aligned} Bias_{neg} = &0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG \\ &+ 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG \end{aligned}$$

$$TLE_{neg} = 6.5491\ PCT + 0\ PCT = 6.5491\ PCT$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

The allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

4.4 Technical Specifications

The allowable value for the Power Range Neutron Flux P-7 function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV\ \leq 12\%\ RTP$$

Per SPC-RP-047 (Reference 8.4.1) Section 1.2, values from the technical specifications(References 8.5.1 and 8.5.2) are given values of PCT with no conversions of the values. Therefore, for this calculation RTP and PCT are equivalent.

Thus, the following relationship is true:

$$AV\ 12\%\ RTP = 12\ PCT$$

4.5 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1318.3 (Reference 8.6.2) and SP 2318.3 (Reference 8.6.3).

$$APS = 0.908\ VDC\ =\ (0.908\ vdc) \times \left(\frac{120\ PCT}{10\ vdc}\right)\ = 10.9\ PCT$$

$$AFT = \pm 0.01\ VDC =\ (\pm 0.01\ vdc) \times \left(\frac{120\ PCT}{10\ vdc}\right)\ =\ \pm\ 0.12\ PCT$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The extrapolated analyzed drift tolerance interval for the Westinghouse 3359C39G01 Power Range Bistables (NC308) was calculated in SPC-DR-026 (Reference 8.3.1) using percent span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Sections 4.3) below.

$$DA\_Ext\_Rand_{bistable} = \pm 0.080\%\ Calibrated\ Span = \pm 0.080\%\ Span \times \frac{120\ PCT}{100\%\ Span} = 0.096\ PCT$$

$$DA\_Ext\_Bias_{bistable} = \pm 0\%\ Calibrated\ Span = 0\ PCT$$

6.2 Extrapolated Vendor Drift

Per section 4.1, only the reactor trip bistable (1N41-NC308) has an extrapolated analyzed drift tolerance from a drift analysis calculation extrapolated to a 30-month Surveillance Interval value. To include the Power Range detector, current meter, and summing and level amplifier in the Total Loop Error calculation (Section 6.3), the extrapolated drift tolerance is calculated using vendor data. The extrapolated drift tolerance is calculated using vendor data included in Forms 1, 2 and 3 of SPC-DR-047 (Reference 8.4.1) and the equations given below.

$$d_R = \left(\frac{\mathrm{CI}}{\mathrm{DT}}\right)(\mathrm{vd})\left(\frac{\mathrm{PS}}{\mathrm{CS}}\right)$$

$$D_{30} = \sqrt{a^2 + {d_R}^2 + m^2}$$

6.2.1 Power Range Detector (1NE-41)

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0\ PCT$$

$$a = 0.6000\ PCT$$

$$m = 0\ PCT$$

$$D_{30detector} = \sqrt{0.6000^2 + 0^2 + 0^2} = 0.6000\ PCT$$

6.2.1 Current Meter (1N41-NI301)

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0\ PCT$$

$$a = 0.1200\ PCT$$

$$m = 0.3134\ PCT$$

$$D_{30current\ meter} = \sqrt{0.1200^2 + 0^2 + 0.3134^2} = 0.3356\ PCT$$

6.2.3 Summing and Level Amplifier (1N41-NM310)

$$Calibration\ Interval\ (CI) = 0.066\ months$$

$$Drift\ Time\ (DT) = 0.137\ \text{months.}$$

$$Vendor\ Drift\ (vd) = 0.1\%\ Range$$

$$vd = (0.1\ \% \times 0.4\ vdc) \times \left(\frac{120\ PCT}{0.4\ vdc}\right)$$

$$vd = 0.120\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 0.4\ vdc$$

$$d_R = 0.0578\ PCT$$

$$a = 0.6000\ PCT$$

$$m = 0.3470\ PCT$$

$$D_{30Amplifier} = \sqrt{0.6000^2 + 0.0576^2 + 0.3470^2} = 0.6955\ PCT$$

6.3 Total Loop Error (TLE)

Instrument drift from SPC-DR-026 (Reference 8.3.1) is used to replace the instrument accuracy, drift, and measurement and test equipment allowance of the reactor trip bistable (1N41-NC308). The using the methodology shown below.

$$D_{30detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

$$TLE\ (SRSS) = \Big[D_{30detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{1/2}$$

$$TLE\ (SRSS) = [(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (0.0960\ PCT)^2 + (\ 0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + \ (0\ PCT^2) + (0\ PCT^2) + (0\ PCT)^2 + (2.4\ PCT)^2 + (5\ PCT)^2]^{\frac{1}{2}} = \pm 5.6325\ PCT$$

$$Bias_{neg} = D_{30Detector}Bias_n + + D_{30current\ meter}Bias_n + D_{30Amplifier}Bias_n + DA\_Ext\_Bias_{bistablen} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$TLE_{neg} = TLE\ (-SRSS) - Bias_{neg}$$

$$TLE_{neg} = -5.6325\ PCT + 0\ PCT = -5.6325\ PCT$$

6.4 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.3 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + \ TLE_{neg} = 17.5\ PCT - \ 5.6325\ PCT = 11.8675\ PCT$$

6.5 Allowable Value (AV)

The allowable value for the low power reactor trip is calculated using the NTSP and the Loop Drift using the equations shown below.

$Loop\ Drift_{Random}\ (LD_R) =$

$$\sqrt{D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}{}^2}$$

$$LD_R = \sqrt{(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (.0960\ PCT)^2 + (0\ PCT)} = 0.9826\ PCT$$

$$Loop\ Drift_{\ PositiveBias}(LD_{BP}) =$$

$$D_{30DetectorBP} + D_{30current\ meterBP} + D_{30AmplifierBP} + DA\_Ext\_Bistable_{BP} + R_{NBP}$$

$$LD_{BP} = 0\ PCT + 0\ PCT + 0\ PCT + 0PCT + 0PCT = 0\ PCT$$

$$AV = NTSP + LD_R + LD_{BP}$$

$$AV = 11.8675\ PCT + 0.9826\ PCT + 0\ PCT = 12.8501\ PCT$$

6.6 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.4 and the AFT and APS values given in section 4.5 the setpoint margin is evaluated below.

$$Acceptance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$11.8675\ PCT \geq 10.9\ PCT + \pm 0.12\ PCT$$

$$11.8675\ PCT\ \geq 11.02\ PCT$$

6.7 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is evaluated using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

$$AV_{Tech\ Spec} \leq 12\ \%\ RTP\ (PCT)$$

$$12\ PCT \leq 12.8501\ PCT$$

7.0 Conclusions and Plant Impact

The total loop error, nominal trip setpoint, and allowable value were calculated using the new drift values provided in drift calculation SPC-DR-026 (Reference 8.3.1) and vendor data, this attachment incorporated the values for the Process Considerations (PC) as defined in section 2.0. The new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, a change to the subject setpoint and allowable value is not needed.

8.0 References

8.1 Industry Guidance

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs"

8.1.2 ISA-RP-67.15-1991, (ISA-S-67.04 PART II COMMITTEE DRAFT 10) "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation" 1991

8.2 Engineering Manuals

8.2.1 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations"

8.2.2 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift"

8.3 Drift Calculations

8.3.1 SPC-DR-026, Revision 0, "Drift Analysis of As-Found/As-Left Data for Westinghouse 3359C39G01 Power Range Bistables and intermediate Range Bistables"

8.4 Setpoint Calculations

8.4.1 SPC-RP-047, Revision 0, "Unit 1 NIS Power Range P10 Input to P7 Interlock"

8.5 Technical Specifications

8.5.1 Unit 1, "Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42), Amendment 230"

8.5.2 Unit 2, "Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60), Amendment 218"

8.6 Surveillance Procedures

8.6.1 SP 1005, Revision 50, "NIS Power Range Daily Calibration"

8.6.2 SP 1318.3, Revision 32, "Nis Power Range Channel Calibration"

8.6.3 SP 2318.3, Revision 32, "Nis Power Range Channel Calibration"

8.6.4 SP 1006A, Revision 46, "Nuclear Power Range Axial Offset Calibration"

8.6.5 SP, 1006B, Revision 60, "Nis Power Range Axial Offset Calibration Power Less Than 50% Power"

8.6.6 SP 1006C, Revision 20, "Nis Power Range Axial Offset Calibration Power Greater Than 50% Power"

8.6.7 SP 2006A, Revision 44, "Nuclear Power Range Axial Offset Calibration"

8.6.8 SP, 2006B, Revision 61, "Nis Power Range Axial Offset Calibration Power Less Than 50% Power"

8.6.9 SP 2006C, Revision 20, "Nis Power Range Axial Offset Calibration Power Greater Than 50% Power"

8.7 Design Control Documents

8.7.1 EC 6EQVENG24891, Revision 0, "Nuclear Instrumentation System (NIS) Display Upgrade"

8.7.2 Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2

8.7.3 Westinghouse NIS Technical Manual Appendix "Digital Meter 2.0 – Power Range A & B". Revision 2

8.7.4 Westinghouse Nuclear Instrumentation System Instruction Book, XH-1-1931 Revision 7

8.8 Work Orders

8.8.1 WO 700028102, 10/12/2019
8.8.2 WO 700028103, 10/3/2018
8.8.3 WO 700028104, 10/2/2018
8.8.4 WO 700028105, 10/2/2018
8.8.5 WO 700028106, 10/1/2018
8.8.6 WO 700028107, 10/14/2019
8.8.7 WO 700028108, 10/13/2019
8.8.8 WO 700028109, 10/18/2019

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Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Unit 1 and 2 Low Power Reactor Trip Block instrument loops. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1PT-485	Foxboro	E11GM-SAD1
1PT-486	Foxboro	E11GM-SAD1
2PT-485	Foxboro	E11GM-SAD1
2PT-486	Foxboro	E11GM-SAD1
1PC-485A/B	NUS Instruments	DAM503-03
1PC-486A/B	NUS Instruments	DAM503-03
2PC-485A/B	NUS Instruments	DAM503-03
2PC-486A/B	NUS Instruments	DAM503-03

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 1 and 2 setpoint calculations SPC-RP-027 (Reference 8.4.1) and SPC-RP-028 (Reference 8.4.2) provide different values for the process span and resulting values calculated using the process span. Because of this, the design inputs in Section 4.0 and analysis in Section 6.0 are given separately for setpoint calculations SPC-RP-027 and SPC-RP-028 (References 8.4.1 and 8.4.2).

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 1.1 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-007, "Drift Analysis of As-Found/As-Left Data for Foxboro Transmitter E11GM" (Reference 8.3.1) and SPC-DR-037, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (mA)" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each is summarized in the following Sections.

4.1.1 SPC-DR-007

The Foxboro Transmitter E11GM was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{transmitter} = \pm 0.440\%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{transmitter} = \pm 0\%\ Calibrated\ Span$$

4.1.2 SPC-DR-037

The NUS Bistable DAM503-03 (mA) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.0697\%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{bistable} = \pm 0\%\ Calibrated\ Span$$

4.2 Setpoint/Uncertainty Calculations

The low power reactor trip setpoint is evaluated in two setpoint calculations: SPC-RP-027, "UNIT 1 Turbine Impulse Pressure Permissive Input to P-7" (Reference 8.4.1) and SPC-RP-028, "UNIT 2 Turbine Impulse Pressure Permissive Input to P-7" (Reference 8.4.2). Pertinent information from each calculation for this evaluation is summarized below:

Form 1 of SPC-RP-027 (Reference 8.4.1) provides the following information:

$$Process\ Span = 0\ to\ 531.90\ PSIG$$

$$Analytical\ Limit\ (AL) = 93.08\ PSIG$$

Form 1 of SPC-RP-028 (Reference 8.4.2) provides the following information:

$$Process\ Span = 0\ to\ 532.20\ PSIG$$

$$Analytical\ Limit\ (AL) = 93.14\ PSIG$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS)\ =\ \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{neg} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-027), the total loop error is calculated as:

$$TLE\ (SRSS) = [14.146\ (PSIG^2) + 8.0236\ (PSIG^2) + 33.099\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 7.0729\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 707.29\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{\frac{1}{2}} = \pm 27.742\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -27.742\ PSIG - 0\ PSIG = -27.742\ PSIG$$

After entering the data for Unit 2 (SPC-RP-028), the total loop error is calculated as:

$$TLE\ (SRSS) = [14.162\ (PSIG^2) + 8.0327(PSIG^2) + 33.136\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 5.7355\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 708.09\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{\frac{1}{2}} = \pm 27.734\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -27.734\ PSIG - 0\ PSIG = -27.734\ PSIG$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

The allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

4.3 Technical Specifications

The allowable value for the Reactor Coolant Flow – Low function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 12\%\ \text{RTP}$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.3).

The Unit 1 APS and AFT are given as follows in SP 1002A:

$$APS = 11.66\ mA$$
$$AFT = \pm 0.20\ mA$$

The Unit 2 APS and AFT are given as follows in SP 2002A:

$$APS = 11.68\ mA$$

$$AFT = \pm 0.20\ mA$$

The actual plant setting (APS) and as found tolerance (AFT) are given in mADC and are converted into PSIG, the process unit using the input span of the Foxboro Transmitters given in surveillance procedures SP 1002B.3 and SP 2002B.3 (References 8.6.2 and 8.6.4).

Calculating for Unit 1 (SPC-RP-027):

$$Transsmitter\ Input\ Span = 606.5\ PSIG - 6.5\ PSIG = 600\ PSIG$$

$$Bistable\ Input\ Span = 50\ mA - 10\ mA = 40\ mA$$

$$APS = \frac{11.66\ mA - 10\ mA}{40\ mA} \times 600\ PSIG = 24.90\ PSIG$$

$$AFT = \frac{0.20\ mA}{40\ mA} \times 600\ PSIG = 3.00\ PSIG$$

Calculating for Unit 2 (SPC-RP-028):

$$Transsmitter\ Input\ Span = 608.0\ PSIG - 8.0\ PSIG = 600\ PSIG$$

$$Bistable\ Input\ Span = 50\ mA - 10\ mA = 40\ mA$$

$$APS = \frac{11.68\ mA - 10\ mA}{40\ mA} \times 600\ PSIG = 25.20\ PSIG$$

$$AFT = \frac{0.20\ mA}{40\ mA} \times 600\ PSIG = 3.00\ PSIG$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument as given in SPC-DR-007 (References 8.3.1) and SPC-DR-037 (Reference 8.3.2) is calculated in percent span. To interface with the equations and values taken from setpoint calculations SPC-RP-027 (Reference 8.4.1) and SPC-RP-028 (Reference 8.4.2), the drift data is converted into the process unit using the process span (Given in Section 4.2) below.

Calculating for Unit 1 (SPC-RP-027):

Foxboro Transmitter E11GM:

$$DA\_Ext\_Rand_{trans} = \pm 0.440\%\ Span \times \frac{531.9\ PSIG}{100\%\ Span} = 2.340\ PSIG$$

NUS Bistable DAM503-03:

$$DA\_Ext\_Rand_{bistable} = \pm 0.0697\%\ Span \times \frac{531.9\ PSIG}{100\%\ Span} = 0.371\ PSIG$$

Calculating for Unit 2 (SPC-RP-028):

Foxboro Transmitter E11GM:

$$DA\_Ext\_Rand_{trans} = \pm 0.440\%\ Span \times \frac{532.2\ PSIG}{100\%\ Span} = 2.342\ PSIG$$

NUS Bistable DAM503-03:

$$DA\_Ext\_Rand_{bistable} = \pm 0.0697\%\ Span \times \frac{532.2\ PSIG}{100\%\ Span} = 0.371\ PSIG$$

6.2 Total Loop Error (TLE)

Instrument drift from SPC-DR-007 (Reference 8.3.1) and SPC-DR-037 (Reference 8.3.2) is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

$$TLE\ (SRSS) = \left[DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

Substituting in the values corresponding to Unit 1 (SPC-RP-027):

$$TLE\ (SRSS) = [(2.340\ PSIG)^2 + (0.371\ PSIG)^2 + 0\ (PSIG^2) + 0\ (PSIG^2) + 0 (PSIG^2) + 0\ (PSIG^2) + 7.0729\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 707.29\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{\frac{1}{2}} = \pm 26.832\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -26.832\ PSIG - 0\ PSIG = -26.832\ PSIG$$

Substituting in the values corresponding to Unit 2 (SPC-RP-028):

$$TLE\ (SRSS) = [(2.342\ PSIG)^2 + (0.371\ PSIG)^2 + 0\ (PSIG^2) + 0\ (PSIG^2) + 0(PSIG^2) + 0\ (PSIG^2) + 5.7355\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 708.09\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{\frac{1}{2}} = \pm 26.823\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -26.832\ PSIG - 0\ PSIG = -26.823\ PSIG$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equation from Section 4.2 and the new calculated TLE values for Unit 1 and Unit 2, the nominal trip setpoint is calculated below.

Unit 1 (SPC-RP-027):

$$NTSP = AL + TLE_{neg} = 93.08\ PSIG - 26.832\ PSIG = 66.248\ PSIG$$

Unit 2 (SPC-RP-028):

$$NTSP = AL + TLE_{neg} = 93.14\ PSIG - 26.823\ PSIG = 66.317\ PSIG$$

6.4 Allowable Value (AV)

The allowable value for the low power reactor trip is calculated using the NTSP and the Loop Drift using the equations shown below.

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBN}$$

$$AV = NTSP + LD_R + LD_{Bp}$$

Substituting in values for Unit 1 (SPC-RP-027):

$$LD_R = \sqrt{(2.340\ PSIG)^2 + (0.371\ PSIG)^2 + (0\ PSIG)} = 2.370\ PSIG$$

$$LD_{BN} = 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 66.248\ PSIG + 2.370\ PSIG + 0\ PSIG = 68.618\ PSIG$$

Substituting in values for Unit 2 (SPC-RP-028):

$$LD_R = \sqrt{(2.342\ PSIG)^2 + (0.371\ PSIG)^2 + (0\ PSIG)} = 2.371\ PSIG$$

$$LD_{BN} = 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 66.317PSIG + 2.371\ PSIG + 0\ PSIG = 68.688\ PSIG$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP

value calculated in Section 6.3 and the AFT and APS values calculated in Section 4.4 the setpoint margin is evaluated below.

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

Substituting in values for Unit 1 (SPC-RP-027):

$$66.248\ PSIG \geq 24.90\ PSIG + 3.00\ PSIG$$

$$66.248\ PSIG \geq 27.90\ PSIG$$

Substituting in values for Unit 2 (SPC-RP-028):

$$66.317\ PSIG \geq 25.20\ PSIG + 3.00\ PSIG$$

$$66.317\ PSIG \geq 28.20\ PSIG$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is evaluated using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2. First converting the calculated AV from Section 6.4 into percent process span, the AV is evaluated below.

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

Substituting in values for Unit 1 (SPC-RP-027):

$$AV_{Calc} = \frac{68.618\ PSIG}{531.90\ PSIG} \times 100\%\ Span = 12.901\%$$

$$AV_{Tech\ Spec} \leq 12\%\ RTP$$

$$12\% \leq 12.901\%$$

Substituting in values for Unit 2 (SPC-RP-028):

$$AV_{Calc} = \frac{68.688\ PSIG}{532.20\ PSIG} \times 100\%\ Span = 12.906\%$$

$$AV_{Tech\ Spec} \leq 12\%\ \text{RTP}$$

$$12\% \leq 12.906\%$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-007 (Reference 8.3.1) and SPC-DR-037 (Reference 8.3.2), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Low Power Reactor Trip Block instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs"

8.2 Engineering Manuals

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift"

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations"

8.3 Drift Calculations

8.3.1 SPC-DR-007, Revision 0, "Drift Analysis of As-Found/As-Left Data for Foxboro Transmitter E11GM"

8.3.2 SPC-DR-037, Revision 0, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (mA)"

8.4 Setpoint Calculations

8.4.1 SPC-RP-027, Revision 2B, "Unit 1 Turbine Impulse Pressure Permissive Input to P-7"

8.4.2 SPC-RP-028, Revision 2, "Unit 2 Turbine Impulse Pressure Permissive Input to P-7"

8.5 Technical Specifications

8.5.1 Unit 1, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE"

8.5.2 Unit 2, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE"

8.6 Surveillance Procedures

8.6.1 SP 1002A, Revision 50, "Analog Protection System Calibration"

8.6.2 SP 1002B.3, Revision 1, "Reactor Protection and Control Transmitter Calibration/Inspection First Stage Turbine Pressure"

8.6.3 SP 2002A, Revision 51, "Analog Protection System Calibration"

8.6.4 SP 2002B.3, Revision 0, "Reactor Protection and Control Transmitter Calibration/Inspection First Stage Turbine Pressure"

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Table of Contents

1.0 Purpose

The purpose of this attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for Units 1 and 2 NIS Power Range P-8 Interlock. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment applies to each Unit 1 and Unit 2 Power Range Neutron Flux instrument loops (channel N41). The power range instruments are listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1NE-41	WESTINGHOUSE	WL-23686
1N41-NI301	WESTINGHOUSE	10072C10G01
1N41-NI302	WESTINGHOUSE	10072C10G01
1N41-NM310	WESTINGHOUSE	3359C48G01
1N41-NC304	WESTINGHOUSE	3359C39G01
1NE-42	WESTINGHOUSE	WL-23686
1N42-NI301	WESTINGHOUSE	10072C10G01
1N42-NI302	WESTINGHOUSE	10072C10G01
1N42-NM310	WESTINGHOUSE	3359C48G01
1N42-NC304	WESTINGHOUSE	3359C39G01
1NE-43	WESTINGHOUSE	WL-23686
1N43-NI301	WESTINGHOUSE	10072C10G01
1N43-NI302	WESTINGHOUSE	10072C10G01
1N43-NM310	WESTINGHOUSE	3359C48G01
1N43-NC304	WESTINGHOUSE	3359C39G01
1NE-44	WESTINGHOUSE	WL-23686
1N44-NI301	WESTINGHOUSE	10072C10G01
1N44-NI302	WESTINGHOUSE	10072C10G01
1N44-NM310	WESTINGHOUSE	3359C48G01
1N44-NC304	WESTINGHOUSE	3359C39G01
2NE-41	WESTINGHOUSE	WL-23686
2N41-NI301	WESTINGHOUSE	10072C10G01
2N41-NI302	WESTINGHOUSE	10072C10G01
2N41-NM310	WESTINGHOUSE	3359C48G01
2N41-NC304	WESTINGHOUSE	3359C39G01
2NE-42	WESTINGHOUSE	WL-23686
2N42-NI301	WESTINGHOUSE	10072C10G01
2N42-NI302	WESTINGHOUSE	10072C10G01
2N42-NM310	WESTINGHOUSE	3359C48G01
2N42-NC304	WESTINGHOUSE	3359C39G01
2NE-43	WESTINGHOUSE	WL-23686
2N43-NI301	WESTINGHOUSE	10072C10G01

2N43-NI302	WESTINGHOUSE	10072C10G01
2N43-NM310	WESTINGHOUSE	3359C48G01
2N43-NC304	WESTINGHOUSE	3359C39G01
2NE-44	WESTINGHOUSE	WL-23686
2N44-NI301	WESTINGHOUSE	10072C10G01
2N44-NI302	WESTINGHOUSE	10072C10G01
2N44-NM310	WESTINGHOUSE	3359C48G01
2N44-NC304	WESTINGHOUSE	3359C39G01

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 2 setpoint calculation is not available. The Unit 1 and Unit 2 Nuclear Instrument Power Range drawer loop components are identical in design and qualification. The design source documents are identical between the two units, and the method of calibration is identical. Process Measurement Accuracy (PMA) and Process Considerations (PC) evaluated in the Reference 8.4.1 calculation have been reviewed and determined to be consistent between Unit 1 and Unit 2 for the purposes of drift and setpoint analysis. Therefore, based on review, the Unit 1 setpoint calculation can be considered applicable to Unit 2 function and the Unit 1 setpoint calculation (Reference 8.4.1) is extended to Unit 2 by review.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 SPC-DR-026 Drift Calculation for NC304

This attachment uses data from drift calculation SPC-DR-026, “Drift Analysis of As-Found /As -Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables” (Reference 8.3.1). The data taken from the drift calculation is summarized below:

Westinghouse Bistable Model 3359C39G01 (NC304)

$$DA\_Ext\_Rand = \pm 0.080\ \%Calibrated\ Span$$

$$DA\_Ext\_Bias = \pm 0\ \%Calibrated\ Span$$

4.2 Input Data for the Power Range Detector, NI 301/302 and NM 310

Drift analysis was not performed on the following instruments in the Power Range Neutron Flux P-8 Interlock loop:

4.2.1 Power Range Detector NE-41, NE-42, NE-43, and NE-44

The Power Range Detectors are not calibrated instruments in a surveillance procedure that would provide As-Found (AF) and As-Left (AL) data for drift analysis. EM 3.3.4.2 (Reference 8.2.1) provides guidance for cases where there is not sufficient AF/AL drift data and specifies, in section 6.4.2, that vendor data can be used to establish drift data. The setpoint calculation SPC-RP-041, "Unit 1 NIS Power Range P-8 Interlock" (Reference 8.4.1) evaluated the Power Range detector uncertainty from published vendor data, this method is consistent with EM 3.3.4.2 (Reference 8.2.1) guidance. Therefore, this Attachment incorporates the vendor drift allowance from SPC-RP-041 (Reference 8.4.1) as described in Section 4.2.4 and listed in Section 6.2.3.

4.2.2 NI 301/302

Per Design Equivalent Change 6EQVENG28491 (Reference 8.7.1) the Power Range Drawer B upper and lower detector digital current meters (NI 301 and NI 302) installed per Westinghouse Field Kit Instructions ITTC/NIS (88)-370 were replaced with new designed and qualified Digital Meter 2.0 assemblies per Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2 (Reference 8.7.2). The new meter installations occurred in 2018 and 2019 per the Work Orders listed in References 8.8.1 through 8.8.8, limiting the number of available data points to less than required to have a statistically valid pool for drift analysis, as defined in EM 3.3.4.2 section 6.4.2 (Reference 8.2.1). As a result, the drift analysis project excluded the power range upper and lower detector current meters from the drift analysis scope. Therefore, this Attachment will use vendor data to establish drift data as described in section 6.4.2 of EM 3.3.4.2 (Reference 8.2.1) for conditions of insufficient drift data due to new or new or replaced components. The vendor data will be used to develop a drift allowance by evaluating the calibration interval and manufacturer's drift specification as described in section 4.2.3 below.

The NI 301 and NI 302 vendor data is provided in Westinghouse design input document NIS Technical Manual Appendix Digital Meter 2.0 – Power Range A & B Section 1.3.1 Specification of Digital Meter (Reference 8.7.3) and as evaluated in Design Equivalent Change 6EQVENG28491 Section B.4 Design Evaluation (Reference 8.7.1).

Characteristic	Detail
Noise Rejection	Greater than 54 dB at 1 Hz (“SLOW” meter rate)
	Greater than 100 dB at 60 Hz (“SLOW” or “FAST” meter rate)
Conversion Rate	5 conversions per second
Accuracy	± 0.03% of reading (± 0.003%, meter alone)
Zero Stability	Auto-zero, ± 0.2 μV/ C (400.0 mV full scale input)
Display	4 digits, red LED, 0.43” high digits
Temperature Range	-10 to +50 degrees C Temperature
Coefficient	± 7 ppm of reading per degree C
Relative Humidity	0 to 90 %, non-condensing

Per References 8.4.1, 8.7.1, and 8.7.3 the current setpoint calculation evaluates meter accuracy as = 0.1% span, vendor drift allowance at 0 and drift time at 1.0 months. The meter accuracy value bounds the meter replacement specification as described in Reference 8.7.1 and represents worst case error. Vendor drift allowance and drift time are not specified in the referenced engineering change (Reference 8.7.1 and 8.7.3). However, the engineering change incorporates the Original Equipment Manufacturer approved equivalent replacement (Reference 8.7.3). As such, this Attachment will use the SPC-RP-041 (Reference 8.4.1) allowance for meter drift and drift time as bounding values in section 6 vendor drift analysis.

As described in Section 2.2.4.1 of Reference 8.7.4, "The current signals from the two detector sections are summed, then averaged by Summing and Level Amplifier NM310 to produce a single voltage which is proportional to average reactor output." The two detector sections are identical, each consisting of an upper (or lower) Power Range Detector and a Detector Current Meter. Per Reference 8.1.2, because these two input channels are averaged, their resulting uncertainties can be averaged. SPC-RP-041 (Reference 8.4.1) incorporated this method to average the two current inputs to the NM310 Summing and Level Amplifier channel uncertainties by including only one Power Range Detector and one Detector Current Meter in the instrument loop. This Attachment will evaluate loop uncertainty consistent with SPC-RP-041 (Reference 8.4.1) as described in 4.2.4.

4.2.3 NM 310

Per SP 1005 (Reference 8.6.1) and Plant Technical Speciation Surveillance Requirements 3.3.1.2, 3.3.1.3, and 3.3.1.6 (References 8.5.1 and 8.5.2) the Power Range output current from the summing and level amplifier is normalized each day to heat balance results and quarterly to in core flux mapping. The adjustments occur throughout the fuel cycle and occur after the surveillance channel calibration has been performed. The Power Range current adjustments during the fuel cycle result in a change in the NM310 output, and it is likely that the As Found value for the next channel calibration will not correspond to the As

Left value from the previous calibration. That change is not exclusively instrument drift. Rather it more accurately reflects the adjustments made to make the summing and level amplifier output and the Power Range drawer to agree with to fuel cycle core measurement currents. On the basis of this condition the NM 310 data was excluded from drift analysis.

However, as previously described, EM 3.3.4.2 (Reference 8.2.1) provides guidance for cases where there is not sufficient drift data and specifies, in section 6.4.2, that vendor data can be used to establish drift data. The setpoint calculation SPC-RP-041, "Unit 1 NIS Power Range P-8 Interlock" (Reference 8.4.1) developed a drift allowance consistent with EM 3.3.4.2 (Reference 8.2.1) and guidance from ISA-RP 67.04 (References 8.1.2) to characterize expected instrument drift by correlating Calibration Interval (CI) to performance predicted by the manufacturer's drift specification. The NM 310 daily drift allowance in this Attachment will be evaluated consistent with SPC-RP-041 as described in 4.2.4.

- Westinghouse Nuclear Instrumentation System Instruction Book XH-1-1931 (Reference 8.7.4), Section 1.4.3.1, states that the summing and level amplifier (Westinghouse model 3359C48G01) has a stability (i.e., drift) of 0.1 % per 100 hours. SPC-RP-041 (Reference 8.4.1) develops drift data using the vendor drift time (DT) as: $DT = \left(\frac{100\ hours}{\frac{730\ hours}{month}}\right)$ = 0.137 months.

- As described above the NM 310 calibration interval (CI) is daily. The rationale of a daily calibration is based on review of SP 1005 (Reference 8.6.1). SPC-RP-041 (Reference 8.4.1) develops the CI for daily calibration as:

$$CI = \left(\frac{1 day}{\frac{365\ days}{year}}\right) \times \left(\frac{12\ months}{year}\right) = 0.033\ months.$$

  The setpoint calculation (Reference 8.4.1) allows for the surveillance to be performed up to 48 hours (two days) apart this results in CI_{calc}:

$$CI_{calc} = 2 \times 0.033\ months = 0.066\ months$$

4.2.4 Calibration Interval and Manufacturer's Drift Specification for the NIS Power Range detectors, NI 301/302 and NM 310

EM 3.3.4.1 (Reference 8.2.2) provides adequate guidance for conditions where drift is not defined or the drift analysis not acceptable. The guidance also includes instruction to adjust vendor drift to match the calibration period of an instrument when the vendor period does not agree with the calibration period of the instrument. Section 6.3.2 of EM 3.3.4.1 (Reference 8.2.2) provides the following equation to adjust drift to match the calibration period of an instrument "where drift is considered to be a linear condition over the entire

period between calibrations." Reference 8.1.2 states that "in the absence of other data, it is considered reasonable, and perhaps conservative, to make this assumption" of linearity. The linear condition is chosen to match the method used for analysis in the setpoint calculation (Reference 8.4.1)

Instrument Drift (d) $= \left(\frac{1.25*tc}{td}\right)\left(\frac{vd}{cs}\right)$

where:

vd = vendor's drift specification

td = vendor's time period for which drift specification is valid.

tc = instrument calibration period (months)

cs = instrument calibrated span

1.25 = maximum allowance on time requirements in technical specifications

The setpoint calculation SPC-RP-041, "Unit 1 NIS Power Range P-8 Interlock" (Reference 8.4.1) developed a drift allowance consistent with guidance from ISA-RP 67.04 (Reference 8.1.2) to characterize expected instrument behavior by correlating Calibration Interval (CI) to performance predicted by the manufacturer. The calculation considered drift linear over time and calculated drift using the following equation

SPC-RP-041 calculates drift as $Drift\ (d) = \left(\frac{CI}{DT}\right)(vd)\left(\frac{PS}{CS}\right)$

where:

vd = vendor's drift expression

CI = Calibration Interval

DT = Drift Time

PS = Process Span

CS = Calibrated Span

SPC-RP-041 (Reference (8.4.1) determines drift consistent with industry guidance ISA-RP-67.15-1991 (Reference 8.1.2). SPC-RP-041 is the calculation of record for the interlock function. Therefore, the evaluation of the loop setpoint will incorporate manufacturer's drift for the current meters (NI 301/302) and NM310 consistent with SPC-RP-041.

4.3 Setpoint/Uncertainty Calculations

The Power Range P-8 Interlock Setpoint is evaluated in setpoint calculation: SPC-RP-041, "Unit 1 NIS Power Range P-8 Interlock" (Reference 8.4.1). As described in section 2.0 Methodology the unit 1 calculation also applies to Unit 2. Pertinent information from the calculation for this evaluation is summarized below:

Form 1 of SPC-RP-041 (Reference 8.4.1) provides the following information:

$$Process\ Span = 0\ to\ 120\ PCT$$

SPC-RP-041 Form 1 and Section 1.2 "Results - Parameter Table" (Reference 8.4.1) provides the following information:

$$Analytical\ Limit\ (AL) = 17.000\ PCT$$

Total Loop Error for a seismic event and potential subsequent loss of non-seismic HVAC:

$$TLE\ (SRSS) = \big(A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\big)^{\frac{1}{2}}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLES_{pos} = SRSSS + Bias_{pos}$$

$$TLES_{neg} = -SRSSS - Bias_{neg}$$

Entering the data from SPC-RP-041, the total loop error is calculated as:

$$TLE\ (SRSS) = \Bigg((0.74880\ PCT^2) + (0.16264\ PCT^2) + (0.21879\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT)^2 + \left(0.36\%\ Span\ \times \frac{120\ PCT}{100\%\ Span}\right)^2 + \left(5\%\ Span \times \frac{120\ PCT}{100\%\ Span}\right)^2\Bigg)^{1/2} = 6.1088\ PCT$$

$$Bias_{pos} = (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) = 0\ PCT$$

$$Bias_{neg} = (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) = 0\ PCT$$

$$TLES_{pos} = 6.1088\ PCT + 0\ PCT = 6.1088\ PCT$$

$$TLES_{neg} = -\ 6.1088\ PCT - 0\ PCT = -\ 6.1088\ PCT$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

The allowable value (AV) for an increasing process is determined using the following equations:

$$For\ an\ increasing\ process: AV = NTSP + LD_R + LD_{BP}$$

$$LD_R\ (Loop\ Drift, random\ component) = (A + D_r + M + R_{NR})^{1/2}$$

$$LD\ (Loop\ Drift, positive\ bias\ component) = D_{BP} + R_{NBP}$$

4.4 Technical Specifications

The allowable value for the Power Range Neutron Flux – Low function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 11\%\ RTP$$

Per SPC-RP-041 (Reference 8.4.1) Section 1.2, values from the technical specifications (References 8.5.1 and 8.5.2) are given values of PCT with no conversion of the values. Therefore, for this calculation RTP and PCT are equivalent.

Thus, the following relationship is true:

$$AV\ 11\%\ RTP = 11\ PCT$$

4.5 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1318.2 (Reference 8.6.2) and SP 2318.2 (Reference 8.6.3).

$$APS = 0.783\ VDC$$

$$AFT = \pm 0.01\ VDC$$

These values are taken from NC304, which has a span of 0 to 10 VDC (Reference 8.4.1). Converting to PCT:

$$APS = 0.783\ VDC \times \frac{120\ PCT}{10\ VDC} = 9.4\ PCT$$

$$AFT = \pm 0.01\ VDC \times \frac{120\ PCT}{10\ VDC} = 0.12\ PCT$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Extrapolated Analyzed Drift

The total calculated drift tolerance interval for the trip bistables in Section 4.1 was calculated in Reference 8.3.1 using calibrated percent span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below.

Westinghouse Bistable NC304 (PCT) and Process Span from Section 4.3:

$$DA\_Ext\_Rand_{bistable} = \pm 0.080\ \%\ calibrated\ span$$

$$= \pm 0.080\ \%\ calibrated\ span \times \frac{120\ PCT}{100\ \%\ calibrated\ span}$$

$$= \pm 0.096\ \ PCT$$

$$DA\_Ext\_Bias_{bistable,pos} = 0\%\ calibrated\ span = 0\ PCT$$

$$DA\_Ext\_Bias_{bistable,neg} = 0\%\ calibrated\ span = 0\ PCT$$

6.2 Extrapolated Vendor Drift

Per section 4.1, only the reactor trip bistable (1N41-NC304) has an extrapolated analyzed drift tolerance from a drift analysis calculation. To include the Power Range detector, current meter, and summing and level amplifier in the Total Loop Error calculation (Section 6.3), the extrapolated drift tolerance is calculated using vendor data. The extrapolated drift tolerance is calculated using vendor data included in Forms 1 and 2 of SPC-DR-041 (Reference 8.4.1) and the equations given below.

$$d_R = \left(\frac{\mathrm{CI}}{\mathrm{DT}}\right)(\mathrm{vd})\left(\frac{\mathrm{PS}}{\mathrm{CS}}\right)$$

$$D_{30} = \sqrt{a^2 + d_R{}^2 + m^2}$$

6.2.1 Power Range Detector (1NE-41)

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0\ PCT$$

$$a = 0.6000\ PCT$$

$$m = 0\ PCT$$

$$D_{30detector} = \sqrt{.6000^2 + 0^2 + 0^2} = 0.6000\ PCT$$

6.2.2 Current Meter (1N41-NI301)

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0\ PCT$$

$$a = 0.1200\ PCT$$

$$m = 0.3134\ PCT$$

$$D_{30current\ meter} = \sqrt{0.1200^2 + 0^2 + 0.3134^2} = 0.3356\ PCT$$

6.2.3 Summing and Level Amplifier (1N41-NM310)

$Calibration\ Interval\ (CI) = 0.066\ months$ (Reference 8.4.1, Section 3.0)

$$Drift\ Time\ (DT) = 0.137\ \text{months.}$$

$$Vendor\ Drift\ (vd) = 0.120\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0.0578\ PCT$$

$$a = 0.6000\ PCT$$

$$m = 0.34697\ PCT$$

$$D_{30Amplifier} = \sqrt{0.6000^2 + 0.0578^2 + 0.3470^2} = 0.6955\ PCT$$

6.3 Total Loop Error (TLE)

Instrument drift from the referenced drift calculation is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

Therefore, for a seismic event and potential subsequent loss of non-seismic HVAC:

$$TLE\ (SRSS) = \Big[D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{\frac{1}{2}}$$

$$TLE\ (SRSS) = \Bigg[(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (0.096\ PCT)^2 + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT)^2 + \left(0.36\%\ Span \times \frac{120\ PCT}{100\%\ Span}\right)^2 + \left(5\%\ Span \times \frac{120\ PCT}{100\%\ Span}\right)^2\Bigg]^{1/2} = 6.0953\ PCT$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$DA\_Ext\_Bias_{bistable,pos}$ and $DA\_Ext\_Bias_{bistable,neg}$ are = 0. Per SCP-RP-041, (Reference 8.4.1) the bias components for the Detector, Current Meter, or Summing and Level Amplifier are = 0. Therefore $D_{Bp} = 0$.

$$Bias_{pos} = (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) = 0\ PCT$$

$$Bias_{neg} = (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) + (0\ PCT) = 0\ PCT$$

$$TLES_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLES_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

$$TLE_{pos} = 6.0953\ PCT + 0\ PCT = 6.0953\ PCT\ or$$

$$TLE_{pos} = \left(6.0953\ PCT \times \frac{100\%\ Span}{120\ PCT}\right) = 5.079\ \%\ of\ Process\ Span.$$

$$TLE_{neg} = -6.0953\ PCT - 0\ PCT = -6.0953\ PCT\ or$$

$$TLE_{neg} = \left(-6.0953\ PCT \times \frac{100\%\ Span}{120\ PCT}\right) = -5.079\ \%\ of\ Process\ Span.$$

6.4 Nominal Trip Setpoint (NTSP)

Using the equations from sections 4.3 and the new calculated TLE values the nominal trip setpoint using the new drift value is calculated below:

For an increasing process, the Nominal Trip Setpoint (NTSP) for Normal Conditions:

$$NTSP = AL + TLE_{neg}$$

$$Where, AL = Analytical\ Limit = \ 17.000\ PCT$$

$$Therefore\ the\ NTSP = \ 17.000\ PCT - 6.0953\ PCT\ = 10.9047\ PCT$$

6.5 Allowable Value (AV)

For an increasing process, the following equation is used to calculate AV:

$$AV_{CALC} = NTSP + LD_R + LD_{BP}$$

Where:

$$LD_R\ (Loop\ Drift, Random\ Component) = \left(D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}\right)^{1/2}$$

$$LD_{BP}\ (Loop\ Drift, Bias\ Posititve\ Component) = Bias_{pos} + R_{NBP}$$

$$LD_R = \left((0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + \ (0.096\ \ PCT)^2 + (0\ PCT)\right)^{1/2} = 0.98260\ PCT$$

$$LD_{BP} = (0\ PCT) + (0\ PCT) = 0\ PCT$$

$$AV_{CALC} = 10.9047\ PCT + 0.9826\ PCT + 0\ PCT = 11.8873\ PCT$$

6.6 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using each of the NTSP values calculated in Section 6.3 and the AFT and APS values in Section 4.5 the setpoint margin is evaluated below:

$$Acceptance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$NTSP \geq APS + AFT$$

$$10.9047\ PCT\ \ \geq 9.4\ PCT + 0.12\ PCT$$

$$10.9047\ PCT \geq 9.52\ PCT$$

$$Margin_{30} = NTSP - APS - AFT = 1.3847\ PCT$$

Positive margin exists for the calculated NTSP. Therefore, the acceptance criteria in Section 3.0 of the Summary Setpoint Calculation Main Body is satisfied for the calculated NTSP.

6.7 Allowable Value Acceptance

$$For\ Increasing\ Setpoints: AV_{Tech\ Spec} \leq AV_{Calc}$$

Per Section 4.4, $AV_{Tech\ Spec} \leq 11\%\ RTP\ (PCT)$

Per Section 6.5, $AV_{Calc} = 11.8873\ PCT$

AV_{Calc} is greater than $AV_{Tech\ Spec}$. Therefore, the calculated Allowable Value is conservative and satisfies the acceptance criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body.

7.0 Conclusions and Plant Impact

The total loop error, nominal trip setpoint, and allowable value were calculated using the new drift values provided in drift calculation SPC-DR-026 (Reference 8.3.1) and vendor specifications where applicable. The new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Power Range Neutron Flux (P-8 Interlock) Reactor Trip Bistable Function instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, Guidelines for Instrument Calibration Extension/Reduction Programs.

8.1.2 ISA-RP-67.15-1991, (ISA-S-67.04 PART II COMMITTEE DRAFT 10) Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation 1991

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, The Analysis of Instrument Drift.

8.2.2 EM 3.3.4.1, Revision 2, Instrument Setpoint/Uncertainty Calculations.

8.3 Drift Calculations:

8.3.1 SPC-DR-026, Revision 0, Drift Analysis of As-Found /As -Left Data for Westinghouse 359C39G01 Power Range Indicators and Intermediate Range Indicators.

8.4 Setpoint Calculations:

8.4.1 SPC-RP-041, Revision 0A, Unit 1 NIS Power Range P-8 Interlock.

8.5 Technical Specifications:

8.5.1 Unit 1, Norther States Power Company Docket No. 50-282 Prairie Island Nuclear Generating Plant, Unit 1 Renewed Facility Operating License, Amendment 230

8.5.2 Unit 2, Northern States Power Company Docket No. 50-306 Prairie Island Nuclear Generating Plant, Unit 2 Renewed Facility Operating License, Amendment 218

8.6 Surveillance Procedures:

8.6.1 SP 1005, Revision 50, NIS Power Range Daily Calibration

8.6.2 SP 1318.2, Revision 32, NIS Power Range Channel Calibration

8.6.3 SP 2318.2, Revision 32, NIS Power Range Channel Calibration

8.7 Design Control Documents

8.7.1 Design Equivalent Change, 6EQVENG28491, Revision: 0 Nuclear Instrumentation System (NIS) Display Upgrade

8.7.2 Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2

8.7.3 Westinghouse NIS Technical Manual Appendix Digital Meter 2.0 – Power Range A & B. Revision 2

8.7.4 Westinghouse Nuclear Instrumentation System Instruction Book, XH-1-1931 Revision 7

8.8 Work Orders

8.8.1 WO 700028102, 10/12/2019

8.8.2 WO 700028103, 10/3/2018

8.8.3 WO 700028104, 10/2/2018

8.8.4 WO 700028105, 10/2/2018

8.8.5 WO 700028106, 10/1/2018

8.8.6 WO 700028107, 10/14/2019

8.8.7 WO 700028108, 10/13/2019

8.8.8 WO 700028109, 10/18/2019

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Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Reactor Trip System interlock P9 instrument loops. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment applies to all four Unit 1 and Unit 2 Power Range High Flux (high setpoint) instrumentation loops (i.e. channels N41, N42, N43, and N44). The power range instruments are listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1NE-41A	Westinghouse	WL-23648
1NE-41B	Westinghouse	WL-23648
1NE-42A	Westinghouse	WL-23648
1NE-42B	Westinghouse	WL-23648
1NE-43A	Westinghouse	WL-23648
1NE-43B	Westinghouse	WL-23648
1NE-44A	Westinghouse	WL-23648
1NE-44B	Westinghouse	WL-23648
1N41-NI301	Westinghouse	10072C10G01
1N41-NI302	Westinghouse	10072C10G01
1N42-NI301	Westinghouse	10072C10G01
1N42-NI302	Westinghouse	10072C10G01
1N43-NI301	Westinghouse	10072C10G01
1N43-NI302	Westinghouse	10072C10G01
1N44-NI301	Westinghouse	10072C10G01
1N44-NI302	Westinghouse	10072C10G01
1N41-NM310	Westinghouse	3359C48G01
1N42-NM310	Westinghouse	3359C48G01
1N43-NM310	Westinghouse	3359C48G01
1N44-NM310	Westinghouse	3359C48G01
1N41-NC307	Westinghouse	3359C39G01
1N42-NC307	Westinghouse	3359C39G01
1N43-NC307	Westinghouse	3359C39G01
1N44-NC307	Westinghouse	3359C39G01
2NE-41A	Westinghouse	WL-23648
2NE-41B	Westinghouse	WL-23648
2NE-42A	Westinghouse	WL-23648
2NE-42B	Westinghouse	WL-23648
2NE-43A	Westinghouse	WL-23648
2NE-43B	Westinghouse	WL-23648
2NE-44A	Westinghouse	WL-23648

2NE-44B	Westinghouse	WL-23648
2N41-NI301	Westinghouse	10072C10G01
2N41-NI302	Westinghouse	10072C10G01
2N42-NI301	Westinghouse	10072C10G01
2N42-NI302	Westinghouse	10072C10G01
2N43-NI301	Westinghouse	10072C10G01
2N43-NI302	Westinghouse	10072C10G01
2N44-NI301	Westinghouse	10072C10G01
2N44-NI302	Westinghouse	10072C10G01
2N41-NM310	Westinghouse	3359C48G01
2N42-NM310	Westinghouse	3359C48G01
2N43-NM310	Westinghouse	3359C48G01
2N44-NM310	Westinghouse	3359C48G01
2N41-NC307	Westinghouse	3359C39G01
2N42-NC307	Westinghouse	3359C39G01
2N43-NC307	Westinghouse	3359C39G01
2N44-NC307	Westinghouse	3359C39G01

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 2 setpoint calculation is not available. The following were review for Unit 1 and 2 Nuclear Instrumentation Power Range drawer components:

- The design source documents are applicable to both units (Reference 8.7.4).
- The method of calibration and M&TE is identical for both units (References 8.6.1, 8.6.2, 8.6.3, 8.6.4, and 8.6.5).
- Process Measurement Accuracy (PMA) source document (Reference 8.7.5) states in Section 1.0 that it is applicable to Units 1 and 2.
- From Section 1.0 of SPC-RP-043 (Reference 8.4.1) there is no Analytical Limit for P-9. According to Assumption 1 of SPC-RP-043, the Process Limit for P-9 of 47.5 %RTP is based on the plant's load rejection design basis.
- The Allowable Values (AV) from the Unit 1 and Unit 2 Tech Specs (References 8.5.1 and 8.5.2 respectively) are identical.

Therefore, based on this review, the Unit 1 setpoint calculation can be considered applicable to Unit 2 function and the Unit 1 setpoint calculation (Reference 8.4.1) is extended to Unit 2 by review.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculation SPC-DR-026 for NC307

This attachment uses data from drift calculation SPC-DR-026, "Drift Analysis of As-Found /As - Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables" (Reference 8.3.1). The drift value provided from Reference 8.3.1 will bound NC307 hardware performance with a 95% probability at a 95% confidence level. The probability value establishes the portion of the population that is included within the tolerance interval. The data taken from the drift calculation is summarized below.

Westinghouse Bistable Model 3359C39G01 (NC307)

$$DA\_Ext\_Rand_{Bistable} = \pm 0.080\ \%\ Span$$

$$DA\_Ext\_Bias_{Bistable} = \pm 0\ \%\ Span$$

4.2 Input Data for Power Range Detector, NI 301/302 and NM 310

Drift analysis was not performed on the following instruments in the Power Range Neutron Flux High Reactor Trip loop:

4.2.1 Power Range Detector NE-41, NE-42, NE-43, and NE-44.

The Power Range Detectors are not calibrated instruments in a surveillance procedure that would provide As-Found (AF) and As-Left (AL) data for drift analysis. EM 3.3.4.2 (Reference 8.2.1) provides guidance for cases where there is not sufficient AF/AL drift data and specifies, in section 6.4.2, that vendor data can be used to establish drift data. The setpoint calculation SPC-RP-043, "UNIT 1 NIS Power Range P-9 Interlock" (Reference 8.4.1) evaluated the Power Range detector uncertainty from published vendor data, this method is consistent with EM 3.3.4.2 (Reference 8.2.1) guidance. Therefore, this Attachment incorporates the vendor drift allowance from SPC-RP-043 as described in Section 4.2.4 and listed in Section 6.2.1.

4.2.2 NI 301/302

Per Design Equivalent Change 6EQVENG28491 (Reference 8.7.1) the Power Range Drawer B upper and lower detector digital current meters (NI 301 and NI 302) installed per Westinghouse Field Kit Instructions ITTC/NIS (88)-370 were replaced with new designed and qualified Digital Meter 2.0 assemblies per Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2 (Reference 8.7.2).

The new meter installations occurred over 2018 and 2019 and limited the size of the available calibration data points to less than a statistically valid pool, as defined in EM

3.3.4.2 section 6.4.2. (Reference 8.2.1). As a result, the drift analysis project excluded the power range upper and lower detector current meters from the drift analysis scope. Therefore, this Attachment will use vendor data to establish drift extrapolated to 30 months as described in section 6.4.2 of EM 3.3.4.2 (Reference 8.2.1) for conditions of insufficient drift data due to new or new or replaced components. The vendor data will be used to develop a drift allowance by evaluating the calibration interval and manufacture's drift specification as described in section 4.2.3 below.

The NI 301 and NI 302 vendor data is provided in Westinghouse design input document NIS Technical Manual Appendix Digital Meter 2.0 – Power Range A & B Section 1.3.1 "Digital Meter 2.0 – Power Range A & B" (Reference 8.7.3) and as evaluated in Design Equivalent Change 6EQVENG28491 Section B.4 "Design Evaluation" (Reference 8.7.1).

Characteristic	**Detail**
Noise Rejection	Greater than 54 dB at 1 Hz ("SLOW" meter rate)
	Greater than 100 dB at 60 Hz ("SLOW" or "FAST" meter rate)
Conversion Rate	5 conversions per second
Accuracy	± 0.03% of reading (± 0.003%, meter alone)
Zero Stability	Auto-zero, ± 0.2 µV/ C (400.0 mV full scale input)
Display	4 digits, red LED, 0.43" high digits
Temperature Range	-10 to +50 degrees C Temperature
Coefficient	± 7 ppm of reading per degree C
Relative Humidity	0 to 90 %, non-condensing

Per References 8.4.1 and 8.7.1 the current setpoint calculation evaluates meter accuracy as = 0.1% Span. This accuracy value bounds the meter replacement specification as described in Reference 8.7.1 and represents worst case error.

As described in Section 2.2.4.1 of Reference 8.7.4, "The current signals from the two detector sections are summed, then averaged by Summing and Level Amplifier NM310 to produce a single voltage which is proportional to average reactor output." The two detector sections are identical, each consisting of an upper (or lower) Power Range Detector and a Detector Current Meter. Per Reference 8.2.2, because these two input channels are averaged, their resulting uncertainties can be averaged. SPC-RP-043 (Reference 8.4.1) incorporated this method to average the two current inputs to the NM310 Summing and Level Amplifier channel uncertainties by including only one Power Range Detector and one Detector Current Meter in the instrument loop. This Attachment will evaluate loop uncertainty consistent with SPC-RP-043 as described in Section 4.2.3 of this Attachment.

4.2.3 NM 310

Per SP 1005 (Reference 8.6.5) and Plant Technical Speciation Surveillance Requirements 3.3.1.2, 3.3.1.3, and 3.3.1.6 (References 8.5.1 and 8.5.2) the Power Range output current from the summing and level amplifier is normalized each day to heat balance results and quarterly to in core flux mapping. The adjustments occur throughout the fuel cycle and occur after the surveillance channel calibration has been performed. The Power Range current adjustments during the fuel cycle result in a change in the NM310 output, therefore the As Found value for the next channel calibration will not correspond with the As Left value from the previous calibration. That change is not exclusively instrument drift. Rather it more accurately reflects the adjustments made to make the summing and level amplifier output and the Power Range drawer agree with fuel cycle core measurement currents. On the basis of this condition the NM 310 data was excluded from drift analysis.

However, as previously described, EM 3.3.4.2 (Reference 8.2.1) provides guidance for cases where there is not sufficient drift data and specifies, in section 6.4.2, that vendor data can be used to establish drift data. The setpoint calculation SPC-RP-043, “UNIT 1 NIS Power Range P-9 Interlock”(Reference 8.4.1) developed a drift allowance consistent with EM 3.3.4.2 (Reference 8.2.1) and guidance from ISA-RP 67.04 (References 8.1.2) to characterize expected instrument drift by correlating Calibration Interval (CI) to performance predicted by the manufacture’s drift specification. The NM 310 daily drift allowance in this Attachment will be evaluated consistent with SPC-RP-043 as described in Section 4.2.3 of this Attachment.

- Westinghouse Nuclear Instrumentation System Instruction Book XH-1-1931 (Reference 8.7.4), Section 1.4.3.1, states that the summing and level amplifier (Westinghouse model 3359C48G01) has a stability (i.e., drift) of 0.1 % per 100 hours. SPC-RP-043(Reference 8.4.1) develops drift data using the vendor drift time (DT) as:

$$DT = \left(\frac{100\ hours}{\frac{730\ hours}{month}}\right) = 0.137 \text{ months.}$$

- As described above the NM 310 calibration interval (CI) is daily. The rationale of a daily calibration is based on review of SP 1005 (Reference 8.6.5). SPC-RP-043 (Reference 8.4.1) develops the CI for daily calibration as:

$$CI = \left(\frac{1day}{\frac{365\ days}{year}}\right) \times \left(\frac{12\ months}{year}\right) = 0.033\ months.$$

The setpoint calculation (Reference 8.4.1) allows for the surveillance to be performed up to 48 hours (two days) apart this results in CI_{calc}:

$$CI_{calc} = 2\ \times\ 0.033\ months = 0.066\ months$$

4.2.4 Calibration Interval and Manufacture's Drift Specification for NI 301/302 and NM 310

EM 3.3.4.1 (Reference 8.2.2) provides adequate guidance for conditions where drift is not defined or the drift analysis not acceptable. The guidance also includes instruction to adjust vendor drift to match the calibration period of an instrument when the vendor period does not agree with the calibration period of the instrument. Section 6.3.2 of EM 3.3.4.1 (Reference 8.2.2) provides the following equation to adjust drift to match the calibration period of an instrument "where drift is considered to be a linear condition over the entire period between calibrations:" The linear condition is chosen to match the method used for analysis in the setpoint calculation (Reference 8.4.1)

NOTE: The linear condition is chosen to match the method used for analysis in the setpoint calculation (Reference 8.4.1)

$$\text{Instrument Drift (d)} = \left(\frac{1.25*tc}{td}\right)\left(\frac{vd}{cs}\right)$$

where:
vd = vendor's drift specification
td = vendor's time period for which drift specification is valid.
tc = instrument calibration period (months)
cs = instrument calibrated span
1.25 = maximum allowance on time requirements in technical specifications

The setpoint calculation SPC-RP-043, "UNIT 1 Power Range High Flux Reactor Trip High Setpoint" (Reference 8.4.1) developed a drift allowance consistent with guidance from ISA-RP 67.04 (Reference 8.1.2) to characterize expected instrument behavior by correlating Calibration Interval (CI) to performance predicted by the manufacturer. The calculation considered drift linear over time and calculated drift using the following equation:

SPC-RP-043 calculates drift as:

$$Drift\ (d) = \left(\frac{CI}{DT}\right)(vd)\left(\frac{PS}{CS}\right)$$

where:
vd = vendor's drift expression
CI = Calibration Interval
DT = Drift Time
PS = Process Span
CS = Calibrated Span

SPC-RP-043 determines drift consistent with industry guidance (Reference 8.1.2). SPC-RP-043 is the calculation of record for the trip function. Therefore, the evaluation of the loop setpoint will incorporate manufacture's drift for the current meters (NI 301/302) and NM310 consistent with SPC-RP-043.

4.3 Setpoint/Uncertainty Calculations

The reactor trip interlock P9 setpoint was evaluated in setpoint calculation SPC-RP-043, "UNIT 1 NIS Power Range P-9 Interlock" (Reference 8.4.1). As described in Section 2.0 of this Attachment, The Unit 1 calculation also applies to Unit 2. Pertinent information from this calculation for this evaluation is summarized below:

Form 1 of SPC-RP-043 (Reference 8.4.1) provides the following information:

$$Process\ Span = 0\ to\ 120\ PCT$$

Also, from Form 1 of SPC-RP-043 (Reference 8.4.1):

$$Analytical\ Limit\ (AL) = 47.5\ PCT$$

Section 5.4 of SPC-RP-043 (Reference 8.4.1) calculates Total Loop Error for a seismic event and potential loss of non-seismic HVAC using the following equations:

$$TLES_{pos} = SRSSS + Bias_{pos}$$

$$TLES_{neg} = -SRSSS - Bias_{neg}$$

$$SRSSS = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NBp} + R_{NBp} + H_{NBp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp} + IR_{Bp}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NBn} + R_{NBn} + H_{NBn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn} + IR_{Bn}$$

After entering the data for Unit 1 from SPC-RP-043 (Reference 8.4.1), the total loop error is calculated as:

$$SRSSS = [0.74880\ (PCT^2) + 0.163318\ (PCT^2) + 0.21879\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + (0\ PCT)^2 + (0.432\ PCT)^2 + (6.0\ PCT)^2]^{\frac{1}{2}} = \pm 6.1088\ PCT$$

$$Bias_{pos} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$TLES_{pos} = 6.1088\ PCT + 0\ PCT = 6.1088\ PCT$$

$$TLES_{neg} = -6.1088\ PCT - 0\ PCT = -6.1088\ PCT$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equations from Section 5.4 of SPC-RP-043 (Reference 8.4.1):

$$NTSP = AL + TLES_{neg}$$

The allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

4.4 Technical Specifications

The Allowable Value (AV) for the Reactor Trip System, Power Range Neutron Flux P9 Interlock function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 12\%\ RTP$$

4.5 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1318.3 and SP 2318.8 (Reference 8.6.3 and 8.6.4 respectively).

$$APS = 0.833\ VDC$$

$$AFT = \pm 0.01\ VDC$$

Converting from VDC to RTP:

From Surveillance Procedures SP 1318.3 and SP 2318.3 (Reference 8.6.3 and 8.6.4 respectively) Summing Amplifier output is 0-10 VDC.

$$APS = 0.833\ VDC * \frac{120\ PCT}{10\ VDC} = 10\ PCT$$

$$AFT = \pm 0.01\ VDC * \frac{120\ PCT}{10\ VDC} = \pm 0.12\ PCT$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Analyzed Drift

The extrapolated analyzed drift tolerance interval for the Westinghouse 3359C39G01 Power Range Bistables was calculated in SPC-DR-026 (Reference 8.4.1) in terms of percent calibrated span (% CS). To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Sections 4.3).

$$DA\_Ext\_Rand_{bistable} = \pm 0.080\%CS = \pm 0.080\%CS \times \frac{120\ PCT}{100\%CS} = 0.096\ PCT$$

$$DA\_Ext\_Bias_{bistable} = \pm 0\%CS = 0\ PCT$$

6.2 Extrapolated Drift for Loop Devices

Per section 4.1, only the reactor trip bistable (1N41-NC307) has an analyzed drift tolerance from a drift analysis calculation extrapolated to a 30 month Surveillance Interval value. To include the Power Range detector, current meter, and summing and level amplifier in the Total Loop Error calculation (Section 6.3), the extrapolated drift tolerance is calculated using vendor data. The extrapolated drift tolerance is calculated using vendor data included in Forms 1, 2 and 3 of SPC-RP-043 (Reference 8.4.1) and the equations given below.

$$D_R = \left(\frac{\mathrm{CI}}{\mathrm{DT}}\right)(\mathrm{vd})\left(\frac{\mathrm{PS}}{\mathrm{CS}}\right)$$

$$D_{30} = \sqrt{a^2 + {d_R}^2 + m^2}$$

6.2.1 Power Range Detector (1NE-41)

From Section 4.2.1 of this Attachment:

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0\ PCT$$

$$a = 0.6000\ PCT$$

$$m = 0\ PCT$$

$$D_{30detector} = \sqrt{.6000^2 + 0^2 + 0^2} = .6000\ PCT$$

6.2.2 Current Meter (1N41-NI301)

From Section 4.2.2 of this Attachment:

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0\ PCT$$

$$a = 0.1200\ PCT$$

$$m = 0.3134\ PCT$$

$$D_{30current\ meter} = \sqrt{0.1200^2 + 0^2 + 0.3134^2} = 0.3356\ PCT$$

6.2.3 Summing and Level Amplifier (1N41-NM310)

From Section 4.2.3 of this Attachment:

$$Calibration\ Interval\ (CI) = 0.066\ months$$

$$Drift\ Time\ (DT) = 0.1370\ \text{months.}$$

$$Vendor\ Drift\ (vd) = 0.120\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0.0578 PCT$$

$$a = 0.6000\ PCT$$

$$m = 0.3470\ PCT$$

$$D_{30Amplifier} = \sqrt{0.6000^2 + 0.0578^2 + 0.3470^2} = 0.6955\ PCT$$

6.3 Total Loop Error (TLE)

Instrument drift from SPC-DR-026 (Reference 8.3.1) is used to replace the instrument accuracy, drift, and measurement and test equipment allowance of the reactor trip bistable (1N41-NC307). The using the methodology shown below.

$$D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

Substituting terms in the equations from Section 4.3:

$$SRSSS = \Big[D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{1/2}$$

$$SRSSS = [(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (0.0960\ PCT)^2 + 0(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0(PCT^2) + (0.4320\ PCT)^2 + (6\ PCT)^2]^{\frac{1}{2}} = \pm 6.0953\ PCT$$

$$Bias_{Neg} = DA\_Ext\_Bias_{detector} + DA\_Ext\_Bias_{meter} + DA\_Ext\_Bias_{amplifier} + DA\_Ext\_Bias_{bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{Neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$TLES_{Neg} = -SRSS - Bias_{Neg}$$

$$TLES_{Neg} = -6.0953\ PCT - 0\ PCT = 6.0953\ PCT$$

6.4 Nominal Trip Setpoint (NTSP)

Using the equation from section 4.3 and the new calculated TLE_{neg} value, the nominal trip setpoint for an increasing process is calculated below.

For and increasing Process:

$$NTSP = AL + TLE_{neg}$$

Substituting:

$$NTSP = 47.5\ PCT + (-6.0953)\ PCT = 41.4047\ PCT$$

6.5 Allowable Value (AV)

The allowable value for Reactor Trip System, Power Range Neutron Flux P9 Interlock is calculated using the NTSP and the Loop Drift in the equations shown below.

For an increasing process:

$$AV = NTSP + LD_R + LD_{BN}$$

Where:

$$Loop\ Drift_{Random}\ (LD_R) =$$

$$\sqrt{D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}{}^2}$$

$$LD_R = \sqrt{(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (.0960\ PCT)^2 + (0\ PCT)} = 0.9826\ PCT$$

$$Loop\ Drift_{\ NegativeBias}(LD_{BN}) =$$

$$DA\_Ext\_Detector_{NP}{}^2 + DA\_Ext\_Meter_{NP}{}^2 + DA\_Ext\_Amplifier_{BN}{}^2 + DA\_Ext\_Bistable_{NP}{}^2 + R_{NBP}$$

$$LD_{BN} = 0\ PCT + 0\ PCT + 0\ PCT + 0PCT + 0PCT = 0\ PCT$$

Substituting:

$$AV = 41.4047\ PCT + 0.9826\ PCT + 0\ PCT = 42.3873\ PCT$$

6.6 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values given in section 4.5 the setpoint margin is evaluated below.

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$41.4047\ PCT \geq 10.0\ PCT + 0.12\ PCT$$

$$41.4047\ PCT \geq 10.12\ PCT$$

The results of the 30-month drift impact analysis are acceptable the calculated NTSP is greater than the APS + AFT.

6.7 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is evaluated using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

$$12\ PCT \leq 42.3873\ PCT$$

The results of the 30-month drift impact analysis are acceptable, the Allowable Value is conservative with respect to the AV_{Calc} considering the calculated uncertainty.

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-RP-043 (Reference 8.4.1), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Reactor Coolant Low Flow Function instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.1.2 ISA-RP-67.15-1991, (ISA-S-67.04 PART II COMMITTEE DRAFT 10) "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation" 1991

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-026, Rev. 0, "Drift Analysis of As-Found /As -Left Data for Westinghouse Bistable 3359C39G01"

8.4 Setpoint Calculations:

8.4.1 SPC-RP-043, Revision 0A, "UNIT 1 NIS Power Range P-9 Interlock"

8.5 Technical Specifications:

8.5.1 Unit 1, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE" (No. DPR-42) Amendment 230

8.5.2 Unit 2, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE" (No. DPR-60) Amendment 218

8.6 Surveillance Procedures:

8.6.1 SP 1006B, Rev. 60, "NIS Power Range Axial Offset Calibration Greater Than 50% Power"

8.6.2 SP 2006B, Rev. 60, "NIS Power Range Axial Offset Calibration Greater Than 50% Power"

8.6.3 SP 1318.3, Rev. 32, "NIS Power Range Channel Calibration"

8.6.4 SP 2318.3, Rev. 32, "NIS Power Range Channel Calibration"

8.6.5 SP 1005, Revision 50, "NIS Power Range Daily Calibration"

8.7 Design Control Documents

8.7.1 Design Equivalent Change, 6EQVENG28491, Revision: 0 "Nuclear Instrumentation System (NIS) Display Upgrade"

8.7.2 Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2

8.7.3 Westinghouse NIS Technical Manual Appendix "Digital Meter 2.0 – Power Range A & B". Revision 2

8.7.4 Westinghouse Nuclear Instrumentation System Instruction Book, XH-1-1931 Revision 7

8.7.5 ER-532, Bounding Uncertainty for Thermal Power Determination at Prairie Island Unit 1 NPP Using the LEFM, Revision 1A, Dated 10/31/13

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1.0 Purpose

The purpose of this calculation is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation of the Power Range Neutron Flux P-10, Reactor Trip System Interlock Function 16e in Technical Specification Table 3.3.1-1. This justification will provide input to the LAR being submitted to extend the surveillance intervals. This setpoint Attachment considers the instruments listed in Table 1.1 below.

Table 1.1: Instruments

Instrument Number	Manufacturer	Model
1NE-41	Westinghouse	WL-23686
1NE-42	Westinghouse	WL-23686
1NE-43	Westinghouse	WL-23686
1NE-44	Westinghouse	WL-23686
2NE-41	Westinghouse	WL-23686
2NE-42	Westinghouse	WL-23686
2NE-43	Westinghouse	WL-23686
2NE-44	Westinghouse	WL-23686
1N41-NC308	Westinghouse	3359C39G01
1N42-NC308	Westinghouse	3359C39G01
1N43-NC308	Westinghouse	3359C39G01
1N44-NC308	Westinghouse	3359C39G01
2N41-NC308	Westinghouse	3359C39G01
2N42-NC308	Westinghouse	3359C39G01
2N43-NC308	Westinghouse	3359C39G01
2N44-NC308	Westinghouse	3359C39G01
1N41-NM310	Westinghouse	3359C48G01
1N42-NM310	Westinghouse	3359C48G01
1N43-NM310	Westinghouse	3359C48G01
1N44-NM310	Westinghouse	3359C48G01
2N41-NM310	Westinghouse	3359C48G01
2N42-NM310	Westinghouse	3359C48G01
2N43-NM310	Westinghouse	3359C48G01
2N44-NM310	Westinghouse	3359C48G01
1N41-NI301	Westinghouse	10072C10G01
1N42-NI301	Westinghouse	10072C10G01
1N43-NI301	Westinghouse	10072C10G01
1N44-NI301	Westinghouse	10072C10G01
2N41-NI301	Westinghouse	10072C10G01
2N42-NI301	Westinghouse	10072C10G01
2N43-NI301	Westinghouse	10072C10G01
2N44-NI301	Westinghouse	10072C10G01
1N41-NI302	Westinghouse	10072C10G01
1N42-NI302	Westinghouse	10072C10G01

1N43-NI302	Westinghouse	10072C10G01
1N44-NI302	Westinghouse	10072C10G01
2N41-NI302	Westinghouse	10072C10G01
2N42-NI302	Westinghouse	10072C10G01
2N43-NI302	Westinghouse	10072C10G01
2N44-NI302	Westinghouse	10072C10G01

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Unit 2 Setpoint Calculation

The Unit 2 setpoint calculation is not available. The Unit 1 and Unit 2 Nuclear Instrument Power Range drawer detectors and loop components are identical in design and qualification. The design source documents are identical between the two units, and the method of calibration is identical. Process Measurement Accuracy (PMA) and Process Considerations (PC) evaluated in SPC-RP-045 (Reference 8.4.1) have been reviewed and determined to be consistent between Unit 1 and Unit 2 for the purposes of drift and setpoint analysis. Therefore, based on review, the Unit 1 setpoint calculation can be considered applicable to Unit 2 function and the Unit 1 setpoint calculation (Reference 8.4.1) is extended to Unit 2 by review.

4.2 Drift Calculations

This Attachment uses data in the loop setpoint evaluation from drift calculation SPC-DR-026, “Drift Analysis of As-Found /As -Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables” (Reference 8.3.1). The drift value provided in SPC-DR-026 (Reference 8.3.1) will bound the bistables’ performance with a 95% probability at a 95% confidence level. The data taken from the drift calculation is summarized below.

$$DA\_Ext\_Rand_{Bistable} = \pm 0.080\ \%\ Calibrated\ Span\ (95\%/95\%\ factor)$$

$$DA\_Ext\_Bias_{Bistable} = \pm 0\ \%\ Calibrated\ Span$$

4.3 Insufficient Drift Data

4.3.1 Power Range Detector (1NE-41)

The NIS Power Range Detectors are not calibrated by a surveillance procedure in a manner that provides As-Found (AF) and As-Left (AL) data for drift analysis. EM 3.3.4.2 (Reference 8.2.2) provides guidance for cases where there is not sufficient AF/AL drift data and specifies, in Section 6.4.2, that vendor data can be used to establish drift data. Setpoint calculation SPC-RP-045 (Reference 8.4.1) evaluates the Power Range detector uncertainty

from vendor data. This method is consistent with EM 3.3.4.2 guidance, therefore, this Attachment incorporates the vendor drift allowance from SPC-RP-045 (Reference 8.4.1) as described in Section 4.3.4 and listed in Section 6.2.3.

4.3.2 Power Range Drawer B Digital Current Meters (1N41-NI301)

Per Design Equivalent Change 6EQVENG28491 (Reference 8.7.1) the Power Range Drawer B upper and lower detector digital Current Meters 1(2)N41-NI301(2), 1(2)N42-NI301(2), 1(2)N43-NI301(2), and 1(2)N44-NI301(2) were replaced with new designed and qualified Digital Meter 2.0 assemblies per Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2 (Reference 8.7.2).

The new meter installations occurred over 2018 and 2019 per Work Orders listed in Design Input Transmittals 601000002918-001 and 601000002918-004 (References 8.7.5 and 8.7.6). The recent installations limit the number of available data points to less than 10. At least 10 data points are required to have a statistically valid pool for drift analysis, as defined in EM 3.3.4.2 Section 6.4.2 (Reference 8.2.2). As a result, no drift analysis was conducted for the power range upper and lower detector current meters. Therefore, this Attachment will use vendor data to establish drift data as described in Section 6.4.2 of EM 3.3.4.2 (Reference 8.2.2) for conditions of insufficient drift data due to new or replaced components. The vendor data will be used to develop a drift allowance by evaluating the calibration interval and manufacturer's drift specification as described in Section 4.3.4.

The vendor data for the Power Range Drawer B digital current meters is shown below as provided in Westinghouse design input document NIS Technical Manual Appendix Digital Meter 2.0 – Power Range A & B Section 1.3.1 "Specification of Digital Meter"(Reference 8.7.3). The vendor data is evaluated in Design Equivalent Change 6EQVENG28491 Section B.4 "Design Evaluation" (Reference 8.7.1).

<u>Specifications of Digital Meter 2.0</u>

Characteristic	**Detail**
Noise Rejection	Greater than 54 dB at 1 Hz ("SLOW" meter rate)
	Greater than 100 dB at 60 Hz ("SLOW" or "FAST" meter rate)
Conversion Rate	5 conversions per second
Accuracy	± 0.03% of reading (± 0.003%, meter alone)
Zero Stability	Auto-zero, ± 0.2 µV/ C (400.0 mV full scale input)
Display	4 digits, red LED, 0.43" high digits
Temperature Range	-10 to +50 degrees C Temperature
Coefficient	± 7 ppm of reading per degree C
Relative Humidity	0 to 90 %, non-condensing

Per References 8.4.1, 8.7.1 and 8.7.3 the current setpoint calculation evaluates meter accuracy as 0.1% span, vendor drift allowance as 0% span and drift time at 1.0 months. The meter accuracy value bounds the meter replacement specification as described in Reference 8.7.1 and represents worst case error. Vendor drift allowance and drift time are not specified in the referenced engineering change (Reference 8.7.1 and 8.7.3). However, the

engineering change incorporates the Original Equipment Manufacturer approved equivalent replacement (Reference 8.7.3). As such, this Attachment will use the SPC-RP-045 (Reference 8.4.1) allowance for meter drift and drift time as bounding values in Section 6 vendor drift analysis.

As described in Section 2.2.4.1 of Reference 8.7.4, "The current signals from the two detector sections are summed, then averaged by Summing and Level Amplifier NM310 to produce a single voltage which is proportional to average reactor current." The two detector sections are identical, each consisting of an upper (or lower) Power Range Detector and a Detector Current Meter. Per Reference 8.1.2, because these two input channels are averaged, their resulting uncertainties can be averaged. SPC-RP-045 (Reference 8.4.1) incorporated this method to average the two current inputs to the NM310 Summing and Level Amplifier channel uncertainties by including only one Power Range Detector and one Detector Current Meter in the instrument loop. This Attachment will evaluate loop uncertainty consistent with SPC-RP-045 (Reference 8.4.1) as described in Section 4.4.

4.3.3 Power Range Summing and Level Amplifier (1N41-NM310)

Per SP 1005 (Reference 8.6.1) and Plant Technical Speciation Surveillance Requirements 3.3.1.2, 3.3.1.3, and 3.3.1.6 (References 8.5.1 and 8.5.2) the Power Range output current from the Summing and Level Amplifier is normalized each day to heat balance results and quarterly to in core flux mapping. The adjustments occur throughout the fuel cycle and occur after the surveillance channel calibration has been performed. The Power Range current adjustments during the fuel cycle result in a change in the Summing and Level Amplifier output, therefore the As Found value for the next channel calibration will not correspond with the As Left value from the previous calibration. The change is not exclusively instrument drift as it reflects adjustments made to align the Summing and Level Amplifier output and Power Range drawer fuel cycle core measurement currents. On this basis the Power Range Summing and Level Amplifier data was excluded from drift analysis.

However, as previously described, EM 3.3.4.2 Section 6.4.2 (Reference 8.2.2) provides guidance for cases where there is not sufficient drift data and specifies that vendor data can be used to establish drift data. Setpoint calculation SPC-RP-045 (Reference 8.4.1) developed a drift allowance consistent with EM 3.3.4.2 (Reference 8.2.2) and guidance from ISA-RP 67.04 (Reference 8.1.2) to characterize expected instrument drift by correlating Calibration Interval (CI) to performance predicted by the manufacturer’s drift specification. The Power Range Summing and Level amplifier daily drift allowance in this Attachment will be evaluated consistent with SPC-RP-045 (Reference 8.4.1) as described in 4.3.4.

Westinghouse Nuclear Instrumentation System Instruction Book XH-1-1931 (Reference 8.7.4), Section 1.4.3.1, states that the Summing and Level Amplifier (Westinghouse model 3359C48G01) has a stability (i.e., drift) of 0.1 % per 100 hours. SPC-RP-045 (Reference 8.4.1) develops drift data using the vendor drift time (DT) as:

$$DT = \left(100\ hours\ \times \frac{1\ month}{730\ hours}\right) = 0.137\ months$$

As described above the Power Range Summing and Level calibration interval (CI) is daily based on review of SP 1005 (Reference 8.6.1). SPC-RP-045 (Reference 8.4.1) develops the CI for daily calibration as:

$$CI = \left(1\ Day \times \frac{1\ year}{365\ days}\right) \times \left(\frac{12\ months}{1\ year}\right) = 0.033\ months$$

The setpoint calculation (Reference 8.4.1) allows for the surveillance to be performed up to 48 hours (two days) apart this results in CI_{calc}:

$$CI_{calc} = 2\ \times\ 0.033\ months = 0.066\ months$$

4.3.4 Calibration Interval and Manufacturer's Drift Specification

Setpoint calculation SPC-RP-045, (Reference 8.4.1) developed a drift allowance consistent with guidance from ISA-RP 67.04 (References 8.1.2) to characterize expected instrument behavior by correlating Calibration Interval (CI) to performance predicted by the manufacturer. SPC-RP-045, (Reference 8.4.1) considers drift linear over time and calculates drift using manufacturer specifications for the Power Range detector (1NE-41), Current Meter (1N41-NI301) and Summing and Level Amplifier (1N41-NM310) using the equation given below.

$$Drift\ (d) = \left(\frac{CI}{DT}\right)(vd)\left(\frac{PS}{CS}\right)$$

where:

vd = vendor's drift expression
CI = Calibration Interval
DT = Drift Time
PS = Process Span
CS = Calibrated Span

4.4 Setpoint/Uncertainty Calculations

The Power Range Permissive P-10 bistable is evaluated in setpoint calculation SPC-RP-045, (Reference 8.4.1). As described in Section 4.1 the Unit 1 calculation also applies to Unit 2. Pertinent information from the calculation for this evaluation is summarized below.

Form 1 of SPC-RP-045 (Reference 8.4.1) provides the following information:

$$Process\ Span = 0\ to\ 120\ PCT$$

$$Analytical\ Limit\ (AL) = 3\ PCT$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSSS)\ =\ \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$TLE_{pos} = TLE\ (SRSSS) + Bias_{pos}$$

After entering the data for Unit 1 (SPC-RP-045), the total loop error is calculated as:

$$TLE\ (SRSSS) = [.7488\ (PCT^2) + .1626\ (PCT^2) + .2188\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + (0\ PCT)^2 + (2.4\ PCT)^2 + (6\ PCT)^2]^{\frac{1}{2}} = \pm 6.5491\ PCT$$

$$Bias_{pos} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$TLE_{pos} = 6.5491\ PCT + 0\ PCT = 6.5491\ PCT$$

The nominal trip setpoint (NTSP) is calculated for a decreasing process using the following equation:

$$NTSP = AL + TLE_{pos}$$

The allowable value (AV) for a decreasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = D_{BN} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

4.5 Technical Specifications

The allowable value for the Power Range Neutron Flux P-10 function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 9\%\ RTP$$

Per SPC-RP-045 (Reference 8.4.1) Section 1.2, values from the technical specifications (References 8.5.1 and 8.5.2) are given values of PCT with no conversion of the values. Therefore, for this calculation RTP and PCT are equivalent. Thus, the following relationship is true.

$$AV\ 9\%\ RTP = 9\ PCT$$

4.6 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) for the bistable P-10 trip are taken from surveillance procedures SP 1318.3 (Reference 8.6.2) and SP 2318.3 (Reference 8.6.3). The actual plant setting and as found tolerance are converted to PCT using the Summing and Level Amplifier output range of 0 VDC to 10 VDC given in SP 1318.3 (Reference 8.6.2) and SP 2318.3 (Reference 8.6.3).

$$APS = 0.908\ VDC \times \left(\frac{120\ PCT}{10\ VDC - 0\ VDC}\right) = 10.9\ PCT$$

$$AFT = \pm 0.01\, VDC \times \left(\frac{120\, PCT}{10\, VDC - 0\, VDC}\right) = \pm 0.12\, PCT$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The extrapolated analyzed drift tolerance interval for the Westinghouse 3359C39G01 Power Range Bistables was calculated in SPC-DR-026 (Reference 8.3.1) using percent calibrated span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Sections 4.3) below.

$$DA\_Ext\_Rand_{bistable} = \pm 0.080\%\ Calirated\ Span \times \frac{120\, PCT}{100\%\ Calibrated\ Span} = \pm 0.096\, PCT$$

$$DA\_Ext\_Bias_{bistable} = \pm 0\%\ Calibrated\ Span = 0\, PCT$$

6.2 Extrapolated Drift for Loop Devices

Per Section 4.2 and 4.3, only the reactor trip bistable (1N41-NC308) has an extrapolated analyzed drift tolerance from a drift analysis calculation. To include the Power Range detector, Current Meter, and Summing and Level Amplifier in the Total Loop Error calculation (Section 6.3), the extrapolated drift tolerance is calculated using vendor data. The extrapolated drift tolerance is calculated for a 30 month calibration interval using vendor data included in Forms 1, 2 and 3 of SPC-DR-045 (Reference 8.4.1) and the equations given below.

$$D_R = \left(\frac{\mathrm{CI}}{\mathrm{DT}}\right)(\mathrm{vd})\left(\frac{\mathrm{PS}}{\mathrm{CS}}\right)$$

$$DA\_Ext\_Rand = \sqrt{a^2 + {d_R}^2 + m^2}$$

6.2.1 Power Range Detector (1NE-41)

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0\ PCT$$

$$a = 0.6000\ PCT$$

$$m = 0\ PCT$$

$$D_{30detector} = \sqrt{.6000^2 + 0^2 + 0^2} = .6000\ PCT$$

6.2.2 Current Meter (1N41-NI301)

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0\ PCT$$

$$a = 0.1200\ PCT$$

$$m = 0.3134\ PCT$$

$$D_{30current\ meter} = \sqrt{0.1200^2 + 0^2 + 0.3134^2} = 0.3356\ PCT$$

6.2.3 Summing and Level Amplifier (1N41-NM310)

$$Calibration\ Interval\ (CI) = 0.066\ months$$

$$Drift\ Time\ (DT) = 0.1370\ \text{months.}$$

$$Vendor\ Drift\ (vd) = 0.1\%\ Range$$

$$vd = (0.1\ \% \times 0.4\ VDC) \times \left(\frac{120\ PCT}{0.4\ VDC}\right)$$

$$vd = 0.120\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = \left(\frac{0.066}{0.1370}\right)(0.120)\left(\frac{120\ \text{PCT}}{120\ \text{PCT}}\right) = 0.0578\ PCT$$

$$a = 0.6000\ PCT$$

$$m = 0.3470\ PCT$$

$$D_{30amplifier} = \sqrt{0.6000^2 + 0.0578^2 + 0.3470^2} = 0.6955\ PCT$$

6.3 Total Loop Error (TLE)

Instrument drift from SPC-DR-026 (Reference 8.3.1) is used to replace the instrument accuracy, drift, and measurement and test equipment allowance of the reactor trip bistable (1N41-NC308). The using the methodology shown below.

$$D_{30detector}{}^2 + D_{30current\ meter}{}^2 + D_{30amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

$$TLE\ (SRSSS) = \Big[D_{30detector}{}^2 + D_{30current\ meter}{}^2 + D_{30amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{1/2}$$

$$TLE\ (SRSSS) = [(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (.0960\ PCT)^2 + (\ 0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT)^2 + (2.4\ PCT)^2 + (6\ PCT)^2]^{\frac{1}{2}} = \pm 6.5365\ PCT$$

$$Bias_{pos} = DA\_Ext\_Bias_{detector} + DA\_Ext\_Bias_{meter} + DA\_Ext\_Bias_{amplifier} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$TLE_{pos} = TLE\ (SRSSS) + Bias_{pos}$$

$$TLE_{pos} = 6.5365\ PCT + 0\ PCT = 6.5365\ PCT$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equation from Section 4.4 and the new calculated TLE_{pos} value, the nominal trip setpoint for a decreasing process is calculated below.

$$NTSP = AL + TLE_{pos} = 3\ PCT + 6.5365\ PCT = 9.5365\ PCT$$

6.4 Allowable Value (AV)

The allowable value for the low power reactor trip is calculated using the NTSP and the Loop Drift using the equations shown below.

$Loop\ Drift_{Random}\ (LD_R) =$

$$\sqrt{D_{30detector}{}^2 + D_{30current\ meter}{}^2 + D_{30amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$LD_R = \sqrt{(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (.0960\ PCT)^2 + (0\ PCT)} = 0.9826\ PCT$$

$Loop\ Drift_{\ Negative\ Bias}(LD_{BN}) =$

$$DA\_Ext\_Detector_{BN}{}^2 + DA\_Ext\_Meter_{BN}{}^2 + DA\_Ext\_Amplifier_{BN}{}^2 + DA\_Ext\_Bistable_{BN}{}^2 + R_{NBN}$$

$$LD_{BN} = 0\ PCT + 0\ PCT + 0\ PCT + 0PCT + 0PCT = 0\ PCT$$

$$AV = NTSP - LD_R - LD_{BN}$$

$$AV = 9.5365\ PCT - 0.9826\ PCT - 0\ PCT = 8.5539\ PCT$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values given in Section 4.6 the setpoint margin is evaluated below.

$$Accetpance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

$$9.5365\ PCT \leq 10.9\ PCT - 0.12\ PCT$$

$$9.5365\ PCT \leq 10.78\ PCT$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is evaluated using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$AV_{Tech\ Spec} \geq 9\%\ RTP\ (PCT)$$

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

$$9\ PCT \geq 8.5539\ PCT$$

7.0 Conclusions and Plant Impact

The total loop error, nominal trip setpoint, and allowable value were calculated using the new drift values provided in drift calculation SPC-DR-026 (Reference 8.3.1) and vendor data. The new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Power Range Neutron Flux P-10 Reactor Trip instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs"

8.1.2 ISA-RP-67.15-1991, (ISA-S-67.04 PART II COMMITTEE DRAFT 10) "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation" 1991

8.2 Engineering Manuals

8.2.1 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations"

8.2.2 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift"

8.3 Drift Calculations

8.3.1 SPC-DR-026, Revision 0, "Drift Analysis of As-Found/As-Left Data for Westinghouse 3359C39G01 Power Range Bistables and intermediate Range Bistables"

8.4 Setpoint Calculations

8.4.1 SPC-RP-045, Revision 0, "Unit 1 NIS Power Range P-10 Interlock"

8.5 Technical Specifications

8.5.1 Unit 1, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE"

8.5.2 Unit 2, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE"

8.6 Surveillance Procedures

8.6.1 SP 1005, Revision 50, "NIS Power Range Daily Calibration"

8.6.2 SP 1318.3, Revision 32, "NIS Power Range Channel Calibration"

8.6.3 SP 2318.3, Revision 32, "NIS Power Range Channel Calibration"

8.7 Design Control Documents

8.7.1 EC 6EQVENG24891, Revision 0, "Nuclear Instrumentation System (NIS) Display Upgrade"

8.7.2 Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2

8.7.3 Westinghouse NIS Technical Manual Appendix "Digital Meter 2.0 – Power Range A & B", Revision 2

8.7.4 Westinghouse Nuclear Instrumentation System Instruction Book, XH-1-1931 Revision 7

8.7.5 DIT 601000002918-001, transmitting and containing AFAL_Instrumentation_R.03_ Results.xlsx, last modified on 3/30/2021

8.7.6 DIT 601000002918-004, transmitting and containing Additional_AFAL_Instrumentation _R.2_Results.xlsx, last modified on 5/28/2021

Prepared By:	Steve Vanderslice	Steve Vanderslice (Signature)	Digitally signed by Steve Vanderslice Date: 2021.07.09 17:27:44 -05'00' (Date)
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1.0 Purpose

The purpose of this attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Power Range Neutron Flux (high setpoint) Reactor Trip Bistable channels. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment applies to all four Unit 1 and Unit 2 Power Range High Flux (high setpoint) instrumentation loops (i.e. channels N41, N42, N43, and N44). The power range instruments are listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1NE-41	Westinghouse	WL-23686
1N41-NI301	Westinghouse	10072C10G01
1N41-NI302	Westinghouse	10072C10G01
1N41-NM310	Westinghouse	3359C48G01
1N41-NC306	Westinghouse	3359C39G01
1NE-42	Westinghouse	WL-23686
1N42-NI301	Westinghouse	10072C10G01
1N42-NI302	Westinghouse	10072C10G01
1N42-NM310	Westinghouse	3359C48G01
1N42-NC306	Westinghouse	3359C39G01
1NE-43	Westinghouse	WL-23686
1N43-NI301	Westinghouse	10072C10G01
1N43-NI302	Westinghouse	10072C10G01
1N43-NM310	Westinghouse	3359C48G01
1N43-NC306	Westinghouse	3359C39G01
1NE-44	Westinghouse	WL-23686
1N44-NI301	Westinghouse	10072C10G01
1N44-NI302	Westinghouse	10072C10G01
1N44-NM310	Westinghouse	3359C48G01
1N44-NC306	Westinghouse	3359C39G01
2NE-41	Westinghouse	WL-23686
2N41-NI301	Westinghouse	10072C10G01
2N41-NI302	Westinghouse	10072C10G01
2N41-NM310	Westinghouse	3359C48G01
2N41-NC306	Westinghouse	3359C39G01
2N42-NI301	Westinghouse	10072C10G01
2NE-42	Westinghouse	WL-23686
2N42-NI302	Westinghouse	10072C10G01
2N42-NM310	Westinghouse	3359C48G01
2N42-NC306	Westinghouse	3359C39G01
2NE-43	Westinghouse	WL-23686
2N43-NI301	Westinghouse	10072C10G01

2N43-NI302	Westinghouse	10072C10G01
2N43-NM310	Westinghouse	3359C48G01
2N43-NC306	Westinghouse	3359C39G01
2NE-44	Westinghouse	WL-23686
2N44-NI301	Westinghouse	10072C10G01
2N44-NI302	Westinghouse	10072C10G01
2N44-NM310	Westinghouse	3359C48G01
2N44-NC306	Westinghouse	3359C39G01

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 2 setpoint calculation is not available. The Unit 1 and Unit 2 Nuclear Instrument Power Range drawer detectors and loop components are identical in design and qualification. The design source documents are identical between the two units, and the method of calibration is identical. Process Measurement Accuracy (PMA) and Process Considerations (PC) evaluated in the Reference 8.4.1 calculation have been reviewed and determined to be consistent between Unit 1 and Unit 2 for the purposes of drift and setpoint analysis. Therefore, based on review, the Unit 1 setpoint calculation can be considered applicable to Unit 2 function and the Unit 1 setpoint calculation (Reference 8.4.1) is extended to Unit 2 by review.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 SPC-DR-026 Drift Calculation for NC306

This attachment uses data from drift calculation SPC-DR-026, “Drift Analysis of As-Found /As - Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables” (Reference 8.3.1). The drift value provided from Reference 8.3.1 will bound NC306

hardware performance with a 95% probability at a 95% confidence level. The probability value establishes the portion of the population that is included within the tolerance interval. The data taken from the drift calculation is summarized below:

Westinghouse Bistable Model 3359C39G01 (NC306)

$$DA_{Ext_{Rand}} = \pm 0.080\ \%Calibrated\ Span$$

$$DA_{Ext_{Bias}} = \pm 0\ \%\ Calbrated\ Span$$

4.2 Input Data for the Power Range Detector, NI 301/302 and NM 310

Drift analysis was not performed on the following instruments in the Power Range Neutron Flux High Reactor Trip loop:

4.2.1 Power Range Detector NE-41, NE-42, NE-43, and NE-44.

The Power Range Detectors are not calibrated instruments in a surveillance procedure that would provide As-Found (AF) and As-Left (AL) data for drift analysis. EM 3.3.4.2 (Reference 8.2.1) provides guidance for cases where there is not sufficient AF/AL drift data and specifies, in section 6.4.2, that vendor data can be used to establish drift data. The setpoint calculation SPC-RP-029, "UNIT 1 Power Range High Flux Reactor Trip High Setpoint" (Reference 8.4.1) evaluated the Power Range detector uncertainty from published vendor data, this method is consistent with EM 3.3.4.2 guidance. Therefore, this Attachment incorporates the vendor drift allowance from SPC-RP-029 as described in Section 4.2.4 and listed in Section 6.2.3.

4.2.2 NI 301/302

Per Design Equivalent Change 6EQVENG28491 (Reference 8.7.1) the Power Range Drawer B upper and lower detector digital current meters (NI 301 and NI 302) installed per Westinghouse Field Kit Instructions ITTC/NIS (88)-370 were replaced with new designed and qualified Digital Meter 2.0 assemblies per Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2 (Reference 8.7.2). Review of Work Orders (Reference 8.8) indicated the new meter installations occurred over 2018 and 2019 and limited the size of the available calibration data points to less than a statistically valid pool, as defined in EM 3.3.4.2section 6.4.2. (Reference 8.2.1). As a result, the drift analysis project excluded the power range upper and lower detector current meters from the drift analysis scope. Therefore, this Attachment will use vendor data to establish drift data as described in section 6.4.2 of EM 3.3.4.2 (Reference 8.2.1) for conditions of insufficient drift data due to components that are new or replaced and data points are not available. The vendor data will be used to develop a drift allowance by evaluating the calibration interval and manufacture's drift specification as described in below section 4.2.4

The NI 301 and NI 302 vendor data is provided in Westinghouse design input document Nuclear Instrument System (NIS) Technical Manual Appendix Digital Meter 2.0 – Power Range A & B

Section 1.3.1 "Specification of Digital Meter"(Reference 8.7.3) and as evaluated in Design Equivalent Change 6EQVENG28491 Section B.4 "Design Evaluation" (Reference 8.7.1).

Characteristic	**Detail**
Noise Rejection	Greater than 54 dB at 1 Hz ("SLOW" meter rate)
	Greater than 100 dB at 60 Hz ("SLOW" or "FAST" meter rate)
Conversion Rate	5 conversions per second
Accuracy	± 0.03% of reading (± 0.003%, meter alone)
Zero Stability	Auto-zero, ± 0.2 µV/ C (400.0 mV full scale input)
Display	4 digits, red LED, 0.43" high digits
Temperature Range	-10 to +50 degrees C Temperature
Coefficient	± 7 ppm of reading per degree C
Relative Humidity	0 to 90 %, non-condensing

Per References 8.4.1, 8.7.1, and 8.7.3 the current setpoint calculation evaluates meter accuracy as = 0.1% span, vendor drift allowance at 0 and drift time at 1.0 months. The meter accuracy value bounds the meter replacement specification as described in Reference 8.7.1 and represents worst case error. Vendor drift allowance and drift time are not specified in the referenced engineering change (Reference 8.7.1 and 8.7.3). However, the engineering change incorporates the Original Equipment Manufacturer approved equivalent replacement (Reference 8.7.3). As such, this Attachment will use the SPC-RP-029 (Reference 8.4.1) allowance for meter drift and drift time as bounding values in section 6 vendor drift analysis.

As described in Section 2.2.4.1 of Reference 8.7.4, "The current signals from the two detector sections are summed, then averaged by Summing and Level Amplifier NM310 to produce a single voltage which is proportional to average reactor output." The two detector sections are identical, each consisting of an upper (or lower) Power Range Detector and a Detector Current Meter. Per Reference 8.1.2, because these two input channels are averaged, their resulting uncertainties can be averaged. SPC-RP-029 (Reference 8.4.1) incorporated this method to average the two current inputs to the NM310 Summing and Level Amplifier channel uncertainties by including only one Power Range Detector and one Detector Current Meter in the instrument loop. This Attachment will evaluate loop uncertainty consistent with SPC-RP-029 as described in 4.2.4.

4.2.3 NM 310

Per SP 1005 (Reference 8.6.1) and Plant Technical Speciation Surveillance Requirements 3.3.1.2, 3.3.1.3, and 3.3.1.6 (References 8.5.1 and 8.5.2) the Power Range output current from the summing and level amplifier is normalized each day to heat balance results and quarterly to in core flux mapping. The adjustments occur throughout the fuel cycle and occur after the surveillance channel calibration has been performed. The Power Range current adjustments

during the fuel cycle result in a change in the NM310 output, and it is likely that the As Found value for the next channel calibration will not correspond to the As Left value from the previous calibration. That change is not exclusively instrument drift. Rather it more accurately reflects the adjustments made to make the summing and level amplifier output and the Power Range drawer to agree with to fuel cycle core measurement currents. On the basis of this condition the NM 310 data was excluded from drift analysis.

However, as previously described, EM 3.3.4.2 (Reference 8.2.1) provides guidance for cases where there is not sufficient drift data and specifies, in section 6.4.2, that vendor data can be used to establish drift data. The setpoint calculation SPC-RP-029, "UNIT 1 Power Range High Flux Reactor Trip High Setpoint" (Reference 8.4.1) developed a drift allowance consistent with EM 3.3.4.1 (Reference 8.2.2) and guidance from ISA-RP 67.04 (References 8.1.2) to characterize expected instrument drift by correlating Calibration Interval (CI) to performance predicted by the manufacture's drift specification. The NM 310 daily drift allowance in this Attachment will be evaluated consistent with SPC-RP-029 as described in Section 4.2.4.

- Westinghouse Nuclear Instrumentation System Instruction Book XH-1-1931 (Reference 8.7.4), Section 1.4.3.1, states that the summing and level amplifier (Westinghouse model 3359C48G01) has a stability (i.e., drift) of 0.1 % per 100 hours. SPC-RP-029 (Reference 8.4.1) develops drift data using the vendor drift time (DT) as: $DT = \left(\frac{100\ hours}{\frac{730\ hours}{month}}\right)$ = 0.137 months.

- As described above the NM 310 calibration interval (CI) is daily. The rationale of a daily calibration is based on review of SP 1005 (Reference 8.6.1). SPC-RP-029 (Reference 8.4.1) develops the CI for daily calibration as:

  $$CI = \left(\frac{1 day}{\frac{365\ days}{year}}\right) \times \left(\frac{12\ months}{year}\right) = 0.033\ months.$$

  The setpoint calculation (Reference 8.4.1) allows for the surveillance to be performed up to 48 hours (two days) apart this results in CI_{calc}:

  $$CI_{calc} = 2\ \times\ 0.033\ months = 0.066\ months$$

4.2.4 Calibration Interval and Manufacture's Drift Specification for the NIS Power Range detectors, NI 301/302 and NM 310

EM 3.3.4.1 (Reference 8.2.2) provides adequate guidance for conditions where drift is not defined or the drift analysis not acceptable. The guidance also includes instruction to adjust

vendor drift to match the calibration period of an instrument when the vendor period does not agree with the calibration period of the instrument. Section 6.3.2 of EM 3.3.4.1 (Reference 8.2.2) provides the following equation to adjust drift to match the calibration period of an instrument "where drift is considered to be a linear condition over the entire period between calibrations." Reference 8.1.2 states that "in the absence of other data, it is considered reasonable, and perhaps conservative, to make this assumption" of linearity. The linear condition is chosen to match the method used for analysis in the setpoint calculation (Reference 8.4.1)

Instrument Drift (d) = $\left(\frac{1.25*tc}{td}\right)\left(\frac{vd}{cs}\right)$

where:
vd = vendor's drift specification
td = vendor's time period for which drift specification is valid.
tc = instrument calibration period (months)
cs = instrument calibrated span
1.25 = maximum allowance on time requirements in technical specifications

The setpoint calculation SPC-RP-029, "UNIT 1 Power Range High Flux Reactor Trip High Setpoint" (Reference 8.4.1) developed a drift allowance consistent with guidance from ISA-RP 67.04 (References 8.1.2) to characterize expected instrument behavior by correlating Calibration Interval (CI) to performance predicted by the manufacturer. The calculation considered drift linear over time and calculated drift using the following equation:

SPC-RP-029 calculates drift as $Drift\ (d) = \left(\frac{CI}{DT}\right)(vd)\left(\frac{PS}{CS}\right)$

where:
vd = vendor's drift expression
CI = Calibration Interval
DT = Drift Time
PS = Process Span
CS = Calibrated Span

SPC-RP-029 determines drift consistent with industry guidance (Reference 8.1.2). SPC-RP-029 is the calculation of record for the trip function. Therefore, the evaluation of the loop setpoint will incorporate manufacture's drift for the current meters (NI 301/302) and NM310 consistent with SPC-RP-029.

4.3 Setpoint/Uncertainty Calculations

The Power Range Neutron Flux High reactor trip setpoint is evaluated in setpoint calculation SPC-RP-029, "UNIT 1 Power Range High Flux Reactor Trip High Setpoint" (Reference 8.4.1). As described in section 2.0 Methodology the unit 1 calculation also applies to Unit 2. Pertinent information from the calculation for this evaluation is summarized below:

Form 1 of SPC-RP-029 (Reference 8.4.1) provides the following information:

$$Process\ Span = 0\ to\ 120\ PCT$$

SPC-RP-029 Form 1 and Section 1.2 "Results - Parameter Table" (Reference 8.4.1) provides the following Analytical Limit value :

$$Analytical\ Limit\ (AL) = 118\ PCT$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS)\ =\ \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{Negative} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{neg}$$

After entering the data from (SPC-RP-029), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.7488\ (PCT^2) + 0.162645\ (PCT^2) + 0.240705(PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 5.76\ (PCT)^2 + 36\ (PCT)^2]^{1/2} = \pm 6.5507\ PCT$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$TLE_{neg} = -\ 6.5507\ PCT -\ 0\ PCT = -\ 6.5507\ PCT$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

The allowable value (AV) for a increasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Postive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

4.4 Technical Specifications

The allowable value for the Power Range Neutron Flux – High function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 110\%\ RTP$$

Per SPC-RP-029 (reference 8.4.1) section 1.2, values from the technical specifications (References 8.5.1 and 8.5.2) are given values of PCT with no conversion of the values. Therefore, for this calculation RTP and PCT are equivalent.

Thus, the following relationship is true:

$$AV\ 110\%\ RTP = 110\ PCT$$

This relationship is used throughout the calculations in this Attachment

4.5 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1318.3 (Reference 8.6.2) and SP 2318.3 (Reference 8.6.3).

$$APS = 8.950\ VDC\ =\ (8.95\ vdc) \times \left(\frac{120\ PCT}{10\ vdc}\right) = (107.4\ PCT)$$

$$AFT = \pm 0.01\ VDC =\ (\pm 0.01\ vdc \times \left(\frac{120\ PCT}{10\ vdc}\right)\ =\ \pm 0.12\ PCT)$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Extrapolated Analyzed Drift

The total calculated drift tolerance interval for the trip bistables was calculated in Reference 8.3.1 using calibrated percent span. To interface with the equations and values taken from the

setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below:

Westinghouse Bistable NC306 (PCT) and Process Span from Section 4.3:

$$DA_{Ext_{Rand}} = \pm 0.080\ \%\ Calibrated\ Span\ =\ \pm 0.080\ \%\ Calibrated\ Span \times \frac{120\ PCT\ (PS)}{100\%\ Span}$$

$$=\ 0.096\ PCT$$

$$DA_{Ext_{Bias_{bistable}}} = \pm 0\%\ CalibratedSpan\ =\ 0\ PCT$$

6.2 Extrapolated Vendor Drift

Per section 4.1, only the reactor trip bistable (1N41-NC306) has an analyzed drift tolerance from a drift analysis calculation extrapolated to a 30 month Surveillance Interval value. To include the Power Range detector, current meter, and summing and level amplifier in the Total Loop Error calculation (Section 6.3), the extrapolated drift tolerance is calculated using vendor data. The extrapolated drift tolerance is calculated using vendor data included in Forms 1, 2 and 3 of SPC-RP-029 (Reference 8.4.1) and the equations given below.

$$d_R = \left(\frac{\mathrm{CI}}{\mathrm{DT}}\right)(\mathrm{vd})\left(\frac{\mathrm{PS}}{\mathrm{CS}}\right)$$

$$D_{30} = \sqrt{a^2 +\ {d_R}^2 + m^2}$$

6.2.1 Power Range Detector (1NE-41)

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0\ PCT$$

$$a = 0.6000\ PCT$$

$$m = 0\ PCT$$

$$D_{30detector}\ = \sqrt{.6000^2 +\ 0^2 + 0^2} =\ .6000\ PCT$$

6.2.2 Current Meter (1N41-NI301)

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = \ 0\ PCT$$

$$a = 0.1200\ PCT$$

$$m = 0.3134\ PCT$$

$$D_{30current\ meter} = \sqrt{0.1200^2 + \ 0^2 + 0.3134^2} = \ 0.3356\ PCT$$

6.2.3 Summing and Level Amplifier (1N41-NM310)

$$Calibration\ Interval\ (CI) = 0.066\ months$$

$$Drift\ Time\ (DT) = 0.137\text{months.}$$

$$Vendor\ Drift\ (vd) = 0.1\%\ Range$$

$$vd \ = \ (0.1\ \% \ \times \ 0.4\ vdc) \ \times \left(\frac{120\ PCT}{0.4\ vdc}\right)$$

$$vd \ = \ 0.120\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 0.4\ vdc$$

$$d_R = \ 0.0578 PCT$$

$$a = 0.6000\ PCT$$

$$m = 0.3470\ PCT$$

$$D_{30Amplifier} = \sqrt{0.6000^2 + \ 0.0578^2 + 0.3470^2} = \ 0.6955\ PCT$$

6.3 Total Loop Error (TLE)

Instrument drift from SPC-DR-026 (Reference 8.3.1) is used to replace the instrument accuracy, drift, and measurement and test equipment allowance of the reactor trip bistable (1N41-NC306) using the methodology shown below.

$$D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

$$TLE\ (SRSS) = \Big[D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{1/2}$$

$$TLE\ (SRSS) = [(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (.0960\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT)^2 + (0\ PCT^2) + (0\ PCT)^2 + (2.4\ PCT)^2 + (6\ PCT)^2]^{\frac{1}{2}} = \pm 6.5365\ PCT$$

$$Bias_{neg} = D_{30Detector}Bias_n + D_{30current\ meter}Bias_n + D_{30Amplifier}Bias_n + DA\_Ext\_Bias_{bistablen} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$TLE_{neg} = TLE\ (-SRSS) - Bias_{neg}$$

$$TLE_{neg} = -6.5365\ PCT + 0\ PCT = -6.5365\ PCT$$

6.4 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.3 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL - TLE_{neg} = 118\ PCT - 6.5365\ PCT = 111.4635\ PCT$$

6.5 Allowable Value (AV)

The allowable value for the Power Range Neutron Flux (high) setpoint is calculated using the NTSP and the Loop Drift using the equations shown below.

$$Loop\ Drift_{Random}\ (LD_R) = \sqrt{D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}{}^2}$$

$$LD_R = \sqrt{(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (.0960\ PCT)^2 + (0\ PCT)^2} = 0.9826\ PCT$$

$$Loop\ Drift_{\ PositiveBias}(LD_{BP}) = D_{30DetectorBP} + D_{30current\ meterBP} + D_{30AmplifierBP} + DA\_Ext\_Bistable_{BP} + R_{NBP}$$

$$LD_{BP} = 0\ PCT + 0\ PCT + 0\ PCT + 0PCT + 0PCT = 0\ PCT$$

$$AV = NTSP + LD_R + LD_{BP}$$

$$AV = 111.4635\ PCT + 0.9826\ PCT + 0\ PCT = 112.4461\ PCT$$

6.6 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.4 and the AFT and APS values given in section 4.5 the setpoint margin is evaluated below.

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$111.4635\ PCT \geq 107.4\ PCT + \pm 0.12\ PCT$$

$$111.4635\ PCT\ \geq 107.52\ PCT$$

6.7 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is evaluated using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

$$AV_{Tech\ Spec} \leq 110\%\ RTP\ (PCT)$$

$$110\ PCT \leq 112.4461\ PCT$$

7.0 Conclusions and Plant Impact

The total loop error, nominal trip setpoint, and allowable value were calculated using the new drift values provided in drift calculation SPC-DR-026 (Reference 8.3.1) and vendor specifications where applicable The new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Power Range Neutron Flux (high setpoint) Reactor Trip Bistable Function instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.1.2 ISA-RP-67.15-1991, (ISA-S-67.04 PART II COMMITTEE DRAFT 10) "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation" 1991

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-026, Revision 0, "Drift Analysis of As-Found /As -Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables"

8.4 Setpoint Calculations:

8.4.1 SPC-RP-029, Revision 0, "UNIT 1 Power Range High Flux Reactor Trip High Setpoint".

8.5 Technical Specifications:

8.5.1 Unit 1, "Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42), Amendment 230"

8.5.2 Unit 2, "Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60), Amendment 218"

8.6 Surveillance Procedures:

8.6.1 SP 1005, Revision 50, "NIS Power Range Daily Calibration"

8.6.2 SP 1318.3, Revision 32, "NIS Power Range Channel Calibration"

8.6.3 SP 2318.3, Revision 32, "NIS Power Range Channel Calibration"

8.7 Design Control Documents

8.7.1 Design Equivalent Change, 6EQVENG28491, Revision: 0 "Nuclear Instrumentation System (NIS) Display Upgrade"

8.7.2 Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2

8.7.3 Westinghouse NIS Technical Manual Appendix "Digital Meter 2.0 – Power Range A & B", Revision 2

8.7.4 Westinghouse Nuclear Instrumentation System Instruction Book, XH-1-1931 Revision 7

8.8 Work Orders

8.8.1 WO 700028102, 10/12/2019
8.8.2 WO 700028103, 10/3/2018
8.8.3 WO 700028104, 10/2/2018
8.8.4 WO 700028105, 10/2/2018
8.8.5 WO 700028106, 10/1/2018
8.8.6 WO 700028107, 10/14/2019
8.8.7 WO 700028108, 10/13/2019
8.8.8 WO 700028109, 10/18/2019

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1.0 Purpose

The purpose of this attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Power Range Neutron Flux (low setpoint) Reactor Trip Bistable channels. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment applies to all four Unit 1 and Unit 2 Power Range Neutron Flux (low setpoint) instrumentation loops (i.e. channels N41, N42, N43, and N44). The power range instruments are listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1NE-41	Westinghouse	WL-23686
1N41-NI301	Westinghouse	10072C10G01
1N41-NI302	Westinghouse	10072C10G01
1N41-NM310	Westinghouse	3359C48G01
1N41-NC305	Westinghouse	3359C39G01
1NE-42	Westinghouse	WL-23686
1N42-NI301	Westinghouse	10072C10G01
1N42-NI302	Westinghouse	10072C10G01
1N42-NM310	Westinghouse	3359C48G01
1N42-NC305	Westinghouse	3359C39G01
1NE-43	Westinghouse	WL-23686
1N43-NI301	Westinghouse	10072C10G01
1N43-NI302	Westinghouse	10072C10G01
1N43-NM310	Westinghouse	3359C48G01
1N43-NC305	Westinghouse	3359C39G01
1NE-44	Westinghouse	WL-23686
1N44-NI301	Westinghouse	10072C10G01
1N44-NI302	Westinghouse	10072C10G01
1N44-NM310	Westinghouse	3359C48G01
1N44-NC305	Westinghouse	3359C39G01
2NE-41	Westinghouse	WL-23686
2N41-NI301	Westinghouse	10072C10G01
2N41-NI302	Westinghouse	10072C10G01
2N41-NM310	Westinghouse	3359C48G01
2N41-NC305	Westinghouse	3359C39G01
2NE-42	Westinghouse	WL-23686
2N42-NI301	Westinghouse	10072C10G01
2N42-NI302	Westinghouse	10072C10G01
2N42-NM310	Westinghouse	3359C48G01
2N42-NC305	Westinghouse	3359C39G01
2NE-43	Westinghouse	WL-23686
2N43-NI301	Westinghouse	10072C10G01

2N43-NI302	Westinghouse	10072C10G01
2N43-NM310	Westinghouse	3359C48G01
2N43-NC305	Westinghouse	3359C39G01
2NE-44	Westinghouse	WL-23686
2N44-NI301	Westinghouse	10072C10G01
2N44-NI302	Westinghouse	10072C10G01
2N44-NM310	Westinghouse	3359C48G01
2N44-NC305	Westinghouse	3359C39G01

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 2 setpoint calculation is not available. The Unit 1 and Unit 2 Nuclear Instrument Power Range drawer detectors and loop components are identical in design and qualification. The design source documents are identical between the two units, and the method of calibration is identical. Process Measurement Accuracy (PMA) and Process Considerations (PC) evaluated in the Reference 8.4.1 calculation have been reviewed and determined to be consistent between Unit 1 and Unit 2 for the purposes of drift and setpoint analysis. Therefore, based on review, the Unit 1 setpoint calculation can be considered applicable to Unit 2 function and the Unit 1 setpoint calculation (Reference 8.4.1) is extended to Unit 2 by review.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 SPC-DR-026 Drift Calculation for NC305

This attachment uses data from drift calculation SPC-DR-026, “Drift Analysis of As-Found /As - Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables” (Reference 8.3.1). The drift value provided from Reference 8.3.1 will bound NC305

hardware performance with a 95% probability at a 95% confidence level. The probability value establishes the portion of the population that is included within the tolerance interval. The data taken from the drift calculation is summarized below:

Westinghouse Bistable Model 3359C39G01 (NC305)

$$DA_{Ext_{Rand}} = \pm 0.080\ \% Calibrated\ Span$$

$$DA_{Ext_{Bias}} = \pm 0\ \%\ Calbrated\ Span$$

4.2 Input Data for the Power Range Detector, NI 301/302 and NM 310

Drift analysis was not performed on the following instruments in the Power Range Neutron Flux low Reactor Trip loop:

4.2.1 Power Range Detector NE-41, NE-42, NE-43, and NE-44.

The Power Range Detectors are not calibrated instruments in a surveillance procedure that would provide As-Found (AF) and As-Left (AL) data for drift analysis. EM 3.3.4.2 (Reference 8.2.1) provides guidance for cases where there is not sufficient AF/AL drift data and specifies, in section 6.4.2, that vendor data can be used to establish drift data. The setpoint calculation SPC-RP-075, "UNIT 1 NIS High Flux Reactor Trip Low Setpoint" (Reference 8.4.1) evaluated the Power Range detector uncertainty from published vendor data, this method is consistent with EM 3.3.4.2 guidance. Therefore, this Attachment incorporates the vendor drift allowance from SPC-RP-075 as described in Section 4.2.4 and listed in Section 6.2.3.

4.2.2 NI 301/302

Per Design Equivalent Change 6EQVENG28491 (Reference 8.7.1) the Power Range Drawer B upper and lower detector digital current meters (NI 301 and NI 302) installed per Westinghouse Field Kit Instructions ITTC/NIS (88)-370 were replaced with new designed and qualified Digital Meter 2.0 assemblies per Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2 (Reference 8.7.2). Review of Work Orders (Reference 8.8) indicated the new meter installations occurred over 2018 and 2019 and limited the size of the available calibration data points to less than a statistically valid pool, as defined in EM 3.3.4.2section 6.4.2. (Reference 8.2.1). As a result, the drift analysis project excluded the power range upper and lower detector current meters from the drift analysis scope. Therefore, this Attachment will use vendor data to establish drift data as described in section 6.4.2 of EM 3.3.4.2 (Reference 8.2.1) for conditions of insufficient drift data due to components that are new or replaced and data points are not available. The vendor data will be used to develop a drift allowance by evaluating the calibration interval and manufacture's drift specification as described in below section 4.2.4

The NI 301 and NI 302 vendor data is provided in Westinghouse design input document Nuclear Instrument System (NIS) Technical Manual Appendix Digital Meter 2.0 – Power Range A & B

Section 1.3.1 "Specification of Digital Meter"(Reference 8.7.3) and as evaluated in Design Equivalent Change 6EQVENG28491 Section B.4 "Design Evaluation" (Reference 8.7.1).

Characteristic	**Detail**
Noise Rejection	Greater than 54 dB at 1 Hz ("SLOW" meter rate)
	Greater than 100 dB at 60 Hz ("SLOW" or "FAST" meter rate)
Conversion Rate	5 conversions per second
Accuracy	± 0.03% of reading (± 0.003%, meter alone)
Zero Stability	Auto-zero, ± 0.2 μV/ C (400.0 mV full scale input)
Display	4 digits, red LED, 0.43" high digits
Temperature Range	-10 to +50 degrees C Temperature
Coefficient	± 7 ppm of reading per degree C
Relative Humidity	0 to 90 %, non-condensing

Per References 8.4.1, 8.7.1, and 8.7.3 the current setpoint calculation evaluates meter accuracy as = 0.1% span, vendor drift allowance at 0 and drift time at 1.0 months. The meter accuracy value bounds the meter replacement specification as described in Reference 8.7.1 and represents worst case error. Vendor drift allowance and drift time are not specified in the referenced engineering change (Reference 8.7.1 and 8.7.3). However, the engineering change incorporates the Original Equipment Manufacturer approved equivalent replacement (Reference 8.7.3). As such, this Attachment will use the SPC-RP-075 (Reference 8.4.1) allowance for meter drift and drift time as bounding values in section 6 vendor drift analysis.

As described in Section 2.2.4.1 of Reference 8.7.4, "The current signals from the two detector sections are summed, then averaged by Summing and Level Amplifier NM310 to produce a single voltage which is proportional to average reactor output." The two detector sections are identical, each consisting of an upper (or lower) Power Range Detector and a Detector Current Meter. Per Reference 8.1.2, because these two input channels are averaged, their resulting uncertainties can be averaged. SPC-RP-075 (Reference 8.4.1) incorporated this method to average the two current inputs to the NM310 Summing and Level Amplifier channel uncertainties by including only one Power Range Detector and one Detector Current Meter in the instrument loop. This Attachment will evaluate loop uncertainty consistent with SPC-RP-075 as described in 4.2.4.

4.2.3 NM 310

Per SP 1005 (Reference 8.6.1) and Plant Technical Speciation Surveillance Requirements 3.3.1.2, 3.3.1.3, and 3.3.1.6 (References 8.5.1 and 8.5.2) the Power Range output current from the summing and level amplifier is normalized each day to heat balance results and quarterly to in core flux mapping. The adjustments occur throughout the fuel cycle and occur after the surveillance channel calibration has been performed. The Power Range current adjustments

during the fuel cycle result in a change in the NM310 output, and it is likely that the As Found value for the next channel calibration will not correspond to the As Left value from the previous calibration. That change is not exclusively instrument drift. Rather it more accurately reflects the adjustments made to make the summing and level amplifier output and the Power Range drawer to agree with to fuel cycle core measurement currents. On the basis of this condition the NM 310 data was excluded from drift analysis.

However, as previously described, EM 3.3.4.2 (Reference 8.2.1) provides guidance for cases where there is not sufficient drift data and specifies, in section 6.4.2, that vendor data can be used to establish drift data. The setpoint calculation SPC-RP-075, "UNIT 1 NIS High Flux Reactor Trip Low Setpoint" (Reference 8.4.1) developed a drift allowance consistent with EM 3.3.4.1 (Reference 8.2.2) and guidance from ISA-RP 67.04 (References 8.1.2) to characterize expected instrument drift by correlating Calibration Interval (CI) to performance predicted by the manufacture's drift specification. The NM 310 daily drift allowance in this Attachment will be evaluated consistent with SPC-RP-075 as described in Section 4.2.4.

- Westinghouse Nuclear Instrumentation System Instruction Book XH-1-1931 (Reference 8.7.4), Section 1.4.3.1, states that the summing and level amplifier (Westinghouse model 3359C48G01) has a stability (i.e., drift) of 0.1 % per 100 hours. SPC-RP-075 (Reference 8.4.1) develops drift data using the vendor drift time (DT) as: $DT = \left(\frac{100\ hours}{\frac{730\ hours}{month}}\right)$ = 0.137 months.

- As described above the NM 310 calibration interval (CI) is daily. The rationale of a daily calibration is based on review of SP 1005 (Reference 8.6.1). SPC-RP-075 (Reference 8.4.1) develops the CI for daily calibration as:

$$CI = \left(\frac{1 day}{\frac{365\ days}{year}}\right) \times \left(\frac{12\ months}{year}\right) = 0.033\ months.$$

The setpoint calculation (Reference 8.4.1) allows for the surveillance to be performed up to 48 hours (two days) apart this results in CI_{calc}:

$$CI_{calc} = 2\ \times\ 0.033\ months = 0.066\ months$$

4.2.4 Calibration Interval and Manufacture's Drift Specification for the NIS Power Range detectors, NI 301/302 and NM 310

EM 3.3.4.1 (Reference 8.2.2) provides adequate guidance for conditions where drift is not defined or the drift analysis not acceptable. The guidance also includes instruction to adjust

vendor drift to match the calibration period of an instrument when the vendor period does not agree with the calibration period of the instrument. Section 6.3.2 of EM 3.3.4.1 (Reference 8.2.2) provides the following equation to adjust drift to match the calibration period of an instrument "where drift is considered to be a linear condition over the entire period between calibrations." Reference 8.1.2 states that "in the absence of other data, it is considered reasonable, and perhaps conservative, to make this assumption" of linearity. The linear condition is chosen to match the method used for analysis in the setpoint calculation (Reference 8.4.1)

Instrument Drift (d) = $\left(\frac{1.25*tc}{td}\right)\left(\frac{vd}{cs}\right)$

where:
vd = vendor's drift specification
td = vendor's time period for which drift specification is valid.
tc = instrument calibration period (months)
cs = instrument calibrated span
1.25 = maximum allowance on time requirements in technical specifications

The setpoint calculation SPC-RP-075, "UNIT 1 NIS High Flux Reactor Trip Low Setpoint" (Reference 8.4.1) developed a drift allowance consistent with guidance from ISA-RP 67.04 (References 8.1.2) to characterize expected instrument behavior by correlating Calibration Interval (CI) to performance predicted by the manufacturer. The calculation considered drift linear over time and calculated drift using the following equation:

SPC-RP-075 calculates drift as $Drift\ (d) = \left(\frac{CI}{DT}\right)(vd)\left(\frac{PS}{CS}\right)$

where:
vd = vendor's drift expression
CI = Calibration Interval
DT = Drift Time
PS = Process Span
CS = Calibrated Span

SPC-RP-075 determines drift consistent with industry guidance (Reference 8.1.2). SPC-RP-075 is the calculation of record for the trip function. Therefore, the evaluation of the loop setpoint will incorporate manufacture's drift for the current meters (NI 301/302) and NM310 consistent with SPC-RP-075.

4.3 Setpoint/Uncertainty Calculations

The Power Range Neutron Flux Low reactor trip setpoint is evaluated in setpoint calculation SPC-RP-075, "UNIT 1 NIS High Flux Reactor Trip Low Setpoint" (Reference 8.4.1). As described in section 2.0 Methodology the unit 1 calculation also applies to Unit 2. Pertinent information from the calculation for this evaluation is summarized below:

Form 1 of SPC-RP-075 (Reference 8.4.1) provides the following information:

$$Process\ Span = 0\ to\ 120\ PCT$$

SPC-RP-075 Form 1 and Section 1.2 “Results - Parameter Table” (Reference 8.4.1) provides the following Analytical Limit value :

$$Analytical\ Limit\ (AL) = 50\ PCT$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$Bias_{Negative} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{neg}$$

After entering the data from (SPC-RP-075), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.7488\ (PCT^2) + 0.162645\ (PCT^2) + 0.240774(PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0.186624\ (PCT)^2 + 36\ (PCT)^2]^{1/2} = \pm 6.11055\ PCT$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$TLE_{neg} = -\ 6.11055\ PCT -\ 0\ PCT = -\ 6.11055\ PCT$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

The allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Postive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

4.4 Technical Specifications

The allowable value for the Power Range Neutron Flux – Low function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 40\ \%\ RTP$$

Per SPC-RP-075 (reference 8.4.1) section 1.2, values from the technical specifications (References 8.5.1 and 8.5.2) are given values of PCT with no conversion of the values. Therefore, for this calculation RTP and PCT are equivalent.

Thus, the following relationship is true:

$$AV\ 40\%\ RTP = 40\ PCT$$

This relationship is used throughout the calculations in this Attachment

4.5 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1318.3 (Reference 8.6.2) and SP 2318.3 (Reference 8.6.3).

$$APS = 2.033\ VDC\ =\ (2.033\ vdc) \times \left(\frac{120\ PCT}{10\ vdc}\right)\ = 24.396\ PCT$$

$$AFT = \pm 0.01\ VDC =\ (\pm 0.01\ vdc \times \left(\frac{120\ PCT}{10\ vdc}\right)\ =\ \pm 0.12\ PCT$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Extrapolated Analyzed Drift

The total calculated drift tolerance interval for the trip bistables was calculated in Reference 8.3.1 using calibrated percent span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below:

Westinghouse Bistable NC305 (PCT) and Process Span from Section 4.3:

$$DA_{Ext_{Rand}} = \pm 0.080\,\%\,Calibrated\ Span\ =\ \pm 0.080\,\%\,Calibrated\ Span \times \frac{120\ PCT\ (PS)}{100\%\ Span}$$
$$=\ 0.096\ PCT$$

$$DA_{Ext_{Bias_{bistable}}} = \pm 0\%\ CalibratedSpan\ =\ 0\ PCT$$

6.2 Extrapolated Vendor Drift

Per section 4.1, only the reactor trip bistable (1N41-NC305) has an analyzed drift tolerance from a drift analysis calculation extrapolated to a 30 month Surveillance Interval value. To include the Power Range detector, current meter, and summing and level amplifier in the Total Loop Error calculation (Section 6.3), the extrapolated drift tolerance is calculated using vendor data. The extrapolated drift tolerance is calculated using vendor data included in Forms 1, 2 and 3 of SPC-RP-075 (Reference 8.4.1) and the equations given below.

$$d_R = \left(\frac{\mathrm{CI}}{\mathrm{DT}}\right)(\mathrm{vd})\left(\frac{\mathrm{PS}}{\mathrm{CS}}\right)$$

$$D_{30} = \sqrt{a^2 +\ {d_R}^2 + m^2}$$

6.2.1 Power Range Detector (1NE-41)

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = 0\ PCT$$

$$a = 0.6000\ PCT$$

$$m = 0\ PCT$$

$$D_{30detector}\ = \sqrt{.6000^2 +\ 0^2 + 0^2} =\ .6000\ PCT$$

6.2.2 Current Meter (1N41-NI301)

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 1\ months$$

$$Vendor\ Drift\ (vd) = 0$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 120\ PCT$$

$$d_R = \ 0\ PCT$$

$$a = 0.1200\ PCT$$

$$m = 0.3134\ PCT$$

$$D_{30current\ meter} \ = \sqrt{0.1200^2 + \ 0^2 + 0.3134^2} = \ 0.3356\ PCT$$

6.2.3 Summing and Level Amplifier (1N41-NM310)

$$Calibration\ Interval\ (CI) = 0.066\ months$$

$$Drift\ Time\ (DT) = 0.137\text{months.}$$

$$Vendor\ Drift\ (vd) = 0.1\%\ Range$$

$$vd \ = \ (0.1\ \% \ \times \ 0.4\ vdc) \ \times \left(\frac{120\ PCT}{0.4\ vdc}\right)$$

$$vd \ = \ 0.120\ PCT$$

$$Process\ Span\ (PS) = 0\ to\ 120\ PCT$$

$$Input\ Span\ (CS) = 0\ to\ 0.4\ vdc$$

$$d_R = \ 0.0578 PCT$$

$$a = 0.6000\ PCT$$

$$m = 0.3470\ PCT$$

$$D_{30Amplifier} \ = \sqrt{0.6000^2 + \ 0.0578^2 + 0.3470^2} = \ 0.6955\ PCT$$

6.3 Total Loop Error (TLE)

Instrument drift from SPC-DR-026 (Reference 8.3.1) is used to replace the instrument accuracy, drift, and measurement and test equipment allowance of the reactor trip bistable (1N41-NC305) using the methodology shown below.

$$D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

$$TLE\ (SRSS) = \Big[D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{1/2}$$

$$TLE\ (SRSS) = [(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (.0960\ PCT^2) + (\ 0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT^2) + (0\ PCT)^2 + (.432\ PCT)^2 + (6\ PCT)^2]^{\frac{1}{2}} = \pm 6.09526\ PCT$$

$$Bias_{neg} = D_{30Detector}Bias_n + D_{30current\ meter}Bias_n + D_{30Amplifier}Bias_n + DA\_Ext\_Bias_{bistablen} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$TLE_{neg} = TLE\ (-SRSS) - Bias_{neg}$$

$$TLE_{neg} = -6.09526PCT + 0\ PCT = -6.09526\ PCT$$

6.4 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.3 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL - TLE_{neg} = 50\ PCT - 6.09526\ PCT = 43.90474\ PCT$$

6.5 Allowable Value (AV)

The allowable value for the Power Range Neutron Flux (low) setpoint is calculated using the NTSP and the Loop Drift using the equations shown below.

$Loop\ Drift_{Random}\ (LD_R) =$

$$\sqrt{D_{30Detector}{}^2 + D_{30current\ meter}{}^2 + D_{30Amplifier}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}{}^2}$$

$$LD_R = \sqrt{(0.6000\ PCT)^2 + (0.3356\ PCT)^2 + (0.6955\ PCT)^2 + (.0960\ PCT)^2 + (0\ PCT)^2} = 0.9826\ PCT$$

$Loop\ Drift\ _{PositiveBias}(LD_{BP}) =$

$D_{30DetectorBP} + D_{30current\ meterBP} + D_{30AmplifierBP} + DA\_Ext\_Bistable_{BP} + R_{NBP}$

$$LD_{BP} = 0\ PCT + 0\ PCT + 0\ PCT + 0PCT + 0PCT = 0\ PCT$$

$$AV = NTSP + LD_R + LD_{BP}$$

$$AV = 43.90474\ PCT + 0.9826\ PCT + 0\ PCT = 44.88734PCT$$

6.6 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.4 and the AFT and APS values given in section 4.5 the setpoint margin is evaluated below.

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$43.90474\ PCT \geq 24.396\ PCT + .12\ PCT$$

$$43.90474\ PCT\ \geq 24.516\ PCT$$

6.7 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is evaluated using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

$$AV_{Tech\ Spec} \leq 40\%\ RTP\ (PCT)$$

$$40\ PCT \leq 44.88734CT$$

7.0 Conclusions and Plant Impact

The total loop error, nominal trip setpoint, and allowable value were calculated using the new drift values provided in drift calculation SPC-DR-026 (Reference 8.3.1) and vendor specifications where applicable The new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Power Range Neutron Flux (low setpoint) Reactor Trip Bistable Function instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.1.2 ISA-RP-67.15-1991, (ISA-S-67.04 PART II COMMITTEE DRAFT 10) "Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation" 1991

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-026, Revision 0, "Drift Analysis of As-Found /As -Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables"

8.4 Setpoint Calculations:

8.4.1 SPC-RP-075, Revision 0A, "UNIT 1 NIS High Flux Reactor Trip Low Setpoint."

8.5 Technical Specifications:

8.5.1 Unit 1, "Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42), Amendment 230"

8.5.2 Unit 2, "Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60), Amendment 218"

8.6 Surveillance Procedures:

8.6.1 SP 1005, Revision 50, "NIS Power Range Daily Calibration"

8.6.2 SP 1318.3, Revision 32, "NIS Power Range Channel Calibration"

8.6.3 SP 2318.3, Revision 32, "NIS Power Range Channel Calibration"

8.7 Design Control Documents

8.7.1 Design Equivalent Change, 6EQVENG28491, Revision: 0 "Nuclear Instrumentation System (NIS) Display Upgrade"

8.7.2 Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2

8.7.3 Westinghouse NIS Technical Manual Appendix "Digital Meter 2.0 – Power Range A & B", Revision 2

8.7.4 Westinghouse Nuclear Instrumentation System Instruction Book, XH-1-1931 Revision 7

8.8 Work Orders

8.8.1 WO 700028102, 10/12/2019
8.8.2 WO 700028103, 10/3/2018
8.8.3 WO 700028104, 10/2/2018
8.8.4 WO 700028105, 10/2/2018
8.8.5 WO 700028106, 10/1/2018
8.8.6 WO 700028107, 10/14/2019
8.8.7 WO 700028108, 10/13/2019
8.8.8 WO 700028109, 10/18/2019

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Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for Units 1 and 2 Power Range Neutron Flux Rate – High Positive Rate instrument loops which perform reactor trips. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table listed which are found in Surveillance Procedures SP 1318.3 and SP 2318.3 (References 8.6.1 and 8.6.2) in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1N41-NC303	Westinghouse	3359C39G01
1N41-NM311	Westinghouse	3359C41G01
1N42-NC303	Westinghouse	3359C39G01
1N42-NM311	Westinghouse	3359C41G01
1N43-NC303	Westinghouse	3359C39G01
1N43-NM311	Westinghouse	3359C41G01
1N44-NC303	Westinghouse	3359C39G01
1N44-NM311	Westinghouse	3359C41G01
2N41-NC303	Westinghouse	3359C39G01
2N41-NM311	Westinghouse	3359C41G01
2N42-NC303	Westinghouse	3359C39G01
2N42-NM311	Westinghouse	3359C41G01
2N43-NC303	Westinghouse	3359C39G01
2N43-NM311	Westinghouse	3359C41G01
2N44-NC303	Westinghouse	3359C39G01
2N44-NM311	Westinghouse	3359C41G01

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

2.1 Missing Unit 2 Calculation

Per Table 1.1, the Unit 1 and 2 Power Range Neutron Flux Rate – High Positive Rate bistables and rate modules are the same manufacturers and model numbers (Reference 8.7.1). Per References 8.6.1 and 8.6.2, the Unit 1 and Unit 2 Power Range Neutron Flux Rate – High Positive Rate function is calibrated with the same M&TE, are configured to the same actual plant setpoint, and have the same as-found tolerances. After a review of schematics in XH-1-1931-1 (Reference 8.8.1), the loop configurations for Unit 1 and 2 are identical. The Allowable Values (AV) from the Unit 1 and Unit 2 Tech Specs (References 8.5.1 and 8.5.2 respectively) are

identical. Therefore, based on review, the Unit 1 setpoint calculation can be considered applicable to Unit 2 function and the Unit 1 setpoint calculation (Reference 8.4.1) is extended to Unit 2 by review.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-026, “Drift Analysis of As Found / As-Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables” (Reference 8.3.1) and SPC-DR-033, “As-Found / As -Left Data for Westinghouse Rate Module 3359C41G01” (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculation. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-026

The Westinghouse Bistable Model 3359C39G01 (NC303) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.080\ \%Calibrated\ Span$$

$$DA\_Ext\_Bias_{bistable} = 0\ \%Calibrated\ Span$$

4.1.2 SPC-DR-033

The Westinghouse Rate Module Model 3359C41G01 (NM311) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{rate\ module} = \pm 0.366\ \%Calibrated\ Span$$

$$DA\_Ext\_Bias_{rate\ module} = 0\ \%Calibrated\ Span$$

4.2 Setpoint/Uncertainty Calculations

The Power Range Neutron Flux Rate – High Positive Rate Reactor Trip setpoint is evaluated in setpoint calculation: SPC-RP-049, “U1 NIS Power Range Positive Rate Trip” (Reference 8.4.1). Pertinent information from this evaluation is summarized below:

Form 1 of SPC-RP-049 (Reference 8.4.1) provides the following information:

$$Process\ Span = 0\ to\ 15.000\ PCT\ Power$$

$$Analytical\ Limit\ (AL) = 6.0600\ PCT\ Power$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-049), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.01440\ (PCT\ Power^2) + 0.29494\ (PCT\ Power^2) + 7.6625E - 04\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0 (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + (0\ PCT\ Power)^2 + (0\ PCT\ Power)^2 + (0\ PCT\ Power)^2]^{1/2} = \pm 0.55688\ PCT\ Power$$

$$Bias_{pos} = 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power = 0\ PCT\ Power$$

$$Bias_{neg} = 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0.06\ PCT\ Power = 0.06\ PCT\ Power$$

$$TLE_{pos} = 0.55688\ PCT\ Power + 0\ PCT\ Power = 0.55688\ PCT\ Power$$

$$TLE_{neg} = -0.55688\ PCT\ Power - 0.06\ PCT\ Power = -0.61688\ PCT\ Power$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

$$NTSP = 6.0600\ PCT\ Power + (-0.61688) PCT\ Power = 5.44312\ PCT\ Power$$

The allowable value (AV) for an increasing process is determined using the following equations below. The negative bias equations are not utilized for an increasing process.

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{0.01440\ (PCT\ Power^2) + 0.29494\ (PCT\ Power^2) + 7.6625E-04 (PCT\ Power^2) + 0\ (PCT\ Power^2)} = 0.55688\ PCT\ Power$$

$$LD_{BP} = 0\ PCT\ Power + 0\ PCT\ Power = 0\ PCT\ Power$$

$$AV = 5.44312\ PCT\ Power + 0.55688\ PCT\ Power + 0\ PCT\ Power = 6.00000\ PCT\ Power$$

4.3 Technical Specifications

The allowable value for the Power Range Neutron Flux Rate – High Positive Rate from Table 3.3.1-1, Function 3a is taken from the technical specification for Units 1 and 2 (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 6.0\%\ RTP\ with\ time\ constant\ \geq 2\ sec$$

4.4 Calibration Procedures

The actual plant setting (APS) is taken from step 8.6.28 in surveillance procedures SP 1318.3 (Reference 8.6.1) and SP 2318.3 (Reference 8.6.2). The as found tolerance (AFT) is taken from Form 2 of SPC-RP-049 (Reference 8.4.1) for Bistable NC303.

$$APS = 5.0\ PCT\ Power$$

$$AFT = \pm 0.01\ VDC$$

To interface with the equations, the AFT value is converted into process units using the input span taken from Form 2 of SPC-RP-049 (Reference 8.4.1).

$$Input\ Span\ of\ Bistables = 0\ to\ 1.2500\ VDC$$

$$AFT = \frac{0.01\ VDC}{1.2500\ VDC} \times 15\ PCT\ Power = 0.12\ PCT\ Power$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent (%) span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below:

Westinghouse Bistable Model 3359C39G01 (NC303):

$$DA\_Ext\_Rand_{bistable} = \pm 0.080\ \%Calibrated\ Span = \pm 0.080\ \%Calibrated\ Span \times \frac{15.0\ PCT\ Power}{100\ \%Span} = \pm 0.012\ PCT\ Power$$

$$DA\_Ext\_Bias_{bistable} = 0\ \%Calibrated\ Span = 0\ \%Calibrated\ Span \times \frac{15.0\ PCT\ Power}{100\ \%Span} = 0\ PCT\ Power$$

Westinghouse Rate Module Model 3359C41G01 (NM311):

$$DA\_Ext\_Rand_{rate\ module} = \pm 0.366\ \%Calibrated\ Span = \pm 0.366\ \%Calibrated\ Span \times \frac{15.0\ PCT\ Power}{100\ \%Span} = \pm 0.0549\ PCT\ Power$$

$$DA\_Ext\_Bias_{rate\ module} = 0\ \%Calibrated\ Span = 0\ \%Calibrated\ Span \times \frac{15.0\ PCT\ Power}{100\ \%Span} = 0\ PCT\ Power$$

6.2 Total Loop Error (TLE)

This attachment uses the Unit 1 data from SPC-RP-049 (Reference 8.4.1) which calculates the total loop error for both units, since Unit 2 setpoint calculation does not exist. Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$(DA\_Ext\_Rand_{rate\ module}{}^2 + DA\_Ext\_Rand_{bistable}{}^2) = A + D_R + M$$

New total loop error (TLE) under seismic event and potential loss of non-seismic HVAC for Units 1 and 2 is calculated using the following equations:

$$TLE\ (SRSS) = \left[DA\_Ext\_Rand_{rate\ module}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$TLE\ (SRSS) = [\ (0.0549\ PCT\ Power)^2 + (0.012\ PCT\ Power)^2 + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0(PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + (0\ PCT\ Power)^2 + (0\ PCT\ Power)^2 + (0\ PCT\ Power)^2]^{1/2} = \pm\ 0.0562 PCT\ Power$$

$$Bias_{pos} = DA\_Ext\_Bias_{rate\ module} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power = 0\ PCT\ Power$$

$$Bias_{neg} = DA\_Ext\_Bias_{rate\ module} + DA\_Ext\_Bias_{bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0.06\ PCT\ Power = 0.06\ PCT\ Power$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLE_{pos} = 0.0562\ PCT\ Power + 0\ PCT\ Power = 0.0562\ PCT\ Power$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

$$TLE_{neg} = -0.0562\ PCT\ Power - 0.06\ PCT\ Power = -0.1162\ PCT\ Power$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from Section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE_{neg}$$

$$NTSP = 6.0600\ PCT\ Power + (-0.1162) PCT\ Power = 5.9438\ PCT\ Power$$

6.4 Allowable Value (AV)

The allowable value for Power Range Neutron Flux Rate – High Positive Rate is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{rate\ module}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = DA\_Ext\_Bias_{rate\ module} + DA\_Ext\_Bias_{bistable} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{(0.0549\ PCT\ Power)^2 + (0.012\ PCT\ Power)^2 + 0\ (PCT\ Power^2)}$$
$$= 0.0562\ PCT\ Power$$

$$LD_{BP} = 0\ PCT\ Power + 0\ PCT\ Power = 0\ PCT\ Power$$

$$AV = 5.9438\ PCT\ Power + 0.0562\ PCT\ Power + 0\ PCT\ Power = 6.0000\ PCT\ Power$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values the setpoint margin is evaluated below:

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$NTSP \geq APS + AFT$$

$$5.9438\ PCT\ Power \geq 5.0\ PCT\ Power + 0.12\ PCT\ Power$$

$$5.9438\ PCT\ Power \geq 5.12\ PCT\ Power$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

The AV taken from the Unit 1 and Unit 2 Technical Specifications is shown below:

$$AV_{Tech\ Spec} \leq AV_{Calc}$$

$$6.0\%\ RTP\ (with\ time\ constant\ \geq 2\ \mathrm{sec}) \leq 6.0000\%\ RTP$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-026 (Reference 8.3.1) and SPC-DR-033 (Reference 8.3.2), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the for Power Range Neutron Flux Rate – High Positive Rate instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals**:**

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-026, Revision 0, "Drift Analysis of As-Found/As-Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables".

8.3.2 SPC-DR-033, Revision 0, "As-Found / As -Left Data for Westinghouse Rate Module 3359C41G01".

8.4 Setpoint Calculation:

8.4.1 SPC-RP-049, Revision 0, "Unit 1 NIS Power Range Positive Rate Trip".

8.5 Technical Specifications:

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42) Amendment 230.

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60) Amendment 218.

8.6 Surveillance Procedures:

8.6.1 Surveillance Procedure SP 1318.3, Rev. 32, "NIS Power Range Channel Calibration".

8.6.2 Surveillance Procedure SP 2318.3, Rev. 32, "NIS Power Range Channel Calibration".

8.7 SAP Database:

8.7.1 Instrument Data from Prairie Island's SAP Database (January – February 2021).

8.8 Schematic:

8.8.1 Northern States Power Technical Manual Number XH-1-1931-1, Rev. 9, "NIS Drawings".

Prepared By:	Corey Crawford	Corey R. Crawford (Signature)	Digitally signed by Corey R. Crawford Date: 2021.07.01 14:17:55 -04'00' (Date)
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Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for Units 1 and 2 Power Range Neutron Flux Rate – High Negative Rate instrument loops which perform reactor trips. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table listed which are found in Surveillance Procedures SP 1318.3 and SP 2318.3 (References 8.6.1 and 8.6.2) in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1N41-NC301	Westinghouse	3359C39G01
1N41-NM311	Westinghouse	3359C41G01
1N42-NC301	Westinghouse	3359C39G01
1N42-NM311	Westinghouse	3359C41G01
1N43-NC301	Westinghouse	3359C39G01
1N43-NM311	Westinghouse	3359C41G01
1N44-NC301	Westinghouse	3359C39G01
1N44-NM311	Westinghouse	3359C41G01
2N41-NC301	Westinghouse	3359C39G01
2N41-NM311	Westinghouse	3359C41G01
2N42-NC301	Westinghouse	3359C39G01
2N42-NM311	Westinghouse	3359C41G01
2N43-NC301	Westinghouse	3359C39G01
2N43-NM311	Westinghouse	3359C41G01
2N44-NC301	Westinghouse	3359C39G01
2N44-NM311	Westinghouse	3359C41G01

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

2.1 Missing Unit 2 Calculation

Per Table 1.1, the Unit 1 and 2 Power Range Neutron Flux Rate – High Negative Rate bistables and rate modules are the same manufacturers and model numbers (Reference 8.7.1). Per References 8.6.1 and 8.6.2, the Unit 1 and Unit 2 Power Range Neutron Flux Rate – High Negative Rate function is calibrated with the same M&TE, are configured to the same actual plant setpoint, and have the same as-found tolerances. After a review of schematics in XH-1-1931-1 (Reference 8.8.1), the loop configurations for Unit 1 and 2 are the same. The Allowable Values (AV) from the Unit 1 and Unit 2 Tech Specs (References 8.5.1 and 8.5.2

respectively) are identical. Therefore, based on review, the Unit 1 setpoint calculation can be considered applicable to Unit 2 function and the Unit 1 setpoint calculation (Reference 8.4.1) is extended to Unit 2 by review.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-026, "Drift Analysis of As Found / As-Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables" (Reference 8.3.1) and SPC-DR-033, "As-Found / As -Left Data for Westinghouse Rate Module 3359C41G01" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculation. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-026

The Westinghouse Bistable Model 3359C39G01 (NC301) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.080\ \%Calibrated\ Span$$

$$DA\_Ext\_Bias_{bistable} = 0\ \%Calibrated\ Span$$

4.1.2 SPC-DR-033

The Westinghouse Rate Module Model 3359C41G01 (NM311) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{rate\ module} = \pm 0.366\ \%Calibrated\ Span$$

$$DA\_Ext\_Bias_{rate\ module} = 0\ \%Calibrated\ Span$$

4.2 Setpoint/Uncertainty Calculations

The Power Range Neutron Flux Rate – High Negative Rate Reactor Trip setpoint is evaluated in setpoint calculation: SPC-RP-051, "Unit 1 NIS Power Range Negative Rate Reactor Trip Setpoint" (Reference 8.4.1). Pertinent information from this evaluation is summarized below:

Form 1 of SPC-RP-051 (Reference 8.4.1) provides the following information:

$$Process\ Span = 0\ to\ 15.000\ PCT\ Power$$

$$Analytical\ Limit\ (AL) = 10.000\ PCT\ Power$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-051), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.01440\ (PCT\ Power^2) + 0.29494\ (PCT\ Power^2) + 7.6625E - 04\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0(PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + (0\ PCT\ Power)^2 + (0\ PCT\ Power)^2 + (0\ PCT\ Power)^2]^{1/2} = \pm 0.55688\ PCT\ Power$$

$$Bias_{pos} = 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power = 0\ PCT\ Power$$

$$Bias_{neg} = 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0.06\ PCT\ Power = 0.06\ PCT\ Power$$

$$TLE_{pos} = 0.55688\ PCT\ Power + 0\ PCT\ Power = 0.55688\ PCT\ Power$$

$$TLE_{neg} = -0.55688\ PCT\ Power - 0.06\ PCT\ Power = -0.61688\ PCT\ Power$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

$$NTSP = 10.000\ PCT\ Power + (-0.61688) PCT\ Power = 9.38312\ PCT\ Power$$

The allowable value (AV) for an increasing process is determined using the following equations below. The negative bias equations are not utilized for an increasing process.

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{0.01440\ (PCT\ Power^2) + 0.29494\ (PCT\ Power^2) + 7.6625E-04(PCT\ Power^2) + 0\ (PCT\ Power^2)} = 0.55688\ PCT\ Power$$

$$LD_{BP} = 0\ PCT\ Power + 0\ PCT\ Power = 0\ PCT\ Power$$

$$AV = 9.38312\ PCT\ Power + 0.55688\ PCT\ Power + 0\ PCT\ Power = 9.9400\ PCT\ Power$$

4.3 Technical Specifications

The allowable value for the Power Range Neutron Flux Rate – High Negative Rate from Table 3.3.1-1, Function 3b is taken from the technical specification for Units 1 and 2 (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 8.0\%\ RTP\ with\ time\ constant\ \geq 2\ sec$$

4.4 Calibration Procedures

The actual plant setting (APS) is taken from a Note for step 8.6.21 in surveillance procedures SP 1318.3 (Reference 8.6.1) and SP 2318.3 (Reference 8.6.2). The as found tolerance (AFT) is taken from Form 2 of SPC-RP-051 (Reference 8.4.1) for Bistable NC301.

$$APS = 5.0\ PCT\ Power$$

$$AFT = \pm 0.01\ VDC$$

To interface with the equations, the AFT value is converted into process units using the input span taken from Form 2 of SPC-RP-051 (Reference 8.4.1).

$$Input\ Span\ of\ Bistables = 0\ to\ 1.2500\ VDC$$

$$AFT = \frac{0.01\ VDC}{1.2500\ VDC} \times 15\ PCT\ Power = 0.12\ PCT\ Power$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent (%) span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below:

Westinghouse Bistable Model 3359C39G01 (NC301):

$$DA\_Ext\_Rand_{bistable} = \pm 0.080\ \%Calibrated\ Span$$
$$= \pm 0.080\ \%Calibrated\ Span \times \frac{15.0\ PCT\ Power}{100\ \%Span} = \pm 0.012\ PCT\ Power$$

$$DA\_Ext\_Bias_{bistable} = 0\ \%Calibrated\ Span = 0\ \%Calibrated\ Span \times \frac{15.0\ PCT\ Power}{100\ \%Span}$$
$$= 0\ PCT\ Power$$

Westinghouse Rate Module Model 3359C41G01 (NM311):

$$DA\_Ext\_Rand_{rate\ module} = \pm 0.366\ \%Calibrated\ Span$$
$$= \pm 0.366\ \%Calibrated\ Span \times \frac{15.0\ PCT\ Power}{100\ \%Span} = \pm 0.0549\ PCT\ Power$$

$$DA\_Ext\_Bias_{rate\ module} = 0\ \%Calibrated\ Span = 0\ \%Calibrated\ Span \times \frac{15.0\ PCT\ Power}{100\ \%Span}$$
$$= 0\ PCT\ Power$$

6.2 Total Loop Error (TLE)

This attachment uses the Unit 1 data from SPC-RP-051 (Reference 8.4.1) which calculates the total loop error for both units, since Unit 2 setpoint calculation does not exist. Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$(DA\_Ext\_Rand_{rate\ module}{}^2 + DA\_Ext\_Rand_{bistable}{}^2) = A + D_R + M$$

New total loop error (TLE) under seismic event and potential loss of non-seismic HVAC for Units 1 and 2 is calculated using the following equations:

$$TLE\ (SRSS) = \big[DA\_Ext\_Rand_{rate\ module}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\big]^{1/2}$$

$$TLE\ (SRSS) = [\ (0.0549\ PCT\ Power)^2 + (0.012\ PCT\ Power)^2 + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0(PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + 0\ (PCT\ Power^2) + (0\ PCT\ Power)^2 + (0\ PCT\ Power)^2 + (0\ PCT\ Power)^2]^{1/2} = \pm\ 0.0562 PCT\ Power$$

$$Bias_{pos} = DA\_Ext\_Bias_{rate\ module} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power = 0\ PCT\ Power$$

$$Bias_{neg} = DA\_Ext\_Bias_{rate\ module} + DA\_Ext\_Bias_{bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0\ PCT\ Power + 0.06\ PCT\ Power = 0.06\ PCT\ Power$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLE_{pos} = 0.0562\ PCT\ Power + 0\ PCT\ Power = 0.0562\ PCT\ Power$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

$$TLE_{neg} = -0.0562\ PCT\ Power - 0.06\ PCT\ Power = -0.1162\ PCT\ Power$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from Section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE_{neg}$$

$$NTSP = 10.000\ PCT\ Power + (-0.1162) PCT\ Power = 9.8838\ PCT\ Power$$

6.4 Allowable Value (AV)

The allowable value for Power Range Neutron Flux Rate – High Negative Rate is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{rate\ module}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = DA\_Ext\_Bias_{rate\ module} + DA\_Ext\_Bias_{bistable} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{(0.0549\ PCT\ Power)^2 + (0.012\ PCT\ Power)^2 + 0\ (PCT\ Power^2)}$$
$$= 0.0562\ PCT\ Power$$

$$LD_{BP} = 0\ PCT\ Power + 0\ PCT\ Power = 0\ PCT\ Power$$

$$AV = 9.8838\ PCT\ Power + 0.0562\ PCT\ Power + 0\ PCT\ Power = 9.9400\ PCT\ Power$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values the setpoint margin is evaluated below:

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$NTSP \geq APS + AFT$$

$$9.8838\ PCT\ Power \geq 5.0\ PCT\ Power + 0.12\ PCT\ Power$$

$$9.8838\ PCT\ Power \geq 5.12\ PCT\ Power$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

The AV taken from the Unit 1 and Unit 2 Technical Specifications is shown below:

$$AV_{Tech\ Spec} \leq AV_{Calc}$$

$$8.0\%\ RTP\ (with\ time\ constant\ \geq 2\ \text{sec}) \leq 9.9400\%\ RTP$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-026 (Reference 8.3.1) and SPC-DR-033 (Reference 8.3.2), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the for Power Range Neutron Flux Rate – High Negative Rate instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals**:**

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-026, Revision 0, "Drift Analysis of As-Found/As-Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables".

8.3.2 SPC-DR-033, Revision 0, "As-Found / As -Left Data for Westinghouse Rate Module 3359C41G01".

8.4 Setpoint Calculation:

8.4.1 SPC-RP-051, Revision 0, "Unit 1 NIS Power Range Negative Rate Reactor Trip Setpoint".

8.5 Technical Specifications:

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42) Amendment 230.

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60) Amendment 218.

8.6 Surveillance Procedures:

8.6.1 Surveillance Procedure SP 1318.3, Rev. 32, "NIS Power Range Channel Calibration".

8.6.2 Surveillance Procedure SP 2318.3, Rev. 32, "NIS Power Range Channel Calibration".

8.7 SAP Database:

8.7.1 Instrument Data from Prairie Island's SAP Database (January – February 2021).

8.8 Schematic:

8.8.1 Northern States Power Technical Manual Number XH-1-1931-1, Rev. 9, "NIS Drawings".

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1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Intermediate Range Neutron Flux instruments. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table:

Table 1.1: Affected Instrumentation

Drawer	Instrument Number	Manufacturer	Model
1N35	1N35-NC206	WESTINGHOUSE	3359C39G01
1N35	1N35-NM201	PHILBRICK	2372A27
1N36	1N36-NC206	WESTINGHOUSE	3359C39G01
1N36	1N36-NM201	PHILBRICK	2372A27
2N35	2N35-NC206	WESTINGHOUSE	3359C39G01
2N35	2N35-NM201	PHILBRICK	2372A27
2N36	2N36-NC206	WESTINGHOUSE	3359C39G01
2N36	2N36-NM201	PHILBRICK	2372A27

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

This calculation applies to both Units 1 and 2 Intermediate Range Neutron Flux Drawers N35 and N36 (1N35, 1N36, 2N35, and 2N36). All the drawers in this evaluation contain the same instruments (References 8.7.1 and 8.8.1). The Units 1 and 2 NIS Intermediate Range Neutron Flux drawers are calibrated with the same M&TE and have the same as-found tolerances (References 8.6.1 and 8.6.2). Both Units 1 and 2 use the same methodology to calculate the actual plant setting at each surveillance interval. However, since core conditions between the two Units are difficult to compare the setpoint margin in this evaluation is calculated individually for each Unit using the most recent bistable trip setpoint determined during surveillance.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-026, "Drift Analysis of As-Found/As-Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables" (Reference 8.3.1) and SPC-DR-034, "Drift Analysis of As-Found/As-Left Data for Philbrick Log Current Amp 2372A27" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculation. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-026

The Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables were evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.080\%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{bistable} = \pm 0\%\ Cablibrated\ Span$$

4.1.2 SPC-DR-034

The Philbrick Log Current Amp 2372A27 was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{amp} = \pm 0.555\%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{amp} = \pm 0\%\ Calibrated\ Span$$

4.2 Setpoint/Uncertainty Calculations

The NIS Intermediate Range (IR) High Flux Reactor Trip setpoint is evaluated in setpoint calculation SPC-RP-071, "Unit 1 NIS Intermediate Range High Flux Reactor Trip Setpoint" (Reference 8.4.1). Pertinent information from each calculation for this evaluation is summarized below:

Uncertainties for the IR Neutron Flux instruments are combined by linearizing the function over a small range of interest in units of percent Equivalent Linear Full Scale (%ELFS) using the following relationships:

$$FACTOR = \frac{X_{true} + X_{error}}{X_{true}}$$

$$FACTOR = 10^{(\%ELFS \times n)}$$

$$n = 8$$

The primary point of interest (POI) is the Calculational Limit (CL) of 40% RTP:

$$POI_{RTP} = 0.40\ RTP$$

Attachment 1 of Reference 8.4.1 provides sample data from startups and shutdowns which was used to determine a relationship between RTP and average IR current at the POI:

$$POI_I = 3.223 \times 10^{-4}\ A$$

The POI is then converted to a voltage to input into the trip bistable as follows:

$$V_{out} = 1.25 \times \log\left(\frac{I}{10^{-11}\ \mathrm{A}}\right)$$

$$POI_V = 9.39\ VDC$$

Total loop error is calculated using log amplifier accuracy (X_{alog}) and M&TE (X_{mlog1} and X_{mlog2}) as well as bistable accuracy (X_{ab}), drift (X_{dbv}), and M&TE (X_{mb}) using the following equation:

$$TLE\ = \sqrt{{X_{alog}}^2 + {X_{ab}}^2 + {X_{dbv}}^2 + \left(X_{mlog1} + X_{mlog2}\right)^2 + {X_{mb}}^2}$$

After entering the data for SPC-RP-071, the total loop error is calculated as:

$$TLE = [(8.603 \times 10^{-4}\ \%\ ELFS)^2 + (2.883 \times 10^{-4}\ \%\ ELFS)^2 + (1.443 \times 10^{-4}\ \%\ ELFS)^2 + (1.355 \times 10^{-4}\ \%\ ELFS + 5.778 \times 10^{-5}\ \%\ ELFS)^2 + (5.778 \times 10^{-5}\ \%\ ELFS)^2]^{1/2} = 9.407 \times 10^{-4}\ \%\ ELFS$$

$$FACTOR_{TLE} = 10^{\left(9.407 \times 10^{-4}\right) \times 8} = 1.017$$

The calculated limit is equal to the POI in current units:

$$CL = 3.223 \times 10^{-4}\ A$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = \frac{CL}{FACTOR_{TLE}}$$

The allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ LD = \sqrt{{X_{alog}}^2 + {X_{ab}}^2 + {X_{dbv}}^2 + \left(X_{mlog1} + X_{mlog2}\right)^2 + {X_{mb}}^2}$$

$$FACTOR_{LD} = 10^{LD \times n}$$

$$AV = NTSP \times FACTOR_{LD}$$

4.3 Technical Specifications

The allowable value for the Intermediate Range Neutron Flux function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 40\%\ RTP$$

4.4 Calibration Procedures

The as found tolerance (AFT) can be taken from surveillance procedures SP 1318.2 (Reference 8.6.1) and SP 2318.2 (Reference 8.6.2). However, the actual plant setting (APS) is calculated each surveillance interval using the 25% recorded IR drawer current so there is no static value to compare against.

$$AFT = \pm 0.01\ VDC$$

4.5 Work Orders

Work order values for the most recent NC206 High Level Trip are taken for each unit for a point of comparison against the updated NTSP value calculated in this evaluation. The values below are taken from the most recent NIS Intermediate Range Channel Calibration work order for each unit (References 8.9.1 and 8.9.2):

Unit 1 Bistable NC206 High Level Trip (Reference 8.9.2):

$$\mathrm{Trip_{1N35}} = 9.30\ \mathrm{VDC}$$

$$\mathrm{Trip_{1N36}} = 9.21\ \mathrm{VDC}$$

Unit 2 Bistable NC206 High Level Trip (Reference 8.9.1):

$$\mathrm{Trip_{2N35}} = 9.07\ \mathrm{VDC}$$

$$\mathrm{Trip_{2N36}} = 9.14\ \mathrm{VDC}$$

The greater of the two values from each unit is conservatively taken for an evaluation of the setpoint margin (Increasing process) in Section 6.6.

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Intermediate Range Detector

The Intermediate Range detector was excluded from drift analysis; however, detector uncertainty is extrapolated using vendor data, in accordance with EM 3.3.4.2 (Reference 8.4.1) and included in the Total Loop Error calculation (Section 6.3).

The Intermediate Range detectors are similar to the Power Range detectors in uncertainties that should be considered. Assuming the same accuracy for the calorimetric (2.0% RTP) and Process Measurement Accuracy (PMA) effects for this function is reasonable since the channel sees the same conditions as the Power Range in the region of interest (Reference 8.4.1). SPC-RP-071 (Reference 8.4.1) assumes a single allowance of 10% RTP to conservatively envelope the Intermediate Range PMA. For the purposes of this evaluation, the extrapolated detector drift tolerance is calculated using the vendor data for detector accuracy included in SPC-RP-029 (Reference 8.4.2) consistent with the similarity with the power range detectors using the equations and data given below:

$$d_R = \left(\frac{CI}{DT}\right)(vd)\left(\frac{PS}{CS}\right)$$

$$D_{30} = \sqrt{a^2 + {d_R}^2 + m^2}$$

For Intermediate Range Detector (1NE-35, 1NE-36, 2NE-35, and 2NE-36):

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 24\ month$$

$$Vendor\ Drift\ (vd) = 0\%\ Calibrated\ Span$$

$$Process\ Span\ (PS) = 10^{-11}\ to\ 10^{-3}\ A$$

$$Input\ Span\ (CS) = 10^{-11}\ to\ 10^{-3}\ A$$

$$d_R = 0\%\ Calibrated\ Span$$

$$a = 0.5\%\ Calibrated\ Span$$

$$m = 0\%\ Calibrated\ Span$$

$$D_{30\ Detector} = \sqrt{0.5^2 + 0^2 + 0^2} = 0.5\%\ Calibrated\ Span$$

6.2 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent calibrated span. The extrapolated drift for the Intermediate Range detectors is calculated in Section 6.1 using percent calibrated span. These values are first converted into %ELFS using the methodology in Section 4.2:

Westinghouse Bistable:

$$DA\_Ext\_Rand_{bistable} = \pm 0.080\%\ Calibrated\ Span = 0.0008 \times 10\ VDC = 0.008\ VDC$$

$$FACTOR_{DA\_EXT\_RAND\ (Bistable)} = \frac{9.39\ VDC + 0.008\ VDC}{9.39\ VDC} = 1.00085$$

$$X_{DA\_EXT\_RAND\ (Bistable)} = \frac{\log\left(FACTOR_{DA\_EXT\_RAND\ (Bistable)}\right)}{8} = 4.6231 \times 10^{-5}\ \%\ ELFS$$

Philbrick Log Current Amplifier:

$$DA\_Ext\_Rand_{amp} = \pm 0.555\%\ Calibrated\ Span = 0.00555 \times 10\ VDC = 0.0555\ VDC$$

$$FACTOR_{DA\_EXT\_RAND\ (Amp)} = \frac{9.39\ VDC + 0.0555\ VDC}{9.39\ VDC} = 1.00591$$

$$X_{DA\_EXT\_RAND\ (Amp)} = \frac{\log\left(FACTOR_{DA\_EXT\_RAND\ (Amp)}\right)}{8} = 3.1992 \times 10^{-4}\ \%\ ELFS$$

Detector Extrapolated Drift:

$$D_{30\ Detector} = \pm 0.5\%\ Calibrated\ Span = 0.005 \times 10\ VDC = 0.05\ VDC$$

$$FACTOR_{30\ Detector} = \frac{9.39\ VDC + 0.05\ VDC}{9.39\ VDC} = 1.0053$$

$$X_{30\ Detector} = \frac{\log(FACTOR_{30\ Detector})}{8} = 2.8830 \times 10^{-4}\ \%\ ELFS$$

6.3 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations and the extrapolated detector drift is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$X_{DA\_EXT\_RAND\ (Bistable)}{}^2 + X_{DA\_EXT\_RAND\ (Amp)}{}^2 + X_{30\ Detector}{}^2 = X_{alog}{}^2 + X_{ab}{}^2 + X_{dbv}{}^2 + \left(X_{mlog1} + X_{mlog2}\right)^2 + X_{mb}{}^2$$

$$TLE = \sqrt{X_{DA\_EXT\_RAND\ (Bistable)}{}^2 + X_{DA\_EXT\_RAND\ (Amp)}{}^2 + X_{30\ Detector}{}^2}$$

$$TLE = [(4.6231 \times 10^{-5}\ \%\ ELFS)^2 + (3.1992 \times 10^{-4}\ \%\ ELFS)^2 + (2.8830 \times 10^{-4}\ \%\ ELFS)]^{1/2} = 4.3313 \times 10^{-4}\ \%\ ELFS$$

$$FACTOR_{TLE} = 10^{(4.3313\times10^{-4})\times8} = 1.00801$$

6.4 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = \frac{CL}{FACTOR_{TLE}}$$

$$NTSP_{\mathrm{I}} = \frac{3.223 \times 10^{-4}\ A}{1.00801} = 3.1974 \times 10^{-4}\ A$$

The NTSP is converted to VDC below:

$$\mathrm{NTSP} = 1.25 \times \log\left(\frac{\mathrm{NTSP_I}}{10^{-11}\ \mathrm{A}}\right) = 1.25 \times \log\left(\frac{3.1974 \times 10^{-4}\ A}{10^{-11}\ \mathrm{A}}\right) = 9.3810\ \mathrm{VDC}$$

6.5 Allowable Value (AV)

The allowable value for the Intermediate Range High Flux Reactor Trip Setpoint is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ LD = \sqrt{X_{DA\_EXT\_RAND\ (Bistable)}{}^2 + X_{DA\_EXT\_RAND\ (Amp)}{}^2 + X_{30\ Detector}{}^2}$$

$$LD = [(4.6231 \times 10^{-5}\ \%\ ELFS)^2 + (3.1992 \times 10^{-4}\ \%\ ELFS)^2 + (2.8830 \times 10^{-4}\ \%\ ELFS)^2]^{1/2} = 4.3313 \times 10^{-4}\ \%\ ELFS$$

$$FACTOR_{TLE} = 10^{(4.3313\times10^{-4})\times8} = 1.00801$$

$$AV = NTSP \times FACTOR_{LD}$$

$$AV = 3.1974 \times 10^{-4}\ A \times 1.00801 = 3.223 \times 10^{-4}\ A$$

Per Reference 8.4.1 this corresponds to a power level of 40% RTP.

6.6 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint cannot be directly evaluated for the Intermediate Range High Flux Trip setpoint. The actual plant setting is a calculated value using current core conditions and changes with each calibration (Section 4.4). To provide a point of comparison for the updated NTSP value calculated in Section 6.4 the setpoint margin is calculated below comparing against the largest of the calibrated high bistable trip setpoints from the most recent calibration for each unit (Section 4.5):

$$\text{Acceptance Criteria (Increasing): NTSP} \geq \text{APS} + \text{AFT}$$

Unit 1 (1N35):

$$9.3810\ \text{VDC} \geq 9.30\ \text{VDC} + 0.01\ \text{VDC}$$

$$9.3810\ \text{VDC} \geq 9.31\ \text{VDC}$$

Unit 2 (2N36):

$$9.3810\ \text{VDC} \geq 9.14\ \text{VDC} + 0.01\ \text{VDC}$$

$$9.3810\ \text{VDC} \geq 9.15\ \text{VDC}$$

Therefore, when compared against the most recent surveillance data the setpoint margin is acceptable using the updated instrument drift.

6.7 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2. The AV is evaluated below:

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

$$AV_{Tech\ Spec} \leq AV_{Calc}$$

$$40\%\ RTP \leq 40\%\ RTP$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-026 (Reference 8.3.1) and SPC-DR-034 (Reference 8.3.2), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Intermediate Range Neutron Flux instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-026, Revision 0, "Drift Analysis of As-Found/As-Left Data for Westinghouse 3359C39G01 Power Range Bistables and Intermediate Range Bistables".

8.3.2 SPC-DR-034, Revision 0, "Drift Analysis of As-Found/As-Left Data for Philbrick Log Current Amp 2372A27".

8.4 Setpoint Calculations:

8.4.1 SPC-RP-071, Revision 0, "U1 NIS Intermediate High Flux Reactor Trip Setpoint".

8.4.2 SPC-RP-029, Revision 0, "U1 Pwr Range High Flux Reactor Trip High Setpoint".

8.5 Technical Specifications:

8.5.1 Unit 1, "Northern States Power Company Docket No. 50-282 Prairie Island Nuclear Generating Plant, Unit 1 Renewed Facility Operating License", Amendment 230.

8.5.2 Unit 2, "Northern States Power Company Docket No. 50-306 Prairie Island Nuclear Generating Plant, Unit 2 Renewed Facility Operating License", Amendment 218.

8.6 Surveillance Procedures:

8.6.1 SP 1318.2, Revision 22, "NIS Intermediate Range Channel Calibration".

8.6.2 SP 2318.2, Revision 22, "NIS Intermediate Range Channel Calibration".

8.7 SAP Database:

8.7.1 Data Pulled from Prairie Island's SAP Database (January – February 2021).

8.8 Design Control Documents:

8.8.1 Northern States Power Technical Manual Number XH-1-1931, Rev. 7 Nuclear Instrumentation System.

8.9 Work Orders:

8.9.1 Work Order 700029518, Revision 2, "SP 2318.2 – Intermediate Range Chnl Cal".

8.9.2 Work Order 700044386, Revision 2, "SP 1318.2 Intermediate Range Channel Cal".

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1.0 Purpose

The purpose of this attachment is to provide justification that the change in the surveillance interval from 24 to 30 months for does not adversely impact the plant operation for Source Range Neutron Flux Instruments that perform trips listed in the Unit 1 and Unit 2 Tech Specs, Table 3.3.1-1, Function 5 (1). This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers following instruments:

Table 1-1: Affected Instrumentation

Drawer	Instrument Number	Manufacturer	Model
1N31	1N31-NM101	WESTINGHOUSE	6052D22G01
1N31	1N31-NM102	WESTINGHOUSE	3363C63G01
1N31	1N31-NM103	WESTINGHOUSE	3365C61G01
1N31	1N31-NM104	WESTINGHOUSE	3359C35G01
1N31	1N31-NM105	WESTINGHOUSE	3359C33G01
1N31	1N31-NC101	WESTINGHOUSE	3359C39G01
1N32	1N32-NM101	WESTINGHOUSE	6052D22G01
1N32	1N32-NM102	WESTINGHOUSE	3363C63G01
1N32	1N32-NM103	WESTINGHOUSE	3365C61G01
1N32	1N32-NM104	WESTINGHOUSE	3359C35G01
1N32	1N32-NM105	WESTINGHOUSE	3359C33G01
1N32	1N32-NC101	WESTINGHOUSE	3359C39G01
2N31	2N31-NM101	WESTINGHOUSE	6052D22G01
2N31	2N31-NM102	WESTINGHOUSE	3363C63G01
2N31	2N31-NM103	WESTINGHOUSE	3365C61G01
2N31	2N31-NM104	WESTINGHOUSE	3359C35G01
2N31	2N31-NM105	WESTINGHOUSE	3359C33G01
2N31	2N31-NC101	WESTINGHOUSE	3359C39G01
2N32	2N32-NM101	WESTINGHOUSE	6052D22G01
2N32	2N32-NM102	WESTINGHOUSE	3363C63G01
2N32	2N32-NM103	WESTINGHOUSE	3365C61G01
2N32	2N32-NM104	WESTINGHOUSE	3359C35G01
2N32	2N32-NM105	WESTINGHOUSE	3359C33G01
2N32	2N32-NC101	WESTINGHOUSE	3359C39G01

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

2.1. Missing Unit 2 Calculations

This calculation applies to both Unit 1 Source Range Neutron Flux Drawers, 1N31 and 1N32, and both Unit 2 Source Range Neutron Flux Drawers, 2N31 and 2N32. Per References 8.7.1 and 8.8.1, all the drawers in this evaluation contain the same instruments. Per References 8.6.1 and 8.6.2, the U1 and U2 NIS Source Range Neutron Flux drawers are calibrated with the same M&TE, are configured to the same actual plant setpoint, and have the same as-found tolerances.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria. This function is part of the Terminal Requirement Manual; hence the Allowable Value calculation is not required.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from Drift Calculation SPC-DR-036, "Drift Analysis of As-Found /As-Left Data for Westinghouse Source Range Indicators (NM101, NM102, NM103, NM104, NM105, and NC101)" (Reference 8.3.1). This calculation evaluates the instrument drift of the instruments used in this setpoint calculation.

4.1.1 SPC-DR-036

The Source Range Neutron Flux Drawers were evaluated, and the following values were calculated:

$$\text{DA\_Ext\_Rand} = \pm 0.01421 \text{ VDC}$$

$$\text{DA\_Ext\_Bias} = 0 \text{ VDC}$$

4.2 Setpoint/Uncertainty Calculations

The NIS Source Range High Flux Reactor Trip Setpoint is evaluated in setpoint calculation: SPC-RP-073, "U1 NIS Source Range High Flux Reactor Trip Setpoint" (Reference 8.4.1). Pertinent information from this calculation for this evaluation is summarized below:

Section 2.0 of Reference 8.4.1 provides the following information:

> $\text{Process Span} = 10^1 \text{ to } 10^6 \text{ counts per second (cps)}$
> $\text{Allowable Value (AV)} = 10^6 \text{ cps}$ (See also Reference 8.5.1 and 8.5.2)
> Analytical Limit = The Point of Adding Heat (POAH). The POAH is roughly 1.5 decades above the upper limit of Source Range Instrumentation, thus the true AV is out of the Source Range Calibrated Span and is not determined by Reference 8.4.1. For the purposes of this calculation, the AV is set at the upper limit of Source Range Span, 10^6 cps.

Per Section 3.0 of Reference 8.4.1, Total Loop Error of the Source Range Drawer components (TLE_D) for normal conditions is calculated using the following equation:

$$\text{TLE}_D \text{ (SRSS)} = [a^2 + d^2 + m^2 + t^2]^{1/2}$$

Where:

a	=	Accuracy for the Source Range Drawer as given in Reference 8.7.1
d	=	Drift for the Source Range Drawer (conservatively estimated to be equal to drawer accuracy).
m	=	Measurement and Test Equipment allowance for the Source Range Drawer.
t	=	Source Range Drawer temperature effects.

Per Section 3.0 of Reference 8.4.1:
- Accuracy (a) is 3×10^4 cps
- Drift (d) is 3×10^4 cps
- Measurement and Test Equipment Allowance (m) is 2×10^4 cps
- Temperature effects are 1×10^4 cps

After entering the data, the total loop error is calculated as:

$$\text{TLE}_D = [(3 \times 10^4 \text{ cps})^2 + (3 \times 10^4 \text{ cps})^2 + (2 \times 10^4 \text{ cps})^2 + (1 \times 10^4 \text{ cps})^2]^{\frac{1}{2}}$$

$$\text{TLE}_\text{D} = 4.796 \times 10^4 \text{ cps}$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AV - TLE_D$$

Per Reference 8.4.1, SPC-RP-073, Section 3.0, the relationship between Source Range Counts and voltage is:

$$VDC = \left(\frac{5}{3}\right) \cdot \log\left(\frac{cps}{10^0}\right)$$

(10 VDC / 6 decades = 5/3)

4.3 Calibration Procedures

The Actual Plant Setting (APS) & As Found Tolerance (AFT) are taken from SPC-RP-073 and Surveillance Procedures SP 1318.1, SP 2318.1 (References 8.4.1, 8.6.1, 8.6.2)

$$\text{APS} = 8.34 \text{ VDC or } 10^5 \text{ cps}$$

$$\text{AFT} = \pm 0.01 \text{ VDC}$$

$$APS_{High} = APS + AFT = 8.34\,VDC + 0.01\,VDC = 8.35VDC$$

$$APS_{Low} = APS - AFT = 8.34\,VDC - 0.01\,VDC = 8.33VDC$$

Converting APS_{High} and APS_{Low} to cps using the relationship in section 4.2:

$$APS_{High} = 10^0 \times 10^{\left(\frac{3}{5}\right)(8.35)} = 1.023 \times 10^5\,cps$$

$$APS_{Low} = 10^0 \times 10^{\left(\frac{3}{5}\right)(8.33)} = 0.995 \times 10^5\,cps$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each drawer was calculated in SPC-DR-036 (Reference 8.3.1) using VDC. To interface with the equations and values taken from SPC-RP-073 (Reference 8.4.1) the drift data is converted into process units using the relationship described in section 4.2:

$$\text{DA\_Ext\_Rand} = \pm 0.01421 \text{ VDC} = \pm 10^0 \times 10^{\left(\frac{3}{5}\right)(0.01421)} = \pm 1.0198 \times 10^0\,cps$$

$$\text{DA\_Ext\_Bias} = 0 \text{ VDC} = 0 \text{ cps}$$

6.2 Total Loop Error (TLE)

Instrument drift from the SPC-DR-036 (Reference 8.3.1) is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$(DA\_Ext\_Rand)^2 = a^2 + d^2 + m^2$$

Therefore, using PINGP's Setpoint Methodology:

$$TLE_D\ (SRSS) = \ [(DA\_Ext\_Rand)^2 + t^2]^{1/2}$$

$$TLE_D(SRSS) = [(1.0198 \times 10^0 \text{cps})^2\ + (1 \times 10^4\ cps)^2]^{\frac{1}{2}} = \pm\ 1.0000 \times 10^4\ cps$$

$$DA\_Ext\_Bias = 0 \text{ cps}$$

$$TLE_D\ = 1.0000 \times 10^4 cps\ or\ \left(\frac{1.0000 \times 10^4}{10^6}\right)\% = 0.01\ \%\ of\ Process\ Span$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from sections 4.2 and the new calculated TLE_D values the nominal trip setpoint using the new drift value is calculated below:

For conservatism, and because of the unique relationship between the Analytical Limit and Allowable Value for this function, this Nominal Trip Setpoint (NTSP) is found by the following method:

$$NTSP = AV - TLE_D;$$

$$Where, AV = Allowable\ Value = \ 10^6\ cps \text{ (Section 4.2)}$$

$$Therefore\ the\ NTSP = \ 10^6\ cps - 1.0000 \times 10^4\ cps\ \ = \ 9.9 \times 10^5\ cps$$

6.4 Allowable Value (AV)

The allowable value is given by SPC-RP-073, Section 2.0. Therefore, the allowable value calculation is not required.

6.5 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in SPC-AF-EA-RC-RP-001, Main Body Section 3.1. Using each of the NTSP values calculated in Section 6.3 and the AFT and APS values the setpoint margin is evaluated below:

$$Acceptance\ Criteria\ (Increasing): NTSP\ \geq\ APS_{High}$$

$$9.9 \times 10^5\ cps\ \ \geq 1.023 \times 10^5\ cps$$

6.6 Allowable Value Acceptance

The allowable value is given by SPC-RP-073, Section 2.0 (Reference 8.4.1). The allowable value was not calculated by this Attachment. Therefore, the allowable value acceptance criteria is not required.

7.0 Conclusions and Plant Impact

After calculating an updated total loop error and nominal trip setpoint using the new calculated drift values provided in drift calculation SPC-DR-036 (Reference 8.3.1), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Source Range Neutron Flux Drawers can be extended to 30 months without impact to the subject setpoint.

8.0 References

8.1 Industry Guidance

8.1.1 EPRI Report TR-103335, Revision 2, Guidelines for Instrument Calibration Extension/Reduction Programs.

8.2 Engineering Manuals

8.2.1 EM 3.3.4.2, Revision 1, The Analysis of Instrument Drift.

8.2.2 EM 3.3.4.1, Revision 2, Instrument Setpoint/Uncertainty Calculations.

8.3 Drift Calculations

8.3.1 SPC-DR-036, Revision 1, Drift Analysis of As-Found /As-Left Data for Westinghouse Source Range Indicators (NM101, NM102, NM103, NM104, NM105, and NC101).

8.4 Setpoint Calculations

8.4.1 SPC-RP-073, Revision 0, U1 NIS Source Range High Flux Reactor Trip Setpoint.

8.5 Technical Specifications

8.5.1 Unit 1, Northern States Power Company Docket No. 50-282 Prairie Island Nuclear Generating Plant, Unit 1 Renewed Facility Operating License, Amendment 230

8.5.2 Unit 2, Northern States Power Company Docket No. 50-306 Prairie Island Nuclear Generating Plant, Unit 2 Renewed Facility Operating License, Amendment 218

8.6 Surveillance Procedures

8.6.1 Surveillance Procedure SP 1318.1, NIS Source Range Channel Calibration, Rev.22

8.6.2 Surveillance Procedure SP 2318.1, NIS Source Range Channel Calibration, Rev. 22

8.7 Design Control Documents

8.7.1 Northern States Power Technical Manual Number XH-1-1931, Rev. 7, Nuclear Instrumentation System.

8.8 Database

8.8.1 Instrument Data From Prairie Island's SAP Database (January – February 2021)

Prepared By:	Savim Acharya	Digitally signed by Savim Acharya Date: 2021.07.13 15:37:27 -05'00' (Signature)	See Signature (Date)
Reviewed By:	Jack Cash	Jack S. Cash Jr. Digitally signed by Jack S. Cash Jr. Date: 2021.07.13 15:41:56 -05'00' (Signature)	See Signature (Date)

Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Overtemperature Delta-T instrument loops which perform Reactor Trip. This justification will provide input into the LAR being submitted to extend surveillance intervals. This Attachment considers the following instruments (see References 8.4.1 through 8.4.10).

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1PT-429	ROSEMOUNT	3154NG6R2F0E7
1PT-430	ROSEMOUNT	3154NG6R2F0E7
1PT-431	ROSEMOUNT	3154NG6R2F0E7
1PT-449	ROSEMOUNT	3154NG6R2F0E7
1TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-402B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-403B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-404B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TE-401B	RDF	21450
1TE-402B	RDF	21450
1TE-403B	RDF	21450
1TE-404B	RDF	21450
1TT-401B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-402B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-403B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-404B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TM-401BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
1TM-402BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
1TM-403BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
1TM-404BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
1TE-405A	RDF	21450
1TE-402A	RDF	21450
1TE-403A	RDF	21450
1TE-404A	RDF	21450
1TT-401A	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-402A	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-403A	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-404A	NUS INSTRUMENTS	RTL501-3/13 C-011
1TM-405R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
1TM-406R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
1TM-407R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
1TM-408R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
1TC-405C/D	NUS INSTRUMENTS	DAM503-03*
1TC-406C/D	NUS INSTRUMENTS	DAM503-03
1TC-407C/D	NUS INSTRUMENTS	DAM503-03
1TC-408C/D	NUS INSTRUMENTS	DAM503-03

1NE-41A/B	WESTINGHOUSE	WL-23686
1NE-42A/B	WESTINGHOUSE	WL-23686
1NE-43A/B	WESTINGHOUSE	WL-23686
1NE-44A/B	WESTINGHOUSE	WL-23686
1N41-NI301	WESTINGHOUSE	10072C10G01
1N42-NI301	WESTINGHOUSE	10072C10G01
1N43-NI301	WESTINGHOUSE	10072C10G01
1N44-NI301	WESTINGHOUSE	10072C10G01
1N41-NI302	WESTINGHOUSE	10072C10G01
1N42-NI302	WESTINGHOUSE	10072C10G01
1N43-NI302	WESTINGHOUSE	10072C10G01
1N44-NI302	WESTINGHOUSE	10072C10G01
1N41-NM306	WESTINGHOUSE	N200-3
1N42-NM306	WESTINGHOUSE	N200-3
1N43-NM306	WESTINGHOUSE	N200-3
1N44-NM306	WESTINGHOUSE	N200-3
1N41-NM307	WESTINGHOUSE	N200-3
1N42-NM307	WESTINGHOUSE	N200-3
1N43-NM307	WESTINGHOUSE	N200-3
1N44-NM307	WESTINGHOUSE	N200-3
1TM-401T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
1TM-402T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
1TM-403T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
1TM-404T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
2PT-429	ROSEMOUNT	1154GP9RC
2PT-430	ROSEMOUNT	1154GP9RC **
2PT-431	ROSEMOUNT	1154GP9RC
2PT-432	ROSEMOUNT	1154GP9RC
2TM-401B	FOXBORO	TMD500-20/05/05/00-08-08-03
2TM-402B	FOXBORO	TMD500-20/05/05/00-08-08-03
2TM-403B	FOXBORO	TMD500-20/05/05/00-08-08-03
2TM-404B	FOXBORO	TMD500-20/05/05/00-08-08-03
2TE-401B	Ultra-Electronics	N9355E-2A-20
2TE-402B	Ultra-Electronics	N9355E-2A-20
2TE-403B	Ultra-Electronics	N9355E-2A-20
2TE-404B	Ultra-Electronics	N9355E-2A-20
2TT-401B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-402B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-403B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-404B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TM-401BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
2TM-402BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
2TM-403BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
2TM-404BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
2TE-405A	Ultra-Electronics	N9355E-2A-20
2TE-402A	Ultra-Electronics	N9355E-2A-20
2TE-403A	Ultra-Electronics	N9355E-2A-20
2TE-404A	Ultra-Electronics	N9355E-2A-20

2TT-401A	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-402A	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-403A	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-404A	NUS INSTRUMENTS	RTL501-3/13 C-011
2TM-405R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
2TM-406R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
2TM-407R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
2TM-408R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
2TC-405C/D	NUS INSTRUMENTS	DAM503-03
2TC-406C/D	NUS INSTRUMENTS	DAM503-03
2TC-407C/D	NUS INSTRUMENTS	DAM503-03
2TC-408C/D	NUS INSTRUMENTS	DAM503-03
2NE-41A/B	WESTINGHOUSE	WL-23686
2NE-42A/B	WESTINGHOUSE	WL-23686
2NE-43A/B	WESTINGHOUSE	WL-23686
2NE-44A/B	WESTINGHOUSE	WL-23686
2N41-NI301	WESTINGHOUSE	10072C10G01
2N42-NI301	WESTINGHOUSE	10072C10G01
2N43-NI301	WESTINGHOUSE	10072C10G01
2N44-NI301	WESTINGHOUSE	10072C10G01
2N41-NI302	WESTINGHOUSE	10072C10G01
2N42-NI302	WESTINGHOUSE	10072C10G01
2N43-NI302	WESTINGHOUSE	10072C10G01
2N44-NI302	WESTINGHOUSE	10072C10G01
2N41-NM306	WESTINGHOUSE	N200-3
2N42-NM306	WESTINGHOUSE	N200-3
2N43-NM306	WESTINGHOUSE	N200-3
2N44-NM306	WESTINGHOUSE	N200-3
2N41-NM307	WESTINGHOUSE	N200-3
2N42-NM307	WESTINGHOUSE	N200-3
2N43-NM307	WESTINGHOUSE	N200-3
2N44-NM307	WESTINGHOUSE	N200-3
2TM-401T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
2TM-402T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
2TM-403T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
2TM-404T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001

* Existing Setpoint calculation (SPC-RP-064, Rev 1A) shows instrument 1TC405 C/D dual alarm trip bistable as Model number DAM505-03. However, all the NUS dual alarm units installed at PINGP are Model number DAM503-03.

**This instrument will be replaced with a Rosemount 3154NG6R2F0E7, and as such, it is analyzed as a Rosemount 3154NG6R2F0E7 in this calculation.

2.0 Methodology

SPC-RP-062 (Reference 8.4.1), SPC-RP-063 (Reference 8.4.2), SPC-RP-064 (Reference 8.4.3), SPC-RP-065 (Reference 8.4.4), SPC-RP-065 (Reference 8.4.4), SPC-RP-092 (Reference 8.4.6), SPC-RP-093 (Reference 8.4.7), SPC-RP-094 (Reference 8.4.8),and SPC-RP-095 (Reference 8.4.9) calculate OTΔT loop uncertainties using the uncertainty combination methodology of EM 3.3.4.1 (Reference 8.2.1). This Attachment updates the loop uncertainties determined in each

calculation using the results of 30-month instrument drift analyses (Section 6.1.1 and Section 6.1.14) per SPC-AF-EA-RC-RP-001 Section 2.1.

The four unit 1 uncertainty calculations provide input to SPC-RP-066 (Reference 8.4.5) and the four unit 2 uncertainty calculations provide input to SPC-RP-096 (Reference 8.4.10) to evaluate the Unit 1 and Unit 2 OTΔT reactor trip setpoints. The evaluations in SPC-RP-066 and SPC-RP-096 differ from the methodology in SPC-AF-EA-RC-RP-001 Section 2. Each calculation determines the Analytical Limit (AL), Nominal Trip Setpoint (NTSP), Calculated Allowable Value (AV_{Calc}), COLR Allowable Value (AV_{COLR}), and Actual Trip Setpoint (ATSP). The methodology for the calculation of these terms within SPC-RP-066 and SPC-RP-096 is detailed in Sections 4.3.9 and 4.3.10 of this Attachment, respectively.

This Attachment updates each value in accordance with the existing methodology of each calculation. The updated values are evaluated against the same acceptance criteria used in SPC-RP-066 and SPC-RP-096 (see Section 3.0 of this Attachment).

The Unit 1 and Unit 2 setpoint calculations SPC-RP-066 (Reference 8.4.5) and SPC-RP-096 (Reference 8.4.10) provide different values for the total loop error and subsequently different nominal trip setpoints and allowable values. Because of this, the design inputs in Section 4.0 and analysis in Section 6.0 are given separately for Unit 1 and Unit 2.

3.0 Acceptance Criteria

This Attachment evaluates the OTΔT Allowable Value and Nominal Trip Setpoint against the same acceptance criteria used in SPC-RP-066 (Reference 8.4.5) and SPC-RP-096 (Reference 8.4.10). The results are considered acceptable if the following criteria are met:

1. The Actual Trip Setpoint is conservative to the Nominal Trip Setpoint (ATSP ≤ NTSP)
2. The COLR Allowable Value is conservative to the calculated Allowable Value (AVCOLR ≤ AVCalc)
3. The Nominal Trip Setpoint is conservative to the calculated Allowable Value (NTSP ≤ AVCalc)

This Attachment does not utilize the Setpoint Margin Acceptance Criteria in SPC-AF-EA-RC-RP-001 Section 3.1 because the OTΔT Trip function has no fixed setpoint (see Section 2.0).

The comparison of AVCOLR to AVCalc is equivalent to the Allowable Value Acceptance Criteria in SPC-AF-EA-RC-RP-001 Section 3.2 (AVTech Spec ≤ AVCalc) since the Technical Specifications (References 8.5.1 and 8.5.2) define the OTΔT Allowable Value using COLR parameters (see References 8.5.3 and 8.5.4).

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from following drift calculations:

1. SPC-DR-012, Drift Analysis of As-Found /As -Left Data for NUS R/V Converter RTL501 (Reference 8.3.1)
2. SPC-DR-014, Drift Analysis of As-Found /As -Left Data for NUS HI Selector SGU501 (Reference 8.3.2)
3. SPC-DR-016, Drift Analysis of As-Found /As -Left Data for NUS Lead /Lag Unit TMD500-20/00/00/00-08-08-03 IDS D-009 IDS (Reference 8.3.3)
4. SPC-DR-017, Drift Analysis of As-Found /As -Left Data for NUS Lag Unit TMD500-06/00/00/00-06-08-03 D-016 (Reference 8.3.4)
5. SPC-DR-018, Drift Analysis of As-Found/As -Left Data for NUS TMD500-20/05/05/00-08-08-03 Flux – Control Room (Reference 8.3.5)
6. SPC-DR-021, Drift Analysis of As-Found /As -Left Data for Rosemount Transmitter 1154GP9RC (Reference 8.3.6)
7. SPC-DR-029, Drift Analysis of As-Found /As -Left Data for Westinghouse Isolation Amplifier N200-3 (Reference 8.3.7)
8. SPC-DR-037, Drift Analysis of As-Found /As -Left Data for NUS Bistable DAM503-03 (mA) (Reference 8.3.8)
9. SPC-DR-040, Drift Analysis of As-Found/As -Left Data for NUS TMD500-20/05/05/00-08-08-03 Temperature and Pressure – Control Room (Reference 8.3.9)

These calculations evaluate the drift of the instruments listed in Table 1.1. Data from each calculation is listed in Sections 4.1.1 through 4.1.9.

4.1.1 SPC-DR-012

The NUS R/V Converter RTL501-3/13 C-011 was evaluated and the following values were calculated:

$$\text{DA\_Ext\_Rand}_{\text{RTL501}} = \pm 0.201\ \%\ \text{Calibrated Span}$$
$$\text{DA\_Ext\_Bias}_{\text{RTL501}} = 0\ \%\ \text{Calibrated Span}$$

4.1.2 SPC-DR-014

The NUS HI Selector SGU501 was evaluated and the following values were calculated:

$$\text{DA\_Ext\_Rand}_{\text{SGU501}} = \pm 0.316\ \%\ \text{Calibrated Span}$$
$$\text{DA\_Ext\_Bias}_{\text{SGU501}} = +\,0.067\ \%\ \text{Calibrated Span}$$

4.1.3 SPC-DR-016

The NUS Lead/Lag Unit TMD500-20/00/00/00-08-08-03 IDS D-009 was evaluated and the following values were calculated:

$$\text{DA\_Ext\_Rand}_{TMD500-20/00/00/00} = \pm 0.367\ \%\ \text{Calibrated Span}$$
$$\text{DA\_Ext\_Bias}_{TMD500-20/00/00/00} = +\,0.080\ \%\ \text{Calibrated Span}$$

4.1.4 SPC-DR-017

The NUS Lead/Lag Unit TMD500-06/00/00/00-06-08-03 D-016 was evaluated and the following values were calculated:

$$\text{DA\_Ext\_Rand}_{TMD500-06/00/00/00} = \pm 0.254\ \%\ \text{Calibrated Span}$$

$$\text{DA\_Ext\_Bias}_{TMD500-06/00/00/00} = 0 \text{ \% Calibrated Span}$$

4.1.5 SPC-DR-018

The NUS Unit TMD500-20/05/05/00-08-08-03 Flux was evaluated and the following values were calculated:

$$\text{DA\_Ext\_Rand}_{TMD500-20/05/05/00-Flux} = \pm 0.262 \text{ \% Calibrated Span}$$
$$\text{DA\_Ext\_Bias}_{TMD500-20/05/05/00-Flux} = +0.052 \text{ \% Calibrated Span}$$

4.1.6 SPC-DR-021

The Rosemount Transmitter 1154GP9RC was evaluated and the following values were calculated:

$$\text{DA\_Ext\_Rand}_{\text{1154GP9RC}} = \pm 1.264 \text{ \% Calibrated Span}$$
$$\text{DA\_Ext\_Bias}_{\text{1154GP9RC}} = 0 \text{ \% Calibrated Span}$$

4.1.7 SPC-DR-029

The Westinghouse N200-3 was evaluated and the following values were calculated:

$$\text{DA\_Ext\_Rand}_{\text{N200}-3} = \pm 0.243 \text{ \% Calibrated Span}$$
$$\text{DA\_Ext\_Bias}_{\text{N200}-3} = +0.055 \text{ \% Calibrated Span}$$

4.1.8 SPC-DR-037

The Westinghouse DAM503-03 (mA) was evaluated and the following values were calculated:

$$\text{DA\_Ext\_Rand}_{\text{DAM503}-03} = \pm 0.0697 \text{ \% Calibrated Span}$$
$$\text{DA\_Ext\_Bias}_{\text{DAM503}-03} = +0 \text{ \% Calibrated Span}$$

4.1.9 SPC-DR-040

The NUS Unit TMD500-20/05/05/00-08-08-03 Temperature and Pressure (maDC) was evaluated and the following values were calculated:

$$\text{DA\_Ext\_Rand}_{\text{TMD500}-20/05/05-\text{T\&P}} = \pm 0.289 \text{ \% Calibrated Span}$$
$$\text{DA\_Ext\_Bias}_{\text{TMD500}-20/05/05-\text{T\&P}} = +0.033 \text{ \% Calibrated Span}$$

4.2 Insufficient Drift Data:

4.2.1 Rosemount Transmitter 3154NG6R2F0E7

ECR Document Number 601000001191, Revision 0 (Reference 8.7.6) replaces existing Rosemount Transmitter 1154GP9RC with Rosemount Transmitter 3154NG6R2F0E7. Vendor Technical Manual NX-20728-1 (Reference 8.7.5) provides the new uncertainties for the replacement transmitters. This attachment incorporates the changes in uncertainty associated with this replacement for the following instruments: 1PT-429, 1PT-430, 1PT-431, 1PT-449 and 2PT-430. The 3154N pressure transmitters which replace the 1154N transmitter were installed on 9/22/2020 per Design Input Transmittal 601000002918-001 (Reference 8.7.7). Because of the recent installation, the number of available data points is less than required to have a statistically valid pool for drift analysis, as defined in EM 3.3.4.2 Section 6.4.2 (Reference 8.2.2). As a result, no drift analysis was conducted for the 3154N pressure transmitters. Therefore, this Attachment will use vendor data to establish drift as described in Section 6.4.2 of EM 3.3.4.2.

4.2.2 Power Range Drawer B Digital Current Meter 10072C10G01

Per Design Equivalent Change 6EQVENG28491 (Reference 8.7.1) the Power Range Drawer B upper and lower detector digital current meters 1(2)N41-NI301(2), 1(2)N42-NI301(2), 1(2)N43-NI301(2), and 1(2)N44-NI301(2) were replaced with newly designed and qualified Digital Meter 2.0 assemblies per Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2 (Reference 8.7.2).

The new meter installations occurred in 2018 and 2019, limiting the number of available data points to less than required to have a statistically valid pool for drift analysis, as defined in EM 3.3.4.2 section 6.4.2 (Reference 8.2.2). As a result, no drift analysis was conducted for the power range upper and lower detector current meters. Therefore, this Attachment will use vendor data to establish drift data as described in section 6.4.2 of EM 3.3.4.2 (Reference 8.2.2) for conditions of insufficient drift data due to new or replaced components. The vendor data will be used to develop a drift allowance by evaluating the calibration interval and manufacture's drift specification as described in section 4.2.3 below.

The vendor data for the Power Range Drawer B digital current meters is provided in Westinghouse design input document NIS Technical Manual Appendix Digital Meter 2.0 – Power Range A & B Section 1.3.1 "Specification of Digital Meter"(Reference 8.7.3) and as evaluated in Design Equivalent Change 6EQVENG28491 Section B.4 "Design Evaluation" (Reference 8.7.1).

Characteristic	Detail
Noise Rejection	Greater than 54 dB at 1 Hz ("SLOW" meter rate)
	Greater than 100 dB at 60 Hz ("SLOW" or "FAST" meter rate)
Conversion Rate	5 conversions per second
Accuracy	± 0.03% of reading (± 0.003%, meter alone)
Zero Stability	Auto-zero, ± 0.2 µV/ C (400.0 mV full scale input)
Display	4 digits, red LED, 0.43" high digits
Temperature Range	-10 to +50 degrees C Temperature
Coefficient	± 7 ppm of reading per degree C
Relative Humidity	0 to 90 %, non-condensing

* Per References 8.4.12 and 8.7.1 the current setpoint calculation evaluates meter accuracy as = 0.1% span. This accuracy value bounds the meter replacement specification as described in Reference 8.7.1 and represents worst case error.

4.2.3 Ultra Electronics RTD N9355E-2A-20:

Form 3 in Section 4.3 of SPC-RC-093, Rev. 0A (Reference 8.4.7) provides a drift value of 0.3333 DEG F for 2TE-401B which is Ultra Electronics model N9355E-2A-20. Drift specification is provided for 12 months per Design Input 16 (0.2°F) and extrapolated to 0.3333 °F for 24 months in section 5.2.2 with additional 25% late factor allowance.

4.2.4 RTD 21450:

Form 3 in Section 4.3 of SPC-RC-063, Rev. 1A (Reference 8.4.2) provides a vendor drift value of 0 DEG F for 1TE-401B which is an RDF model 21450 RTD .

4.3 Setpoint/Uncertainty Calculations

The Overtemperature ΔT function has ten (10) associated setpoint calculations. The methodology and final values from each calculation are listed in Sections 4.2.1 through 4.2.5.

Unit 1:

1. SPC-RP-062, "UNIT 1 REACTOR COOLANT LOW FLOW REACTOR TRIP" (Reference 8.4.1)
2. SPC-RP-063, "Tavg Signal Error Contribution to OTDT Trip" (Reference 8.4.2)
3. SPC-RP-064, "Delta T Signal Error Contribution to OTDT Trip" (Reference 8.4.3)
4. SPC-RP-065, "Flux Tilt Penalty Signal Error Contribution to OTDT Trip" (Reference 8.4.4)
5. SPC-RP-066, "Overtemperature Delta T Reactor Trip Instrument Channel Uncertainty Combination & Setpoint Analysis" (Reference 8.4.5)

Unit 2:

1. SPC-RP-092, “Pressurizer Pressure Signal Error Contribution to OTDT Trip” (Reference 8.4.6)
2. SPC-RP-093, “Tavg Signal Error Contribution to OTDT Trip” (Reference 8.4.7)
3. SPC-RP-094, “Delta T Signal Error Contribution to OTDT Trip” (Reference 8.4.8)
4. SPC-RP-095, “Flux Tilt Penalty Signal Error Contribution to OTDT Trip” (Reference 8.4.9)
5. SPC-RP-096, “Unit 2 Overtemperature Delta T Reactor Trip Instrument Channel Uncertainty Combination & Setpoint Analysis” (Reference 8.4.10)

4.3.1 : SPC-RP-062:- Pressurizer Pressure input to OTDT trip bistable

Form 1 of SPC-RP-062 (Reference 8.4.1) provides the following information:

$$\text{Process Span} = 1715.0 \text{ To } 2515.0 \text{ PSIG}$$
$$\text{Analytical Limit (AL)} = 2410 \text{ PSIG}$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$\text{SRSS} = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$\text{Bias}_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$\text{Bias}_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$\text{TLE}_{pos} = \text{SRSS} + \text{Bias}_{pos}$$
$$\text{TLE}_{neg} = -SRSS - Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-062), the total loop error (TLE) is calculated as:

$$\text{SRSS} = [32 \text{ (PSIG}^2) + 27.620 \text{ (PSIG}^2) + 116.68 \text{ (PSIG}^2) + 0 \text{ (PSIG}^2) + 0 \text{ (PSIG}^2) + 0 \text{ (PSIG}^2) + 0.07840 \text{(PSIG}^2) + 222.20 \text{ (PSIG}^2) + 900 \text{ (PSIG}^2) + 0 \text{ (PSIG}^2) + 225 \text{ (PSIG}^2) + 0 \text{(PSIG}^2) + (0 \text{ PSIG})^2 + (0 \text{ PSIG})^2 + (0 \text{ PSIG})^2]^{\frac{1}{2}} = \pm 39.033 \text{ PSIG}$$

$$\text{Bias}_{pos} = 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} = 0 \text{ PSIG}$$

$$\text{Bias}_{neg} = 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} + 0 \text{ PSIG} = 0 \text{ PSIG}$$

$$\mathbf{TLE_{pos}} = 39.033 \text{ PSIG} + 0 \text{ PSIG} = 39.033 \text{ PSIG}$$
$$\mathbf{TLE_{neg}} = -39.033 \text{ PSIG} - 0 \text{ PSIG} = -39.033 \text{ PSIG}$$

SPC-RP-062 provides input to the calculation SPC-RP-066. The total loop error will be used in SPC-RP-066 to calculate the new total loop error.

4.3.2 : SPC-RP-092:- Pressurizer Pressure input to OTDT trip bistable

Form 1 of SPC-RC-092 (Reference 8.4.6) provides the following information:

$$\text{Process Span} = 1715.0 \text{ To } 2515.0 \text{ PSIG}$$
$$\text{Analytical Limit (AL)} = 2410 \text{ PSIG}$$

Total loop error for a Normal condition is calculated using the following equations:

$$\text{SRSSN} = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NR} + R_{NR} + H_{NSR} + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$\text{TLEN}_{pos} = \text{SRSSN} + \text{Bias}_{pos}$$
$$\text{TLEN}_{neg} = -SRSSN - Bias_{neg}$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$\text{SRSS} = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$\text{Bias}_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$\text{Bias}_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$\text{TLE}_{pos} = \text{SRSS} + \text{Bias}_{pos}$$
$$\text{TLE}_{neg} = -SRSS - Bias_{neg}$$

After entering the data for Unit 2 (SPC-RP-092), the total loop error (TLE) is calculated as:

$$\text{SRSSN} = [32\ (\text{PSIG}^2) + 27.620\ (\text{PSIG}^2) + 86.608\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0.07840(\text{PSIG}^2) + 71.113\ (\text{PSIG}^2) + 900\ (\text{PSIG}^2) + 0(\text{PSIG}^2) + (0\ \text{PSIG})^2 + (0\ \text{PSIG})^2 + (0\ \text{PSIG})^2]^{\frac{1}{2}} = \pm 33.428\ \text{PSIG}$$

$$\text{SRSS} = [32\ (\text{PSIG}^2) + 27.620\ (\text{PSIG}^2) + 86.608\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0.07840(\text{PSIG}^2) + 71.113\ (\text{PSIG}^2) + 900\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 225\ (\text{PSIG}^2) + 0(\text{PSIG}^2) + (0\ \text{PSIG})^2 + (0\ \text{PSIG})^2 + (0\ \text{PSIG})^2]^{\frac{1}{2}} = \pm 36.639\ \text{PSIG}$$

$$\text{Bias}_{pos} = 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} = 0\ \text{PSIG}$$

$$\text{Bias}_{neg} = 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} = 0\ \text{PSIG}$$

Per SPC-RP-092 (Reference 8.4.6), The normal environmental condition values will be used by OTDT setpoint calculation SPC-RP-096.

$$\mathbf{TLEN_{pos}} = 33.428\text{ PSIG} + 0\text{ PSIG} = 33.428\text{ PSIG}$$
$$\mathbf{TLEN_{neg}} = -33.428\text{ PSIG} - 0\text{ PSIG} = -33.428\text{ PSIG}$$

SPC-RP-092 provides input to the calculation SPC-RP-096. The total loop error will be used in SPC-RP-096 to calculate the new total loop error.

4.3.3: SPC-RP-063:- Tavg Signal Error Contribution to OTDT Trip

Form 1 of SPC-RP-063 (Reference 8.4.2) provides the following information:

$$\text{Process Span} = 520 \text{ To } 620\text{ °F}$$
$$\text{Analytical Limit (AL)} = 567.3\text{ °F}$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$\text{SRSS} = \left[\text{A} + \text{D}_\text{R} + \text{M} + \text{OPE}_\text{R} + \text{SPEZ}_\text{R} + \text{SPES}_\text{R} + \text{P}_\text{R} + \text{T}_\text{NSR} + \text{R}_\text{NR} + \text{H}_\text{NSR} + \text{S}_\text{R} + \text{READ} + \text{PEA}_\text{NR}{}^2 + \text{PMA}_\text{NR}{}^2 + \text{PC}_\text{NR}{}^2\right]^{1/2}$$

$$\text{Bias}_\text{pos} = \text{D}_\text{Bp} + \text{OPE}_\text{Bp} + \text{SPEZ}_\text{Bp} + \text{SPES}_\text{Bp} + \text{P}_\text{Bp} + \text{T}_\text{NSBp} + \text{R}_\text{NBp} + \text{H}_\text{NSBp} + \text{S}_\text{Bp} + \text{PEA}_\text{NBp} + \text{PMA}_\text{NBp} + \text{PC}_\text{NBp}$$

$$\text{Bias}_\text{neg} = \text{D}_\text{Bn} + \text{OPE}_\text{Bn} + \text{SPEZ}_\text{Bn} + \text{SPES}_\text{Bn} + \text{P}_\text{Bn} + \text{T}_\text{NSBn} + \text{R}_\text{NBn} + \text{H}_\text{NSBn} + \text{S}_\text{Bn} + \text{PEA}_\text{NBn} + \text{PMA}_\text{NBn} + \text{PC}_\text{NBn}$$

$$\text{TLE}_\text{pos} = \text{SRSS} + \text{Bias}_\text{pos}$$
$$\text{TLE}_\text{neg} = -SRSS - Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-063), the total loop error (TLE) is calculated as:

$$\text{SRSS} = [0.76778\ (\text{°F}^2) + 0.10050\ (\text{°F}^2) + 0.72155\ (\text{°F}^2) + 0\ (\text{°F}^2) + 0\ (\text{°F}^2) + 0\ (\text{°F}^2) + 0(\text{°F}^2) + 1.5256\ (\text{°F}^2) + 0\ (\text{°F}^2) + 0\ (\text{°F}^2) + 0(\text{°F}^2) + (0\text{ °F})^2 + (0\text{ °F})^2 + (0\text{ °F})^2]^{\frac{1}{2}} = \pm 1.7651\text{ °F}$$

$$\text{Bias}_\text{POS} = 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} = 0\text{ °F}$$

$$\text{Bias}_\text{neg} = 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} + 0\text{ °F} = 0.500\text{ °F (Assumption 5 of SPCRP063, Rev 1A)}$$

$$\mathbf{TLE_{pos}} = 1.7651\text{ °F} + 0\text{ °F} = 1.7651\text{ °F}$$
$$\mathbf{TLE_{neg}} = -1.7651\text{ °F} - 0.500\text{ °F} = -2.2651\text{ °F}$$

SPC-RP-063 provides input to the calculation SPC-RP-066. The total loop error will be used in OTDT setpoint calculation SPC-RP-066.

4.3.4: SPC-RP-093:- Tavg Signal Error Contribution to OTDT Trip

Form 1 of SPC-RP-093 (Reference 8.4.7) provides the following information:

$$\text{Process Span} = 520 \text{ To } 620\ °\text{F}$$
$$\text{Analytical Limit (AL)} = 0\ °\text{F}$$

Note: There is no Analytical/Process Limit (AL/PL) associated with the calculation of the uncertainty of the Tavg input to the Overtemperature Delta T (OTDT) function. Therefore, a value of zero (0) degrees Fahrenheit is used in this calculation for the AL/PL. Since this calculation is an uncertainty calculation and does not generate any trip setpoints or Allowable Values, the AL/PL is for reference only and has no numerical impact on the calculation

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$\text{SRSS} = \left[\text{A} + \text{D}_\text{R} + \text{M} + \text{OPE}_\text{R} + \text{SPEZ}_\text{R} + \text{SPES}_\text{R} + \text{P}_\text{R} + \text{T}_\text{NSR} + \text{R}_\text{NR} + \text{H}_\text{NSR} + \text{S}_\text{R} + \text{READ} + \text{PEA}_\text{NR}{}^2 + \text{PMA}_\text{NR}{}^2 + \text{PC}_\text{NR}{}^2\right]^{1/2}$$

$$\text{Bias}_\text{pos} = \text{D}_\text{Bp} + \text{OPE}_\text{Bp} + \text{SPEZ}_\text{Bp} + \text{SPES}_\text{Bp} + \text{P}_\text{Bp} + \text{T}_\text{NSBp} + \text{R}_\text{NBp} + \text{H}_\text{NSBp} + \text{S}_\text{Bp} + \text{PEA}_\text{NBp} + \text{PMA}_\text{NBp} + \text{PC}_\text{NBp}$$

$$\text{Bias}_\text{neg} = \text{D}_\text{Bn} + \text{OPE}_\text{Bn} + \text{SPEZ}_\text{Bn} + \text{SPES}_\text{Bn} + \text{P}_\text{Bn} + \text{T}_\text{NSBn} + \text{R}_\text{NBn} + \text{H}_\text{NSBn} + \text{S}_\text{Bn} + \text{PEA}_\text{NBn} + \text{PMA}_\text{NBn} + \text{PC}_\text{NBn}$$

$$\text{TLE}_\text{pos} = \text{SRSS} + \text{Bias}_\text{pos}$$
$$\text{TLE}_\text{neg} = -SRSS - Bias_{neg}$$

After entering the data for Unit 2 (SPC-RP-093), the total loop error (TLE) is calculated as:

$$\text{SRSS} = [0.76778\ (°\text{F}^2) + 1.21375\ (°\text{F}^2) + 0.82767\ (°\text{F}^2) + 0\ (°\text{F}^2) + 0\ (°\text{F}^2) + 0\ (°\text{F}^2) + 0 (°\text{F}^2) + 1.2357\ (°\text{F}^2) + 0\ (°\text{F}^2) + 0\ (°\text{F}^2) + 0 (°\text{F}^2) + (0\ °\text{F})^2 + (0\ °\text{F})^2 + (0\ °\text{F})^2]^{\frac{1}{2}} = \pm 2.0112\ °\text{F}$$

$$\text{Bias}_\text{POS} = 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} = 0\ °\text{F}$$

$$\text{Bias}_\text{neg} = 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} = 0\ °\text{F}$$

$$\mathbf{TLE_{pos}} = 2.0112\ °\text{F} + 0\ °\text{F} = 2.0112\ °\text{F}$$
$$\mathbf{TLE_{neg}} = -2.0112\ °\text{F} - 0\ °\text{F} = -2.0112\ °\text{F}$$

SPC-RP-093 provides input to the calculation SPC-RP-096. The total loop error will be used in OTDT setpoint calculation SPC-RP-096.

4.3.5 SPC-RP-064:- Delta T Signal Error Contribution to OTDT Trip

Form 1 of SPC-RP-064 (Reference 8.4.3) provides the following information:

$$\text{Process Span} = 0 \text{ To } 100\ °\text{F}$$
$$\text{Analytical Limit (AL)} = 71.035\ °\text{F}$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$\mathrm{SRSS} = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}^2 + PMA_{NR}^2 + PC_{NR}^2\right]^{1/2}$$

$$\mathrm{Bias}_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$\mathrm{Bias}_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$\mathrm{TLE}_{pos} = \mathrm{SRSS} + \mathrm{Bias}_{pos}$$

$$\mathrm{TLE}_{neg} = -SRSS - Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-064), the total loop error (TLE) is calculated as:

$$\mathrm{SRSS} = [1.0356\ (°F^2) + 0.09962\ (°F^2) + 0.32943\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 0(°F^2) + 6.2330\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 0(°F^2) + (0\ °F)^2 + (0\ °F)^2 + (0\ °F)^2]^{\frac{1}{2}} = \pm 2.7745\ °F$$

$$\mathrm{Bias}_{pos} = 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F = 0\ °F$$

$$\mathrm{Bias}_{neg} = 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F = 0\ °F$$

$$\mathbf{TLE_{pos}} = 2.7745\ °F + 0\ °F = 2.7745\ °F$$

$$\mathbf{TLE_{neg}} = 2.7745\ °F - 0.500\ °F = -2.7745\ °F$$

SPC-RP-064 provides input to the calculation SPC-RP-096. The total loop error will be used in OTDT setpoint calculation SPC-RP-096.

4.3.6 SPC-RP-094:- Delta T Signal Error Contribution to OTDT Trip

Form 1 of SPC-RP-094 (Reference 8.4.8) provides the following information:

$$\text{Process Span} = 0 \text{ To } 100\ °F$$

$$\text{Analytical Limit (AL)} = 0\ °F$$

Note: There is no Analytical/Process Limit (AL/PL) associated with the calculation of the uncertainty of the Delta T input to the Overtemperature Delta T (OTDT) function. Therefore, a value of zero (0) degrees Fahrenheit is used in this calculation for the AL/PL. Since this calculation is an uncertainty calculation and does not generate any trip setpoints or Allowable Values, the AL/PL is for reference only and has no numerical impact on the calculation

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$\mathrm{SRSS} = \left[\mathrm{A} + \mathrm{D_R} + \mathrm{M} + \mathrm{OPE_R} + \mathrm{SPEZ_R} + \mathrm{SPES_R} + \mathrm{P_R} + \mathrm{T_{NSR}} + \mathrm{R_{NR}} + \mathrm{H_{NSR}} + \mathrm{S_R} + \mathrm{READ} + \mathrm{PEA_{NR}}^2 + \mathrm{PMA_{NR}}^2 + \mathrm{PC_{NR}}^2\right]^{1/2}$$

$$\mathrm{Bias_{pos}} = \mathrm{D_{Bp}} + \mathrm{OPE_{Bp}} + \mathrm{SPEZ_{Bp}} + \mathrm{SPES_{Bp}} + \mathrm{P_{Bp}} + \mathrm{T_{NSBp}} + \mathrm{R_{NBp}} + \mathrm{H_{NSBp}} + \mathrm{S_{Bp}} + \mathrm{PEA_{NBp}} + \mathrm{PMA_{NBp}} + \mathrm{PC_{NBp}}$$

$$\mathrm{Bias_{neg}} = \mathrm{D_{Bn}} + \mathrm{OPE_{Bn}} + \mathrm{SPEZ_{Bn}} + \mathrm{SPES_{Bn}} + \mathrm{P_{Bn}} + \mathrm{T_{NSBn}} + \mathrm{R_{NBn}} + \mathrm{H_{NSBn}} + \mathrm{S_{Bn}} + \mathrm{PEA_{NBn}} + \mathrm{PMA_{NBn}} + \mathrm{PC_{NBn}}$$

$$\mathrm{TLE_{pos}} = \mathrm{SRSS} + \mathrm{Bias_{pos}}$$

$$\mathrm{TLE_{neg}} = -SRSS - Bias_{neg}$$

After entering the data for Unit 2 (SPC-RP-094), the total loop error (TLE) is calculated as:

$$\mathrm{SRSS} = [1.0356\ (°\mathrm{F}^2) + 2.41233\ (°\mathrm{F}^2) + 0.52224\ (°\mathrm{F}^2) + 0\ (°\mathrm{F}^2) + 0\ (°\mathrm{F}^2) + 0\ (°\mathrm{F}^2) + 0(°\mathrm{F}^2) + 5.0024\ (°\mathrm{F}^2) + 0\ (°\mathrm{F}^2) + 0\ (°\mathrm{F}^2) + 0(°\mathrm{F}^2) + (0\ °\mathrm{F})^2 + (0\ °\mathrm{F})^2 + (0\ °\mathrm{F})^2]^{\frac{1}{2}} = \pm 2.9954\ °\mathrm{F}$$

$$\mathrm{Bias_{POS}} = 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} = 0\ °\mathrm{F}$$

$$\mathrm{Bias_{neg}} = 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} = 0\ °\mathrm{F}$$

$$\mathbf{TLE_{pos}} = 2.9954\ °\mathrm{F} + 0\ °\mathrm{F} = 2.9954\ °\mathrm{F}$$

$$\mathbf{TLE_{neg}} = -2.9954\ °\mathrm{F} - 0\ °\mathrm{F} = -2.9954\ °\mathrm{F}$$

SPC-RP-094 provides input to the calculation SPC-RP-096. The total loop error will be used in OTDT setpoint calculation SPC-RP-096.

4.3.7 SPC-RP-065:- Flux Tilt Penalty Signal Error Contribution to OTDT Trip

Form 1 of SPC-RP-065 (Reference 8.4.4) provides the following information:

$$\text{Process Span} = 0 \text{ To } 120 \text{ PCT}$$

$$\text{Analytical Limit (AL)} = 120 \text{ PCT}$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$\mathrm{SRSS} = \left[\mathrm{A} + \mathrm{D_R} + \mathrm{M} + \mathrm{OPE_R} + \mathrm{SPEZ_R} + \mathrm{SPES_R} + \mathrm{P_R} + \mathrm{T_{NSR}} + \mathrm{R_{NR}} + \mathrm{H_{NSR}} + \mathrm{S_R} + \mathrm{READ} + \mathrm{PEA_{NR}}^2 + \mathrm{PMA_{NR}}^2 + \mathrm{PC_{NR}}^2\right]^{1/2}$$

$$\mathrm{Bias_{pos}} = \mathrm{D_{Bp}} + \mathrm{OPE_{Bp}} + \mathrm{SPEZ_{Bp}} + \mathrm{SPES_{Bp}} + \mathrm{P_{Bp}} + \mathrm{T_{NSBp}} + \mathrm{R_{NBp}} + \mathrm{H_{NSBp}} + \mathrm{S_{Bp}} + \mathrm{PEA_{NBp}} + \mathrm{PMA_{NBp}} + \mathrm{PC_{NBp}}$$

$$\mathrm{Bias_{neg}} = \mathrm{D_{Bn}} + \mathrm{OPE_{Bn}} + \mathrm{SPEZ_{Bn}} + \mathrm{SPES_{Bn}} + \mathrm{P_{Bn}} + \mathrm{T_{NSBn}} + \mathrm{R_{NBn}} + \mathrm{H_{NSBn}} + \mathrm{S_{Bn}} + \mathrm{PEA_{NBn}} + \mathrm{PMA_{NBn}} + \mathrm{PC_{NBn}}$$

$$\mathrm{TLE_{pos}} = \mathrm{SRSS} + \mathrm{Bias_{pos}}$$

$$\mathrm{TLE_{neg}} = -SRSS - Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-065), the total loop error (TLE) is calculated as:

$$\mathrm{SRSS} = [3.6288\ (\mathrm{PCT}^{\,2}) + 0.57546\ (\mathrm{PCT}^{\,2}) + 1.0722\ (\mathrm{PCT}^{\,2}) + 0\ (\mathrm{PCT}^{\,2}) + 0\ (\mathrm{PCT}^{\,2}) + 0\ (\mathrm{PCT}^{\,2}) + 0(\mathrm{PCT}^{\,2}) + 0.22414\ (\mathrm{PCT}^{\,2}) + 0\ (\mathrm{PCT}^{\,2}) + 0\ (\mathrm{PCT}^{\,2}) + 0(\mathrm{PCT}^{\,2}) + (0\ \mathrm{PCT})^2 + (0\ \mathrm{PCT})^2 + (3.12\ \mathrm{PCT})^2]^{\frac{1}{2}} = \pm 3.9032\ \mathrm{PCT}$$

$$\mathrm{Bias}_{\mathrm{POS}} = 0.10800\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} = 0.10800\ \mathrm{PCT}$$

$$\mathrm{Bias}_{\mathrm{neg}} = 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} = 0\ \mathrm{PCT}$$

$$\mathbf{TLE_{pos}} = 3.9032\ \mathrm{PCT} + 0.10800\ \mathrm{PCT} = 4.0112\ \ \mathrm{PCT}$$

$$\mathbf{TLE_{neg}} = 3.9032\ \mathrm{PCT} - 0.500\ \mathrm{PCT} = -3.9032\ \mathrm{PCT}$$

SPC-RP-065 provides input to the calculation SPC-RP-066. The total loop error will be used in OTDT setpoint calculation SPC-RP-066.

4.3.8 SPC-RP-095:- Flux Tilt Penalty Signal Error Contribution to OTDT Trip

Form 1 of SPC-RP-095 (Reference 8.4.9) provides the following information:

$$\text{Process Span} = 0\ \text{To}\ 120\ \mathrm{PCT}$$

$$\text{Analytical Limit (AL)} = 0\ \mathrm{PCT}$$

Note: There is no Analytical/Process Limit (AL/PL) associated with the calculation of the uncertainty of the Flux Tilt Penalty input to the Overtemperature Delta T (OTDT) function. Therefore, a value of zero (0) PCT is used in this calculation for the AL/PL. Since this calculation is an uncertainty calculation and does not generate any trip setpoints or Allowable Values, the AL/PL is for reference only and has no numerical impact on the calculation.

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$\mathrm{SRSS} = \left[\mathrm{A} + \mathrm{D_R} + \mathrm{M} + \mathrm{OPE_R} + \mathrm{SPEZ_R} + \mathrm{SPES_R} + \mathrm{P_R} + \mathrm{T_{NSR}} + \mathrm{R_{NR}} + \mathrm{H_{NSR}} + \mathrm{S_R} + \mathrm{READ} + \mathrm{PEA_{NR}}^2 + \mathrm{PMA_{NR}}^2 + \mathrm{PC_{NR}}^2\right]^{1/2}$$

$$\mathrm{Bias_{pos}} = \mathrm{D_{Bp}} + \mathrm{OPE_{Bp}} + \mathrm{SPEZ_{Bp}} + \mathrm{SPES_{Bp}} + \mathrm{P_{Bp}} + \mathrm{T_{NSBp}} + \mathrm{R_{NBp}} + \mathrm{H_{NSBp}} + \mathrm{S_{Bp}} + \mathrm{PEA_{NBp}} + \mathrm{PMA_{NBp}} + \mathrm{PC_{NBp}}$$

$$\mathrm{Bias_{neg}} = \mathrm{D_{Bn}} + \mathrm{OPE_{Bn}} + \mathrm{SPEZ_{Bn}} + \mathrm{SPES_{Bn}} + \mathrm{P_{Bn}} + \mathrm{T_{NSBn}} + \mathrm{R_{NBn}} + \mathrm{H_{NSBn}} + \mathrm{S_{Bn}} + \mathrm{PEA_{NBn}} + \mathrm{PMA_{NBn}} + \mathrm{PC_{NBn}}$$

$$\mathrm{TLE_{pos}} = \mathrm{SRSS} + \mathrm{Bias_{pos}}$$

$$\mathrm{TLE_{neg}} = -SRSS - Bias_{neg}$$

After entering the data for Unit 2 (SPC-RP-095), the total loop error (TLE) is calculated a**s:**

$$\mathrm{SRSS} = [3.6288\ (\mathrm{PCT}^2) + 0.88122\ (\mathrm{PCT}^2) + 1.0618\ (\mathrm{PCT}^2) + 0\ (\mathrm{PCT}^2) + 0\ (\mathrm{PCT}^2) + 0\ (\mathrm{PCT}^2) + 0(\mathrm{PCT}^2) + 0.57665\ (\mathrm{PCT}^2) + 0\ (\mathrm{PCT}^2) + 0\ (\mathrm{PCT}^2) + 0(\mathrm{PCT}^2) + (0\ \mathrm{PCT})^2 + (0\ \mathrm{PCT})^2 + (4.92\ \mathrm{PCT})^2]^{\frac{1}{2}} = \pm 5.5095\ \mathrm{PCT}$$

$$\mathrm{Bias}_{POS} = 0.10800\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} = 0.10800\ \mathrm{PCT}$$

$$\mathrm{Bias}_{neg} = 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} = 0\ \mathrm{PCT}$$

$$\mathbf{TLE_{pos}} = 5.5095\ \mathrm{PCT} + 0.10800\ \mathrm{PCT} = 5.6175\ \mathrm{PCT}$$

$$\mathbf{TLE_{neg}} = -5.5095\ \mathrm{PCT} - 0.00\ \mathrm{PCT} = -5.5095\ \mathrm{PCT}$$

SPC-RP-095 provides input to the calculation SPC-RP-096. The total loop error will be used in OTDT setpoint calculation SPC-RP-096.

4.3.9 SPC-RP-066: - Overtemperature Delta T Reactor Trip Instrument Channel Uncertainty Combination & Setpoint Analysis

Setpoint calculation SPC-RP-066 (Reference 8.4.5) determines the Nominal Trip Setpoint (NTSP) and Allowable Value (AV) for overtemperature delta T (OTΔT) Reactor Trip Function for the Unit 1.

The calculation references SPC-RP-062, SPC-RP-063, SPC-RP-064, and SPC-RP-065 for the Pressurizer Pressure Signal error, T_{avg} error associated with the setpoint calculator, ΔT process signal error, and Flux Tilt Penalty error respectively. Assumption 3.3 establishes OTΔT as an increasing process.

Section 2 of SPC-RP-066, Rev 2B, (Reference 8.4.5) determines the following parameters:

1. Analytical Limit (AL) for the ΔT setpoint using Westinghouse analysis limits
2. Nominal Trip Setpoint (NTSP) using Westinghouse analysis limits and the total instrument loop error
3. Calculated Allowable Value (AV_{calc}) using Westinghouse analysis limits, the NTSP, and the random instrument loop error
4. Core Operating Limits Report Allowable Value (AV_{COLR}) using COLR limits and plant parameters
5. Actual Trip Setpoint (ATSP) using plant parameters and limits from the PINGP Precautions, Limitations, and Setpoints (PLS) document

Per SPC-RP-066 Section 4.2, the calculation uses the following setpoint formula which has been derived from the plant Technical Specification Allowable Value formula and simplified assuming steady-state full RCS flow conditions at 100% RTP (Assumption 3.1):

$$\Delta\mathrm{T_{sp1}} = \Delta\mathrm{T_0}\ \{\mathrm{K_1} - \mathrm{K_2}(\mathrm{T} - \mathrm{T'}) + K_3(P - P') - f(\Delta\mathrm{I})\}$$

Where:

ΔT_{sp1} is the setpoint for the Measured RCS ΔT, °F
ΔT_0 is the indicated ΔT at RTP, °F
T is the measured RCS average Temperature , °F
T′ is the Nominal Tavg at RTP, 560.0 °F
P is the measured pressurizer pressure, psig
P′ is the nominal RCS operating pressure, 2235 psig
K_1 is a constant
K_2 is a constant (1/°F)
K_3 is a constant (1/psig)
T_1 is a constant
T_2 is a constant
F(ΔI) is the Flux tilt penalty in decimal percent RTP

Per SPC-RP-066, Rev 2B, Section 4.3, 4.4 and 4.5, the following values are used as input parameters:

	Core Operating Limits Report (COLR) (1)	Westinghouse Analysis (WEST) (2)	Plant Parameters (PLANT) (2)
K_1	1.17	1.23	1.17
K_2 (°F^{-1})	0.014	0.014	0.014
K_3 (psig^{-1})	0.001	0.001	0.001
T’ (°F)	560	560.0	560
P’ (psig)	2235	2235	2235
ΔT_0 (°F)	65.2	65.2	59.7
fΔIpen (RTP)	-	0	-

(1) See Reference 8.5.3
(2) See SPC-RP-066 Reference 8.4.5

The following uncertainty values are defined according to SPC-RP-062, SPC-RP-063, SPC-RP-064, and SPC-RP-065 as shown in section 4.3.1, section 4.3.3, section 4.3 5, and section 4.3.7 respectively.

Taken from SPC-RP-062 (Ref 8.4.1):

PZRRandom = 39.033 psig

$PZRBias_{pos}$ = 0 psig

$PZRBias_{neg}$ = 0 psig

$PZRunc_{pos}$ = 39.033 psig

$PZRunc_{neg}$ = -39.033 psig

Taken from SPC-RP-063 (Ref 8.4.2):

TavgRandom = 1.7651 °F

$TavgBias_{pos}$ = 0 °F

$TavgBias_{neg}$ = 0.5 °F

$Tavgunc_{pos}$ = 1.7651 °F

$Tavgunc_{neg}$ = -2.2651 °F

Taken From SPC-RP-064 (Ref 8.4.3):

ΔTuncRandom = 2.7445 °F

$\Delta TuncBias_{pos}$ = 0 °F

$\Delta TuncBias_{neg}$ = 0 °F

$\Delta Tunc_{pos}$ = 2.7445 °F

$\Delta Tunc_{neg}$ = -2.7445 °F

Taken From SPC-RP-065 (Ref 8.4.4):

$F\Delta Iunc_{pos}$ = 4.0112 %RTP

$F\Delta Iunc_{neg}$ = -3.9032 %RTP

Taken from SPC-RP-066 (Ref 8.4.5)

Per SPC-RP-066, Rev 2B, Section 5, Uncertainty associated with development of the flux tilt penalty signal in the calculation SPC-RP-063 is included in FΔIsigunc, but an additional conservative flux tilt penalty signal uncertainty of 0.5% RTP is included when combining uncertainties through the setpoint calculator/summer module.

FΔIsigunc = 0.005 decimal fraction of RTP

The random and bias uncertainties associated with the summer and the propagated input uncertainties is combined as follows:

$$\mathrm{U_S} = \sqrt{(\mathrm{K_{2COLR}}|TaveBiasneg|)^2 + (\mathrm{K_{3COLR}}|PZRBiaspos|)^2 + \mathrm{F\Delta Isigunc}^2}$$

$$= \sqrt{(0.014/°\mathrm{F} * 0.5\ °\mathrm{F})^2 + (0.001/psig * 0\ psig)^2 + (0.005\ decimal\ Farction\ of\ RTP)^2}$$

$$= 8.602 * 10^{-3}\ decimal\ Fraction\ of\ RTP$$

The loop random uncertainties are combined in a similar manner, with the bias terms left out:

$$\mathrm{U_{Srand}} = \sqrt{(\mathrm{K_{2COLR}}|TaveRandom|)^2 + (\mathrm{K_{3COLR}}|PZRRandom|)^2 + \mathrm{F\Delta Isigunc}^2}$$

$$= \sqrt{(0.014/°\mathrm{F} * 1.7651\ °\mathrm{F})^2 + (0.001/psig * 39.003\ PSIG)^2 + (0.005\ decimal\ Fraction\ of\ RTP)^2}$$

$$= 0.0465\ decimal\ Fraction\ of\ RTP$$

For conservatism, $\mathrm{U_S}$ and $\mathrm{U_{Srand}}$ are converted to Δ T units (°F) using the Westinghouse ΔT_0 value:

$$\mathrm{U_{S\Delta T}} = \mathrm{U_S} * \ \Delta T_{0wes}$$

$$\mathrm{U_{S\Delta T}} = 8.602 * 10^{-3} * 65.2\ (°\mathrm{F})$$

$$\mathrm{U_{S\Delta T}} = 0.561\ (°\mathrm{F})$$

$$\mathrm{U_{Srand\Delta T}} = \mathrm{U_{Srand}} * \ \Delta T_{0wes}$$

$$\mathrm{U_{Srand\Delta T}} = 0.0465 * 65.2\ (°\mathrm{F})$$

$$\mathrm{U_{Srand\Delta T}} = 3.03\ °\mathrm{F}$$

SPC-RP-066 Section 5 combines the uncertainties from SPC-RP-064 to determine the total loop uncertainty (U_T) and the total loop random uncertainty (U_{TRand}):

$$\mathrm{U_T} = \sqrt{(\mathrm{U_{S\Delta T}})^2 + (\Delta\mathrm{Tunc_{pos}})^2}$$

$U_T = \sqrt{(0.561)^2 + (2.7445)^2}$ (Uncertainty from Ref 8.4.3 (SPC- RP-064))

$U_T = 2.801\ °F$

$U_{Trand} = \sqrt{(U_{srand\Delta T})^2 + (\Delta Tunc_{pos})^2}$

$U_{Trand} = \sqrt{(3.03)^2 + (2.7445)^2}$ (Uncertainty from Ref 8.4.3 (SPC- RP-064))

$U_{Trand} = 4.088\ °F$

$\mathbf{U_T = 2.801\ °F}$

$\mathbf{U_{Trand} = 4.088\ °F}$

SPC-RP-066 Sections 6 and 7 determine values of SP_1 using COLR parameters, Westinghouse analysis parameters, and plant parameters. SP_1 is defined as follows:

$SP_1 = \{K'_{1plant} - K_{2plant}(T - Tavgspan_{lo}) + K_{3plant}(P - PZRPspan_{lo}) - F(\Delta I)\}$

Using Plant parameters

Consolidating bias terms by evaluating SP1 at the minimum of each input span, and assuming $F(\Delta I)$ value of 0:

$F(\Delta I)_{plant} = 0$

$K'_{1plant} = 1.195$

Westinghouse analysis parameters

Consolidating bias terms by evaluating SP1 at the minimum of each input span, and assuming $F(\Delta I)$ value of 0:

$F(\Delta I)_{wes} = 0$

$K'_{1wes} = 1.255$

Using COLR parameters

$F(\Delta I)_{colr} = 0$

$K'_{1colr} = 1.195$

SPC-RP-066 Section 7 calculates the flux tilt penalty. The Flux tilt penalty is calculated using the following formula:

Flux Tilt Penalty:

The flux tilt penalty breakpoints are -13% and +8% ΔI. The permissible operational Axial Flux Difference is -9% and +8% ΔI at 100%RTP.

Flux tilt penalty must be accounted for and calculated for any conditions under which the algebraic sum of permissible positive axial flux difference and $F\Delta Iunc_{pos}$ (or permissible negative AFD and $F\Delta Iunc_{neg}$) would exceed the positive or negative flux tilt penalty breakpoints.

$F\Delta Iunc_{pos}$ = 4.0112 %RTP

$F\Delta Iunc_{neg}$ = -3.9032 %RTP

The sum of permissible negative operational AFD (-9%) and $F\Delta Iunc_{neg}$ is less than the negative flux tilt penalty breakpoint, thus we do not need to account for flux tilt penalty due to negative AFD in this calculation.

The permissible positive operational AFD is greater than the positive flux tilt penalty breakpoint, therefore we must account for flux tilt penalty that would result from AFD equal to $F\Delta Iunc_{pos}$ using the positive flux tilt penalty slope of 1. 73 %RTP/%ΔI listed in References 8.5.3 and 8.5.4:

Positive Flux tilt penalty need to be accounted for and calculated as the positive flux tilt exceeds penalty breakpoints.

$F\Delta I_{pen}$ = 0.0173 * $F\Delta Iunc_{pos}$ %RTP

$F\Delta I_{pen}$ = 0.069394 % RTP

The Analytical Limit is calculated using the following formula:

$AL = \Delta T_{0WEST} \times SP_{1WEST}$

$SP_{1wes}(560, 2235, 0) = \{K'_{1wes} - K_{2wes}(T - Tavgspan_{lo}) + K_{3wes}(P - PZRPspan_{lo}) - f(\Delta I)\}$

$SP_{1wes}(560, 2235, 0) = \{1.255 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

$SP_{1wes}(560, 2235, 0) = 1.23$

AL = 65.2 x 1.23 °F

AL = 80.196 °F

The Nominal Trip Setpoint is calculated using the following formula:

$NTSP = \Delta T_{0WEST} \times SP_{1wes} - U_T$

SP_{1wes} (560, 2235, 0.069394) = $\{K'_{1wes} - K_{2wes}(T - Tavgspan_{lo}) + K_{3wes}(P - PZRPspan_{lo}) - f(\Delta I)\}$

SP_{1wes} (560, 2235, 0.069394) = $\{1.255 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0.069)\}$

SP_{1wes} (560, 2235, 0.069394) = 1.160606

NTSP = 65.2 × 1.160606 – U_T

NTSP = 75.6715 – 2.801

NTSP = 72.87 °F

The Calculated Allowable Value is calculated using the following formula:

AV_{calc} = AL – (U_T + U_{TRand}) + U_{TRand}

AV_{calc} = 80.196 – (2.801 + 4.088) + 4.088

AV_{calc} = 77.395 °F

The COLR Allowable Value is calculated using the following formula:

$AV_{COLR} = \Delta T_{0COLR} \times SP_{1COLR}$

SP_{1colr} (560, 2235, 0) = $\{K'_{1colr} - K_{2colr}(T - Tavgspan_{lo}) + K_{3colr}(P - PZRPspan_{lo}) - f(\Delta I)\}$

SP_{1colr} (560, 2235, 0) = $\{1.195 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

SP_{1colr} (560, 2235, 0) = 1.17

AV_{COLR} = 65.2 × 1.17

AV_{COLR} = 76.284 °F

The Actual Plant Trip Setpoint is calculated using the following formula:

ATSP = $\Delta T_{0PLANT} \times SP_{1PLANT}$

SP_{1colr} (560, 2235, 0) = $\{K'_{1plant} - K_{2pkant}(T - Tavgspan_{lo}) + K_{3plant}(P - PZRPspan_{lo}) - f(\Delta I)\}$

SP_{1colr} (560, 2235, 0) = $\{1.195 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

SP_{1colr} (560, 2235, 0) = 1.17

ATSP = 59.7× 1.17 °F

ATSP = 69.849 °F

SPC-RP-066 Section 8 provides conclusion of the analysis:

Analytical Limit (AL)	80.196 °F
Calculated Allowable Value (AV_{calc})	77.395 °F
COLR Allowable Value (AV_{COLR})	76.284 °F
Nominal Trip Setpoint (NTSP)	72.87 °F
Actual Plant Trip Setpoint	69.849 °F

4.3.10 SPC-RP-096: - Overtemperature Delta T Reactor Trip Instrument Channel Uncertainty Combination & Setpoint Analysis

Setpoint calculation SPC-RP-096 (Reference 8.4.10) determines the Nominal Trip Setpoint (NTSP) and Allowable Value (AV) for overtemperature delta T (OTDT) Reactor Trip Function for the Unit 2.

The calculation references SPC-RP-092, SPC-RP-093, SPC-RP-094, and SPC-RP-095 for the Pressurizer Pressure Signal error, T_{avg} error associated with the setpoint calculator, ΔT process signal error, and Flux Tilt Penalty error respectively. Input 4.4 of Rev 1 of the calculation SPC-RP-096 establishes the OTΔT trip as an increasing process.

Section 2 of SPC-RP-096, Rev 1, determines the following parameters:

1. Analytical Limit (AL) for the ΔT setpoint using Westinghouse analysis limits
2. Nominal Trip Setpoint (NTSP) using Westinghouse analysis limits and the total instrument loop error
3. Calculated Allowable Value (AV_{calc}) using Westinghouse analysis limits, the NTSP, and the random instrument loop error
4. Core Operating Limits Report Allowable Value (AV_{COLR}) using COLR limits and plant parameters
5. Actual Trip Setpoint (ATSP) using plant parameters and limits from the PINGP Precautions, Limitations, and Setpoints (PLS) document

Per SPC-RP-096, Rev 1, Input 4.1 and 4.6, the calculation uses the following setpoint formula which has been derived from the plant Technical Specification Allowable Value formula and simplified assuming steady-state full RCS flow conditions at 100% RTP:

$$\Delta T_{sp1} = \Delta T_0 \{K_1 - K_2(T - T') + K_3(P - P') - F(\Delta I)\}$$

Where:

ΔT_{sp1} is the setpoint for the Measured RCS ΔT, °F
ΔT_0 is the indicated ΔT at RTP, °F
T is the measured RCS average Temperature , °F
T' is the Nominal Tavg at RTP, 560.0 °F
P is the measured pressurizer pressure, psig
P' is the nominal RCS operating pressure, 2235 psig
K_1 is a constant
K_2 is a constant
K_3 is a constant
T_1 is a constant
T_2 is a constant
F(ΔI) is the Flux tilt penalty in decimal percent RTP

Per SPC-RP-096, Rev 1, Section 4.8, 4.9,and 4.10 , the following values are used as input parameters:

	Core Operating Limits Report (COLR) (1)	Westinghouse Analysis (WEST) (2)	Plant Parameters (PLANT) (2)
K_1	1.17	1.23	1.17
K_2 (°F^{-1})	0.014	0.014	0.014
K_3 (psig^{-1})	0.001	0.001	0.001
T’ (°F)	560	560.0	560
P’ (psig)	2235	2235	2235
ΔT_0 (°F)	65.2	65.2	58.64
fΔIpen (RTP)	-	0	-

(1) See Reference 8.5.4
(2) See SPC-RP-066 Reference 8.4.10

The following uncertainty values are defined according to SPC-RP-092, SPC-RP-093, SPC-RP-094, and SPC-RP-095 as shown in section 4.3.2, 4.3.4, 4.3.6 and 4.3.8 respectively.

Taken from SPC-RP-092 (Ref 8.4.6):

PZRRandom = 33.428 psig

$PZRBias_{pos}$ = 0 psig

$PZRBias_{neg}$ = 0 psig

$PZRunc_{pos}$ = 33.428 psig

$PZRunc_{neg}$ = -33.428 psig

Taken from SPC-RP-093 (Ref 8.4.7):

TavgRandom = 2.0112 °F

$TavgBias_{pos}$ = 0 °F

$TavgBias_{neg}$ = 0 °F

$Tavgunc_{pos}$ = 2.0112 °F

$Tavgunc_{neg}$ = -2.0112 °F

Taken from SPC-RP-094 (Ref 8.4.8):

ΔTuncRandom = 2.9954 °F

$\Delta uncBias_{pos}$ = 0 °F

$\Delta uncBias_{neg}$ = 0 °F

$\Delta Tunc_{pos}$ = 2.9954 °F

$\Delta Tunc_{neg}$ = -2.9954 °F

Taken From SPC-RP-095 (Ref 8.4.9):

$F\Delta Iunc_{pos}$ = 5.6175 %RTP

$F\Delta Iunc_{neg}$ = -5.5095 %RTP

Taken From SPC-RP-096 (Reference 8.4.10)

Per SPC-RP-096 Section 7.1, Uncertainty associated with development of the flux tilt penalty signal in the calculation SPC-RP-093 is included in FΔIsigunc, but an additional conservative flux tilt penalty signal uncertainty of 0.5% RTP is included when combining uncertainties through the setpoint calculator/summer module.

FΔIsigunc = 0.005 decimal fraction of RTP

The random and bias uncertainties associated with the summer and the propagated input uncertainties is combined as follows:

$$\mathrm{U_S} = \sqrt{(\mathrm{K_{2COLR}}|TaveBiasneg|)^2 + (\mathrm{K_{3COLR}}|PZRBiaspos|)^2 + \mathrm{F\Delta Isigunc}^2}$$

$$= \sqrt{(0.014/°\mathrm{F} * 0\ °\mathrm{F})^2 + (0.001/\mathrm{psig} * 0\ \mathrm{PSIG})^2 + (0.005\ decimal\ Farction\ of\ RTP)^2}$$

$$= 5 * 10^{-3}\ decimal\ Fraction\ of\ RTP$$

The loop random uncertainties are combined in a similar manner, with the bias terms left out:

$$\mathrm{U_{Srand}} = \sqrt{(\mathrm{K_{2COLR}}|TaveRandom|)^2 + (\mathrm{K_{3COLR}}|PZRRandom|)^2 + \mathrm{F\Delta Isigunc}^2}$$

$$= \sqrt{(0.014/°\mathrm{F} * 1.9834\ °\mathrm{F})^2 + (0.001/psig * 33.428\ PSIG)^2 + +(0.005\ decimal\ Fraction\ of\ RTP)^2}$$

$$= 0.04374\ decimal\ Fraction\ of\ RTP$$

For conservatism, U_S and U_{Srand} are converted to Δ T units (°F) using the Westinghouse ΔT_0 value:

$$U_{S\Delta T} = U_S * \Delta T_{0wes}$$

$$U_{S\Delta T} = 5 * 10^{-3} * 65.2\ (°F)$$

$$U_{S\Delta T} = 0.326\ °F$$

$$U_{Srand\Delta T} = U_{Srand} * \Delta T_{0wes}$$

$$U_{Srand\Delta T} = 0.04374 * 65.2\ (°F)$$

$$U_{Srand\Delta T} = 2.852\ °F$$

SPC-RP-096 Section 7.1.4 combines the uncertainties from SPC-RP-094 to determine the total loop uncertainty (U_T) and the total loop random uncertainty (U_{TRand}):

$$U_T = \sqrt{(U_{s\Delta T})^2 + (\Delta Tunc_{pos})^2}$$

$$U_T = \sqrt{(0.326)^2 + (2.9954)^2}$$ (Uncertainty from Ref 8.4. (SPC- RP-094))

$$U_T = 3.013\ °F$$

$$U_{Trand} = \sqrt{(U_{srand\Delta T})^2 + (\Delta Tunc_{pos})^2}$$

$$U_{Trand} = \sqrt{(2.852)^2 + (2.9954)^2}$$ (Uncertainty from Ref 8.4.8 (SPC- RP-094))

$$U_{Trand} = 4.136\ °F$$

$$\mathbf{U_T = 3.013\ °F}$$

$$\mathbf{U_{Trand} = 4.136\ °F}$$

SPC-RP-066 Sections 6 and 7 determine values of SP_1 using COLR parameters, Westinghouse analysis parameters, and plant parameters. SP_1 is defined as follows:

$$SP_1 = \left\{K'_{1plant} - K_{2plant}(T - Tavgspan_{lo}) + K_{3plant}(P - PZRPspan_{lo}) - F(\Delta I)\right\}$$

<u>Using Plant parameters</u>

Consolidating bias terms by evaluating SP1 at the minimum of each input span, and assuming $F(\Delta I)$ value of 0:

$$F(\Delta I)_{plant} = 0$$

$$K'_{1plant} = 1.195$$

Westinghouse analysis parameters

Consolidating bias terms by evaluating SP1 at the minimum of each input span, and assuming $F(\Delta\mathrm{I})$ value of 0:

$$F(\Delta\mathrm{I})_{wes} = 0$$

$$K'_{1wes} = 1.255$$

Using COLR parameters

$$F(\Delta\mathrm{I})_{colr} = 0$$

$$K'_{1colr} = 1.195$$

SPC-RP-096 Section 7.3 calculates the flux tilt penalty. The Flux tilt penalty is calculated using the following formula

Flux Tilt Penalty:

The flux tilt penalty breakpoints are -13% and +8% ΔI. The permissible operational Axial Flux Difference is -9% and +8% ΔI at 100%RTP.

Flux tilt penalty must be accounted for and calculated for any conditions under which the algebraic sum of permissible positive axial flux difference and $F\Delta Iunc_{pos}$ (or permissible negative AFD and $F\Delta Iunc_{neg}$) would exceed the positive or negative flux tilt penalty breakpoints.

$F\Delta Iunc_{pos}$ = 5.6175 %RTP

$F\Delta Iunc_{neg}$ = -5.5095 %RTP

NegTot = -9 + $F\Delta Iunc_{neg}$ = -14.509

PosTot = 8 + $F\Delta Iunc_{pos}$ = 13.617

FTBPneg = 13 FTPBPpos = 8

The sum of permissible negative operational AFD (-9%) and $F\Delta Iunc_{neg}$ is more negative than the negative flux tilt penalty breakpoint, thus we must account for flux tilt penalty due to negative AFD in this calculation. The negative Flux tilt penalty that would result from AFD equal to $F\Delta Iunc_{neg}$ using the negatvoe flux tilt penalty slope of 3.846%RTP/%ΔI listed in References 8.5.3 and 8.5.4:

Positive and Negative Flux tilt penalty need to be accounted for and calculated as the positive and negative flux tilt exceeds penalty breakpoints.

$f\Delta I_{penn}$ = 0.03846 * (NegTot+FTBPneg) %RTP

$f\Delta I_{penn}$ = 0.03846 * (-14.509+13) %RTP

$f\Delta I_{penn}$ = -0.058 % RTP

The permissible positive operational AFD is greater than the positive flux tilt penalty breakpoint, therefore we must account for flux tilt penalty that would result from AFD equal to $F\Delta Iunc_{pos}$ using the positive flux tilt penalty slope of 1.73 %RTP/%ΔI listed in References 8.5.3 and 8.5.4:

$f\Delta I_{penp}$ = 0.0173 * $F\Delta Iunc_{pos}$ %RTP

$f\Delta I_{penp}$ = 0.097183 % RTP

The Analytical Limit is calculated using the following formula:

AL = $\Delta T_{0WEST} \times SP_{1WEST}$

$SP_{1wes}(560, 2235, 0) = \{K'_{1wes} - K_{2wes}(T - Tavgspan_{lo}) + K_{3wes}(P - PZRPspan_{lo}) - f(\Delta I)\}$

$SP_{1wes}(560, 2235, 0) = \{1.255 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

$SP_{1wes}(560, 2235, 0) = 1.23$

AL = 65.2 x 1.23 °F

AL = 80.196 °F

The Nominal Trip Setpoint is calculated using the following formula:

Using positive Flux Tilt Penalty

NTSP1 = $\Delta T_{0WEST} \times SP_{1wes} - U_T$

$SP_{1wes}(560, 2235, 0.097183) = \{K'_{1wes} - K_{2wes}(T - Tavgspan_{lo}) + K_{3wes}(P - PZRPspan_{lo}) - f(\Delta I)\}$

$SP_{1wes}(560, 2235, 0.097183) = \{1.255 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0.097183)\}$

$SP_{1wes}(560, 2235, 0.097183) = 1.1328$

NTSP1 = 65.2 × 1.1328 – 3.013

NTSP1 = 73.8597 – 3.013

NTSP1 = 70.847 °F

Using Negative Flux Tilt Penalty

NTSP2 = $\Delta T_{0WEST} \times SP_{1wes} - U_T$

SP_{1wes} (560, 2235, 0.058) = $\{1.255 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0.058)\}$

SP_{1wes} (560, 2235, 0.058) = 1.172

NTSP2 = 65.2 × 1.172 – 3.013

NTSP2 = 76.41 – 3.013

NTSP2 = 73.398 °F

The Calculated Allowable Value is calculated using the following formula:

$AV_{calc} = AL - (U_T + U_{TRand}) + U_{TRand}$

AV_{calc} = 80.196 – (3.013 + 4.136) + 4.136

AV_{calc} = 77.18 °F

The COLR Allowable Value is calculated using the following formula:

$AV_{COLR} = \Delta T_{0COLR} \times SP_{1COLR}$

SP_{1colr} (560, 2235, 0) = $\{K'_{1colr} - K_{2colr}(T - Tavgspan_{lo}) + K_{3colr}(P - PZRPspan_{lo}) - F(\Delta I)\}$

SP_{1colr} (560, 2235, 0) = $\{1.195 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

SP_{1colr} (560, 2235, 0) = 1.17

AV_{COLR} = 65.2 × 1.17

AV_{COLR} = 76.284 °F

The Actual Plant Trip Setpoint is calculated using the following formula:

$ATSP = \Delta T_{0PLANT} \times SP_{1PLANT}$

SP_{1colr} (560, 2235, 0) = $\{K'_{1plant} - K_{2pkant}(T - Tavgspan_{lo}) + K_{3plant}(P - PZRPspan_{lo}) - F(\Delta I)\}$

SP_{1colr} (560, 2235, 0) = $\{1.195 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

SP_{1colr} (560, 2235, 0) = 1.17

ATSP = 58.64× 1.17 °F

ATSP = 68.609 °F

SPC-RP-096 Section 8 provides conclusion of the analysis:

Analytical Limit (AL)	80.196 °F
Nominal Trip Setpoint (NTSP1)	70.847 °F
Nominal Trip Setpoint (NTSP2)	73.398 °F
Calculated Allowable Value (AV_{calc})	77.18 °F
COLR Allowable Value (AV_{COLR})	76.284 °F
Actual Plant Trip Setpoint	68.609 °F

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

Section 4.1.1 through 4.1.9 list the instrument drift values in units of percent calibrated span. The values are converted to their respective engineering unit to interface with the equations and values in the existing setpoint calculations.

6.1.1 NUS R/V Converter RTL501-3/13 C-011

NUS R/V Converter RTL501-3/13 C-011 drift value is converted to degrees Fahrenheit using the data from Section 4.1.1. Instruments associated with RTL501-3/13 C-011 are part of OTDT TAVG INPUT and OTDT DELTA T INPUT. Per Worksheet 10a and Section 10.1.4 of SP 1002A (Reference 8.6.3) and SP 2002A (Reference 8.6.4), the calibrated output span of 0-12 VDC corresponds to 495-645 °F, and the process output span of 2-10 VDC corresponds to 520-620 °F.

Per, SPC-RP-063 (Reference 8.4.2) the process span for OTDT TAVG INPUT is 520 °F to 620 °F. Per, SPC-RP-064 (Reference 8.4.3) the process span for OTDT DELTA T INPUT is 0 °F to 100 °F. The process span for the Tavg loop is 100 deg F and the process span for the Delta T loop is 0 to 100 deg F. In both loops, the span is 100 deg F. It is, therefore, mathematically equivalent to use the Tavg calibration span for use in the Delta T loop.

Therefore, the drift value is converted from percent calibrated span to process unit using the following formula:

$$DA_{Ext,Rand,RTL501} = \pm 0.201\ \%\text{Calibrated Span} \times \frac{(100)\ °F}{100\ \%\ \text{Calibrated Span}} = \pm\ 0.201\ °F$$

6.1.2 NUS HI Selector SGU501

NUS HI Selector SGU501 drift value is converted to PCT using the data from Section 4.1.2. Instruments associated with SGU501 are part of OTDT FLUX TILT PENALTY.

Per, SPC-RP-065 (Reference 8.4.4) the process span is 0 PCT to 120 PCT.

$$DA_{Ext,Rand,SGU501} = \pm 0.316\ \%\text{Calibrated Span} \times \frac{(120-0)\ \text{PCT}}{100\ \%\ \text{Calibrated Span}} = \pm\ 0.3792\ \text{PCT}$$

$$DA_{Ext,Bias,SGU501} = +0.067\ \%\text{Calibrated Span} \times \frac{(120-0)\ \text{PCT}}{100\ \%\ \text{Calibrated Span}} = +\ 0.0804\ \text{PCT}$$

6.1.3 NUS Lead/Lag Unit TMD500-20/00/00/00-08-08-03 IDS D-009

NUS Lead/Lag Unit TMD500-20/00/00/00-08-08-03 IDS D-009 drift value is converted to °F using the data from Section 4.1.3. Instruments associated with TMD500-20/00/00/00-08-08-03 IDS D-009 are part of OTDT TAVG INPUT.

Per, SPC-RP-063 (Reference 8.4.2) the process span for OTDT TAVG INPUT is 520 °F to 620 °F.

$$DA_{Ext,Rand,TMD500-20/00/00} = \pm 0.367\ \%\text{Calibrated Span} \times \frac{(620-520)\ °\text{F}}{100\ \%\ \text{Calibrated Span}} = \pm\ 0.367\ °\text{F}$$

$$DA_{Ext,Bias,TMD500-20/00/00} = +0.080\ \%\text{Calibrated Span} \times \frac{(620-520)\ °\text{F}}{100\ \%\ \text{Calibrated Span}} = +\ 0.08\ °\text{F}$$

6.1.4 NUS Lead/Lag Unit TMD500-06/00/00/00-06-08-03 D-016

NUS Lead/Lag Unit TMD500-06/00/00/00-06-08-03 D-016 drift value is converted to °F using the data from Section 4.1.4. Instruments associated with TMD500-06/00/00/00-06-08-03 D-016 are part of OTDT DELTA T INPUT.

Per, SPC-RP-064 (Reference 8.4.3) the process span for OTDT DELTA T INPUT is 0 °F to 100 °F

$$DA_{Ext,Rand,TMD500-06/00/00} = \pm 0.254\ \%\text{Calibrated Span} \times \frac{(0-100)\ °\text{F}}{100\ \%\ \text{Calibrated Span}} = \pm\ 0.254\ °\text{F}$$

6.1.5 NUS Lead/Lag Unit TMD500-20/05/05/00-08-08-03 Flux

NUS Lead/Lag Unit TMD500-20/05/05/00-08-08-03 Flux drift value is converted to PCT using the data from Section 4.1.5. Instruments associated with TMD500-20/05/05/00-08-08-03 Flux are part of OTDT FLUX TILT PENALTY.

Per, SPC-RP-065 (Reference 8.4.4) the process span is 0 PCT to 120 PCT.

$$DA_{Ext,Rand,TMD500-20/00/00\ (flux)} = \pm 0.262\ \%\text{Calibrated Span} \times \frac{(120-0)\ \text{PCT}}{100\ \%\ \text{Calibrated Span}} = \pm\ 0.3144\ \text{PCT}$$

$$DA_{Ext,Bias,TMD500-20/00/00\ (flux)} = +0.052\ \%\text{Calibrated Span} \times \frac{(120-0)\ \text{PCT}}{100\ \%\ \text{Calibrated Span}} = +0.0624\ \text{PCT}$$

6.1.6 Rosemount Transmitter 1154GP9RC

Rosemount Transmitter 1154GP9RC drift value is converted to PSIG using the data from Section 4.1.6. Instruments associated with 1154GP9RC are part of OTDT PRESSURIZER SIGNAL.

Per, SPC-RP-062 (Reference 8.4.1) the process span is 1715 PSIG to 2515 PSIG.

$$DA_{Ext,Rand,TMD500-20/00/00\ (flux)} = \pm 1.264\ \%\text{Calibrated Span} \times \frac{(2515-1715)\ \text{PSIG}}{100\ \%\ \text{Calibrated Span}} = \pm\ 10.112\ \text{PSIG}$$

6.1.7 Westinghouse N200-3

Westinghouse Power Range Isolation Amplifier N200-3 drift value is converted to PCT using the data from Section 4.1.7. Instruments associated with N200-3 are part of OTDT FLUX TILT PENALTY.

Per, SPC-RP-065 (Reference 8.4.4) the process span is 0 PCT to 120 PCT.

$$DA_{Ext,Rand,TMD500-20/00/00\ (flux)} = \pm 0.243\ \%\text{Calibrated Span} \times \frac{(120-0)\ \text{PCT}}{100\ \%\ \text{Calibrated Span}} = \pm\ 0.2916\ \text{PCT}$$

$$DA_{Ext,Bias,TMD500-20/00/00\ (flux)} = +0.055\ \%\text{Calibrated Span} \times \frac{(120-0)\ \text{PCT}}{100\ \%\ \text{Calibrated Span}} = +\ 0.066\ \text{PCT}$$

6.1.8 NUS Bistable DAM503-03 (mA)

NUS Trip Bistable DAM503-03 (mA) drift value is converted to °F using the data from Section 4.1.8. Instruments associated with DAM503-03 (mA) are part of OTDT DELTA T INPUT.

Per, SPC-RP-064 (Reference 8.4.3) the process span for OTDT DELTA T INPUT is 0 °F to 100 °F

$$DA_{Ext,Rand,TMD500-06/00/00} = \pm 0.0697\ \%\text{Calibrated Span} \times \frac{(0-100)\ ^{\circ}\text{F}}{100\ \%\ \text{Calibrated Span}} = \pm\ 0.0697\ ^{\circ}\text{F}$$

6.1.9 NUS Lead/Lag TMD500-20/05/05/00-08-08-03 Temperature & Pressure

NUS Lead/Lag Unit TMD500-20/05/05/00-08-08-03 (Temperature) drift value is converted to °F using the data from Section 4.1.9. Instruments associated with TMD500-20/05/05/00-08-08-03 (Temperature) are part of OTDT TAVG INPUT.

Per, SPC-RP-063 (Reference 8.4.2) the process span for OTDT TAVG INPUT is 520 °F to 620 °F.

$$DA_{Ext,Rand,TMD500-20/00/00\ (T)} = \pm 0.289\ \%\text{Calibrated Span} \times \frac{(620-520)\ °F}{100\ \%\ \text{Calibrated Span}} = \pm\ 0.289\ °F$$

$$DA_{Ext,Bias,TMD500-20/00/00\ (T)} = +0.033\ \%\text{Calibrated Span} \times \frac{(620-520)\ °F}{100\ \%\ \text{Calibrated Span}} = +\ 0.033\ °F$$

NUS Lead/Lag Unit TMD500-20/05/05/00-08-08-03 (Pressure) drift value is converted to PSIG using the data from Section 4.1.9. Instruments associated with TMD500-20/05/05/00-08-08-03 (Pressure) are part of OTDT TAVG INPUT.

Per, SPC-RP-062 (Reference 8.4.1) the process span is 1715 PSIG to 2515 PSIG.

$$DA_{Ext,Rand,TMD500-20/00/00\ (P)} = \pm 0.289\ \%\text{Calibrated Span} \times \frac{(2515-1715)\ \text{PSIG}}{100\ \%\ \text{Calibrated Span}} = \pm\ 2.312\ \text{PSIG}$$

$$DA_{Ext,Bias,TMD500-20/00/00\ (P)} = +0.033\ \%\text{Calibrated Span} \times \frac{(2515-1715)\ \text{PSIG}}{100\ \%\ \text{Calibrated Span}} = +\ 0.264\ \text{PSIG}$$

6.1.10 Calculated Drift for Rosemount Transmitter 3154NG6R2F0E7:

Per Section 4.2, vendor specifications are used to calculate the extrapolated random drift tolerance for the Rosemont 3154N Transmitters currently installed for instruments 1PT-429, 1PT-430, 1PT-431, and 2PT-430. Technical Manual NX-20728-1 (Reference 8.7.2) provides the new uncertainties for accuracy (A) and drift (D_R) using Range Code 6 for the 3154N transmitter manufacturer specifications. Data included in Forms 1, 2, and 3 of SPC-RP-019 (Reference 8.4.13) and SPC-RP-020 (Reference 8.4.14) used to calculate the extrapolated drift tolerance is also given below. This is being calculated for the 30 moth calibration interval (CI).

$$Vendor\ Accuracy\ (va) = \pm 0.25\%\ of\ Calibrated\ Span\ (CS)$$

$$Vendor\ Drift\ (vd) = \pm(0.1\%\ URL + 0.1\%\ span)$$

$$Vendor\ Upper\ Range\ Limit\ (URL) = 4000\ PSIG$$

$$Process\ Span\ (PS) = 1700.0\ to\ 2500.0\ PSIG = 800\ PSIG$$

$$Calibrated\ Span\ (CS) = 1715.0\ to\ 2515.0\ PSIG = 800\ PSIG$$

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 30\ months$$

Substituting these values, the accuracy and drift are calculated as:

$$A = (0.25\%\ \text{Calibrated Span})\left(\frac{800\ \text{PSIG}}{100\%\ \text{Calibrated Span}}\right) = \pm 2.0\ PSIG$$

$$D_R = \left(\frac{30\ \text{Months}}{30\ \text{Months}}\right)\left((0.1\%\ \text{Span})\left(\frac{800\ \text{PSIG}}{100\%\ \text{Span}}\right) + (0.1\%)(4000\ PSIG)\right) = \pm 4.8\ PSIG$$

The Measurement and Test Equipment allowance value for the 3154N pressure transmitter is bounded by Calibration Procedures SP 1002B.1 and SP 2002B.1 (References 8.6.1 and 8.6.2), therefore the existing instrument M&TE value is used.

SPC-RP-019 (Reference 8.4.13) Section 5.2.3 gives the Measurement and Test Equipment allowance value (M) as:

$$M = \pm 6.9953\ PSIG$$

SPC-RP-020 (Reference 8.4.14) Section 5.2.3 gives the Measurement and Test Equipment allowance value (M) as:

$$M = \pm 8.3590\ PSIG$$

Using these values, the Extrapolated Analyzed Drift term (DA_Ext_Rand) can be calculated for Unit 1 and Unit 2 using the following equation.

$$DA\_Ext\_Rand_{trans} = \sqrt{A^2 + {D_R}^2 + M^2}$$

Substituting in values for Unit 1:

$$DA\_Ext\_Rand_{trans} = \sqrt{(2.0\ PSIG)^2 + (4.8\ PSIG)^2 + (6.9953\ PSIG)^2} = 8.7163\ \text{PSIG}$$

Substituting in values for Unit 2:

$$DA\_Ext\_Rand_{trans} = \sqrt{(2.0\ PSIG)^2 + (4.8\ PSIG)^2 + (8.3590\ PSIG)^2} = 9.8444\ \text{PSIG}$$

6.1.11 Westinghouse Current Meter 10072C10G01:

$$\text{Calibration Interval (CI)} = 24\ \text{months}$$

$$\text{Drift Time (DT)} = 1\ \text{months}$$

$$\text{Vendor Drift (vd)} = 0$$

$$\text{Process Span (PS)} = 0\ \text{to}\ 120\ \text{PCT}$$

$$\text{Input Span (CS)} = 0\ \text{to}\ 120\ \text{PCT}$$

$$\text{d}_\text{R} = 0\ \text{PCT}$$

$$\text{a} = 0.1200\ \text{PCT}$$

$$\mathrm{m} = 0.3134\ \mathrm{PCT}$$

$$\mathrm{DA\_Ext\_Rand}_{10072C10G01} = \sqrt{0.1200^2 + 0^2 + 0.3134^2} = 0.3356\ \mathrm{PCT}$$

6.1.12 Westinghouse Power Range Detector WL-23686:

$$\text{Calibration Interval (CI)} = 30\ \text{months}$$

$$\text{Drift Time (DT)} = 1\ \text{months}$$

$$\text{Vendor Drift (vd)} = 0\ \text{PCT}$$

$$\text{Process Span (PS)} = 0\ \text{to}\ 120\ \text{PCT}$$

$$\text{Input Span (CS)} = 0\ \text{to}\ 120\ \text{PCT}$$

$$\mathrm{d_R} = 0\ \mathrm{PCT}$$

$$\mathrm{a} = 0.6000\ \mathrm{PCT}$$

$$\mathrm{m} = 0\ \mathrm{PCT}$$

$$\mathrm{DA\_Ext\_Rand}_{WL-23686} = \sqrt{.6000^2 + 0^2 + 0^2} = .6000\ \mathrm{PCT}$$

6.1.13 Calculated Drift for Ultra Electronics RTD N9355E-2A-20:

The historical drift of the Ultra Electronics N9355E-2A-20 model RTD is not analyzed in a Prairie Island drift calculation. Therefore, this section uses vendor data from SPC-RP-093 (Reference 8.4.7) to account for 2TE-401A uncertainty. Per SPC-RP-093, the instrument accuracy is 0.13333 °F, the instrument drift is 0.33333 °F, and there is no M&TE error associated with 2TE-401A. The drift is calculated according to Section 6.3.1.A of EM 3.3.4.1 (Reference 8.2.1) which applies the Technical Specifications allowance factor of 1.25 to the linearly extrapolated 24-month drift value. Therefore, the instrument drift is accurate for a 30-month calibration interval and does not require additional extrapolation.

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 24\ months$$

$$D_R = (0.3333) = \pm 0.3333 DEG\ F$$

Section 5.2.1 and 5.2.3 of SPC-RC-093, Rev. 0A provides the Accuracy and Instrument M&TE respectively.

$$A = \pm 0.1333\ DEG\ F$$

$$M = \pm 0\ DEG\ F$$

Calculating the $DA\_Ext\_Rand_{N9355E}$ value is as follows:

$$DA\_Ext\_Rand_{N9355E} = \sqrt{A^2 + {D_R}^2 + M^2}$$

$$DA\_Ext\_Rand_{N9355E} = \sqrt{(0.1333\ DEG\ F)^2 + (0.3333\ DEG\ F)^2 + (0\ DEG\ F)^2}$$

$$DA\_Ext\_Rand_{N9355E} = 0.3589\ DEG\ F$$

6.1.14 Calculated Drift for RTD 21450:

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 24\ months$$

Section 5.2.1 of SPC-RC-063, Rev. 0 provides the Drift, Accuracy and Instrument M&TE.

$$D_R = \left(\frac{30\text{ months}}{24\text{ months}}\right)(0) = \pm 0\ DEG\ F$$

$$A = \pm 0.1333\ DEG\ F$$

$$M = \pm 0\ DEG\ F$$

Calculating the $DA\_Ext\_Rand_{RTD}$ value is as follows:

$$DA\_Ext\_Rand_{21450} = \sqrt{A^2 + {D_R}^2 + M^2}$$

$$DA\_Ext\_Rand_{21450} = \sqrt{(0.1333\ DEG\ F)^2 + 0\ DEG\ F^2 + (0\ DEG\ F)^2}$$

$$DA\_Ext\_Rand_{21450} = 0.1333\ DEG\ F$$

6.2 Total Loop Error (TLE)

Instrument drift from Reference 8.3.1 through Reference 8.3.8 is used to replace the instrument accuracy, drift, and measurement and test equipment allowance using the methodology shown below:

$$DA\_Ext\_Rand_{Instrument}{}^2 = A + D_R + M$$

For a Seismic event and potential subsequent loss of non-seismic HVAC:

$$\text{SRSS} = \left[\text{A} + \text{D}_\text{R} + \text{M} + \text{OPE}_\text{R} + \text{SPEZ}_\text{R} + \text{SPES}_\text{R} + \text{P}_\text{R} + \text{T}_\text{NSR} + \text{R}_\text{NR} + \text{H}_\text{NSR} + \text{S}_\text{R} + \text{READ} + \text{PEA}_\text{NR}{}^2 + \text{PMA}_\text{NR}{}^2 + \text{PC}_\text{NR}{}^2\right]^{1/2}$$

$$\text{SRSS} = \left[DA\_Ext\_Rand_{Instrument}{}^2 + \text{OPE}_\text{R} + \text{SPEZ}_\text{R} + \text{SPES}_\text{R} + \text{P}_\text{R} + \text{T}_\text{NSR} + \text{R}_\text{NR} + \text{H}_\text{NSR} + \text{S}_\text{R} + \text{READ} + \text{PEA}_\text{NR}{}^2 + \text{PMA}_\text{NR}{}^2 + \text{PC}_\text{NR}{}^2\right]^{1/2}$$

$$\mathrm{Bias_{pos}} = \mathrm{D_{Bp}} + \mathrm{OPE_{Bp}} + \mathrm{SPEZ_{Bp}} + \mathrm{SPES_{Bp}} + \mathrm{P_{Bp}} + \mathrm{T_{NSBp}} + \mathrm{R_{NBp}} + \mathrm{H_{NSBp}} + \mathrm{S_{Bp}} + \mathrm{PEA_{NBp}} + \mathrm{PMA_{NBp}} + \mathrm{PC_{NBp}}$$

$$\mathrm{Bias_{neg}} = \mathrm{D_{Bn}} + \mathrm{OPE_{Bn}} + \mathrm{SPEZ_{Bn}} + \mathrm{SPES_{Bn}} + \mathrm{P_{Bn}} + \mathrm{T_{NSBn}} + \mathrm{R_{NBn}} + \mathrm{H_{NSBn}} + \mathrm{S_{Bn}} + \mathrm{PEA_{NBn}} + \mathrm{PMA_{NBn}} + \mathrm{PC_{NBn}}$$

$$\mathbf{TLE_{pos}} = \mathrm{SRSS} + \mathrm{Bias_{pos}}$$

$$\mathbf{TLE_{neg}} = -SRSS - Bias_{neg}$$

For normal conditions:

$$\mathrm{SRSSN} = \left[\mathrm{A} + \mathrm{D_R} + \mathrm{M} + \mathrm{OPE_R} + \mathrm{SPEZ_R} + \mathrm{SPES_R} + \mathrm{P_R} + \mathrm{T_{NR}} + \mathrm{R_{NR}} + \mathrm{H_{NR}} + \mathrm{READ} + \mathrm{PEA_{NR}}^2 + \mathrm{PMA_{NR}}^2 + \mathrm{PC_{NR}}^2\right]^{1/2}$$

$$\mathrm{SRSSN} = \left[DA\_Ext\_Rand_{Instrument}{}^2 + \mathrm{OPE_R} + \mathrm{SPEZ_R} + \mathrm{SPES_R} + \mathrm{P_R} + \mathrm{T_{NR}} + \mathrm{R_{NR}} + \mathrm{H_{NR}} + \mathrm{READ} + \mathrm{PEA_{NR}}^2 + \mathrm{PMA_{NR}}^2 + \mathrm{PC_{NR}}^2\right]^{1/2}$$

$$\mathrm{Bias_{pos}} = \mathrm{D_{Bp}} + \mathrm{OPE_{Bp}} + \mathrm{SPEZ_{Bp}} + \mathrm{SPES_{Bp}} + \mathrm{P_{Bp}} + \mathrm{T_{NBp}} + \mathrm{R_{NBp}} + \mathrm{H_{NBp}} + \mathrm{PEA_{NBp}} + \mathrm{PMA_{NBp}} + \mathrm{PC_{NBp}}$$

$$\mathrm{Bias_{neg}} = \mathrm{D_{Bn}} + \mathrm{OPE_{Bn}} + \mathrm{SPEZ_{Bn}} + \mathrm{SPES_{Bn}} + \mathrm{P_{Bn}} + \mathrm{T_{NBn}} + \mathrm{R_{NBn}} + \mathrm{H_{NBn}} + \mathrm{PEA_{NBn}} + \mathrm{PMA_{NBn}} + \mathrm{PC_{NBn}}$$

$$\mathbf{TLE_{pos}} = \mathrm{SRSSN} + \mathrm{Bias_{pos}}$$

$$\mathbf{TLE_{neg}} = -SRSSN - Bias_{neg}$$

6.2.1 Pressurizer Pressure input to OTDT trip bistable

6.2.1.1 SPC-RP-062

SPC-RP-062 (Reference 8.4.1) references the following instruments in the setpoint calculation instrument loop:

Instrument Number	Manufacturer	Model Number
1PT-429	ROSEMOUNT	3154NG6R2F0E7
1PT-430	ROSEMOUNT	3154NG6R2F0E7
1PT-431	ROSEMOUNT	3154NG6R2F0E7
1PT-449	ROSEMOUNT	3154NG6R2F0E7
1TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-402B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-403B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-404B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03

$$DA\_Ext\_Rand_{3154}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(P)}{}^2 = A + D_R + M$$

$$DA\_Ext\_Rand_{3154}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(P)}{}^2 = (8.716\ \text{PSIG})^2 + (2.312\ \text{PSIG})^2 = 81.314\ (PSIG^2)$$

$$\text{SRSS} = \left[DA\_Ext\_Rand_{3154}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(P)}{}^2 + \text{OPE}_\text{R} + \text{SPEZ}_\text{R} + \text{SPES}_\text{R} + \text{P}_\text{R} + \text{T}_\text{NSR} + \text{R}_\text{NR} + \text{H}_\text{NSR} + \text{S}_\text{R} + \text{READ} + \text{PEA}_\text{NR}{}^2 + \text{PMA}_\text{NR}{}^2 + \text{PC}_\text{NR}{}^2\right]^{1/2}$$

$$\text{SRSS} = [81.314\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0.07840(\text{PSIG}^2) + 222.20\ (\text{PSIG}^2) + 900\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 225\ (\text{PSIG}^2) + 0(\text{PSIG}^2) + (0\ \text{PSIG})^2 + (0\ \text{PSIG})^2 + (0\ \text{PSIG})^2]^{\frac{1}{2}} = \pm 37.797\ \text{PSIG}$$

$$\text{Bias}_\text{POS} = 0.264\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} = 0.264\ \text{PSIG}$$

$$\text{Bias}_\text{neg} = 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} = 0\ \text{PSIG}$$

$$Bias_{pos} = 0.264\ \text{PSIG}$$

$$\mathbf{TLEN_{pos}} = 37.797 + 0.264 = 38.061\ \text{PSIG}$$

$$\mathbf{TLEN_{neg}} = -37.797\ \text{PSIG}$$

6.2.1.2 SPC-RP-092

SPC-RP-092 (Reference 8.4.6) references the following instruments in the setpoint calculation instrument loop:

Instrument Number	Manufacturer	Model Number
2PT-429	ROSEMOUNT	1154GP9RC
2PT-430	ROSEMOUNT	3154NG6R2F0E7
2PT-431	ROSEMOUNT	1154GP9RC
2PT-449	ROSEMOUNT	1154GP9RC
2TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
2TM-402B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
2TM-403B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
2TM-404B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03

3154NG6R2F0E7 evaluation (Under Normal Condition):

$$DA\_Ext\_Rand_{3154}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(P)}{}^2 = A + D_R + M$$

$$DA\_Ext\_Rand_{3154}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(P)}{}^2 = (9.8444\ \text{PSIG})^2 + (2.312\ \text{PSIG})^2$$

$$DA\_Ext\_Rand_{3154}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(P)}{}^2 = 81.314\ (PSIG^2)$$

$$\text{SRSSN} = [102.2576\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0.07840(\text{PSIG}^2) + 71.113\ (\text{PSIG}^2) + 900\ (\text{PSIG}^2) + 0(\text{PSIG}^2) + (0\ \text{PSIG})^2 + (0\ \text{PSIG})^2 + (0\ \text{PSIG})^2]^{\frac{1}{2}} = \pm 32.764\ \text{PSIG}$$

1154GP9RC evaluation (Under Normal Condition):

$$DA\_Ext\_Rand_{3154}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(P)}{}^2 = A + D_R + M$$

$$DA\_Ext\_Rand_{1154}{}^2 + DA\_Ext\_Rand_{TMD500-20/05(P)}{}^2 = (10.112\ \text{PSIG})^2 + (2.312\ \text{PSIG})^2$$

$$DA\_Ext\_Rand_{1154}{}^2 + DA\_Ext\_Rand_{TMD500-20/05(P)}{}^2 = 107.598\ (PSIG^2)$$

$$\text{SRSSN} = [107.598\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0\ (\text{PSIG}^2) + 0.07840(\text{PSIG}^2) + 71.113\ (\text{PSIG}^2) + 900\ (\text{PSIG}^2) + 0(\text{PSIG}^2) + (0\ \text{PSIG})^2 + (0\ \text{PSIG})^2 + (0\ \text{PSIG})^2]^{\frac{1}{2}} = \pm 32.845\ \text{PSIG}$$

$$\text{Bias}_{\text{POS}} = 0.264\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} + 0\ \text{PSIG} = 0.264\ \text{PSIG}$$

$$Bias_{pos} = 0.264\ \text{PSIG}$$

Total Loop Error (TLE) associated to Rosemount 1154GP9RC is more conservative, therefore, TLE associated to 1154GP9RC will be used to bound 3154NGR2F0E7 TLE.

$$\mathbf{TLEN_{pos}} = 32.845 + 0.264 = 33.109\ \text{PSIG}$$

$$\mathbf{TLEN_{neg}} = -32.845\ \text{PSIG}$$

6.2.2 Tavg Signal Error Contribution to OTDT Trip (SPC-RP-063 & SPC-RC-093)

6.2.2.1 SPC-RP-063

SPC-RP-063 (Reference 8.4.2) references the following instruments in the setpoint calculation instrument loop:

Instrument Number	Manufacturer	Model Number
1TE-401B	RDF	21450
1TE-402B	RDF	21450
1TE-403B	RDF	21450
1TE-404B	RDF	21450
1TT-401B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-402B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-403B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-404B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TM-401BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009

1TM-402BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
1TM-403BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
1TM-404BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
1TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-402B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-403B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-404B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03

$$DA\_Ext\_Rand_{21450}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{TMD500-20/00/00}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(T)}{}^2 = A + D_R + M$$

$$DA\_Ext\_Rand_{21450}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{TMD500-20/00/00}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(T)}{}^2 = (0.1333\ °\mathrm{F})^2 + (0.201\ °\mathrm{F})^2 + (0.367\ °\mathrm{F})^2 + (0.289\ °\mathrm{F})^2 = 0.2763\ °\mathrm{F}^2$$

$$\mathrm{SRSS} = [0.2763\ °\mathrm{F}^2 + 0\ (°\mathrm{F}^2) + 0\ (°\mathrm{F}^2) + 0\ (°\mathrm{F}^2) + 0(°\mathrm{F}^2) + 1.5256\ (°\mathrm{F}^2) + 0\ (°\mathrm{F}^2) + 0\ (°\mathrm{F}^2) + 0(°\mathrm{F}^2) + (0\ °\mathrm{F})^2 + (0\ °\mathrm{F})^2 + (0\ °\mathrm{F})^2]^{\frac{1}{2}} = \pm 1.342\ °\mathrm{F}$$

$$\mathrm{Bias_{POS}} = 0.08\ °\mathrm{F} + 0.033°\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} = 0.113\ °\mathrm{F}$$

$$\mathrm{Bias_{neg}} = 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} = 0\ °\mathrm{F}$$

$$\mathbf{TLE_{pos}} = 1.342\ °\mathrm{F} + 0.113\ °\mathrm{F} = 1.455\ °\mathrm{F}$$

$$\mathbf{TLE_{neg}} = -1.342\ °\mathrm{F}$$

6.2.2.2 SPC-RP-093

SPC-RP-093 (Reference 8.4.7) references the following instruments in the setpoint calculation instrument loop:

Instrument Number	Manufacturer	Model Number
2TE-401B	RDF	N9355E-2A-20
2TE-402B	RDF	N9355E-2A-20
2TE-403B	RDF	N9355E-2A-20
2TE-404B	RDF	N9355E-2A-20
2TT-401B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-402B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-403B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-404B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TM-401BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03

		IDS D-009
2TM-402BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
2TM-403BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
2TM-404BB	NUS INSTRUMENTS	TMD500-20/00/00/00-08-08-03 IDS D-009
2TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
2TM-402B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
2TM-403B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
2TM-404B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03

$$DA\_Ext\_Rand_{\mathrm{N9355E}}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{TMD500-20/00/00}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05}{}^2 = A + D_R + M$$

$$DA\_Ext\_Rand_{\mathrm{N9355E}}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{TMD500-20/00/00}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05}{}^2 = (0.3589\ ^\circ\mathrm{F})^2 + (0.201\ ^\circ\mathrm{F})^2 + (0.367\ ^\circ\mathrm{F})^2 + (0.289\ ^\circ\mathrm{F})^2 = 0.38742\ ^\circ\mathrm{F}^2$$

$$\mathrm{SRSS} = [0.38749\ (^\circ\mathrm{F}^2) + 0\ (^\circ\mathrm{F}^2) + 0\ (^\circ\mathrm{F}^2) + 0\ (^\circ\mathrm{F}^2) + 0(^\circ\mathrm{F}^2) + 1.2357\ (^\circ\mathrm{F}^2) + 0\ (^\circ\mathrm{F}^2) + 0\ (^\circ\mathrm{F}^2) + 0(^\circ\mathrm{F}^2) + (0\ ^\circ\mathrm{F})^2 + (0\ ^\circ\mathrm{F})^2 + (0\ ^\circ\mathrm{F})^2]^{\frac{1}{2}} = \pm 1.274^\circ\mathrm{F}$$

$$\mathrm{Bias_{POS}} = 0.113\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} = 0.113\ ^\circ\mathrm{F}$$

$$\mathrm{Bias_{neg}} = 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} = 0\ ^\circ\mathrm{F}$$

$$\mathbf{TLE_{pos}} = 1.274\ ^\circ\mathrm{F} + 0.113\ ^\circ\mathrm{F} = 1.387\ ^\circ\mathrm{F}$$

$$\mathbf{TLE_{neg}} = -1.274^\circ\mathrm{F} = -1.274\ ^\circ\mathrm{F}$$

6.2.3 Delta T Signal Error Contribution to OTDT Trip (SPC-RP-064 & SPC-RP-094)

6.2.3.1 SPC-RP-064

SPC-RP-064 (Reference 8.4.3) references the following instruments in the setpoint calculation instrument loop:

Instrument Number	Manufacturer	Model Number
1TE-405A	RDF	21450
1TE-402A	RDF	21450
1TE-403A	RDF	21450

1TE-404A	RDF	21450
1TE-401B	RDF	21450
1TE-402B	RDF	21450
1TE-403B	RDF	21450
1TE-404B	RDF	21450
1TT-401A	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-402A	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-403A	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-404A	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-401B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-402B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-403B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TT-404B	NUS INSTRUMENTS	RTL501-3/13 C-011
1TM-405R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
1TM-406R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
1TM-407R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
1TM-408R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
1TC-405C/D	NUS INSTRUMENTS	DAM503-03
1TC-406C/D	NUS INSTRUMENTS	DAM503-03
1TC-407C/D	NUS INSTRUMENTS	DAM503-03
1TC-408C/D	NUS INSTRUMENTS	DAM503-03

$$DA\_Ext\_Rand_{21450}{}^2 + DA\_Ext\_Rand_{21450}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{TMD500-06/00/00}{}^2 + DA\_Ext\_Rand_{DAM503-03}{}^2 = A + D_R + M$$

$$DA\_Ext\_Rand_{21450}{}^2 + DA\_Ext\_Rand_{21450}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{TMD500-06/00/00}{}^2 + DA\_Ext\_Rand_{DAM503-03}{}^2 = (0.1333\ ^\circ\mathrm{F})^2 + (0.1333\ ^\circ\mathrm{F})^2 + (0.201\ ^\circ\mathrm{F})^2 + (0.201\ ^\circ\mathrm{F})^2 + (0.254\ ^\circ\mathrm{F})^2 + (0.0697\ ^\circ\mathrm{F})^2 = 0.1857\ ^\circ\mathrm{F}^{\ 2}$$

$$\mathrm{SRSS} = [0.1857\ (^\circ\mathrm{F}^{\ 2}) + 0\ (^\circ\mathrm{F}^{\ 2}) + 0\ (^\circ\mathrm{F}^{\ 2}) + 0\ (^\circ\mathrm{F}^{\ 2}) + 0(^\circ\mathrm{F}^{\ 2}) + 6.2330\ (^\circ\mathrm{F}^{\ 2}) + 0\ (^\circ\mathrm{F}^{\ 2}) + 0\ (^\circ\mathrm{F}^{\ 2}) + 0(^\circ\mathrm{F}^{\ 2}) + (0\ ^\circ\mathrm{F})^2 + (0\ ^\circ\mathrm{F})^2 + (0\ ^\circ\mathrm{F})^2]^{\frac{1}{2}} = \pm 2.534\ ^\circ\mathrm{F}$$

$$\mathrm{Bias_{POS}} = 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} = 0\ ^\circ\mathrm{F}$$

$$\mathrm{Bias_{neg}} = 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} = 0\ ^\circ\mathrm{F}$$

$$\mathbf{TLE_{pos}} = 2.577\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} = 2.534\ ^\circ\mathrm{F}$$

$$\mathbf{TLE_{neg}} = 2.577\ ^\circ\mathrm{F} - 0\ ^\circ\mathrm{F} = -2.534\ ^\circ\mathrm{F}$$

6.2.3.2 SPC-RP-094

Instrument Number	Manufacturer	Model Number
2TE-405A	RDF	N9355E-2A-20
2TE-402A	RDF	N9355E-2A-20
2TE-403A	RDF	N9355E-2A-20
2TE-404A	RDF	N9355E-2A-20
2TE-401B	RDF	N9355E-2A-20
2TE-402B	RDF	N9355E-2A-20
2TE-403B	RDF	N9355E-2A-20
2TE-404B	RDF	N9355E-2A-20
2TT-401A	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-402A	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-403A	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-404A	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-401B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-402B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-403B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TT-404B	NUS INSTRUMENTS	RTL501-3/13 C-011
2TM-405R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
2TM-406R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
2TM-407R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
2TM-408R	NUS INSTRUMENTS	TMD500-06/00/00/00-06-08-03 D-016
2TC-405C/D	NUS INSTRUMENTS	DAM503-03
2TC-406C/D	NUS INSTRUMENTS	DAM503-03
2TC-407C/D	NUS INSTRUMENTS	DAM503-03
2TC-408C/D	NUS INSTRUMENTS	DAM503-03

$$DA\_Ext\_Rand_{\mathrm{N9355E}}{}^2 + DA\_Ext\_Rand_{\mathrm{N9355E}}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{TMD500-06/00/00}{}^2 + DA\_Ext\_Rand_{DAM503-03}{}^2 = A + D_R + M$$

$$DA\_Ext\_Rand_{\mathrm{N9355E}}{}^2 + DA\_Ext\_Rand_{\mathrm{N9355E}}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{RTL501}{}^2 + DA\_Ext\_Rand_{TMD500-06/00/00}{}^2 + DA\_Ext\_Rand_{DAM503-03}{}^2 = (0.3589\ \mathrm{°F})^2 + (0.3589\ \mathrm{°F})^2 + (0.201\ \mathrm{°F})^2 + (0.201\ \mathrm{°F})^2 + (0.254\ \mathrm{°F})^2 + (0.0697\ \mathrm{°F})^2 = 0.4077\ \mathrm{°F}^2$$

$$\mathrm{SRSS} = [0.4077\ (\mathrm{°F}^2) + 0\ (\mathrm{°F}^2) + 0\ (\mathrm{°F}^2) + 0\ (\mathrm{°F}^2) + 0(\mathrm{°F}^2) + 5.0024\ (\mathrm{°F}^2) + 0\ (\mathrm{°F}^2) + 0\ (\mathrm{°F}^2) + 0(\mathrm{°F}^2) + (0\ \mathrm{°F})^2 + (0\ \mathrm{°F})^2 + (0\ \mathrm{°F})^2]^{\frac{1}{2}} = \pm 2.326\ \mathrm{°F}$$

$$\text{Bias}_{\text{POS}} = 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} = 0\ °\text{F}$$

$$\text{Bias}_{\text{neg}} = 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} + 0\ °\text{F} = 0\ °\text{F}$$

$$\mathbf{TLE_{pos}} = 2.326\ °\text{F} + 0\ °\text{F} = 2.326\ °\text{F}$$

$$\mathbf{TLE_{neg}} = -2.326\ °\text{F} - 0\ °\text{F} = -2.326\ °\text{F}$$

6.2.4 Flux Tilt Penalty Signal Error Contribution to OTDT Trip (SPC-RP-065 & SPC-RC-095)

6.2.4.1 SPC-RP-065

SPC-RP-065 (Reference 8.4.4) references the following instruments in the setpoint calculation instrument loop:

Instrument Number	Manufacturer	Model Number
1NE-41A	WESTINGHOUSE	WL-23686
1NE-42A	WESTINGHOUSE	WL-23686
1NE-43A	WESTINGHOUSE	WL-23686
1NE-44A	WESTINGHOUSE	WL-23686
1NE-41B	WESTINGHOUSE	WL-23686
1NE-42B	WESTINGHOUSE	WL-23686
1NE-43B	WESTINGHOUSE	WL-23686
1NE-44B	WESTINGHOUSE	WL-23686
1N41-NI301	WESTINGHOUSE	10072C10G01
1N42-NI301	WESTINGHOUSE	10072C10G01
1N43-NI301	WESTINGHOUSE	10072C10G01
1N44-NI301	WESTINGHOUSE	10072C10G01
1N41-NI302	WESTINGHOUSE	10072C10G01
1N42-NI302	WESTINGHOUSE	10072C10G01
1N43-NI302	WESTINGHOUSE	10072C10G01
1N44-NI302	WESTINGHOUSE	10072C10G01
1N41-NM306	WESTINGHOUSE	N200-3
1N42-NM306	WESTINGHOUSE	N200-3
1N43-NM306	WESTINGHOUSE	N200-3
1N44-NM306	WESTINGHOUSE	N200-3
1N41-NM307	WESTINGHOUSE	N200-3
1N42-NM307	WESTINGHOUSE	N200-3
1N43-NM307	WESTINGHOUSE	N200-3
1N44-NM307	WESTINGHOUSE	N200-3
1TM-401T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
1TM-401T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
1TM-401T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
1TM-401T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001

1TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
1TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03

$$DA\_Ext\_Rand_{\mathrm{WL-23686}}{}^2 + DA\_Ext\_Rand_{\mathrm{WL-23686}}{}^2 + DA\_Ext\_Rand_{\mathrm{10072C10G01}}{}^2 + DA\_Ext\_Rand_{\mathrm{10072C10G01}}{}^2 + DA\_Ext\_Rand_{N200-3}{}^2 + DA\_Ext\_Rand_{N200-3}{}^2 + DA\_Ext\_Rand_{SGU501}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(flux)}{}^2 = \\ = (0.6\ \mathrm{PCT})^2 + (0.6\ \mathrm{PCT})^2 + (0.3356\ \mathrm{PCT})^2 + (0.3356\ \mathrm{PCT})^2 + (0.2916\ \mathrm{PCT})^2 + (0.2916\ \mathrm{PCT})^2 + (0.3792\ \mathrm{PCT})^2 + (0.314\ \mathrm{PCT})^2 = 1.3580(\ \mathrm{PCT})^2$$

$$\mathrm{SRSS} = [1.3580\ (\mathrm{PCT}\ ^2) + 0\ (\mathrm{PCT}\ ^2) + 0\ (\mathrm{PCT}\ ^2) + 0\ (\mathrm{PCT}\ ^2) + 0(\mathrm{PCT}\ ^2) + 0.22414\ (\mathrm{PCT}\ ^2) + 0\ (\mathrm{PCT}\ ^2) + 0\ (\mathrm{PCT}\ ^2) + 0(\mathrm{PCT}\ ^2) + (3.12\ \mathrm{PCT})^2 + (0\ \mathrm{PCT})^2 + (0\ \mathrm{PCT})^2]^{\frac{1}{2}} = \pm 3.364\ \mathrm{PCT}$$

$$\mathrm{Bias_{POS}} = 0.066\ \mathrm{PCT} + 0.066\ \mathrm{PCT} + 0.0804\ \mathrm{PCT} + 0.0624\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} = 0.2748\ \mathrm{PCT}$$

$$\mathrm{Bias_{neg}} = 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} = 0\ \mathrm{PCT}$$

$$\mathbf{TLE_{pos}} = 3.364\ \mathrm{PCT} + 0.2748\ \mathrm{PCT} = 3.639\ \ \mathrm{PCT}$$

$$\mathbf{TLE_{neg}} = 3.364\ \mathrm{PCT} = -3.364\ \mathrm{PCT}$$

6.2.4.1 SPC-RP-095

SPC-RP-095 (Reference 8.4.10) references the following instruments in the setpoint calculation instrument loop:

Instrument Number	Manufacturer	Model Number
2NE-41A	WESTINGHOUSE	WL-23686
2NE-42A	WESTINGHOUSE	WL-23686
2NE-43A	WESTINGHOUSE	WL-23686
2NE-44A	WESTINGHOUSE	WL-23686
2NE-41B	WESTINGHOUSE	WL-23686
2NE-42B	WESTINGHOUSE	WL-23686
2NE-43B	WESTINGHOUSE	WL-23686
2NE-44B	WESTINGHOUSE	WL-23686
2N41-NI301	WESTINGHOUSE	10072C10G01
2N42-NI301	WESTINGHOUSE	10072C10G01

2N43-NI301	WESTINGHOUSE	10072C10G01
2N44-NI301	WESTINGHOUSE	10072C10G01
2N41-NI302	WESTINGHOUSE	10072C10G01
2N42-NI302	WESTINGHOUSE	10072C10G01
2N43-NI302	WESTINGHOUSE	10072C10G01
2N44-NI302	WESTINGHOUSE	10072C10G01
2N41-NM306	WESTINGHOUSE	N200-3
2N42-NM306	WESTINGHOUSE	N200-3
2N43-NM306	WESTINGHOUSE	N200-3
2N44-NM306	WESTINGHOUSE	N200-3
2N41-NM307	WESTINGHOUSE	N200-3
2N42-NM307	WESTINGHOUSE	N200-3
2N43-NM307	WESTINGHOUSE	N200-3
2N44-NM307	WESTINGHOUSE	N200-3
2TM-401T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
2TM-401T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
2TM-401T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
2TM-401T	NUS INSTRUMENTS	SGU501-06/06/00-08-08 E-001
2TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
2TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
2TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03
2TM-401B	NUS INSTRUMENTS	TMD500-20/05/05/00-08-08-03

$$DA\_Ext\_Rand_{\mathrm{WL-23686}}{}^2 + DA\_Ext\_Rand_{\mathrm{WL-23686}}{}^2 + DA\_Ext\_Rand_{\mathrm{10072C10G01}}{}^2 + DA\_Ext\_Rand_{\mathrm{10072C10G01}}{}^2 + DA\_Ext\_Rand_{N200-3}{}^2 + DA\_Ext\_Rand_{N200-3}{}^2 + DA\_Ext\_Rand_{SGU501}{}^2 + DA\_Ext\_Rand_{TMD500-20/05/05(flux)}{}^2 =$$
$$= (0.6\ \mathrm{PCT})^2 + (0.6\ \mathrm{PCT})^2 + (0.3356\ \mathrm{PCT})^2 + (0.3356\ \mathrm{PCT})^2 + (0.2916\ \mathrm{PCT})^2 + (0.2916\ \mathrm{PCT})^2 + (0.3792\ \mathrm{PCT})^2 + (0.314\ \mathrm{PCT})^2 = 1.3580\ (\mathrm{PCT}^2)$$

$$\mathrm{SRSS} = [1.3580\ (\mathrm{PCT}^2) + 0\ (\mathrm{PCT}^2) + 0\ (\mathrm{PCT}^2) + 0\ (\mathrm{PCT}^2) + 0 (\mathrm{PCT}^2) + 0.57665\ (\mathrm{PCT}^2) + 0\ (\mathrm{PCT}^2) + 0\ (\mathrm{PCT}^2) + 0 (\mathrm{PCT}^2) + (4.92\ \mathrm{PCT})^2 + (0\ \mathrm{PCT})^2 + (0\ \mathrm{PCT})^2]^{\frac{1}{2}} = \pm 5.113\ \mathrm{PCT}$$

$$\mathrm{Bias_{POS}} = 0.066\ \mathrm{PCT} + 0.066\ \mathrm{PCT} + 0.0804\ \mathrm{PCT} + 0.0624\mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} = 0.2748\ \mathrm{PCT}$$

$$\mathrm{Bias_{neg}} = 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} + 0\ \mathrm{PCT} = 0\ \mathrm{PCT}$$

$$\mathbf{TLE_{pos}} = 5.113\ \mathrm{PCT} + 0.2748\ \mathrm{PCT} = 5.388\ \mathrm{PCT}$$

$$\mathbf{TLE_{neg}} = -5.113\ \text{PCT} = -5.113\ \text{PCT}$$

6.3 Overtemperature Delta T Reactor Trip Instrument Channel Uncertainty Combination & Setpoint Analysis

6.3.1 SPC-RP-066 (Unit 1):

The following uncertainty values are defined according to the values calculated in section 6.2.1.1, 6.2.2.1, 6.2.3.1 and 6.2.4.1.

SPC-RP-062 (Section 6.2.1.1):

PZRRandom = 37.797

$PZRBias_{pos}$ = 0.264 PSIG

$PZRBias_{neg}$ = 0 PSIG

$PZRunc_{pos}$ = 38.061 PSIG

$PZRunc_{neg}$ = -37.797 PSIG

SPC-RP-063 (Section 6.2.2.1):

TavgRandom = 1.342 °F

$TavgBias_{pos}$ = 0.113 °F

$TavgBias_{neg}$ = 0 °F

$Tavgunc_{pos}$ = 1.455 °F

$Tavgunc_{neg}$ = -1.342 °F

SPC-RP-064 (Section 6.2.3.1):

ΔTuncRandom = 2.534 °F

$\Delta TuncBias_{pos}$ = 0 °F

$\Delta TuncBias_{neg}$ = 0 °F

$\Delta Tunc_{pos}$ = 2.534 °F

$\Delta Tunc_{neg}$ = -2.534 °F

SPC-RP-065 (Section 6.2.4.1):

$F\Delta Iunc_{pos}$ = 3.639 %RTP

$F\Delta Iunc_{neg}$ = -3.364 %RTP

$$U_S = \sqrt{(K_{2COLR}|TaveBiasneg|)^2 + (K_{3COLR}|PZRBiaspos|)^2 + F\Delta Isigunc^2}$$

$$= \sqrt{\left(\frac{0.014*0\ °F}{°F}\right)^2 + \left(\frac{0.001*0.264\ psig}{PSIG}\right)\hat{}2 + (0.005\ decimal\ Farction\ of\ RTP)^2}$$

$$= 5.007 * 10^{-3}\ decimal\ Fraction\ of\ RTP$$

The loop random uncertainties are combined in a similar manner, with the bias terms left out:

$$U_{Srand} = \sqrt{(K_{2COLR}|TaveRandom|)^2 + (K_{3COLR}|PZRRandom|)^2 + F\Delta Isigunc^2}$$

$$= \sqrt{(\frac{0.014*1.342\ °F}{°F})^2 + (\frac{0.001*37.797\ psig}{psig})^2 + (0.005\ decimal\ Fraction\ of\ RTP)^2}$$

$$= 0.0425\ decimal\ Fraction\ of\ RTP$$

For conservatism, U_S and U_{Srand} are converted to Δ T units (°F) using the Westinghouse ΔT_0 value:

$$U_{S\Delta T} = U_S * \Delta T_{0wes}$$

$$U_{S\Delta T} = 5.007 * 10^{-3} * 65.2\ (PSIG)$$

$$U_{S\Delta T} = 0.3265\ °F$$

$$U_{Srand\Delta T} = U_{Srand} * \Delta T_{0wes}$$

$$U_{Srand\Delta T} = 0.0425 * 65.2\ (PSIG)$$

$$U_{Srand\Delta T} = 2.7713\ °F$$

The total loop uncertainty (U_T) and the total loop random uncertainty (U_{TRand}):

$$U_T = \sqrt{(U_{s\Delta T})^2 + (\Delta Tunc_{pos})^2}$$

$$U_T = \sqrt{(0.3265)^2 + (2.534)^2}$$

$$U_T = 2.5549\ °F$$

$$U_{Trand} = \sqrt{(U_{srand\Delta T})^2 + (\Delta Tunc_{pos})^2}$$

$$U_{Trand} = \sqrt{(2.7713)^2 + (2.534)^2}$$ (Uncertainty from Ref 8.4.4 (SPC- RP-064))

$$U_{Trand} = 3.7551\ °F$$

$$\mathbf{U_T = 2.5549}\ °F$$

$$\mathbf{U_{Trand} = 3.7551}\ °F$$

Flux Tilt Penalty:

The flux tilt penalty breakpoints are -13% and +8% ΔI. The permissible operational Axial Flux Difference (AFD) is -9% and +8% ΔI at 100%RTP.

Flux tilt penalty must be accounted for and calculated for any conditions under which the algebraic sum of permissible positive axial flux difference and $F\Delta Iunc_{pos}$ (or permissible negative AFD and $F\Delta Iunc_{neg}$) would exceed the positive or negative flux tilt penalty breakpoints.

$F\Delta Iunc_{pos}$ = 3.639 %RTP

$F\Delta Iunc_{neg}$ = -3.364 %RTP

NegTot = -9 + $F\Delta Iunc_{neg}$ = -12.364 % RTP

PosTot = 8 + $F\Delta Iunc_{pos}$ = 11.639 % RTP

FTBPneg = 13

FTPBPpos = 8

The sum of permissible negative operational AFD (-9%) and $F\Delta Iunc_{neg}$ (-3.364%) is less than the negative flux tilt penalty breakpoint (-13%), thus we do not need to account for flux tilt penalty due to negative AFD in this calculation.

The sum of permissible positive operational AFD (8%) and $F\Delta Iunc_{pos}$ (3.639%) is greater than the positive flux tilt penalty breakpoint (8%), therefore we must account for flux tilt penalty that would result from AFD equal to $F\Delta Iunc_{pos}$ using the positive flux tilt penalty slope of 1.73 %RTP/%ΔI listed in References 8.5.3 and 8.5.4:

Positive Flux tilt penalty need to be accounted for and calculated as the positive flux tilt exceeds penalty breakpoints.

$f\Delta I_{pen} = 0.0173 * F\Delta Iunc_{pos}$ %RTP

$f\Delta I_{pen} = 0.0173 * 3.639$ %RTP

$f\Delta I_{pen} = 0.0630$ % RTP

The Analytical Limit is calculated using the following formula:

$AL = \Delta T_{0WEST} \times SP_{1WEST}$

$SP_{1wes}\ (560, 2235, 0) = \{K'_{1wes} - K_{2wes}(T - Tavgspan_{lo}) + K_{3wes}(P - PZRPspan_{lo}) - f(\Delta I)\}$

$SP_{1wes}\ (560, 2235, 0) = \{1.255 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

$SP_{1wes}\ (560, 2235, 0) = 1.23$

AL = 65.2 x 1.23 °F

AL = 80.196 °F (No Change)

The Nominal Trip Setpoint is calculated using the following formula:

$NTSP = \Delta T_{0WEST} \times SP_{1wes} - U_T$

$SP_{1wes}\ (560, 2235, 0.0630) = \{K'_{1wes} - K_{2wes}(T - Tavgspan_{lo}) + K_{3wes}(P - PZRPspan_{lo}) - f(\Delta I)\}$

$SP_{1wes}\ (560, 2235, 0.0630) = \{1.255 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0.0630)\}$

$SP_{1wes}\ (560, 2235, 0.0630) = 1.1670$

$NTSP = 65.2 \times 1.1670 - U_T$

NTSP = 76.0884 – 2.5549

NTSP = 73.5335 °F

The Calculated Allowable Value is calculated using the following formula:

$AV_{calc} = AL - (U_T + U_{TRand}) + U_{TRand}$

$AV_{calc} = 80.196 - (2.5549 + 3.7551) + 3.7551$

$AV_{calc} = 77.6411$ °F

The COLR Allowable Value is calculated using the following formula:

$AV_{COLR} = \Delta T_{0COLR} \times SP_{1COLR}$

SP_{1colr} (560, 2235, 0) = $\{K'_{1colr} - K_{2colr}(T - Tavgspan_{lo}) + K_{3colr}(P - PZRPspan_{lo}) - f(\Delta I)\}$

SP_{1colr} (560, 2235, 0) = $\{1.195 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

SP_{1colr} (560, 2235, 0) = 1.17

AV_{COLR} = 65.2 × 1.17

AV_{COLR} = 76.284 °F (No Change)

The Actual Plant Trip Setpoint is calculated using the following formula:

ATSP = $\Delta T_{0PLANT} \times SP_{1PLANT}$

SP_{1plant} (560, 2235, 0) = $\{K'_{1plant} - K_{2pkant}(T - Tavgspan_{lo}) + K_{3plant}(P - PZRPspan_{lo}) - f(\Delta I)\}$

SP_{1plant} (560, 2235, 0) = $\{1.195 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

SP_{1plant} (560, 2235, 0) = 1.17

ATSP = 59.7× 1.17 °F

ATSP = 69.849 °F (No Change)

Conclusion of the SPC-RP-066 (Unit 1) analysis:

Analytical Limit (AL)	80.196 °F (No Change)
Nominal Trip Setpoint (NTSP)	73.5335 °F
Calculated Allowable Value (AV_{calc})	77.6411 °F
COLR Allowable Value (AV_{COLR})	76.284 °F (No Change)
Actual Plant Trip Setpoint	69.849 °F (No Change)

6.3.2 SPC-RP-096 (Unit 2):

The following uncertainty values are defined according to SPC-RP-092, SPC-RP-093, SPC-RP-094, and SPC-RP-095 as shown in section 6.2.1.2, 6.2.2.2, 6.2.3.2 and 6.2.4.2 respectively.

SPC-RP-092 (Ref 8.4.1):

(Existing calculation uses TLE under normal condition)

PZRRandom = 32.845 psig

$PZRBias_{pos}$ = 0.264 psig

$PZRBias_{neg}$ = 0 psig

$PZRunc_{pos}$ = 33.109 psig

$PZRunc_{neg}$ = -32.845 psig

SPC-RP-093 (Ref 8.4.2):

TavgRandom = 1.274 °F

$TavgBias_{pos}$ = 0.113 °F

$TavgBias_{neg}$ = 0°F

$Tavgunc_{pos}$ = 1.387 °F

$Tavgunc_{neg}$ = -1.274 °F

SPC-RP-094 (Ref 8.4.3):

ΔTuncRandom = 2.326 °F

$\Delta TuncBias_{pos}$ = 0 °F

$\Delta TuncBias_{pos}$ = 0 °F

$\Delta Tunc_{pos}$ = 2.326°F

$\Delta Tunc_{neg}$ = -2.326 °F

SPC-RP-095 (Ref 8.4.4):

$F\Delta Iunc_{pos}$ = 5.388 %RTP

$F\Delta Iunc_{neg}$ = -5.113 %RTP

$$U_S = \sqrt{(K_{2COLR}|TaveBiasneg|)^2 + (K_{3COLR}|PZRBiaspos|)^2 + F\Delta Isigunc^2}$$

$$= \sqrt{(0.014/°F * 0\ °F)^2 + (0.001/PSIG * 0.264\ PSIG)^2 + (0.005\ decimal\ Farction\ of\ RTP)^2}$$

$$= 5.007 * 10^{-3}\ decimal\ Fraction\ of\ RTP$$

The loop random uncertainties are combined in a similar manner, with the bias terms left out:

$$U_{Srand} = \sqrt{(K_{2COLR}|TaveRandom|)^2 + (K_{3COLR}|PZRRandom|)^2 + F\Delta Isigunc^2}$$

$$= \sqrt{\left(0.014/°F * 1.274\ °F\right)^2 + (0.001/psig * 32.845\ psig)^2 + (0.005\ decimal\ Fraction\ of\ RTP)^2}$$

$$= 0.037708\ decimal\ Fraction\ of\ RTP$$

For conservatism, U_S and U_{Srand} are converted to Δ T units (°F) using the Westinghouse

ΔT_0 value:

$$U_{S\Delta T} = U_S * \Delta T_{0wes}$$

$$U_{S\Delta T} = 5.007 * 10^{-3} * 65.2\ °F$$

$$U_{S\Delta T} = 0.3265\ °F$$

$$U_{Srand\Delta T} = U_{Srand} * \Delta T_{0wes}$$

$$U_{Srand\Delta T} = 0.037708 * 65.2\ °F$$

$$U_{Srand\Delta T} = 2.4586\ °F$$

The total loop uncertainty (U_T) and the total loop random uncertainty (U_{TRand}):

$$U_T = \sqrt{(U_{s\Delta T})^2 + (\Delta Tunc_{pos})^2}$$

$$U_T = \sqrt{(0.3265)^2 + (2.326)^2}$$

$$U_T = 2.3488\ °F$$

$$U_{Trand} = \sqrt{(U_{srand\Delta T})^2 + (\Delta Tunc_{pos})^2}$$

$$U_{Trand} = \sqrt{(2.4586)^2 + (2.326)^2}$$ (Uncertainty from Ref 8.4.8 (SPC- RP-094))

$$U_{Trand} = 3.3845\ °F$$

$$\mathbf{U_T = 2.3488}\ ^\circ\mathrm{F}$$

$$\mathbf{U_{Trand} = 3.3845}\ ^\circ\mathrm{F}$$

Flux Tilt Penalty:

The flux tilt penalty breakpoints are -13% and +8% ΔI. The permissible operational Axial Flux Difference is -9% and +8% ΔI at 100%RTP.

Flux tilt penalty must be accounted for and calculated for any conditions under which the algebraic sum of permissible positive AFD and $F\Delta Iunc_{pos}$ (or permissible negative AFD and $F\Delta Iunc_{neg}$) would exceed the positive or negative flux tilt penalty breakpoints.

$F\Delta Iunc_{pos}$ = 5.388 %RTP

$F\Delta Iunc_{neg}$ = -5.1137 %RTP

NegTot = -9 + $F\Delta Iunc_{neg}$ = -14.113 % RTP

PosTot = 8 + $F\Delta Iunc_{pos}$ = 13.388 % RTP

FTBPneg = 13

FTPBPpos = 8

The permissible positive operational AFD is greater than the positive flux tilt penalty breakpoint, therefore we must account for flux tilt penalty that would result from AFD equal to $F\Delta Iunc_{pos}$ using the positive flux tilt penalty slope of 1.73 %RTP/%ΔI listed in References 8.5.3 and 8.5.4:

$f\Delta I_{penp}$ = 0.0173 * $F\Delta Iunc_{pos}$ %RTP

$f\Delta I_{penp}$ = 0.0173 * 5.388 %RTP

$f\Delta I_{penp}$ = 0.0932 % RTP

The permissible negative operational AFD is greater than the negative flux tilt penalty breakpoint, therefore we must account for flux tilt penalty that would result from AFD equal to $F\Delta Iunc_{neg}$ using the negative flux tilt penalty slope of 1.73 %RTP/%ΔI listed in References 8.5.3 and 8.5.4:

$f\Delta I_{penn}$ = 0.03846 * (NegTot+FTBPneg) %RTP

$f\Delta I_{penn}$ = 0.03846 * (-14.113+13) %RTP

$f\Delta I_{penn}$ = -0.0428 % RTP

Positive and Negative Flux tilt penalty need to be accounted for and calculated as the positive and negative flux tilt exceeds penalty breakpoints.

The Analytical Limit is calculated using the following formula:

AL = $\Delta T_{0WEST} \times SP_{1WEST}$

SP_{1wes} (560, 2235, 0) = $\{K'_{1wes} - K_{2wes}(T - Tavgspan_{lo}) + K_{3wes}(P - PZRPspan_{lo}) - f(\Delta I)\}$

SP_{1wes} (560, 2235, 0) = $\{1.255 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

SP_{1wes} (560, 2235, 0) = 1.23

AL = 65.2 x 1.23 °F

AL = 80.196 °F (No Change)

The Nominal Trip Setpoint is calculated using the following formula:

Positive Flux Tilt Penalty:

NTSP1 = $\Delta T_{0WEST} \times SP_{1wes} - U_T$

SP_{1wes} (560, 2235, 0.0932) = $\{K'_{1wes} - K_{2wes}(T - Tavgspan_{lo}) + K_{3wes}(P - PZRPspan_{lo}) - f(\Delta I)\}$

SP_{1wes} (560, 2235, 0.0932) = $\{1.255 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0.0932)\}$

SP_{1wes} (560, 2235, 0.0932) = 1.1368

NTSP1 = 65.2 × 1.1368 – 2.3488

NTSP1 = 74.1194 – 2.3488

NTSP1 = 71.7706 °F

Negative Flux Tilt Penalty:

NTSP2 = $\Delta T_{0WEST} \times SP_{1wes} - U_T$

SP_{1wes} (560, 2235,0.0428) = $\{K'_{1wes} - K_{2wes}(T - Tavgspan_{lo}) + K_{3wes}(P - PZRPspan_{lo}) - f(\Delta I)\}$

SP_{1wes} (560, 2235, 0.0428) = $\{1.255 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0.0428)\}$

SP_{1wes} (560, 2235, 0.0428) = 1.1872

NTSP2 = 65.2 × 1.1872 – 2.3488

NTSP2 = 77.4054 – 2.3488

NTSP2 = 75.0566 °F

The Calculated Allowable Value is calculated using the following formula:

$AV_{calc} = AL - (U_T + U_{TRand}) + U_{TRand}$

AV_{calc} = 80.196 – (2.3488+ 3.3845) + 3.3845

AV_{calc} = 77.8472 °F

The COLR Allowable Value is calculated using the following formula:

$AV_{COLR} = \Delta T_{0COLR} \times SP_{1COLR}$

SP_{1colr} (560, 2235, 0) = $\{K'_{1colr} - K_{2colr}(T - Tavgspan_{lo}) + K_{3colr}(P - PZRPspan_{lo}) - f(\Delta I)\}$

SP_{1colr} (560, 2235, 0) = $\{1.195 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

SP_{1colr} (560, 2235, 0) = 1.17

AV_{COLR} = 65.2 × 1.17

AV_{COLR} = 76.284 °F (No Change)

The Actual Plant Trip Setpoint is calculated using the following formula:

$ATSP = \Delta T_{0PLANT} \times SP_{1PLANT}$

SP_{1plant} (560, 2235, 0) = $\{K'_{1plant} - K_{2pkant}(T - Tavgspan_{lo}) + K_{3plant}(P - PZRPspan_{lo}) - f(\Delta I)\}$

SP_{1plant} (560, 2235, 0) = $\{1.195 - 0.014(560 - 520) + 0.001(2235 - 1700) - 0)\}$

SP_{1plant} (560, 2235, 0) = 1.17

ATSP = 58.64× 1.17 °F

ATSP = 68.609 °F (No Change)

Conclusion of the SPC-RP-096 (Unit 2) analysis:

Analytical Limit (AL)	80.196 °F (No change)
Nominal Trip Setpoint (NTSP1)	71.7706 °F
Nominal Trip Setpoint (NTSP2) (Normal)	75.0566 °F
Calculated Allowable Value (AV_{calc})	77.8472 °F
COLR Allowable Value (AV_{COLR})	76.284 °F (No change)
Actual Plant Trip Setpoint	68.609 °F (No change)

6.4 Analysis

Parameter	Unit 1		Unit 2	
	Existing	New	Existing	New
Calculated Allowable Value (AV_{calc})	77.395 °F	77.6411 °F	77.22 °F	77.8472 °F
Nominal Trip Setpoint (NTSP1)	72.87 °F	73.5335 °F	70.884 °F	71.7706 °F
Nominal Trip Setpoint (NTSP2)	-	-	73.435 °F	75.0566 °F
Actual Plant Trip Setpoint	69.849 °F	69.849 °F	68.609 °F	68.609 °F
Analytical Limit (AL)	80.196 °F	80.196 °F	80.196 °F	80.196 °F
COLR Allowable Value (AV_{COLR})	76.284 °F	76.284 °F	76.284 °F	76.284 °F

6.4.1 Actual Trip Setpoint and Nominal Trip Setpoint

Per Section 6.3.1 and 6.3.2, the Unit 1 NTSP is 73.5335 °F and the Unit 2 NTSP is 75.0566 °F (Worst Case). The Unit 1 ATSP is 69.849 °F and the Unit 2 ATSP is 68.609 °F. The Actual Trip Setpoints are evaluated as follows:

$$\text{ATSP} \leq \text{NTSP}$$

$$69.849\ °\text{F} < 73.5335\ °\text{F}$$

$$68.609\ °\text{F} < 75.0566\ °\text{F}$$

Therefore, the Actual Plant Trip Setpoint is conservative with respect to the Nominal Trip Setpoint for Unit 1 and Unit 2.

6.4.2 COLR Allowable Value and Calculated Allowable Value

Per Section 6.3.1 and 6.3.2, the Unit 1 AV_{Calc} is 77.6411 °F and the Unit 2 AV_{Calc} is 77.8472 °F. The AV_{COLR} is 76.284 °F for both Units. The COLR Allowable Values are evaluated as follows:

$$\text{AV}_{\text{COLR}} \leq \text{AV}_{\text{Calc}}$$

$$76.284\ °\text{F} < 77.6411\ °\text{F}$$

$$76.284\ °\text{F} < 77.8472\ °\text{F}$$

Therefore, the COLR Allowable Value is conservative with respect to the Calculated Value for Unit 1 and Unit 2.

6.4.3 Nominal Trip Setpoint and Calculated Allowable Value

Per Section 6.3.1 and 6.3.2, the Unit 1 NTSP is 73.5335 °F and the Unit 2 NTSP is 75.0566 °F (Worst Case). The Unit 1 AV_{Calc} is 77.6411 °F and the Unit 2 AV_{Calc} is 77.8472 °F. The Calculated Allowable Value is evaluated as follows:

$$\text{NTSP} \leq \text{AV}_{\text{Calc}}$$

$$73.5335\ \text{°F} < 77.6411\ \text{°F}$$

$$75.0566\ \text{°F} < 77.8472\ \text{°F}$$

Therefore, the Nominal Trip Setpoint is conservative with respect to the Calculated Value for Unit 1 and Unit 2.

7.0 Conclusions and Plant Impact

The new calculated values were found acceptable using the criteria outlined in Section 3.0 of this attachment. Therefore, the calibration interval for the Units 1 and 2 Overtemperature Delta-T instrument loops which perform Reactor Trip can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs"

8.2 Engineering Manuals

8.2.1 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations"

8.2.2 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift"

8.3 Drift Calculations

8.3.1 SPC-DR-012, "Drift Analysis of As-Found /As -Left Data for NUS R/V Converter RTL501", Rev 0

8.3.2 SPC-DR-014, "Drift Analysis of As-Found /As -Left Data for NUS HI Selector SGU501", Rev 0

8.3.3 SPC-DR-016, "Drift Analysis of As-Found /As -Left Data for NUS Lead /Lag Unit TMD500-20/00/00/00-08-08-03 IDS D-009", Rev 0

8.3.4 SPC-DR-017, "Drift Analysis of As-Found /As -Left Data for NUS Lag Unit TMD500-06/00/00/00-06-08-03 D-016", Rev 1

8.3.5 SPC-DR-018, "Drift Analysis of As-Found/As -Left Data for NUS TMD500-20/05/05/00-08-08-03 Flux – Control Room" Rev 0

8.3.6 SPC-DR-021, "Drift Analysis of As-Found /As -Left Data for Rosemount Transmitter 1154GP9RC", Rev 0

8.3.7 SPC-DR-029, "Drift Analysis of As-Found /As -Left Data for Westinghouse Isolation Amplifier N200-3", Rev 0

8.3.8 SPC-DR-037, "Drift Analysis of As-Found /As -Left Data for NUS Bistable DAM503-03 (mA)", Rev 0

8.3.9 SPC-DR-040, "Drift Analysis of As-Found/As -Left Data for NUS TMD500-20/05/05/00-08-08-03 Temperature and Pressure – Control Room", Rev 0

8.4 Setpoint Calculations

8.4.1 SPC-RP-062, "UNIT 1 REACTOR COOLANT LOW FLOW REACTOR TRIP", Rev 1A

8.4.2 SPC-RP-063, "Tavg Signal Error Contribution to OTDT Trip" , Rev 1A

8.4.3 SPC-RP-064, "Delta T Signal Error Contribution to OTDT Trip" , Rev 1A

8.4.4 SPC-RP-065, "Flux Tilt Penalty Signal Error Contribution to OTDT Trip" , Rev 1A

8.4.5 SPC-RP-066, "Overtemperature Delta T Reactor Trip Instrument Channel Uncertainty Combination & Setpoint Analysis" , Rev 2B

8.4.6 SPC-RP-092, "Pressurizer Pressure Signal Error Contribution to OTDT Trip" , Rev 0

8.4.7 SPC-RP-093, "Tavg Signal Error Contribution to OTDT Trip" , Rev 0A

8.4.8 SPC-RP-094, "Delta T Signal Error Contribution to OTDT Trip" , Rev 0A

8.4.9 SPC-RP-095, "Flux Tilt Penalty Signal Error Contribution to OTDT Trip" , Rev 0

8.4.10 SPC-RP-096, "Unit 2 Overtemperature Delta T Reactor Trip Instrument Channel Uncertainty Combination & Setpoint Analysis" , Rev 1A

8.4.11 SPC-RP-053, "PRESSURIZER LO PRESSURE SI" , Rev 1A

8.4.12 SPC-RP-045, "Unit 1 NIS Power Range P-10 Interlock" , Rev 0

8.4.13 SPC-RP-019, "Unit 1 Pressurizer High Pressure Reactor Trip", Rev 0A

8.4.14 SPC-RP-020, "Unit 2 Pressurizer High Pressure Reactor Trip" , Rev 0A

8.5 Technical Specifications

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42), Amendment 230

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60), Amendment 218

8.5.3 Prairie Island Nuclear Generating Plant Core Operating Limits Report, Unit 1 – Cycle 32 Rev. 0

8.5.4 Prairie Island Nuclear Generating Plant Core Operating Limits Report, Unit 2 – Cycle 31 Rev. 0

8.6 Surveillance Procedures

8.6.1 Surveillance Procedure SP 1002B.1, "REACTOR PROTECTION & CONTROL TRANSMITTER CALIBRATION / INSPECTION - PRESSURIZER PRESSURE", Rev 004

8.6.2 Surveillance Procedure SP 2002B.1, "REACTOR PROTECTION & CONTROL TRANSMITTER CALIBRATION / INSPECTION - PRESSURIZER PRESSURE", Rev 003

8.6.3 Surveillance Procedure SP 1002A, "ANALOG PROTECTION SYSTEM CALIBRATION", Rev 050
8.6.4 Surveillance Procedure SP 2002A, "ANALOG PROTECTION SYSTEM CALIBRATION", Rev 052
8.6.5 Surveillance Procedure SP 1003, "Analog Protection Functional Test", Rev 82.
8.6.6 Surveillance Procedure SP 2003, " Analog Protection Functional Test", Rev 83
8.6.7 Surveillance Procedure SP 1318.2, "NIS INTERMEDIATE RANGE CHANNEL CALIBRATION", Rev 24
8.6.8 Surveillance Procedure SP 2318.2, "NIS INTERMEDIATE RANGE CHANNEL CALIBRATION", Rev 24

8.7 Design Control Documents

8.7.1 EC 6EQVENG24891, Revision 0, "Nuclear Instrumentation System (NIS) Display Upgrade"
8.7.2 Westinghouse Field Kit Instructions WNA-IP-00563-GEN, Revision 2
8.7.3 Westinghouse NIS Technical Manual Appendix "Digital Meter 2.0 – Power Range A & B". Revision 2
8.7.4 Westinghouse Nuclear Instrumentation System Instruction Book, XH-1-1931 Revision 7
8.7.5 NX-20728-1, Rev. 37 "ROSEMOUNT COMPOSITE MANUAL "
8.7.6 ECR Document Number 601000001191, Revision 0, "Replace 2PT-429, 30, 31, 49, 1PT-429, 30, 31, 49".
8.7.7 DIT 601000002918-001, transmitting and containing AFAL_Instrumentation_R.03_ Results.xlsx, last modified on 3/30/2021

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TABLE OF CONTENTS

1.0 Purpose

The purpose of this Attachment is to verify that the surveillance interval extension from 24 to 30 months does not adversely impact the operation of the Overpower ΔT (OPΔT) reactor trip instrument loops in Units 1 and 2. This Attachment will provide input for the LAR being submitted for surveillance interval extension.

This Attachment considers the following instruments (see References 8.4.1 through 8.4.6, 8.6.1 through 8.6.2, and 8.7.1 through 8.7.8):

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model	Description
1TE-405A	RDF	21450	Hot Leg RTD
1TE-401B	RDF	21450	Cold Leg RTD
1TE-402A	RDF	21450	Hot Leg RTD
1TE-402B	RDF	21450	Cold Leg RTD
1TE-403A	RDF	21450	Hot Leg RTD
1TE-407B	RDF	21450	Cold Leg RTD
1TE-404A	RDF	21450	Hot Leg RTD
1TE-404B	RDF	21450	Cold Leg RTD
2TE-401A	Ultra Electronics	N9355E-2A-20	Hot Leg RTD
2TE-401B	Ultra Electronics	N9355E-2A-20	Cold Leg RTD
2TE-402A	Ultra Electronics	N9355E-2A-20	Hot Leg RTD
2TE-402B	Ultra Electronics	N9355E-2A-20	Cold Leg RTD
2TE-403A	Ultra Electronics	N9355E-2A-20	Hot Leg RTD
2TE-403B	Ultra Electronics	N9355E-2A-20	Cold Leg RTD
2TE-404A	Ultra Electronics	N9355E-2A-20	Hot Leg RTD
2TE-404B	Ultra Electronics	N9355E-2A-20	Cold Leg RTD
1TT-401A	NUS Instruments	RTL501-3/13	R/E Transmitter
1TT-401B	NUS Instruments	RTL501-3/13	R/E Transmitter
1TT-402A	NUS Instruments	RTL501-3/13	R/E Transmitter
1TT-402B	NUS Instruments	RTL501-3/13	R/E Transmitter
1TT-403A	NUS Instruments	RTL501-3/13	R/E Transmitter
1TT-403B	NUS Instruments	RTL501-3/13	R/E Transmitter
1TT-404A	NUS Instruments	RTL501-3/13	R/E Transmitter
1TT-404B	NUS Instruments	RTL501-3/13	R/E Transmitter
2TT-401A	NUS Instruments	RTL501-3/13	R/E Transmitter
2TT-401B	NUS Instruments	RTL501-3/13	R/E Transmitter
2TT-402A	NUS Instruments	RTL501-3/13	R/E Transmitter
2TT-402B	NUS Instruments	RTL501-3/13	R/E Transmitter
2TT-403A	NUS Instruments	RTL501-3/13	R/E Transmitter
2TT-403B	NUS Instruments	RTL501-3/13	R/E Transmitter
2TT-404A	NUS Instruments	RTL501-3/13	R/E Transmitter
2TT-404B	NUS Instruments	RTL501-3/13	R/E Transmitter
1TM-401BB	NUS Instruments	TMD500-20/00/00/00-08-08-03 IDS D-009	E/I Lead/Lag Unit
1TM-402BB	NUS Instruments	TMD500-20/00/00/00-08-08-03 IDS D-009	E/I Lead/Lag Unit

Instrument Number	Manufacturer	Model	Description
1TM-403BB	NUS Instruments	TMD500-20/00/00/00-08-08-03 IDS D-009	E/I Lead/Lag Unit
1TM-404BB	NUS Instruments	TMD500-20/00/00/00-08-08-03 IDS D-009	E/I Lead/Lag Unit
2TM-401BB	NUS Instruments	TMD500-20/00/00/00-08-08-03 IDS D-009	E/I Lead/Lag Unit
2TM-402BB	NUS Instruments	TMD500-20/00/00/00-08-08-03 IDS D-009	E/I Lead/Lag Unit
2TM-403BB	NUS Instruments	TMD500-20/00/00/00-08-08-03 IDS D-009	E/I Lead/Lag Unit
2TM-404BB	NUS Instruments	TMD500-20/00/00/00-08-08-03 IDS D-009	E/I Lead/Lag Unit
1TM-401O	NUS Instruments	TMD500-20/00/00/00-08-08-03 D-020	I/L Lead/Lag Unit
1TM-402O	NUS Instruments	TMD500-20/00/00/00-08-08-03 D-020	I/L Lead/Lag Unit
1TM-403O	NUS Instruments	TMD500-20/00/00/00-08-08-03 D-020	I/L Lead/Lag Unit
1TM-404O	NUS Instruments	TMD500-20/00/00/00-08-08-03 D-020	I/L Lead/Lag Unit
2TM-401O	NUS Instruments	TMD500-20/00/00/00-08-08-03 D-020	I/L Lead/Lag Unit
2TM-402O	NUS Instruments	TMD500-20/00/00/00-08-08-03 D-020	I/L Lead/Lag Unit
2TM-403O	NUS Instruments	TMD500-20/00/00/00-08-08-03 D-020	I/L Lead/Lag Unit
2TM-404O	NUS Instruments	TMD500-20/00/00/00-08-08-03 D-020	I/L Lead/Lag Unit
1TM-401V	NUS Instruments	MTH500-05/00/00/00-08-08-03	Summing Amplifier
1TM-402V	NUS Instruments	MTH500-05/00/00/00-08-08-03	Summing Amplifier
1TM-403V	NUS Instruments	MTH500-05/00/00/00-08-08-03	Summing Amplifier
1TM-404V	NUS Instruments	MTH500-05/00/00/00-08-08-03	Summing Amplifier
2TM-401V	NUS Instruments	MTH500-05/00/00/00-08-08-03	Summing Amplifier
2TM-402V	NUS Instruments	MTH500-05/00/00/00-08-08-03	Summing Amplifier
2TM-403V	NUS Instruments	MTH500-05/00/00/00-08-08-03	Summing Amplifier
2TM-404V	NUS Instruments	MTH500-05/00/00/00-08-08-03	Summing Amplifier
1TM-405R	NUS Instruments	TMD500-06/00/00/00-06-08-03 D-016	E/E Lag Unit
1TM-406R	NUS Instruments	TMD500-06/00/00/00-06-08-03 D-016	E/E Lag Unit
1TM-407R	NUS Instruments	TMD500-06/00/00/00-06-08-03 D-016	E/E Lag Unit
1TM-408R	NUS Instruments	TMD500-06/00/00/00-06-08-03 D-016	E/E Lag Unit
2TM-407R	NUS Instruments	TMD500-06/00/00/00-06-08-03 D-016	E/E Lag Unit
2TM-408R	NUS Instruments	TMD500-06/00/00/00-06-08-03 D-016	E/E Lag Unit
2TM-405R	NUS Instruments	TMD500-06/00/00/00-06-08-03 D-016	E/E Lag Unit
2TM-406R	NUS Instruments	TMD500-06/00/00/00-06-08-03 D-016	E/E Lag Unit
1TC-405A/B	NUS Instruments	DAM503-03	Dual Channel Bistable
1TC-406A/B	NUS Instruments	DAM503-03	Dual Channel Bistable
1TC-407A/B	NUS Instruments	DAM503-03	Dual Channel Bistable
1TC-408A/B	NUS Instruments	DAM503-03	Dual Channel Bistable
2TC-405A/B	NUS Instruments	DAM503-03	Dual Channel Bistable
2TC-406A/B	NUS Instruments	DAM503-03	Dual Channel Bistable
2TC-407A/B	NUS Instruments	DAM503-03	Dual Channel Bistable
2TC-408A/B	NUS Instruments	DAM503-03	Dual Channel Bistable

2.0 Methodology

SPC-RP-067 (Reference 8.4.1), SPC-RP-068 (Reference 8.4.2), SPC-RP-097 (Reference 8.4.4), and SPC-RP-098 (Reference 8.4.5) calculate OPΔT loop uncertainties using the uncertainty combination methodology of EM 3.3.4.1 (Reference 8.2.1). This Attachment updates the loop uncertainties determined in each calculation using the results of 30-month instrument drift analyses (References 8.3.1 through 8.3.6) per SPC-AF-EA-RC-RP-001 Section 2.1.

The four uncertainty calculations provide input to SPC-RP-070 (Reference 8.4.3) and SPC-RP-099 (Reference 8.4.6) to evaluate the Unit 1 and Unit 2 OPΔT reactor trip setpoints. The evaluations in SPC-RP-070 and SPC-RP-099 differ from the methodology in SPC-AF-EA-RC-RP-001 Section 2. Each calculation determines the Analytical Limit (AL), Nominal Trip Setpoint (NTSP), Calculated Allowable Value (AV_{Calc}), COLR Allowable Value (AV_{COLR}), and Actual Trip Setpoint (ATSP). The methodology for the calculation of these terms within SPC-RP-070 and SPC-RP-099 is detailed in Sections 4.2.3 and 4.2.6 of this Attachment, respectively. The methodology is summarized as follows:

- AL is calculated using the OPΔT Allowable Value formula (no T_{Avg} penalty) with Westinghouse input parameters.
- NTSP is calculated by subtracting the combination of loop bias uncertainties (U_T) from the OPΔT Allowable Value formula (with T_{Avg} penalty) with Westinghouse input parameters.
- AV_{Calc} is calculated by subtracting the sum of combined loop uncertainties (U_T + U_{TRand}) and adding the combined random uncertainty (U_{TRand}) to the AL.
- AV_{COLR} is calculated using the OPΔT Allowable Value formula (no T_{Avg} penalty) with COLR input parameters.
- ATSP is calculated using the OPΔT Allowable Value formula (with T_{Avg} penalty) with plant input parameters.

This Attachment updates each value in accordance with the existing methodology of each calculation. The updated values are evaluated against the same acceptance criteria used in SPC-RP-070 and SPC-RP-099 (see Section 3.0 of this Attachment).

This Attachment does not utilize the setpoint evaluation methodology of SPC-AF-EA-RC-RP-001 Section 2 because the OPΔT Trip function has no fixed setpoint. The trip bistables compare a dynamic setpoint signal (ΔT_{SP2}) to the ΔT RCS temperature (ΔTlag) using a differential-input bistable configuration. Per SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.2), the calibration trip setting of 30.53mA is a test setting that corresponds to a simulated input of ΔTlag = 4 VDC (75% power).

For consistency and clarity, this Attachment modifies the names of some terms used in SPC-RP-070 and SPC-RP-099. Table 2.1 defines equivalent terms between each calculation and this Attachment.

Table 2.1: Equivalent Terms

Original term	Modified term	Description
fT_{avg}, Tavgpen	T_{AvgPen}	T_{avg} penalty within the OPΔT Allowable Value formula; decreases the trip setpoint if the measured T_{Avg} exceeds the nominal T_{Avg}
Taverand	$T_{AvgRand}$	Random loop uncertainty per SPC-RP-067 (Unit 1) or SPC-RP-097 (Unit 2)
Tavebiapos	$T_{AvgBiasPos}$	Positive loop bias uncertainty per SPC-RP-067 (Unit 1) or SPC-RP-097 (Unit 2)
Tavebiasneg	$T_{AvgBiasNeg}$	Negative loop bias uncertainty per SPC-RP-067 (Unit 1) or SPC-RP-097 (Unit 2)
$Tavgunc_{pos}$	$T_{AvgUncPos}$	Total positive loop uncertainty per SPC-RP-067 (Unit 1) or SPC-RP-097 (Unit 2)
$Tavgunc_{neg}$	$T_{AvgUncNeg}$	Total negative loop uncertainty per SPC-RP-067 (Unit 1) or SPC-RP-097 (Unit 2)
$\Delta Tunc_{rand}$	ΔT_{Rand}	Random loop uncertainty per SPC-RP-068 (Unit 1) or SPC-RP-098 (Unit 2)
$\Delta Tunc_{biaspos}$	$\Delta T_{BiasPos}$	Positive loop bias uncertainty per SPC-RP-068 (Unit 1) or SPC-RP-098 (Unit 2)
$\Delta Tunc_{biasneg}$	$\Delta T_{BiasNeg}$	Negative loop bias uncertainty per SPC-RP-068 (Unit 1) or SPC-RP-098 (Unit 2)
$\Delta Tunc_{pos}$	ΔT_{UncPos}	Total positive loop uncertainty per SPC-RP-068 (Unit 1) or SPC-RP-098 (Unit 2)
$\Delta Tunc_{neg}$	ΔT_{UncNeg}	Total negative loop uncertainty per SPC-RP-068 (Unit 1) or SPC-RP-098 (Unit 2)

3.0 Acceptance Criteria

This Attachment evaluates the OPΔT Allowable Value and Nominal Trip Setpoint against the same acceptance criteria used in SPC-RP-070 (Reference 8.4.3) and SPC-RP-099 (Reference 8.4.6). The results are considered acceptable if the following criteria are met:

1. The Actual Trip Setpoint is conservative to the Nominal Trip Setpoint (ATSP ≤ NTSP)
2. The COLR Allowable Value is conservative to the calculated Allowable Value ($AV_{COLR} \leq AV_{Calc}$)
3. The Nominal Trip Setpoint is conservative to the calculated Allowable Value ($NTSP \leq AV_{Calc}$)

This Attachment does not utilize the Setpoint Margin Acceptance Criteria in SPC-AF-EA-RC-RP-001 Section 3.1 because the OPΔT Trip function has no fixed setpoint (see Section 2.0).

The comparison of AV_{COLR} to AV_{Calc} is equivalent to the Allowable Value Acceptance Criteria in SPC-AF-EA-RC-RP-001 Section 3.2 ($AV_{Tech\ Spec} \leq AV_{Calc}$) since the Technical Specifications (References 8.5.1 and 8.5.2) define the OPΔT Allowable Value using COLR parameters (see References 8.5.3 and 8.5.4).

4.0 Design Inputs

4.1 Drift Calculations

This Attachment uses results from the following drift calculations:

- SPC-DR-011, "Drift Analysis of As-Found/As-Left Data for NUS Summing Amplifier MTH500-05/00/00/00-08-08-03" (Reference 8.3.1)
- SPC-DR-012, "Drift Analysis of As-Found/As-Left Data for NUS R/V Converter RTL501" (Reference 8.3.2)
- SPC-DR-016, "Drift Analysis of As-Found/As-Left Data for NUS Lead/Lag Unit TMD500-20/00/00/00-08-08-03 IDS D-009" (Reference 8.3.3)
- SPC-DR-017, "Drift Analysis of As-Found/As-Left Data for NUS Lag Unit TMD500-06/00/00/00-06-08-03 D-016" (Reference 8.3.4)
- SPC-DR-037, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (mA)" (Reference 8.3.5)
- SPC-DR-039, "Drift Analysis of As-Found/As-Left Data for NUS Lead/Lag Unit TMD500-20/00/00/00-08-08-03 D-020 (mA)" (Reference 8.3.6)

These calculations analyze the historical drift of instruments listed in Table 1.1. Results from each calculation are listed in Sections 4.1.1 through 4.1.6.

4.1.1 SPC-DR-011

NUS MTH500-05/00/00/00-08-08-03 summing amplifiers are determined to have the following values of random drift and drift bias over a 30-month calibration interval:

$$DA_{Ext,Random} = \pm 0.097\% \text{ span}$$

$$DA_{Ext,Bias} = -0.051\% \text{ span}$$

4.1.2 SPC-DR-012

NUS RTL501-3/13 R/E converters are determined to have the following values of random drift and drift bias over a 30-month calibration interval:

$$DA_{Ext,Random} = \pm 0.201\% \text{ span}$$

$$DA_{Ext,Bias} = 0\% \text{ span}$$

4.1.3 SPC-DR-016

NUS TMD500-20/00/00/00-08-08-03 IDS D-009 lead/lag units are determined to have the following values of random drift and drift bias over a 30-month calibration interval:

$$DA_{Ext,Random} = \pm 0.367\% \text{ span}$$

$$DA_{Ext,Bias} = +0.080\% \text{ span}$$

4.1.4 SPC-DR-017

NUS TMD500-06/00/00/00-06-08-03 D-016 lag units are determined to have the following values of random drift and drift bias over a 30-month calibration interval:

$$DA_{Ext,Random} = \pm 0.254\ \%\ span$$

$$DA_{Ext,Bias} = 0\%\ span$$

4.1.5 SPC-DR-037

NUS DAM503-03 bistables (10-50 mA input span) are determined to have the following values of random drift and drift bias over a 30-month calibration interval:

$$DA_{Ext,Random} = \pm 0.0697\%\ span$$

$$DA_{Ext,Bias} = 0\%\ span$$

4.1.6 SPC-DR-039

NUS TMD500-20/00/00/00-08-08-03 D-020 lead/lag units (10-50 mA input span) are determined to have the following values of random drift and drift bias over a 30-month calibration interval:

$$DA_{Ext,Random} = \pm 0.091\%\ span$$

$$DA_{Ext,Bias} = +0.015\%\ span$$

4.2 Setpoint/Uncertainty Calculations

The Overpower ΔT function has six associated uncertainty and setpoint calculations. The methodology and results of each calculation are listed in Sections 4.2.1 through 4.2.6.

4.2.1 SPC-RP-067

SPC-RP-067, *"Tavg Signal Error Contribution to OPDT Trip"* (Reference 8.4.1), determines the error associated with the T_{Avg} signal input to the Unit 1 OPΔT reactor trip bistable. The T_{Avg} loop is used to calculate the ΔT_{SP2} setpoint. SPC-RP-067 Assumption 12 states that the calculation applies to all four Unit 1 instrumentation loops that provide a T_{Avg} signal to the OPΔT setpoint calculator (loops 1T-401-RP, 1T-402-RP, 1T-403-RP, and 1T-404-RP).

Per SPC-RP-067 Section 5.4, the Total Loop Error (TLE) for the instrument loop is calculated using the Square Root of the Sum of the Squares (SRSS) of the Random terms ± the sum of Bias terms, resulting in the following formulas:

$$TLE_{pos} = SRSS + Bias_{pos} \qquad TLE_{neg} = -SRSS - Bias_{neg}$$

SPC-RP-067 Assumption 1 states that the calculation is performed assuming seismic accident conditions since the Reactor Protection System is required to function during a Design Basis Earthquake (DBE). For conditions following the loss of non-seismic HVAC

due to a seismic event, the SRSS of random terms (SRSSS), positive bias, and negative bias are defined by the following formulas per SPC-RP-067 Section 5.4:

$$\mathrm{SRSSS} = (A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2)^{1/2}$$

$$\mathrm{Bias_{pos}} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$\mathrm{Bias_{neg}} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

The terms in the above formulas are determined in SPC-RP-067 Sections 5.1.4 and 5.3, resulting in the following values:

$$\begin{aligned}\mathrm{SRSSS} &= ((0.83028\ °F^2) + (0.14819\ °F^2) + (0.78254\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (2.6432\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F)^2 + (0\ °F)^2 + (0\ °F)^2)^{1/2} \\ &= 2.0986\ °F\end{aligned}$$

$$\begin{aligned}\mathrm{Bias_{pos}} &= (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) \\ &= 0\ °F\end{aligned}$$

$$\begin{aligned}\mathrm{Bias_{neg}} &= (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0.5\ °F) + (0\ °F) \\ &= 0.5000\ °F\end{aligned}$$

Therefore, the Total Loop Error for the instrument loop is bounded by the following values:

$$\mathrm{TLE} = +2.0986\ °F\ /\ -2.5986\ °F$$

The TLE under normal conditions is also calculated in SPC-RP-067. The TLE under normal conditions is equal to the TLE following the loss of non-seismic HVAC since the loop seismic effect (S_R) is zero, and all other individual uncertainty terms correspond and are equal in value.

4.2.2 SPC-RP-068

SPC-RP-068, *"Delta T Signal Error Contribution to OPDT Trip"* (Reference 8.4.2), determines the process signal error of the ΔT signal input to the Unit 1 OPΔT reactor trip bistable. SPC-RP-068 Assumption 10 states that the calculation applies to all four Unit 1

instrumentation loops that provide a ΔT signal to the OPΔT reactor trip bistable (loops 1T-401-RP, 1T-402-RP, 1T-403-RP, and 1T-404-RP).

Per SPC-RP-068 Section 5.4, the Total Loop Error (TLE) for the instrument loop is calculated using the Square Root of the Sum of the Squares (SRSS) of the Random terms ± the sum of Bias terms, resulting in the following formulas:

$$\mathrm{TLE_{pos}} = \mathrm{SRSS} + \mathrm{Bias_{pos}} \qquad \mathrm{TLE_{neg}} = \text{-}\mathrm{SRSS} - \mathrm{Bias_{neg}}$$

SPC-RP-068 Assumption 1 states that the calculation is performed assuming seismic accident conditions since the Reactor Protection system is required to function during a DBE. For conditions following the loss of non-seismic HVAC due to a seismic event, the SRSS of random terms (SRSSS), positive bias, and negative bias are defined by the following formulas per SPC-RP-068 Section 5.4:

$$\mathrm{SRSSS} = (\mathrm{A} + \mathrm{D_R} + \mathrm{M} + \mathrm{OPE_R} + \mathrm{SPEZ_R} + \mathrm{SPES_R} + \mathrm{P_R} + \mathrm{T_{NSR}} + \mathrm{R_{NR}} + \mathrm{H_{NSR}} + \mathrm{S_R} + \mathrm{READ} + \mathrm{PEA_{NR}}^2 + \mathrm{PMA_{NR}}^2 + \mathrm{PC_{NR}}^2)^{1/2}$$

$$\mathrm{Bias_{pos}} = \mathrm{D_{Bp}} + \mathrm{OPE_{Bp}} + \mathrm{SPEZ_{Bp}} + \mathrm{SPES_{Bp}} + \mathrm{P_{Bp}} + \mathrm{T_{NSBp}} + \mathrm{R_{NBp}} + \mathrm{H_{NSBp}} + \mathrm{S_{Bp}} + \mathrm{PEA_{NBp}} + \mathrm{PMA_{NBp}} + \mathrm{PC_{NBp}}$$

$$\mathrm{Bias_{neg}} = \mathrm{D_{Bn}} + \mathrm{OPE_{Bn}} + \mathrm{SPEZ_{Bn}} + \mathrm{SPES_{Bn}} + \mathrm{P_{Bn}} + \mathrm{T_{NSBn}} + \mathrm{R_{NBn}} + \mathrm{H_{NSBn}} + \mathrm{S_{Bn}} + \mathrm{PEA_{NBn}} + \mathrm{PMA_{NBn}} + \mathrm{PC_{NBn}}$$

The terms in the above formulas are determined in SPC-RP-068 Sections 5.1.4 and 5.3, resulting in the following values:

$$\mathrm{SRSSS} = ((1.0356\ ^\circ\mathrm{F}^2) + (0.09122\ ^\circ\mathrm{F}^2) + (0.32943\ ^\circ\mathrm{F}^2) + (0\ ^\circ\mathrm{F}^2) + (0\ ^\circ\mathrm{F}^2) + (0\ ^\circ\mathrm{F}^2) + (0\ ^\circ\mathrm{F}^2) + (6.2330\ ^\circ\mathrm{F}^2) + (0\ ^\circ\mathrm{F}^2) + (0\ ^\circ\mathrm{F}^2) + (0\ ^\circ\mathrm{F}^2) + (0\ ^\circ\mathrm{F}^2) + (0\ ^\circ\mathrm{F})^2 + (0\ ^\circ\mathrm{F})^2 + (0\ ^\circ\mathrm{F})^2)^{1/2}$$

$$= 2.7729\ ^\circ\mathrm{F}$$

$$\mathrm{Bias_{pos}} = (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F})$$

$$= 0\ ^\circ\mathrm{F}$$

$$\mathrm{Bias_{neg}} = (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F}) + (0\ ^\circ\mathrm{F})$$

$$= 0\ ^\circ\mathrm{F}$$

Therefore, the Total Loop Error for the instrument loop is bounded by the following values:

$$\mathrm{TLE} = +2.7729\ ^\circ\mathrm{F}\ /\ -2.7729\ ^\circ\mathrm{F}$$

The TLE under normal conditions is also calculated in SPC-RP-068. The TLE under normal conditions is equal to the TLE following the loss of non-seismic HVAC since the loop

seismic effect (S_R) is zero, and all other individual uncertainty terms correspond and are equal in value.

4.2.3 SPC-RP-070

SPC-RP-070, *"Overpower Delta T Reactor Trip Instrument Channel Uncertainty Combination and Setpoint Analysis"* (Reference 8.4.3), determines the Nominal Trip Setpoint (NTSP) and Allowable Value (AV) for the Unit 1 Overpower Delta T (OPΔT) reactor trip function. The calculation references SPC-RP-067 (Reference 8.4.1) and SPC-RP-068 (Reference 8.4.2) for the T_{avg} error associated with the setpoint calculation and the ΔT process signal error, respectively. Per SPC-RP-070 Section 3.0, the OPΔT trip is an increasing process.

The calculation determines the following parameters per SPC-RP-070 Section 2.0:

1. Analytical Limit (AL) for the ΔT setpoint using Westinghouse analysis limits
2. Nominal Trip Setpoint (NTSP) using Westinghouse analysis limits and the total loop uncertainty
3. Calculated Allowable Value (AV_{calc}) using Westinghouse analysis limits, the AL, and instrument loop uncertainties
4. Core Operating Limits Report Allowable Value (AV_{COLR}) using COLR limits
5. Actual Trip Setpoint (ATSP) using plant parameters

Per SPC-RP-070 Section 4.0, the calculation uses the following setpoint formula which has been derived from the plant Technical Specifications Allowable Value formula (see Section 4.3) and simplified assuming steady-state full RCS flow conditions at 100% RTP:

$$\begin{aligned}\Delta T_{sp2} &= \Delta T_0 \{K_4 - K_6(T - T')\} \\ &= \Delta T_0 \{K_4 - T_{AvgPen}\} \\ &= \Delta T_0 \{SP_2\}\end{aligned}$$

Where:

ΔT_{sp2}	is the setpoint for the measured RCS ΔT (°F)
ΔT_0	is the indicated ΔT at RTP (°F)
K_4	is a constant (unitless)
K_6	is a constant (°F^{-1})
T	is the measured RCS average temperature (°F)
T'	is the nominal T_{avg} at RTP (°F)
T_{AvgPen}	is the T_{avg} setpoint penalty (unitless)
SP_2	is the setpoint factor (unitless)

Per SPC-RP-070 Section 4.0, the following values are used as input parameters:

Table 4.1: Unit 1 Input Parameters

	Core Operating Limits Report (COLR) (1)	Westinghouse Analysis (WES) (2)	Plant Parameters (PLANT) (3)
K_4	1.11	1.16	1.11
K_5 (°F^{-1})	0.0275	0.0275	0.0275
K_6 (°F^{-1})	0.002	0.002	0.002
T' (°F)	560.0	560.0	560.0
ΔT_0 (°F)	65.2	65.2	59.7

(1) See Reference 8.5.3
(2) See SPC-RP-070 Reference 9.4
(3) See SPC-RP-070 Reference 9.9

The following uncertainty values are defined according to the results of SPC-RP-067 and SPC-RP-068 (see Sections 4.2.1 and 4.2.2):

$$T_{AvgRand} = 2.0986\ °F \qquad \Delta T_{Rand} = 2.7729\ °F$$

$$T_{AvgBiasPos} = 0\ °F \qquad \Delta T_{BiasPos} = 0\ °F$$

$$T_{AvgBiasNeg} = 0.5\ °F \qquad \Delta T_{BiasNeg} = 0\ °F$$

$$T_{AvgUncPos} = 2.0986\ °F \qquad \Delta T_{UncPos} = 2.7729\ °F$$

$$T_{AvgUncNeg} = \text{-}2.5986\ °F \qquad \Delta T_{UncNeg} = \text{-}2.7729\ °F$$

SPC-RP-070 Section 5.0 combines the uncertainties from SPC-RP-067 and SPC-RP-068 to determine the total loop uncertainty (U_T) and the total loop random uncertainty (U_{TRand}):

$$U_T = T_{AvgBiasNeg} + \Delta T_{BiasPos}$$
$$= 0.5\ °F + 0\ °F$$
$$= 0.5\ °F$$

$$U_{TRand} = \sqrt{{T_{AvgRand}}^2 + {\Delta T_{Rand}}^2}$$
$$= \sqrt{(2.0986\ °F)^2 + (2.7729\ °F)^2}$$
$$= 3.478\ °F$$

SPC-RP-070 Sections 6.0 and 7.0 calculate SP_2 using COLR parameters, Westinghouse analysis parameters, and plant parameters to determine the final parameters for analysis. SP_2 is defined by the following formulas:

$$SP_2 = K_4 - K_6(T - T')$$
$$= K_4 - T_{AvgPen}$$

The T_{AvgPen} term is the T_{avg} setpoint penalty that is applied to the portion of T that exceeds T' ($K_6 = 0$ when $T \leq T'$ per Section 4.3). T_{AvgPen} is calculated using the maximum

possible T_{Avg} temperature (T_{AvgHi}) when accounting for loop uncertainty. T_{AvgHi} is calculated by summing T' and the negative T_{avg} uncertainty:

$$\begin{aligned} T_{AvgHi} &= T' + (-T_{AvgUncNeg}) \\ &= 560 + 2.5986\ ^\circ F \\ &= 562.599\ ^\circ F \end{aligned}$$

Therefore, the T_{Avg} setpoint penalty is calculated as follows:

$$\begin{aligned} T_{AvgPen} &= K_6(T_{AvgHi} - T') \\ &= 0.002\ (562.599 - 560)\ RTP \\ &= 5.197 \times 10^{-3}\ RTP \end{aligned}$$

SPC-RP-070 Section 7.0 calculates the final parameters for setpoint analysis. SP_2 is calculated using K_4 and T_{AvgPen} as defined above. T_{AvgPen} is set equal to zero for the calculation of AL, AV_{Calc}, and AV_{COLR}.

The Analytical Limit is calculated using the ΔT_{SP2} formula with Westinghouse parameters from Table 4.1:

$$\begin{aligned} AL &= \Delta T_{0WES} \times SP_{2WES} \\ &= 65.2 \times (1.16 - 0)\ ^\circ F \\ &= 75.632\ ^\circ F \end{aligned}$$

The Nominal Trip Setpoint is calculated using the following formula with Westinghouse parameters from Table 4.1:

$$\begin{aligned} NTSP &= \Delta T_{0WES} \times SP_{2WES} - U_T \\ &= 65.2 \times \left(1.16 - (5.197 \times 10^{-3})\right) - 0.5\ ^\circ F \\ &= 74.793\ ^\circ F \end{aligned}$$

The Calculated Allowable Value is calculated using the following formula:

$$\begin{aligned} AV_{Calc} &= AL - (U_T + U_{TRand}) + U_{TRand} \\ &= 75.632 - (0.5 + 3.478) + 3.478\ ^\circ F \\ &= 75.132\ ^\circ F \end{aligned}$$

The COLR Allowable Value is calculated using the ΔT_{SP2} formula with COLR parameters from Table 4.1:

$$AV_{COLR} = \Delta T_{0COLR} \times SP_{2COLR}$$

$$= 65.2 \times (1.11 - 0)\ °F$$
$$= 72.372\ °F$$

Since $AV_{COLR} < AV_{Calc}$, the Allowable Value equation in the Technical Specifications is conservative with respect to the calculated Allowable Value.

The Actual Plant Trip Setpoint is calculated using the ΔT_{SP2} formula with plant parameters from Table 4.1:

$$\text{ATSP} = \Delta T_{0PLANT} \times SP_{2PLANT}$$
$$= 59.7 \times \left(1.11 - (5.197 \times 10^{-3})\right)\ °F$$
$$= 65.957\ °F$$

Since ATSP < NTSP, the Actual Trip Setpoint for the Unit 1 Overpower ΔT reactor trip is conservative.

4.2.4 SPC-RP-097

SPC-RP-097, *"Tavg Signal Error Contribution to OPDT Trip"* (Reference 8.4.4), determines the error associated with the T_{Avg} signal input to the Unit 2 OPΔT reactor trip bistable. The T_{Avg} signal is used to calculate the ΔT_{SP2} setpoint. SPC-RP-097 Assumption 6 states that the calculation applies to all four Unit 2 instrumentation loops that provide a T_{avg} signal to the OPΔT setpoint calculator (loops 2T-401-RP, 2T-402-RP, 2T-403-RP, and 2T-404-RP).

Per SPC-RP-097 Section 5.4, the Total Loop Error (TLE) for the instrument loop is calculated using the Square Root of the Sum of the Squares (SRSS) of the Random terms ± the sum of Bias terms, resulting in the following formulas:

$$TLE_{pos} = SRSS + Bias_{pos} \qquad TLE_{neg} = -SRSS - Bias_{neg}$$

SPC-RP-097 Assumption 1 states that the calculation is performed assuming seismic accident conditions since the Reactor Protection system is required to function during a DBE. For conditions following the loss of non-seismic HVAC due to a seismic event, the SRSS of random terms (SRSSS), positive bias, and negative bias are defined by the following formulas per SPC-RP-097 Section 5.4:

$$SRSSS = (A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}^2 + PMA_{NR}^2 + PC_{NR}^2)^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

The terms in the above formulas are determined in SPC-RP-097 Sections 5.1.4 and 5.3, resulting in the following values:

$$\begin{aligned} \text{SRSSS} &= ((0.83028\ °\text{F}^2) + (1.33377\ °\text{F}^2) + (0.90360\ °\text{F}^2) + (0\ °\text{F}^2) + (0\ °\text{F}^2) \\ &\quad + (0\ °\text{F}^2) + (0\ °\text{F}^2) + (2.1410\ °\text{F}^2) + (0\ °\text{F}^2) + (0\ °\text{F}^2) + (0\ °\text{F}^2) + \\ &\quad (0\ °\text{F}^2) + (0\ °\text{F})^2 + (0\ °\text{F})^2 + (0\ °\text{F})^2)^{1/2} \\ &= 2.2822\ °\text{F} \end{aligned}$$

$$\begin{aligned} \text{Bias}_{\text{pos}} &= (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) \\ &\quad + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) \\ &= 0\ °\text{F} \end{aligned}$$

$$\begin{aligned} \text{Bias}_{\text{neg}} &= (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) \\ &\quad + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) + (0\ °\text{F}) \\ &= 0\ °\text{F} \end{aligned}$$

Therefore, the Total Loop Error for the instrument loop is bounded by the following values:

$$\text{TLE} = +2.2822\ °\text{F} \ / \ -2.2822\ °\text{F}$$

The TLE under normal conditions is also calculated in SPC-RP-097. The TLE under normal conditions is equal to the TLE following the loss of non-seismic HVAC since the loop seismic effect (S_R) is zero, and all other individual uncertainty terms correspond and are equal in value.

4.2.5 SPC-RP-098

SPC-RP-098, *"Delta T Signal Error Contribution to OPDT Trip"* (Reference 8.4.5), determines the process signal error of the ΔT signal input to the OPΔT reactor trip bistable. SPC-RP-098 Assumption 7 states that the calculation applies to all four Unit 2 instrumentation loops that provide a ΔT signal to the OPΔT reactor trip bistable (loops 2T-401-RP, 2T-402-RP, 2T-403-RP, and 2T-404-RP).

Per SPC-RP-098 Section 5.4, the Total Loop Error (TLE) for the instrument loop is calculated using the Square Root of the Sum of the Squares (SRSS) of the Random terms ± the sum of Bias terms, resulting in the following formulas:

$$\text{TLE}_{\text{pos}} = \text{SRSS} + \text{Bias}_{\text{pos}} \qquad \text{TLE}_{\text{neg}} = \text{-SRSS} - \text{Bias}_{\text{neg}}$$

SPC-RP-098 Assumption 1 states that the calculation is performed assuming seismic accident conditions since the Reactor Protection system is required to function during a DBE. For conditions following the loss of non-seismic HVAC due to a seismic event, the SRSS of random terms (SRSSS), positive bias, and negative bias are defined by the following formulas per SPC-RP-098 Section 5.4:

$$\text{SRSSS} = (A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}^2 + PMA_{NR}^2 + PC_{NR}^2)^{1/2}$$

$$\text{Bias}_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$\text{Bias}_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

The terms in the above formulas are determined in SPC-RP-098 Sections 5.1.4 and 5.3, resulting in the following values:

$$\begin{aligned}\text{SRSSS} &= ((1.0356\ °F^2) + (2.40392\ °F^2) + (0.52224\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (5.0024\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F)^2 + (0\ °F)^2 + (0\ °F)^2)^{1/2} \\ &= 2.9940\ °F\end{aligned}$$

$$\begin{aligned}\text{Bias}_{pos} &= (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) \\ &= 0\ °F\end{aligned}$$

$$\begin{aligned}\text{Bias}_{neg} &= (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) \\ &= 0\ °F\end{aligned}$$

Therefore, the Total Loop Error for the instrument loop is bounded by the following values:

$$\text{TLE} = +2.9940\ °F\ /\ -2.9940\ °F$$

The TLE under normal conditions is also calculated in SPC-RP-098. The TLE under normal conditions is equal to the TLE following the loss of non-seismic HVAC since the loop seismic effect (S_R) is zero, and all other individual uncertainty terms correspond and are equal in value.

4.2.6 SPC-RP-099

SPC-RP-099, *"Unit 2 Overpower Delta T Reactor Trip Instrument Channel Uncertainty Combination and Setpoint Analysis"* (Reference 8.4.6), determines the Nominal Trip Setpoint (NTSP) and Allowable Value (AV) for the Unit 2 OPΔT reactor trip function. The calculation references SPC-RP-097 (Reference 8.4.4) and SPC-RP-098 (Reference 8.4.5) for the T_{avg} error associated with the setpoint calculation and the ΔT process signal error, respectively. Per SPC-RP-099 Section 4.0, the OPΔT trip is an increasing process.

The calculation determines the following parameters per SPC-RP-099 Section 2.0:

1. Analytical Limit (AL) for the ΔT setpoint using Westinghouse analysis limits

2. Nominal Trip Setpoint (NTSP) using Westinghouse analysis limits and the total loop uncertainty
3. Calculated Allowable Value (AV_{calc}) using Westinghouse analysis limits, the AL, and instrument loop uncertainties
4. Core Operating Limits Report Allowable Value (AV_{COLR}) using COLR limits
5. Actual Trip Setpoint (ATSP) using plant parameters

Per SPC-RP-099 Section 4.0, the calculation uses the following setpoint formula which has been derived from the plant Technical Specifications Allowable Value formula (see Section 4.3) and simplified assuming steady-state full RCS flow conditions at 100% RTP:

$$\begin{aligned}\Delta T_{sp2} &= \Delta T_0 \{K_4 - K_6(T - T')\} \\ &= \Delta T_0 \{K_4 - T_{AvgPen}\} \\ &= \Delta T_0 \{SP_2\}\end{aligned}$$

Where:

ΔT_{sp2} is the setpoint for the measured RCS ΔT (°F)
ΔT_0 is the indicated ΔT at RTP (°F)
K_4 is a constant (unitless)
K_6 is a constant ($°F^{-1}$)
T is the measured RCS average temperature (°F)
T’ is the nominal T_{avg} at RTP (°F)
T_{AvgPen} is the T_{avg} setpoint penalty (unitless)
SP_2 is the normalized setpoint value (unitless)

Per SPC-RP-099 Section 4.0, the following values are used as input parameters:

Table 4.2: Unit 2 Input Parameters

	Core Operating Limits Report (COLR) (1)	Westinghouse Analysis (WES) (2)	Plant Parameters (PLANT) (3)
K_4	1.11	1.16	1.11
K_5 ($°F^{-1}$)	0.0275	0.0275	0.0275
K_6 ($°F^{-1}$)	0.002	0.002	0.002
T’ (°F)	560.0	560.0	560.0
ΔT_0 (°F)	65.2	65.2	58.64

(1) See Reference 8.5.4
(2) See SPC-RP-099 Reference 5.3
(3) See SPC-RP-099 Reference 5.6

The following uncertainty values are defined according to the results of SPC-RP-097 and SPC-RP-098 (see Sections 4.2.4 and 4.2.5):

$$\mathrm{T_{AvgRand}} = 2.2822\ °\mathrm{F} \qquad \Delta\mathrm{T_{Rand}} = 2.9940\ °\mathrm{F}$$

$$\mathrm{T_{AvgBiasPos}} = 0\ °\mathrm{F} \qquad \Delta\mathrm{T_{BiasPos}} = 0\ °\mathrm{F}$$

$$\mathrm{T_{AvgBiasNeg}} = 0\ °\mathrm{F} \qquad \Delta\mathrm{T_{BiasNeg}} = 0\ °\mathrm{F}$$

$$\mathrm{T_{AvgUncPos}} = 2.2822\ °\mathrm{F} \qquad \Delta\mathrm{T_{UncPos}} = 2.9940\ °\mathrm{F}$$

$$\mathrm{T_{AvgUncNeg}} = \text{-}2.2822\ °\mathrm{F} \qquad \Delta\mathrm{T_{UncNeg}} = \text{-}2.9940\ °\mathrm{F}$$

SPC-RP-099 Section 7.1 combines the uncertainties from SPC-RP-067 and SPC-RP-068 to determine the total loop uncertainty (U_T) and the total loop random uncertainty (U_{TRand}):

$$\begin{aligned} \mathrm{U_T} &= \mathrm{T_{AvgBiasNeg}} + \Delta\mathrm{T_{BiasPos}} \\ &= 0\ °\mathrm{F} + 0\ °\mathrm{F} \\ &= 0\ °\mathrm{F} \end{aligned}$$

$$\begin{aligned} \mathrm{U_{TRand}} &= \sqrt{\mathrm{T_{AvgRand}}^2 + \Delta\mathrm{T_{Rand}}^2} \\ &= \sqrt{(2.2822\ °\mathrm{F})^2 + (2.9940\ °\mathrm{F})^2} \\ &= 3.765\ °\mathrm{F} \end{aligned}$$

SPC-RP-090 Section 7.2 calculates SP_2 using COLR parameters, Westinghouse analysis parameters, and plant parameters to determine the final parameters for analysis. SP_2 is defined by the following formulas:

$$\begin{aligned} \mathrm{SP_2} &= \mathrm{K_4} - \mathrm{K_6}(\mathrm{T} - \mathrm{T'}) \\ &= \mathrm{K_4} - \mathrm{T_{AvgPen}} \end{aligned}$$

The T_{AvgPen} term is the T_{avg} setpoint penalty that is applied to the portion of T that exceeds T' (K_6 = 0 when T ≤ T' per Section 4.3). T_{AvgPen} is calculated using the maximum possible T_{Avg} temperature (T_{AvgHi}) when accounting for loop uncertainty. T_{AvgHi} is calculated by summing T' and the negative T_{avg} uncertainty:

$$\begin{aligned} \mathrm{T_{AvgHi}} &= \mathrm{T'} + \left(-\mathrm{T_{AvgUncNeg}}\right) \\ &= 560 + 2.2822\ °\mathrm{F} \\ &= 562.282\ °\mathrm{F} \end{aligned}$$

Therefore, the T_{Avg} setpoint penalty term is calculated as follows:

$$\begin{aligned} \mathrm{T_{AvgPen}} &= \mathrm{K_6}\left(\mathrm{T_{AvgHi}} - \mathrm{T'}\right) \\ &= 0.002\ (562.282 - 560)\ \mathrm{RTP} \\ &= 4.564 \times 10^{-3}\ \mathrm{RTP} \end{aligned}$$

SPC-RP-099 Sections 7.4 through 7.8 calculate the final parameters for setpoint analysis. SP_2 is calculated using K_4 and T_{AvgPen} as defined above. T_{AvgPen} is set equal to zero for the calculation of AL, AV_{Calc}, and AV_{COLR}.

The Analytical Limit is calculated using the ΔT_{SP2} formula with Westinghouse parameters from Table 4.1:

$$\begin{aligned} \mathrm{AL} &= \Delta \mathrm{T_{0WES}} \times \mathrm{SP_{2WES}} \\ &= 65.2 \times (1.16 - 0)\ °\mathrm{F} \\ &= 75.632\ °\mathrm{F} \end{aligned}$$

The Nominal Trip Setpoint is calculated using the following formula with Westinghouse parameters from Table 4.1:

$$\begin{aligned} \mathrm{NTSP} &= \Delta \mathrm{T_{0WES}} \times \mathrm{SP_{2WES}} - \mathrm{U_T} \\ &= 65.2 \times \left(1.16 - (4.564 \times 10^{-3})\right) - 0\ °\mathrm{F} \\ &= 75.334\ °\mathrm{F} \end{aligned}$$

The Calculated Allowable Value is calculated using the following formula:

$$\begin{aligned} \mathrm{AV_{Calc}} &= \mathrm{AL} - (\mathrm{U_T} + \mathrm{U_{TRand}}) + \mathrm{U_{TRand}} \\ &= 75.632 - (0 + 3.765) + 3.765\ °\mathrm{F} \\ &= 75.632\ °\mathrm{F} \end{aligned}$$

The COLR Allowable Value is calculated using the ΔT_{SP2} formula with COLR parameters from Table 4.1:

$$\begin{aligned} \mathrm{AV_{COLR}} &= \Delta \mathrm{T_{0COLR}} \times \mathrm{SP_{2COLR}} \\ &= 65.2 \times (1.11 - 0)\ °\mathrm{F} \\ &= 72.372\ °\mathrm{F} \end{aligned}$$

Since $AV_{COLR} < AV_{Calc}$, the Allowable Value equation in the Technical Specifications is conservative with respect to the calculated Allowable Value.

The Actual Plant Trip Setpoint is calculated using the ΔT_{SP2} formula with plant parameters from Table 4.1:

$$\begin{aligned} \mathrm{ATSP} &= \Delta \mathrm{T_{0PLANT}} \times \mathrm{SP_{2PLANT}} \\ &= 58.64 \times \left(1.11 - (4.564 \times 10^{-3})\right)\ °\mathrm{F} \\ &= 64.823\ °\mathrm{F} \end{aligned}$$

Since ATSP < NTSP, the Actual Trip Setpoint for the Unit 2 Overpower ΔT reactor trip is conservative.

4.3 Technical Specifications

The Allowable Value (AV) for the Overpower ΔT function is listed in the Unit 1 and Unit 2 Technical Specifications (References 8.5.1 and 8.5.2). The AV is defined by the following Trip Setpoint formula on page 3.3.1-24 of each Technical Specification:

$$\Delta T \leq \Delta T_0 \left\{K_4 - K_5\left(\frac{\tau_3 s T}{1 + \tau_3 s}\right) - K_6(T - T')\right\}$$

Where:

- ΔT is the measured RCS ΔT (°F)
- ΔT_0 is the indicated ΔT at RTP (°F)
- s is the Laplace transform operator (sec^{-1})
- T is the measured RCS average temperature (°F)
- T' is the nominal T_{avg} at RTP, = * (°F)
- K_4 ≤ * (unitless)
- K_5 = * for increasing T ($°F^{-1}$)
  = * for decreasing T ($°F^{-1}$)
- K_6 = * when T > T' ($°F^{-1}$)
  = * when T ≤ T' ($°F^{-1}$)
- τ_3 = * (sec)

* As specified in COLR (Core Operating Limits Report)

The left side of the inequality above is the actual (measured) ΔT. The right side is the ΔT setpoint (ΔT_{sp2}).

The Unit 1 and Unit 2 Core Operating Limits Reports (References 8.5.3 and 8.5.4) define the following values:

$$T' = 560\ °F$$

$$K_4 \leq 1.11$$

$$K_5 = \begin{cases} 0.0275\ °F^{-1}, & \textit{increasing } T \\ 0\ °F^{-1}, & \textit{decreasing } T \end{cases}$$

$$K_6 = \begin{cases} 0.002\ °F^{-1}, & T > T' \\ 0\ °F^{-1}, & T \leq T' \end{cases}$$

$$\tau_3 = 10 \text{ seconds}$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The instrument drift values are converted to the process unit of measurement (degrees Fahrenheit) to interface with the existing setpoint calculations.

6.1.1 NUS MTH500-05/00/00/00-08-08-03 Drift

NUS MTH500-05/00/00/00-08-08-03 summing amplifier drift values are converted to degrees Fahrenheit using the data from Section 4.1.1.

The output of each summing amplifier is the ΔT_{SP2} setpoint for the corresponding OPΔT trip bistable. Per Section 12.1.5.B of SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.2), the ΔT_{SP2} output span is 10-50 mA and corresponds to 0-150% reactor power. The OPΔT trip function uses ΔT as the measure of reactor power; per the OPΔT instrument block diagrams (References 8.7.1 through 8.7.8) and Section 10.1.4.C of SP 1002A and SP 2002A, the ΔT output has a span of 0-100 °F.

Note: SPC-RP-070 (Reference 8.4.3) Assumption 3.5 and SPC-RP-099 (Reference 8.4.6) Input 4.4 state that ΔT = 65.2 °F at 100% RTP. By linear interpolation of the stated value, 0-150% power would correspond to a ΔT span of 0-97.8 °F. However, 0-100 °F is used in this calculation for conservatism and consistency with the referenced drawings and calibration procedures.

Therefore, the drift values are converted from percent calibrated span to process units using the following formulas:

$$DA_{Ext,Random} = \pm 0.097\%\ \text{span} \times \frac{(100 - 0)\ °F}{100\%\ \text{span}}$$

$$= \pm 0.097\ °F$$

$$DA_{Ext,Bias} = -0.051\%\ \text{span} \times \frac{(100 - 0)\ °F}{100\%\ \text{span}}$$

$$= -0.051\ °F$$

6.1.2 NUS RTL501-3/13 Drift

NUS RTL501-3/13 R/E converter drift values are converted to degrees Fahrenheit using the data from Section 4.1.2.

The R/E converters output the T_{Hot} and T_{Cold} values as measured by their respective RTDs. Per Worksheet 10a and Section 10.1.4 of SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.2), the calibrated output span of 0-12 VDC corresponds to 495-645 °F, and the process output span of 2-10 VDC corresponds to 520-620 °F.

Therefore, the drift values are converted from percent calibrated span to process units using the following formulas:

$$DA_{Ext,Random} = \pm 0.201\%\ \text{span} \times \frac{(645 - 495)\ °F}{100\%\ \text{span}} \times \frac{(620 - 520)\ °F}{(645 - 495)\ °F}$$

$$= \pm 0.201\ °F$$

$$DA_{Ext,Bias} = 0\%\ \text{span} \times \frac{(645 - 495)\ °F}{100\%\ \text{span}} \times \frac{(620 - 520)\ °F}{(645 - 495)\ °F}$$

$$= 0\ °F$$

6.1.3 NUS TMD500-20/00/00/00-08-08-03 IDS D-009 Drift

NUS TMD500-20/00/00/00-08-08-03 IDS D-009 lead/lag unit drift values are converted to degrees Fahrenheit using the data from Section 4.1.3.

The lead/lag units output the T_{Avg} signal used to compute $F(T_{Avg})$. Per Section 10.1.4.F of SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.2), the calibrated output span of 10-50 mA corresponds to a T_{Avg} span of 520-620 °F.

Therefore, the drift values are converted from percent calibrated span to process units using the following formulas:

$$DA_{Ext,Random} = \pm 0.367\%\ \text{span} \times \frac{(620 - 520)\ °F}{100\%\ \text{span}}$$

$$= \pm 0.367\ °F$$

$$DA_{Ext,Bias} = +0.080\%\ \text{span} \times \frac{(620 - 520)\ °F}{100\%\ \text{span}}$$

$$= +0.080\ °F$$

6.1.4 NUS TMD500-06/00/00/00-06-08-03 D-016 Drift

NUS TMD500-06/00/00/00-06-08-03 D-016 lag unit drift values are converted to degrees Fahrenheit using the data from Section 4.1.4.

Each lag unit outputs the ΔTlag signal to the corresponding OPΔT bistable. Per Section 10.1.4.D of SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.2), the calibrated output span of 0-8 VDC corresponds to 0-150% power. 0-150% power corresponds to a ΔT span of 0-100 °F (see Section 6.1.1).

Therefore, the drift values are converted from percent calibrated span to process units using the following formulas:

$$\mathrm{DA_{Ext,Random}} = \pm 0.240\%\ \mathrm{span} \times \frac{(100 - 0)\ °\mathrm{F}}{100\%\ \mathrm{span}}$$

$$= \pm 0.240\ °\mathrm{F}$$

$$\mathrm{DA_{Ext,Bias}} = 0\%\ \mathrm{span} \times \frac{(100 - 0)\ °\mathrm{F}}{100\%\ \mathrm{span}}$$

$$= 0\ °\mathrm{F}$$

6.1.5 NUS DAM503-03 Drift

NUS DAM503-03 bistable drift values are converted to degrees Fahrenheit using the data from Section 4.1.5.

Per the OPΔT instrument block diagrams (References 8.7.1 through 8.7.8), the OPΔT trip bistable input signal is provided from the ΔTlag output of the corresponding lag unit. The ΔTlag span corresponds to a ΔT span of 0-100 °F (see Section 6.1.4). Therefore, the bistable calibrated input span of 10-50 mA corresponds to a ΔT span of 0-100 °F.

Therefore, the drift values are converted from percent calibrated span to process units using the following formulas:

$$\mathrm{DA_{Ext,Random}} = \pm 0.0697\%\ \mathrm{span} \times \frac{(100 - 0)\ °\mathrm{F}}{100\%\ \mathrm{span}}$$

$$= \pm 0.0697\ °\mathrm{F}$$

$$\mathrm{DA_{Ext,Bias}} = 0\%\ \mathrm{span} \times \frac{(100 - 0)\ °\mathrm{F}}{100\%\ \mathrm{span}}$$

$$= 0\ °\mathrm{F}$$

6.1.6 NUS TMD500-20/00/00/00-08-08-03 D-020 Drift

NUS TMD500-20/00/00/00-08-08-03 D-020 lead/lag unit drift values are converted to the process unit of measurement using the data from Section 4.1.6.

Each lead/lag unit outputs the F(T_{avg}) value to the corresponding summing amplifier for the computation of the ΔT_{SP2} setpoint. Per Section 12.1.5.A of SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.2), the 10-50 mA output span of F(T_{avg}) corresponds to 520-620 °F.

Therefore, the drift values are converted from percent calibrated span to degrees Fahrenheit using the following formulas:

$$\mathrm{DA_{Ext,Random}} = \pm 0.091\%\ \mathrm{span} \times \frac{(620 - 520)\ °\mathrm{F}}{100\%\ \mathrm{span}}$$
$$= \pm 0.091\ °\mathrm{F}$$

$$\mathrm{DA_{Ext,Bias}} = +0.015\%\ \mathrm{span} \times \frac{(620 - 520)\ °\mathrm{F}}{100\%\ \mathrm{span}}$$
$$= +0.015\ °\mathrm{F}$$

6.2 Total Loop Error

This section updates the TLE terms calculated in SPC-RP-067 (Reference 8.4.1), SPC-RP-068 (Reference 8.4.2), SPC-RP-097 (Reference 8.4.4), and SPC-RP-098 (Reference 8.4.5) using the results of the 30-month drift analyses associated with the instrument models within each calculation's instrument loop. Per SPC-AF-EA-RC-PR-001 Section 2, the drift analysis results are used to replace the loop Reference Accuracy (A), Time-Dependent Drift (D), and Calibration Uncertainty (M) using the following methodology.

Reference Accuracy, Random Drift (D_R), and Calibration Uncertainty are replaced by the squared sum of random terms associated with *n* loop instruments:

$$\mathrm{A} + \mathrm{D_R} + \mathrm{M} = \sum_{i=1}^{n} {\mathrm{DA_{Ext,Random}}_i}^2$$

Positive Drift Bias (D_{Bp}) is replaced by the sum of positive bias terms associated with *n* loop instruments:

$$\mathrm{D_{Bp}} = \sum_{i=1}^{n} \mathrm{DA_{Ext,Bias}}_i \mid (\mathrm{DA_{Ext,Bias}}_i > 0)$$

Negative Drift Bias (D_{Bn}) is replaced by the sum of negative bias terms associated with *n* loop instruments:

$$\mathrm{D_{Bn}} = \sum_{i=1}^{n} \mathrm{DA_{Ext,Bias}}_i \mid (\mathrm{DA_{Ext,Bias}}_i < 0)$$

6.2.1 TLE of the Unit 1 T_{Avg} Instrument Loop

SPC-RP-067 (Reference 8.4.1) references the following instruments in the Unit 1 T_{Avg} setpoint calculation instrument loop:

- 1TE-405A (RDF 21450 RTD)

- 1TT-401A (NUS RTL501-3/13 R/E converter)
- 1TM-401BB (NUS TMD500-20/00/00/00-08-08-03 IDS D-009 lead/lag unit)
- 1TM-401O (NUS TMD500-20/00/00/00-08-08-03 D-020 lead/lag unit)
- 1TM-401V (NUS MTH500-05/00/00/00-08-08-03 summing amplifier)

Note: This instrument loop averages T_{Hot} and T_{Cold} signals to produce T_{Avg}. Each temperature sensing section is identical (one RTD and one transmitter). Per PINGP's setpoint methodology, because these two signals are averaged, their uncertainties can be averaged. SPC-RP-067 Assumption 13 states that the averaging of the two temperature sensing channel uncertainties is accomplished by including only one RTD and one temperature transmitter in the instrument loop.

The historical drift of the RDF 21450 model RTD is not analyzed in a Prairie Island drift calculation. Therefore, this section uses vendor data from SPC-RP-067 to account for 1TE-405A uncertainty. Per SPC-RP-067, the instrument drift of 1TE-405A equals zero and therefore does not require extrapolation to determine the value for a 30-month calibration interval.

The SRSS of instrument accuracy, drift, and M&TE terms for 1TE-405A is calculated to determine its contribution to A, D_R, and M for the loop:

$$\begin{aligned}\mathrm{SRSS_{RTD,U1}} &= \sqrt{(0.1333\ ^\circ\mathrm{F})^2 + (0\ ^\circ\mathrm{F})^2 + (0\ ^\circ\mathrm{F})^2} \\ &= 0.1333\ ^\circ\mathrm{F}\end{aligned}$$

Per SPC-RP-067, the positive drift bias of 1TE-405A is 0 °F, and the negative drift bias is 0 °F.

The drift values of the remaining loop instruments are obtained from Sections 6.1.2, 6.1.3, 6.1.6, and 6.1.1.

The loop accuracy, random drift, and M&TE terms are replaced by the squared sum of the instruments' random terms:

$$\begin{aligned}\mathrm{A + D_R + M} &= (0.1333\ ^\circ\mathrm{F})^2 + (0.201)^2 + (0.367\ ^\circ\mathrm{F})^2 + (0.091\ ^\circ\mathrm{F})^2 + (0.097\ ^\circ\mathrm{F})^2 \\ &= 0.211\ ^\circ\mathrm{F}^2\end{aligned}$$

The positive loop drift bias is replaced by the sum of the instruments' positive bias terms:

$$\begin{aligned}\mathrm{D_{Bp}} &= 0\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} + 0.080\ ^\circ\mathrm{F} + 0.015\ ^\circ\mathrm{F} + 0\ ^\circ\mathrm{F} \\ &= 0.095\ ^\circ\mathrm{F}\end{aligned}$$

The negative loop drift bias is replaced by the absolute value of the sum of the instruments' negative bias terms:

$$D_{Bn} = 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0.051\ °F$$
$$= 0.051\ °F$$

The new values are used to determine SRSSS, $Bias_{pos}$, and $Bias_{neg}$ per the methodology in Section 4.2.1:

$$SRSSS = ((A + D_R + M) + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}^2 + PMA_{NR}^2 + PC_{NR}^2)^{1/2}$$
$$= ((0.211\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (2.6432\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F)^2 + (0\ °F)^2 + (0\ °F)^2)^{1/2}$$
$$= 1.689\ °F$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$
$$= (0.095\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F)$$
$$= 0.095\ °F$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$
$$= (0.051\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0.5\ °F) + (0\ °F)$$
$$= 0.551\ °F$$

Therefore, the Total Loop Error for the instrument loop is bounded by the following values:

$$TLE = (SRSSS + Bias_{pos})/(-SRSSS - Bias_{neg})$$
$$= +1.784\ °F\ /\ -1.138\ °F$$

6.2.2 TLE of the Unit 1 ΔT Instrument Loop

SPC-RP-068 (Reference 8.4.2) references the following instruments in the Unit 1 ΔT instrument loop:

- 1TE-405A (RDF 21450 hot leg RTD)
- 1TE-401B (RDF 21450 cold leg RTD)
- 1TT-401A (NUS RTL501-3/13 T_{Hot} R/E converter)
- 1TT-401B (NUS RTL501-3/13 T_{Cold} R/E converter)
- 1TM-405R (NUS TMD500-06/00/00/00-06-08-03 D-016 lag unit)
- 1TC-405A (NUS DAM503-03 bistable)

The historical drift of the RDF 21450 model RTD is not analyzed in a Prairie Island drift calculation. Therefore, this section uses vendor data from SPC-RP-068 to account for 1TE-405A and 1TE-401B uncertainty. Per SPC-RP-068, the instrument drift associated with each RTD equals zero, and therefore does not require extrapolation to determine the value for a 30-month calibration interval.

The SRSS of instrument accuracy, drift, and M&TE terms for each RTD is calculated to determine their contribution to A, D_R, and M for the loop:

$$\begin{aligned} SRSS_{RTD,U1} &= \sqrt{(0.1333\ °F)^2 + (0\ °F)^2 + (0\ °F)^2} \\ &= 0.1333\ °F \end{aligned}$$

Per SPC-RP-068, the positive drift bias of each RTD is 0 °F, and the negative drift bias is 0 °F.

The drift values of the remaining loop instruments are obtained from Sections 6.1.2, 6.1.4, and 6.1.5.

The loop accuracy, random drift, and M&TE terms are replaced by the squared sum of the instruments' random drift terms:

$$\begin{aligned} A + D_R + M &= 2(0.1333\ °F)^2 + 2(0.201\ °F)^2 + (0.240\ °F)^2 + (0.0697\ °F)^2 \\ &= 0.179\ °F^2 \end{aligned}$$

The positive loop drift bias is replaced by the sum of the instruments' positive bias terms:

$$\begin{aligned} D_{Bp} &= 2(0\ °F) + 2(0\ °F) + 0\ °F + 0\ °F \\ &= 0\ °F \end{aligned}$$

The negative loop drift bias is replaced by the absolute value of the sum of the instruments' negative bias terms:

$$\begin{aligned} D_{Bn} &= 2(0\ °F) + 2(0\ °F) + 0\ °F + 0\ °F \\ &= 0\ °F \end{aligned}$$

The new values are used to determine SRSSS, $Bias_{pos}$, and $Bias_{neg}$ per the methodology in Section 4.2.2:

$$\begin{aligned} SRSSS &= ((A + D_R + M) + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + \\ &\quad S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2)^{1/2} \end{aligned}$$

$$= ((0.179\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (6.2330\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F)^2 + (0\ °F)^2 + (0\ °F)^2)^{1/2}$$

$$= 2.532\ °F$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$= (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F)$$

$$= 0\ °F$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$= (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F)$$

$$= 0\ °F$$

Therefore, the Total Loop Error for the instrument loop is bounded by the following values:

$$TLE = \left(SRSSS + Bias_{pos}\right)/\left(-SRSSS - Bias_{neg}\right)$$

$$= +2.532\ °F\ /\ -2.532\ °F$$

6.2.3 TLE of the Unit 2 T_{Avg} Instrument Loop

SPC-RP-097 (Reference 8.4.4) references the following instruments in the Unit 2 T_{Avg} setpoint calculation instrument loop:

- 2TE-401A (Ultra Electronics N9355E-2A-20 RTD)
- 2TT-401A (NUS RTL501-3/13 R/E converter)
- 2TM-401BB (NUS TMD500-20/00/00/00-08-08-03 IDS D-009 lead/lag unit)
- 2TM-401O (NUS TMD500-20/00/00/00-08-08-03 D-020 lead/lag unit)
- 2TM-401V (NUS MTH500-05/00/00/00-08-08-03 summing amplifier)

Note: This instrument loop averages T_{Hot} and T_{Cold} signals to produce T_{Avg}. Each temperature sensing section is identical (one RTD and one transmitter). Per PINGP's setpoint methodology, because these two signals are averaged, their uncertainties can be averaged. SPC-RP-097 Assumption 7 states that the averaging of the two temperature sensing channel uncertainties is accomplished by including only one RTD and one temperature transmitter in the instrument loop.

The historical drift of the Ultra Electronics N9355E-2A-20 model RTD is not analyzed in a Prairie Island drift calculation. Therefore, this section uses vendor data from SPC-RP-097 to account for 2TE-401A uncertainty. Per SPC-RP-097, the instrument accuracy is

0.13333 °F, the instrument drift is 0.33333 °F, and there is no M&TE error associated with 2TE-401A. The drift is calculated according to Section 6.3.1.A of EM 3.3.4.1 (Reference 8.2.1) which applies the Technical Specifications allowance factor of 1.25 to the linearly extrapolated 24-month drift value. Therefore, the instrument drift is accurate for a 30-month calibration interval and does not require additional extrapolation.

The SRSS of instrument accuracy, drift, and M&TE terms for 2TE-401A is calculated to determine its contribution to A, D_R, and M for the loop:

$$\mathrm{SRSS}_{\mathrm{RTD,U2}} = \sqrt{(0.13333\ °\mathrm{F})^2 + (0.33333\ °\mathrm{F})^2 + (0\ °\mathrm{F})^2}$$
$$= 0.3590\ °\mathrm{F}$$

Per SPC-RP-097, the positive drift bias of 2TE-401A is 0 °F, and the negative drift bias is 0 °F.

The drift values of the remaining loop instruments are obtained from Sections 6.1.2, 6.1.3, 6.1.6, and 6.1.1.

The loop accuracy, random drift, and M&TE terms are replaced by the squared sum of the instruments' random terms:

$$\mathrm{A} + \mathrm{D_R} + \mathrm{M} = (0.3590)^2 + (0.201)^2 + (0.367\ °\mathrm{F})^2 + (0.091\ °\mathrm{F})^2 + (0.097\ °\mathrm{F})^2$$
$$= 0.322\ °\mathrm{F}^2$$

The positive drift bias is replaced by the sum of the instruments' positive bias terms:

$$\mathrm{D_{Bp}} = 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0.080\ °\mathrm{F} + 0.015\ °\mathrm{F} + 0\ °\mathrm{F}$$
$$= 0.095\ °\mathrm{F}$$

The negative drift bias is replaced by the absolute value of the sum of the instruments' negative bias terms:

$$\mathrm{D_{Bn}} = 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0\ °\mathrm{F} + 0.051\ °\mathrm{F}$$
$$= 0.051\ °\mathrm{F}$$

The new values are used to determine SRSSS, $\mathrm{Bias_{pos}}$, and $\mathrm{Bias_{neg}}$ per the methodology in Section 4.2.4:

$$\mathrm{SRSSS} = ((\mathrm{A} + \mathrm{D_R} + \mathrm{M}) + \mathrm{OPE_R} + \mathrm{SPEZ_R} + \mathrm{SPES_R} + \mathrm{P_R} + \mathrm{T_{NSR}} + \mathrm{R_{NR}} + \mathrm{H_{NSR}} + \mathrm{S_R} + \mathrm{READ} + \mathrm{PEA_{NR}}^2 + \mathrm{PMA_{NR}}^2 + \mathrm{PC_{NR}}^2)^{1/2}$$

$$= ((0.322\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (2.1410\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F^2) + (0\ °F)^2 + (0\ °F)^2 + (0\ °F)^2)^{1/2}$$

$$= 1.569\ °F$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$= (0.095\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F)$$

$$= 0.095\ °F$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$= (0.051\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F)$$

$$= 0.051\ °F$$

Therefore, the Total Loop Error for the instrument loop is bounded by the following values:

$$TLE = \left(SRSSS + Bias_{pos}\right) / \left(-SRSSS - Bias_{neg}\right)$$

$$= +1.664\ °F\ /\ -1.518\ °F$$

6.2.4 TLE of Unit 2 ΔT Instrument Loop

SPC-RP-098 (Reference 8.4.6) references the following instruments in the Unit 2 ΔT instrument loop:

- 2TE-401A (RDF 21450 hot leg RTD)
- 2TE-401B (RDF 21450 cold leg RTD)
- 2TT-401A (NUS RTL501-3/13 T_{Hot} R/E converter)
- 2TT-401B (NUS RTL501-3/13 T_{Cold} R/E converter)
- 2TM-405R (NUS TMD500-06/00/00/00-06-08-03 D-016 lag unit)
- 2TC-405A (NUS DAM503-03 bistable)

The historical drift of the Ultra Electronics N9355E-2A-20 model RTD is not analyzed in a Prairie Island drift calculation. Therefore, this section uses vendor data from SPC-RP-098 to account for 2TE-401A and 2TE-401B uncertainty. Per SPC-RP-098, the instrument accuracy is 0.13333 °F, the instrument drift is 0.3333 °F, and there is no M&TE error. The drift is calculated according to EM 3.3.4.1 Section 6.3.1.A which applies the Technical Specifications allowance factor of 1.25 to the linearly extrapolated 24-month drift value. Therefore, the instrument drift is accurate for a 30-month calibration interval and does not require additional extrapolation.

The SRSS of instrument accuracy, drift, and M&TE terms for each RTD is calculated to determine their contribution to A, D_R, and M for the loop:

$$\begin{aligned} \mathrm{SRSS_{RTD,U2}} &= \sqrt{(0.13333\ °\mathrm{F})^2 + (0.3333\ °\mathrm{F})^2 + (0\ °\mathrm{F})^2} \\ &= 0.3590\ °\mathrm{F} \end{aligned}$$

Per SPC-RP-098, the positive drift bias of each RTD is 0 °F, and the negative drift bias is 0 °F.

The drift values of the remaining loop instruments are obtained from Sections 6.1.2, 6.1.4, and 6.1.5.

The loop accuracy, random drift, and M&TE terms are replaced by the squared sum of the instruments' random drift terms:

$$\begin{aligned} \mathrm{A} + \mathrm{D_R} + \mathrm{M} &= 2(0.3590\ °\mathrm{F})^2 + 2(0.201\ °\mathrm{F})^2 + (0.240\ °\mathrm{F})^2 + (0.0697\ °\mathrm{F})^2 \\ &= 0.401\ °\mathrm{F}^2 \end{aligned}$$

The positive loop drift bias is replaced by the sum of the instruments' positive bias terms:

$$\begin{aligned} \mathrm{D_{Bp}} &= 2(0\ °\mathrm{F}) + 2(0\ °\mathrm{F}) + 0\ °\mathrm{F} + 0\ °\mathrm{F} \\ &= 0\ °\mathrm{F} \end{aligned}$$

The negative loop drift bias is replaced by the absolute value of the sum of the instruments' negative bias terms:

$$\begin{aligned} \mathrm{D_{Bn}} &= 2(0\ °\mathrm{F}) + 2(0\ °\mathrm{F}) + 0\ °\mathrm{F} + 0\ °\mathrm{F} \\ &= 0\ °\mathrm{F} \end{aligned}$$

The new values are used to determine SRSSS, $\mathrm{Bias_{pos}}$, and $\mathrm{Bias_{neg}}$ per the methodology in Section 4.2.5:

$$\begin{aligned} \mathrm{SRSSS} &= ((\mathrm{A} + \mathrm{D_R} + \mathrm{M}) + \mathrm{OPE_R} + \mathrm{SPEZ_R} + \mathrm{SPES_R} + \mathrm{P_R} + \mathrm{T_{NSR}} + \mathrm{R_{NR}} + \mathrm{H_{NSR}} + \\ &\quad \mathrm{S_R} + \mathrm{READ} + \mathrm{PEA_{NR}}^2 + \mathrm{PMA_{NR}}^2 + \mathrm{PC_{NR}}^2)^{1/2} \\ &= ((0.401\ °\mathrm{F}^2) + (0\ °\mathrm{F}^2) + (0\ °\mathrm{F}^2) + (0\ °\mathrm{F}^2) + (0\ °\mathrm{F}^2) + (5.0024\ °\mathrm{F}^2) \\ &\quad + (0\ °\mathrm{F}^2) + (0\ °\mathrm{F}^2) + (0\ °\mathrm{F}^2) + (0\ °\mathrm{F}^2) + (0\ °\mathrm{F})^2 + (0\ °\mathrm{F})^2 + \\ &\quad (0\ °\mathrm{F})^2)^{1/2} \\ &= 2.325\ °\mathrm{F} \end{aligned}$$

$$\begin{aligned} \mathrm{Bias_{pos}} &= \mathrm{D_{Bp}} + \mathrm{OPE_{Bp}} + \mathrm{SPEZ_{Bp}} + \mathrm{SPES_{Bp}} + \mathrm{P_{Bp}} + \mathrm{T_{NSBp}} + \mathrm{R_{NBp}} + \mathrm{H_{NSBp}} + \mathrm{S_{Bp}} \\ &\quad + \mathrm{PEA_{NBp}} + \mathrm{PMA_{NBp}} + \mathrm{PC_{NBp}} \end{aligned}$$

$$= (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F)$$

$$= 0\ °F$$

$$\text{Bias}_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$= (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F) + (0\ °F)$$

$$= 0\ °F$$

Therefore, the Total Loop Error for the instrument loop is bounded by the following values:

$$\text{TLE} = \left(\text{SRSSS} + \text{Bias}_{pos}\right) / \left(-\text{SRSSS} - \text{Bias}_{neg}\right)$$

$$= +2.325\ °F\ /\ -2.325\ °F$$

6.3 Calculated Uncertainties

6.3.1 Unit 1

The following uncertainty values are defined according to the values calculated in Sections 6.2.1 and 6.2.2:

$T_{AvgRand} = 1.689\ °F$ $\Delta T_{Rand} = 2.532\ °F$

$T_{AvgBiasPos} = 0.095\ °F$ $\Delta T_{BiasPos} = 0\ °F$

$T_{AvgBiasNeg} = 0.551\ °F$ $\Delta T_{BiasNeg} = 0\ °F$

$T_{AvgUncPos} = 1.784\ °F$ $\Delta T_{UncPos} = 2.532\ °F$

$T_{AvgUncNeg} = -1.138\ °F$ $\Delta T_{UncNeg} = -2.532\ °F$

The total loop uncertainty (U_T) and the total loop random uncertainty (U_{TRand}) are determined per the methodology in Section 4.2.3:

$$U_T = T_{AvgBiasNeg} + \Delta T_{BiasPos}$$
$$= 0.551\ °F + 0\ °F$$
$$= 0.551\ °F$$

$$U_{TRand} = \sqrt{T_{AvgRand}{}^2 + \Delta T_{Rand}{}^2}$$
$$= \sqrt{(1.689\ °F)^2 + (2.532\ °F)^2}$$
$$= 3.044\ °F$$

Per Section 4.2.3, T_{AvgHi} and T_{AvgPen} are calculated using the input parameters in Section 4.2.3 and the calculated negative uncertainty of the ΔT_{SP2} instrument loop:

$$T_{AvgHi} = T' + \left(-T_{AvgUncNeg}\right)$$
$$= 560 + 1.138\ °F$$

$$= 561.138\ °\text{F}$$

Therefore, the Unit 1 T_{Avg} setpoint penalty term is calculated as follows:

$$\begin{aligned} T_{AvgPen} &= K_6\left(T_{AvgHi} - T'\right) \\ &= 0.002\ (561.138 - 560)\ \text{RTP} \\ &= 2.276 \times 10^{-3}\ \text{RTP} \end{aligned}$$

6.3.2 Unit 2

The following uncertainty values are defined according to the values calculated in Sections 6.2.3 and 6.2.4:

$$T_{AvgRand} = 1.569\ °\text{F} \qquad \Delta T_{Rand} = 2.325\ °\text{F}$$

$$T_{AvgBiasPos} = 0.095\ °\text{F} \qquad \Delta T_{BiasPos} = 0\ °\text{F}$$

$$T_{AvgBiasNeg} = 0.051\ °\text{F} \qquad \Delta T_{BiasNeg} = 0\ °\text{F}$$

$$T_{AvgUncPos} = 1.664\ °\text{F} \qquad \Delta T_{UncPos} = 2.325\ °\text{F}$$

$$T_{AvgUncNeg} = \text{-}1.518\ °\text{F} \qquad \Delta T_{UncNeg} = \text{-}2.325\ °\text{F}$$

The total loop uncertainty (U_T) and the total loop random uncertainty (U_{TRand}) are determined per the methodology in Section 4.2.6:

$$\begin{aligned} U_T &= T_{AvgBiasNeg} + \Delta T_{BiasPos} \\ &= 0.051\ °\text{F} + 0\ °\text{F} \\ &= 0.051\ °\text{F} \end{aligned}$$

$$\begin{aligned} U_{TRand} &= \sqrt{T_{AvgRand}^{\ 2} + \Delta T_{Rand}^{\ 2}} \\ &= \sqrt{(1.569\ °\text{F})^2 + (2.325\ °\text{F})^2} \\ &= 2.805\ °\text{F} \end{aligned}$$

Per Section 4.2.6, T_{AvgHi} and T_{AvgPen} are calculated using the input parameters in Section 4.2.6 and the calculated negative uncertainty of the ΔT_{SP2} instrument loop:

$$\begin{aligned} T_{AvgHi} &= T' + \left(-T_{AvgUncNeg}\right) \\ &= 560 + 1.518\ °\text{F} \\ &= 561.518\ °\text{F} \end{aligned}$$

Therefore, the Unit 2 T_{Avg} setpoint penalty term is calculated as follows:

$$\begin{aligned} T_{AvgPen} &= K_6\left(T_{AvgHi} - T'\right) \\ &= 0.002\ (561.518 - 560)\ \text{RTP} \\ &= 3.036 \times 10^{-3}\ \text{RTP} \end{aligned}$$

6.4 Analytical Limit

Per Section 4.2, the Analytical Limit is calculated using the following formula with no T_{Avg} setpoint penalty:

$$AL = \Delta T_{0WES} \times SP_{2WES}$$

6.4.1 Unit 1

The Unit 1 AL is determined using the Westinghouse input parameters defined in Table 4.1:

$$\begin{aligned} AL &= \Delta T_{0WES} \times (K_{4WES} - 0) \\ &= 65.2 \times (1.16 - 0)\ °F \\ &= 75.632\ °F \end{aligned}$$

6.4.2 Unit 2

The Unit 2 AL is determined using the Westinghouse input parameters defined in Table 4.2:

$$\begin{aligned} AL &= \Delta T_{0WES} \times (K_{4WES} - 0) \\ &= 65.2 \times (1.16 - 0)\ °F \\ &= 75.632\ °F \end{aligned}$$

6.5 Nominal Trip Setpoint

Per Section 4.2, the Nominal Trip Setpoint is calculated using the following formula, including the T_{Avg} setpoint penalty:

$$NTSP = \Delta T_{0WES} \times SP_{2WES} - U_T$$

6.5.1 Unit 1

The Unit 1 NTSP is determined using the Westinghouse input parameters defined in Table 4.1, the T_{Avg} setpoint penalty defined in Section 6.3.1, and the total loop uncertainty defined in Section 6.3.1:

$$\begin{aligned} NTSP &= \Delta T_{0WES} \times \left(K_{4WES} - T_{AvgPen}\right) - U_T \\ &= 65.2 \times \left(1.16 - (2.276 \times 10^{-3})\right) - 0.551\ °F \\ &= 74.933\ °F \end{aligned}$$

6.5.2 Unit 2

The Unit 2 NTSP is determined using the Westinghouse input parameters defined in Table 4.2, the T_{Avg} setpoint penalty defined in Section 6.3.2, and total loop uncertainty defined in Section 6.3.2:

$$\begin{aligned} \text{NTSP} &= \Delta T_{0\text{WES}} \times \left(K_{4\text{WES}} - T_{\text{AvgPen}}\right) - U_T \\ &= 65.2 \times \left(1.16 - (3.036 \times 10^{-3})\right) - 0.051\ {}^{\circ}\text{F} \\ &= 75.383\ {}^{\circ}\text{F} \end{aligned}$$

6.6 Calculated Allowable Value

Per Section 4.2, the Calculated Allowable Value is calculated using the following formula:

$$\text{AV}_{\text{Calc}} = \text{AL} - (U_T + U_{\text{TRand}}) + U_{\text{TRand}}$$

6.6.1 Unit 1

The Unit 1 AV_{Calc} is determined using the AL defined in Section 6.4.1 and the total loop uncertanties defined in Section 6.3.1:

$$\begin{aligned} \text{AV}_{\text{Calc}} &= 75.632 - (0.551 + 3.044) + 3.044\ {}^{\circ}\text{F} \\ &= 75.081\ {}^{\circ}\text{F} \end{aligned}$$

6.6.2 Unit 2

The Unit 2 AV_{Calc} is determined using the AL defined in Section 6.4.2 and the combined loop uncertanties defined in Section 6.3.2:

$$\begin{aligned} \text{AV}_{\text{Calc}} &= 75.632 - (0.051 + 2.805) + 2.805\ {}^{\circ}\text{F} \\ &= 75.581\ {}^{\circ}\text{F} \end{aligned}$$

6.7 COLR Allowable Value

Per Section 4.2, the COLR Allowable Value is calculated using the following formula with no T_{Avg} setpoint penalty:

$$\text{AV}_{\text{COLR}} = \Delta T_{0\text{COLR}} \times \text{SP}_{2\text{COLR}}$$

6.7.1 Unit 1

The Unit 1 AV_{COLR} is determined using the COLR input parameters defined in Table 4.1:

$$\begin{aligned} \text{AV}_{\text{COLR}} &= \Delta T_{0\text{COLR}} \times (K_{4\text{COLR}} - 0) \\ &= 65.2 \times (1.11 - 0)\ {}^{\circ}\text{F} \\ &= 72.372\ {}^{\circ}\text{F} \end{aligned}$$

6.7.2 Unit 2

The Unit 1 AV_{COLR} is determined using the COLR input parameters defined in Table 4.2:

$$\begin{aligned} \text{AV}_{\text{COLR}} &= \Delta T_{0\text{COLR}} \times (K_{4\text{COLR}} - 0) \\ &= 65.2 \times (1.11 - 0)\ {}^{\circ}\text{F} \\ &= 72.372\ {}^{\circ}\text{F} \end{aligned}$$

6.8 Actual Trip Setpoint

Per Section 4.2, the Actual Trip Setpoint is calculated using the following formula, including the T_{Avg} setpoint penalty:

$$\text{ATSP} = \Delta T_{0PLANT} \times SP_{2PLANT}$$

6.8.1 Unit 1

The Unit 1 ATSP is determined using the plant input parameters defined in Table 4.1 and the T_{Avg} setpoint penalty defined in Section 6.3.1:

$$\begin{aligned} \text{ATSP} &= \Delta T_{0PLANT} \times \left(K_{4PLANT} - T_{AvgPen}\right) \\ &= 59.7 \times \left(1.11 - (2.276 \times 10^{-3})\right) \text{°F} \\ &= 66.131 \text{ °F} \end{aligned}$$

6.8.2 Unit 2

The Unit 2 ATSP is determined using the plant input parameters defined in Table 4.2 and the T_{Avg} setpoint penalty defined in Section 6.3.2:

$$\begin{aligned} \text{ATSP} &= \Delta T_{0PLANT} \times \left(K_{4PLANT} - T_{AvgPen}\right) \\ &= 58.64 \times \left(1.11 - (3.036 \times 10^{-3})\right) \text{°F} \\ &= 64.912 \text{ °F} \end{aligned}$$

6.9 Evaluation

The updated values calculated in Sections 6.4 through 6.8 are evaluated against the Acceptance Criteria defined in Section 3.0. The values are presented in the following table:

Table 6.1: Updated Values

Parameter	Unit 1		Unit 2	
	Existing	New	Existing	New
AL (°F)	75.632	75.632	75.632	75.632
NTSP (°F)	74.793	74.933	75.334	75.383
AV_{Calc} (°F)	75.132	75.081	75.632	75.581
AV_{COLR} (°F)	72.372	72.372	72.372	72.372
ATSP (°F)	65.957	66.131	64.823	64.912

6.9.1 Actual Trip Setpoint and Nominal Trip Setpoint

Per Section 6.5, the Unit 1 NTSP is 74.933 °F and the Unit 2 NTSP is 75.383 °F. Per Section 6.8, the Unit 1 ATSP is 66.131 °F and the Unit 2 ATSP is 64.912 °F. The Actual Trip Setpoints are evaluated as follows:

$$\text{ATSP} \leq \text{NTSP}$$

$$66.131\ °F < 74.933\ °F$$

$$64.912\ °F < 75.383\ °F$$

Therefore, the Actual Plant Trip Setpoint is conservative with respect to the Nominal Trip Setpoint for Unit 1 and Unit 2.

6.9.2 COLR Allowable Value and Calculated Allowable Value

Per Section 6.6, the Unit 1 AV_{Calc} is 75.081 °F and the Unit 2 AV_{Calc} is 75.581 °F. Per Section 6.7, AV_{COLR} is 72.372 °F for both Units. The COLR Allowable Values are evaluated as follows:

$$AV_{COLR} \leq AV_{Calc}$$

$$72.372\ °F < 75.081\ °F$$

$$72.372\ °F < 75.581\ °F$$

Therefore, the COLR Allowable Value is conservative with respect to the Calculated Value for Unit 1 and Unit 2.

6.9.3 Nominal Trip Setpoint and Calculated Allowable Value

Per Section 6.5, the Unit 1 NTSP is 74.933 °F and the Unit 2 NTSP is 75.383 °F. Per Section 6.6, the Unit 1 AV_{Calc} is 75.081 °F and the Unit 2 AV_{Calc} is 75.581 °F. The Calculated Allowable Values are evaluated as follows:

$$NTSP \leq AV_{Calc}$$

$$74.933\ °F < 75.081\ °F$$

$$75.383\ °F < 75.581\ °F$$

Therefore, the Nominal Trip Setpoint is conservative with respect to the Calculated Value for Unit 1 and Unit 2.

7.0 Conclusions and Plant Impact

After updating the OPΔT parameters calculated in References 8.4.1 through 8.4.6 using the analyzed drift values in References 8.3.1 through 8.3.6, the parameters were evaluated as acceptable per the criteria stated in Section 3.0 of this Attachment. Therefore, the calibration interval for the OPΔT function instruments may be extended to 30 months without impact to the OPΔT Allowable Value.

8.0 References

8.1 Industry Guidance

8.1.1 EPRI TR-103335-R2, "Guidelines for Instrument Calibration Extension/Reduction", Rev. 2

8.2 Engineering Manuals

8.2.1 PINGP EM 3.3.4.1, "Instrument Setpoint/Uncertainty Calculations", Rev. 2

8.2.2 PINGP EM 3.3.4.2, "The Analysis of Instrument Drift", Rev. 1

8.3 Drift Calculations

8.3.1 SPC-DR-011, "Drift Analysis of As-Found/As-Left Data for NUS Summing Amplifier MTH500-05/00/00/00-08-08-03", Rev. 1

8.3.2 SPC-DR-012, "Drift Analysis of As-Found/As-Left Data for NUS R/V Converter RTL501", Rev. 0

8.3.3 SPC-DR-016, "Drift Analysis of As-Found/As-Left Data for NUS Lead/Lag Unit TMD500-20/00/00/00-08-08-03 IDS D-009", Rev. 0

8.3.4 SPC-DR-017, "Drift Analysis of As-Found/As-Left Data for NUS Lag Unit TMD500-06/00/00/00-06-08-03 D-016", Rev. 1

8.3.5 SPC-DR-037, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (mA)", Rev. 0

8.3.6 SPC-DR-039, "Drift Analysis of As-Found/As-Left Data for NUS Lead/Lag Unit TMD500-20/00/00/00-08-08-03 D-020 (mA)", Rev. 0

8.4 Setpoint Calculations

8.4.1 SPC-RP-067, "Tavg Signal Error Contribution to OPDT Trip", Rev. 1A

8.4.2 SPC-RP-068, "Delta T Signal Error Contribution to OPDT Trip", Rev. 1A

8.4.3 SPC-RP-070, "Overpower Delta T Reactor Trip Instrument Uncertainty Combination and Setpoint Analysis", Rev. 2C

8.4.4 SPC-RP-097, "Tavg Signal Error Contribution to OPDT Trip", Rev. 0A

8.4.5 SPC-RP-098, "Delta T Signal Error Contribution to OPDT Trip", Rev. 0A

8.4.6 SPC-RP-099, "Unit 2 Overpower Delta T Reactor Trip Instrument Uncertainty Combination & Setpoint Analysis", Rev. 1A

8.5 Technical Specifications

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42) Amendment 230

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60) Amendment 218

8.5.3 Prairie Island Nuclear Generating Plant Core Operating Limits Report, Unit 1 – Cycle 32, Rev. 0

8.5.4 Prairie Island Nuclear Generating Plant Core Operating Limits Report, Unit 2 – Cycle 31, Rev. 1

8.6 Surveillance Procedures

8.6.1 Surveillance Procedure SP 1002A, "Analog Protection System Calibration", Rev. 50

8.6.2 Surveillance Procedure SP 2002A, "Analog Protection System Calibration", Rev. 51

8.7 Drawings

8.7.1 XH-1-543, "Instrument Block Diagram Reactor Protection System", Rev. 76
8.7.2 XH-1-544, "Instrument Block Diagram Reactor Protection System", Rev. 76
8.7.3 XH-1-545, "Instrument Block Diagram Reactor Protection System", Rev. 76
8.7.4 XH-1-546, "Instrument Block Diagram Reactor Protection System", Rev. 76
8.7.5 XH-1001-792, "Instrument Block Diagram Reactor Protection System", Rev. 76
8.7.6 XH-1001-793, "Instrument Block Diagram Reactor Protection System", Rev. 76
8.7.7 XH-1001-794, "Instrument Block Diagram Reactor Protection System", Rev. 76
8.7.8 XH-1001-795, "Instrument Block Diagram Reactor Protection System", Rev. 76

Prepared By:	Giovanni Martinez	Giovanni Martinez (0U5393) Digitally signed by Giovanni Martinez (0U5393) Date: 2021.07.01 13:33:17 -05'00' (Signature)	(Date)
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Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Pressurizer Pressure - Low instrument loops which perform reactor trips. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed found in Surveillance Procedures SP 1002A, SP 1002B.1, SP 1199B, SP 2002A, SP 2002B.1 and SP 2199B in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1PT-429	Rosemount	3154NG6R2F0E7
1PT-430	Rosemount	3154NG6R2F0E7
1PT-431	Rosemount	3154NG6R2F0E7
1PT-449	Rosemount	3154NG6R2F0E7
2PT-429	Rosemount	1154GP9RC
2PT-430	Rosemount	1154GP9RC *
2PT-431	Rosemount	1154GP9RC
2PT-449	Rosemount	1154GP9RC
1PC-429E	NUS Instruments	SAM503-03 (mA)
1PC-430H	NUS Instruments	SAM503-03 (mA)
1PC-431J	NUS Instruments	SAM503-03 (mA)
1PC-449A	NUS Instruments	SAM503-03 (mA)
2PC-429E	NUS Instruments	SAM503-03 (mA)
2PC-430H	NUS Instruments	SAM503-03 (mA)
2PC-431J	NUS Instruments	SAM503-03 (mA)
2PC-449A	NUS Instruments	SAM503-03 (mA)
1PM-429B	NUS Instruments	TMD500-20/00/00/00-08-08-03 (VDC)
1PM-430C	NUS Instruments	TMD500-20/00/00/00-08-08-03 (VDC)
1PM-431C	NUS Instruments	TMD500-20/00/00/00-08-08-03 (VDC)
1PM-449B	NUS Instruments	TMD500-20/00/00/00-08-08-03 (VDC)
2PM-429B	NUS Instruments	TMD500-20/00/00/00-08-08-03 (VDC)
2PM-430C	NUS Instruments	TMD500-20/00/00/00-08-08-03 (VDC)
2PM-431C	NUS Instruments	TMD500-20/00/00/00-08-08-03 (VDC)
2PM-449B	NUS Instruments	TMD500-20/00/00/00-08-08-03 (VDC)

* This instrument will be replaced for a Rosemount 3154NG6R2F0E7, and as such, it is analyzed as a Rosemount 3154NG6R2F0E7 in this attachment.

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 1 and 2 setpoint calculations SPC-RP-021 and SPC-RP-022 provided different values for temperature effect. The Unit variables which provides the greatest total loop error will be used in this calculation to conservatively bound the worst case.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

ECR Document Number 601000001191, Revision 0 (Reference 8.7.3) replaces existing Rosemount Transmitter 1154GP9RC with Rosemount Transmitter 3154NG6R2F0E7. Vendor Technical Manual NX-20728-1 (Reference 8.7.1) provides the new uncertainties for the replacement transmitters.

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-015, “Drift Analysis of As-Found / As-Left Data for NUS Lead/Lag Unit TMD500-20/00/00/00-08-08-03 (VDC)” (Reference 8.3.1), SPC-DR-021, “Drift Analysis of As-Found /As-Left for Rosemount Transmitters 1154GP9RC” (Reference 8.3.2), SPC-DR-038, “Drift Analysis of As-Found / As -Left Data for NUS Bistable SAM503 (mA)” (Reference 8.3.3). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-015

The NUS Instruments TMD500-20/00/00/00-08-08-03 (VDC) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{NUSInstrument} = \pm 0.324\ \%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{NUSInstrument} = 0\ \%\ Calibrated\ Span$$

4.1.2 SPC-DR-021

The Rosemount Transmitter 1154GP9RC was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{transmitter1154} = \pm 1.264\ \%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{transmitter1154} = 0\ \%\ Calibrated\ Span$$

4.1.3 SPC-DR-038

The NUS Alarm SAM503-03 was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.101\ \%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{bistable} = 0\ \%\ Calibrated\ Span$$

4.2 Setpoint/Uncertainty Calculations

The reactor coolant low flow reactor trip setpoint is evaluated in four setpoint calculations: SPC-RP-021, “Unit 1 Pressurizer Low Pressure Reactor Trip - for SBLOCA Event” (Reference 8.4.1), SPC-RP-022, “Unit 2 Pressurizer Low Pressure Reactor Trip - SBLOCA Event” (Reference 8.4.2), SPC-RP-082, “Unit 1 Pressurizer Low Pressure Reactor Trip - for non SBLOCA events” (Reference 8.4.3) and SPC-RP-083, “Unit 2 Pressurizer Low Pressure Reactor Trip - for non SBLOCA events” (Reference 8.4.4) . Pertinent information from each calculation for this evaluation is summarized below:

Form 1 of SPC-RP-021 (Reference 8.4.1) and SPC-RP-022 (Reference 8.4.2) provides the following information:

$$Process\ Span = 1700\ to\ 2500\ psig$$

$$Analytical\ Limit\ (AL) = 1685\ psig$$

Form 1 of SPC-RP-082 (Reference 8.4.3) and SPC-RP-083 (Reference 8.4.4) provides the following information:

$$Process\ Span = 1700\ to\ 2500\ psig$$

$$Analytical\ Limit\ (AL) = 1835\ psig$$

Total loop error (TLE) under accident conditions for SPC-RP-021 (Reference 8.4.1) and SPC-RP-022 (Reference 8.4.2) is calculated using the following equations:

$$TLE\ (SRSSA) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{AR} + R_{ANR} + H_{AR} + SPT_R + READ + {PEA_{AR}}^2 + {PMA_{AR}}^2 + {PC_{AR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{ABp} + R_{ANBp} + H_{ABp} + PEA_{ABp} + PMA_{ABp} + PC_{ABp} + IR_{Bp} + SPT_{Bp}$$

$$TLE_{pos} = TLE\ (SRSSA) + Bias_{pos}$$

After entering the data for Unit 1 (SPC-RP-021), the total loop error is calculated as:

$$TLE\ (SRSSA) = [48\ (psig^2) + 31.297\ (psig^2) + 150.55\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0.07840\ (psig^2) + 253.55\ (psig^2) + 900\ (psig^2) + 0\ (psig^2) + 6241\ (psig^2) + 0\ (psig^2) + (0\ psig)^2 + (0\ psig)^2 + (0\ psig)^2]^{\frac{1}{2}} = \pm\ 87.318\ psig$$

$$Bias_{pos} = 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 16.000\ psig + 0\ psig = +\ 16.000\ psig$$

$$TLE_{pos} = 87.318\ psig + 16.000\ psig = +\ 103.318\ psig$$

After entering the data for Unit 2 (SPC-RP-022), the total loop error is calculated as:

$$TLE\ (SRSSA) = [48\ (psig^2) + 31.297\ (psig^2) + 120.48\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0.07840\ (psig^2) + 104.32\ (psig^2) + 900\ (psig^2) + 0\ (psig^2) + 6241\ (psig^2) + 0\ (psig^2) + (0\ psig)^2 + (0\ psig)^2 + (0\ psig)^2]^{\frac{1}{2}} = \pm\ 86.285\ psig$$

$$Bias_{pos} = 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 16.696\ psig + 0\ psig = +\ 16.696\ psig$$

$$TLE_{pos} = 86.285\ psig + 16.696\ psig = +\ 102.981\ psig$$

Total loop error (TLE) under seismic event and potential subsequent loss of non-seismic HVAC for SPC-RP-082 (Reference 8.4.3) and SPC-RP-083 (Reference 8.4.4) is calculated using the following equations:

$$TLE\ (SRSSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{ABp} + PMA_{ABp} + PC_{ABp}$$

After entering the data for Unit 1 (SPC-RP-082), the total loop error is calculated as:

$$TLE\ (SRSS) = [48\ (psig^2) + 31.297\ (psig^2) + 150.55\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0.07840\ (psig^2) + 263.20\ (psig^2) + 900\ (psig^2) + 0\ (psig^2) + 225\ (psig^2) + 0\ (psig^2) + (0\ psig)^2 + (0\ psig)^2 + (0\ psig)^2]^{\frac{1}{2}} = \pm\ 40.226\ psig$$

$$Bias_{pos} = 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig = 0\,psig$$

$$TLE_{pos} = 40.226\ psig + 0\,psig = 40.226\ psig$$

After entering the data for Unit 2 (SPC-RP-083), the total loop error is calculated as:

$$TLE\ (SRSS) = [48\ (psig^2) + 31.297\ (psig^2) + 171.49\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0.07840\ (psig^2) + 263.20\ (psig^2) + 900\ (psig^2) + 0\ (psig^2) + 225\ (psig^2) + 0\ (psig^2) + (0\,psig)^2 + (0\,psig)^2 + (0\,psig)^2]^{\frac{1}{2}} = \pm\,40.485\,psig$$

$$Bias_{pos} = 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig = 0\,psig$$

$$TLE_{pos} = 40.485\ psig + 0\,psig = 40.485\ psig$$

The Unit 1 variables provide the worst-case total loop error for Setpoints SPC-RP-021 and SPC-RP-022; Unit 2 variables provide the worst-case total loop error for Setpoints SPC-RP-082 and SPC-RP-083, therefore they will be used in Section 6 to calculate the new total loop error.

The nominal trip setpoint (NTSP) is calculated for a decreasing process using the following equation:

$$NTSP = AL + TLE_{pos}$$

The allowable value (AV) for a decreasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = D_{BN} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Please note this attachment is to incorporate the changes in uncertainty associated with the replacement of the original Rosemount 1154 series pressure transmitters with new Rosemount 3154 series pressure transmitters in Section 6.0.

4.3 Technical Specifications

The allowable value for the Pressurizer Pressure - Low function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 1845\,psig$$

4.4 Calibration Procedures

The as found tolerance (AFT) is taken from surveillance procedures SP 1002A (Reference 8.6.1), and SP 2002A (Reference 8.6.4) and the Actual Plant Setting (APS) is taken from the Setpoint Calculations (References 8.4.1, 8.4.2, 8.4.3 and 8.4.4).

$$APS = 1900\ psig$$

$$AFT = \frac{0.0020\ VDC}{0.4\ VDC} = \frac{1}{200}\ x\ 800\ psig = 4\ psig$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

SPC-RP-021 (Reference 8.4.1), SPC-RP-022 (Reference 8.4.2), SPC-RP-082 (Reference 8.4.3) and SPC-RP-083 (Reference 8.4.4) provide different total loop errors and subsequently different nominal trip setpoints and allowable values. This attachment will analyze both Unit 1 and 2 values along with both the Rosemount 3154N and 1154 pressure transmitters.

This attachment is to incorporate the changes in uncertainty associated with the replacement of the original Rosemount 1154 series pressure transmitters with new Rosemount 3154 series pressure transmitters for the following instruments: 1PT-429, 1PT-430, 1PT-431, 1PT-449, and 2PT-430 (Reference 8.7.3). Since, the 3154N pressure transmitter has less than 10 data points and replaced the 1154 pressure transmitters on 9/22/2020 according to Design Input Transmittal 601000002918-001 (Reference 8.7.2), therefore per EM 3.3.4.2 (Reference 8.2.1), vendor data can be used to establish drift data (Reference 8.2.2). The manufacturer specifications are conservative with respect to the observed drift values and for this case, the manufacturer specification for drift would be extrapolated to a maximum calibration interval of 30 months for use in these setpoint calculations. The uncertainty associated with instruments 2PT-429, 2PT-431, and 2PT-449 will come from the original Rosemount 1154 series pressure transmitters since these transmitters were not replaced.

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1, 8.3.2, 8.3.3 and 8.3.4 using percent span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Sections 4.2) below:

NUS Instruments TMD500-20/00/00/00-08-08-03 (VDC):

$$DA_{Ext_{Rand}}{}_{NUSInstrumentVDC} = \pm 0.324\ \%\ Calibrated\ Span$$

$$= \pm 0.324\ \%\ Calibrated\ Span \times \frac{800\ psig}{100\ \%\ Span} = 2.592\ psig\ (Reference\ 8.3.1)$$

Rosemount Transmitter 1154GP9RC:

$$DA\_Ext\_Rand_{transmitter1154} = \pm 1.264\ \%\ Calibrated\ Span$$

$$= \pm 1.264\ \%\ Calibrated\ Span \times \frac{800\ psig}{100\ \%\ Span} = 10.112\ psig\ (Reference\ 8.3.2)$$

NUS Bistable SAM503-03 (mA)

$$DA\_Ext\_Rand_{bistablemA} = \pm 0.101\ \%\ Calibrated\ Span$$

$$= \pm 0.101\ \%\ Calibrated\ Span \times \frac{800\ psig}{100\ \%\ Span} = 0.808\ psig\ (Reference\ 8.3.3)$$

6.2 Calculated Drift for Rosemount Transmitter 3154NG6R2F0E7:

Technical Manual NX-20728-1 (Reference 8.7.1) provides the new uncertainties for accuracy (A) and drift (D_R). Use Range Code 6 when looking at the 3154N transmitter manufacturer specifications.

$$Vendor\ Accuracy\ (va) = \pm 0.25\%\ of\ Calibrated\ Span\ (CS)$$

$$Vendor\ Drift\ (vd) = \pm(0.1\%\ URL + 0.1\%\ span)$$

$$URL = 4000\ psig$$

Form 1 and Form 2 of SPC-RP-021 (Reference 8.4.1) provides the following information:

$$Process\ Span\ (PS) = 1700.0\ to\ 2500.0\ psig$$

$$Calibrated\ Span\ (CS) = 1715.0\ to\ 2515.0\ psig$$

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 30\ months$$

Substituting these values, the accuracy and drift are calculated as:

$$A = (\mathrm{va})\left(\frac{\mathrm{PS}}{\mathrm{CS}}\right) = \pm 2.0\ psig$$

$$D_R = \left(\frac{\mathrm{CI}}{\mathrm{DT}}\right)(\mathrm{vd})\left(\frac{\mathrm{PS}}{\mathrm{CS}}\right) = \pm 4.8\ psig$$

See Section 5.2.3 of SPC-RP-021 (Reference 8.4.1) for obtaining Instrument Measurement and Test Equipment allowance value (M) under Device 1. The Measurement and Test Equipment allowance value for the 3154N pressure transmitter is bounded by Calibration Procedures SP 1002B.1 and SP 2002B.1 (References 8.6.2 and 8.6.5), therefore the existing instrument M&TE value is used.

$$M = \pm 6.9953\, psig$$

Substituting these values, the $DA\_Ext\_Rand_{trans}$ value is calculated as:

$$DA\_Ext\_Rand_{transmitter3154} = \sqrt{A^2 + {D_R}^2 + M^2}$$

$$DA\_Ext\_Rand_{trans} = \sqrt{(2.0\, PSIG)^2 + (4.8\, PSIG)^2 + (6.9953\, PSIG)^2}$$

$$DA\_Ext\_Rand_{transmitter3154} = 8.716\, psig$$

6.3 Total Loop Error (TLE)

Attachment V uses Unit 1 and Unit 2 data for substituting these values in TLE, NTSP and AV equations. The 3154N transmitter manufacturer specifications are used to calculate and replace the instrument accuracy, drift, and measurement and test equipment for an updated evaluation of the loop setpoint for Units 1 and 2. Instrument drift from the referenced drift calculations for the NUS Lead/Lag Units, NUS Bistables and the 1154 Rosemount pressure transmitters are used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint for Unit 1 and 2 using the methodology shown below:

$$DA\_Ext\_Rand_{NUSInstrumentVDC}{}^2 + DA\_Ext\_Rand_{transmitter1154/transmitter3154}{}^2 + DA\_Ext\_Rand_{bistableA}{}^2 = A + D_R + M$$

New total loop error (TLE) under accident conditions for Units 1 and 2 for SPC-RP-021 (Reference 8.4.1) and SPC-RP-022 (Reference 8.4.2) is calculated using the following equations:

$$TLE\ (SRSSA) = \left[DA\_Ext\_Rand_{NUSInstrumentVDC}{}^2 + DA\_Ext\_Rand_{transmitter1154/transmitter3154}{}^2 + DA\_Ext\_Rand_{bistableA}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{AR} + R_{ANR} + H_{AR} + SPT_R + READ + {PEA_{AR}}^2 + {PMA_{AR}}^2 + {PC_{AR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{ABp} + R_{ANBp} + H_{ABp} + PEA_{ABp} + PMA_{ABp} + PC_{ABp} + IR_{Bp} + SPT_{Bp}$$

$$TLE_{pos} = TLE\ (SRSSA) + Bias_{pos}$$

After entering the data for Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03, the new TLE under accident condition for Unit 1 for SPC-RP-021 (Reference 8.4.1) is calculated as:

$$TLE\ (SRSSA) = [((2.592\, psig)^2 + (8.716\, psig)^2 + (0.808\, psig)^2) + 0\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0.07840\ (psig^2) + 253.55\ (psig^2) + 900\ (psig^2) + 0\ (psig^2) + 6241\ (psig^2) + 0\ (psig^2) + (0\, psig)^2 + (0\, psig)^2 + (0\, psig)^2]^{\frac{1}{2}}$$
$$= \pm\ 86.475\, psig$$

$$Bias_{pos} = 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 16.000\,psig + 0\,psig = +\,16.000\,psig$$

$$TLE_{pos} = 86.475\,psig + 16.000\,psig = 102.475\,psig$$

After entering the data for Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03, the new TLE under accident condition for Unit 2 for SPC-RP-022 (Reference 8.4.2) is calculated as:

$$TLE\ (SRSSA) = [((2.592\,psig)^2 + (8.716\,psig)^2 + (0.808\,psig)^2) + 0\,(psig^2) + 0\,(psig^2) + 0\,(psig^2) + 0.07840\,(psig^2) + 104.32\,(psig^2) + 900\,(psig^2) + 0\,(psig^2) + 6241\,(psig^2) + 0\,(psig^2) + (0\,psig)^2 + (0\,psig)^2 + (0\,psig)^2]^{\frac{1}{2}} = \pm\,85.608\,psig$$

$$Bias_{pos} = 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 16.696\,psig + 0\,psig = +\,16.696\,psig$$

$$TLE_{pos} = 85.608\,psig + 16.696\,psig = 102.304\,psig$$

After entering the data for Rosemount Transmitter 1154, NUS Lead/Lag Units and NUS Bistable DAM503-03, the new TLE under accident condition for Unit 2 for SPC-RP-022 (Reference 8.4.2) is calculated as:

$$TLE\ (SRSSA) = [((2.592\,psig)^2 + (10.112\,psig)^2 + (0.808\,psig)^2) + 0\,(psig^2) + 0\,(psig^2) + 0\,(psig^2) + 0.07840\,(psig^2) + 104.32\,(psig^2) + 900\,(psig^2) + 0\,(psig^2) + 6241\,(psig^2) + 0\,(psig^2) + (0\,psig)^2 + (0\,psig)^2 + (0\,psig)^2]^{\frac{1}{2}} = \pm\,85.761\,psig$$

$$Bias_{pos} = 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 0\,psig + 16.696\,psig + 0\,psig = +\,16.696\,psig$$

$$TLE_{pos} = 85.761\,psig + 16.696\,psig = 102.457\,psig$$

New Total loop error (TLE) under seismic event and potential subsequent loss of non-seismic HVAC for Units 1 and 2 for SPC-RP-082 (Reference 8.4.3) and SPC-RP-083 (Reference 8.4.4) is calculated using the following equations:

$$TLE\ (SRSSS) = \left[DA\_Ext\_Rand_{NUSInstrumentVDC}{}^2 + DA\_Ext\_Rand_{transmitter1154/transmitter3154}{}^2 + DA\_Ext\_Rand_{bistablemA}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{ABp} + PMA_{ABp} + PC_{ABp}$$

After entering the data for Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03, the new TLE under seismic event and potential subsequent loss of non-seismic HVAC for Unit 1 for SPC-RP-082 (Reference 8.4.3) is calculated as:

$$TLE\ (SRSSS) = [((2.592\ psig)^2 + (8.716\ psig)^2 + (0.808\ psig)^2) + 0\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0.07840\ (psig^2) + 263.20\ (psig^2) + 900\ (psig^2) + 0\ (psig^2) + 225\ (psig^2) + 0\ (psig^2) + (0\ psig)^2 + (0\ psig)^2 + (0\ psig)^2]^{\frac{1}{2}} = \pm\ 38.362\ psig$$

$$Bias_{pos} = 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig = 0\ psig$$

$$TLE_{pos} = 38.362\ \ psig + 0\ psig = 38.362\ psig$$

After entering the data for Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03, the new TLE under seismic event and potential subsequent loss of non-seismic HVAC for Unit 2 for SPC-RP-083 (Reference 8.4.4) is calculated as:

$$TLE\ (SRSSS) = [((2.592\ psig)^2 + (8.716\ psig)^2 + (0.808\ psig)^2) + 0\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0.07840\ (psig^2) + 263.20\ (psig^2) + 900\ (psig^2) + 0\ (psig^2) + 225\ (psig^2) + 0\ (psig^2) + (0\ psig)^2 + (0\ psig)^2 + (0\ psig)^2]^{\frac{1}{2}} = \pm\ 38.362\ psig$$

$$Bias_{pos} = 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig = 0\ psig$$

$$TLE_{pos} = 38.362\ \ psig + 0\ psig = 38.362\ psig$$

After entering the data for Rosemount Transmitter 1154, NUS Lead/Lag Units and NUS Bistable DAM503-03, the new TLE under seismic event and potential subsequent loss of non-seismic HVAC for Unit 2 for SPC-RP-083 (Reference 8.4.2) is calculated as:

$$TLE\ (SRSSS) = [((2.592\ psig)^2 + (10.112\ psig)^2 + (0.808\ psig)^2) + 0\ (psig^2) + 0\ (psig^2) + 0\ (psig^2) + 0.07840\ (psig^2) + 263.20\ (psig^2) + 900\ (psig^2) + 0\ (psig^2) + 225\ (psig^2) + 0\ (psig^2) + (0\ psig)^2 + (0\ psig)^2 + (0\ psig)^2]^{\frac{1}{2}} = \pm\ 38.703\ psig$$

$$Bias_{pos} = 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig + 0\ psig = 0\ psig$$

$$TLE_{pos} = 38.703\ psig + 0\ psig = 38.703\ psig$$

6.4 Nominal Trip Setpoint (NTSP)

Using the equations from Section 4.2 and the new calculated TLE value from Unit 1 for SPC-RP-021 (Reference 8.4.1), the nominal trip setpoint using the new Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 1 are calculated below:

$$NTSP = AL + TLE_{pos} = 1685\, psig + 102.475\, psig \ = 1787.475\, psig$$

Using the equations from Section 4.2 and the new calculated TLE value from Unit 2 for SPC-RP-022 (Reference 8.4.2), the nominal trip setpoint using the new Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 1 are calculated below:

$$NTSP = AL + TLE_{pos} = 1685\, psig + 102.304\, psig \ = 1787.304\, psig$$

Using the equations from Section 4.2 and the new calculated TLE value from Unit 2 for SPC-RP-022 (Reference 8.4.2), the nominal trip setpoint using the new Rosemount Transmitter 1154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 1 are calculated below:

$$NTSP = AL + TLE_{pos} = 1685\, psig + 102.457\, psig \ = 1787.457\, psig$$

Using the equations from Section 4.2 and the new calculated TLE value from Unit 1 for SPC-RP-082 (Reference 8.4.3), the nominal trip setpoint using the new Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 1 are calculated below:

$$NTSP = AL + TLE_{pos} = 1835\, psig + 38.362\ \ psig \ = 1873.362\, psig$$

Using the equations from Section 4.2 and the new calculated TLE value from Unit 2 for SPC-RP-083 (Reference 8.4.4), the nominal trip setpoint using the new Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 1 are calculated below:

$$NTSP = AL + TLE_{pos} = 1835\, psig + 38.362\ \ psig \ = 1873.362\, psig$$

Using the equations from Section 4.2 and the new calculated TLE value from Unit 2 for SPC-RP-083 (Reference 8.4.4), the nominal trip setpoint using the new Rosemount Transmitter 1154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 1 are calculated below:

$$NTSP = AL + TLE_{pos} = 1835\, psig + 38.703\, psig \ = 1873.703\, psig$$

6.5 Allowable Value (AV)

The allowable value for Reactor Coolant Flow – Low is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{NUSInstrumentVDC}{}^2 + DA\_Ext\_Rand_{transmitter\ 1154/transmitter\ 3154}{}^2 + DA\_Ext\_Rand_{bistablemA}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = DA\_Ext\_Bias_{NUSInstrumentVDC} + DA\_Ext\_Bias_{transmitter1154/transmitter3154} + DA\_Ext\_Bias_{bistablemA} + R_{NR}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Substituting these values, the new allowable value for the new Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 1 for SPC-RP-021 (Reference 8.4.1) are calculated below:

$$LD_R = \sqrt{((2.592\ psig)^2 + (8.716\ psig)^2 + (0.808\ psig)^2 + 900\ (psig)^2}$$

$$LD_R = 31.358\ psig$$

$$LD_{BN} = 0 + 0 + 0 + 0 = 0\ psig$$

$$AV = 1787.475\ psig - 31.358\ psig - 0\ psig = 1756.117\ psig$$

Substituting these values, the new allowable value for the new Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 2 for SPC-RP-022 (Reference 8.4.2) are calculated below:

$$LD_R = \sqrt{((2.592\ psig)^2 + (8.716\ psig)^2 + (0.808\ psig)^2 + 900\ (psig)^2}$$

$$LD_R = 31.358\ psig$$

$$LD_{BN} = 0 + 0 + 0 + 0 = 0\ psig$$

$$AV = 1787.304\ psig - 31.358\ psig - 0\ psig = 1755.946\ psig$$

Substituting these values, the new allowable value for the new Rosemount Transmitter 1154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 2 for SPC-RP-022 (Reference 8.4.2) are calculated below:

$$LD_R = \sqrt{((2.592\ psig)^2 + (10.112\ psig)^2 + (0.808\ psig)^2 + 900\ (psig)^2}$$

$$LD_R = 31.775\ psig$$

$$LD_{BN} = 0 + 0 + 0 + 0 = 0\ psig$$

$$AV = 1787.457\ psig - 31.775\ psig - 0\ psig = 1755.682\ psig$$

Substituting these values, the new allowable value for the new Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 1 for SPC-RP-082 (Reference 8.4.3) are calculated below:

$$LD_R = \sqrt{((2.592\,psig)^2 + (8.716\,psig)^2 + (0.808\,psig)^2 + 900\,(psig)^2}$$

$$LD_R = 31.358\,psig$$

$$LD_{BN} = 0 + 0 + \ 0 + 0 = 0\,psig$$

$$AV = 1873.362\,psig - 31.358\,psig - 0\,psig = 1842.004\,psig$$

Substituting these values, the new allowable value for the new Rosemount Transmitter 3154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 2 for SPC-RP-083 (Reference 8.4.4) are calculated below:

$$LD_R = \sqrt{((2.592\,psig)^2 + (8.716\,psig)^2 + (0.808\,psig)^2 + 900\,(psig)^2}$$

$$LD_R = 31.358\,psig$$

$$LD_{BN} = 0 + 0 + \ 0 + 0 = 0\,psig$$

$$AV = 1873.362\,psig - 31.358\,psig - 0\,psig = 1842.004\,psig$$

Substituting these values, the new allowable value for the new Rosemount Transmitter 1154, NUS Lead/Lag Units and NUS Bistable DAM503-03 drift values for Unit 2 for SPC-RP-083 (Reference 8.4.4) are calculated below:

$$LD_R = \sqrt{((2.592\,psig)^2 + (10.112\,psig)^2 + (0.808\,psig)^2 + 900\,(psig)^2}$$

$$LD_R = 31.775\,psig$$

$$LD_{BN} = 0 + 0 + \ 0 + 0 = 0\,psig$$

$$AV = 1873.703\ \ psig - 31.775\ \ psig - 0\,psig = 1841.928\,psig$$

6.6 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation main body Section 3.1. Using the NTSP value calculated in Section 6.4, the AFT and APS values for the setpoint margin are evaluated below:

$$Accetpance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

Using 3154N Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 1 for SPC-RP-021 (Reference 8.4.1):

$$NTSP \leq APS - AFT$$

$$1787.475\,psig \leq 1900\,psig - 4\,psig$$

$$1787.475\,psig \leq 1896\,psig$$

Using 3154N Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 2 for SPC-RP-022 (Reference 8.4.2):

$$NTSP \leq APS - AFT$$

$$1787.304\,psig \leq 1900\,psig - 4\,psig$$

$$1787.304\,psig \leq 1896\,psig$$

Using 1154 Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 2 for SPC-RP-022 (Reference 8.4.2):

$$NTSP \leq APS - AFT$$

$$1787.457\,psig \leq 1900\,psig - 4\,psig$$

$$1787.457\,psig \leq 1896\,psig$$

Using 3154N Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 1 for SPC-RP-082 (Reference 8.4.3):

$$NTSP \leq APS - AFT$$

$$1873.362\,psig \leq 1900\,psig - 4\,psig$$

$$1873.362\,psig \leq 1896\,psig$$

Using 3154N Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 2 for SPC-RP-083 (Reference 8.4.4):

$$NTSP \leq APS - AFT$$

$$1873.362\,psig \leq 1900\,psig - 4\,psig$$

$$1873.362\,psig \leq 1896\,psig$$

Using 1154 Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 2 for SPC-RP-083 (Reference 8.4.4):

$$NTSP \leq APS - AFT$$

$$1873.703\,psig \leq 1900\,psig - 4\,psig$$

$$1873.703\,psig \leq 1896\,psig$$

6.7 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation main body Section 3.2. Using the calculated AV in Section 6.5, the AV is evaluated below:

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

The AV taken from the Unit 1 and Unit 2 Technical Specifications is shown below:

$$AV_{Tech\ Spec} \geq 1845\ psig$$

Using 3154N Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 1 for SPC-RP-021 (Reference 8.4.1):

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$1845\ psig \geq 1756.117\ psig$$

Using 3154N Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 2 for SPC-RP-022 (Reference 8.4.2):

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$1845\ psig \geq 1755.946\ psig$$

Using 1154 Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 2 for SPC-RP-022 (Reference 8.4.2):

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$1845\ psig \geq 1755.682\ psig$$

Using 3154N Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 1 for SPC-RP-082 (Reference 8.4.3):

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$1845\ psig \geq 1842.004\ psig$$

Using 3154N Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 2 for SPC-RP-083 (Reference 8.4.4):

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$1845\ psig \geq 1842.004\ psig$$

Using 1154 Transmitter, NUS Lead/Lag Units and NUS Bistable DAM503-03 from Unit 2 for SPC-RP-083 (Reference 8.4.4):

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$1845\ psig \geq 1841.928\ psig$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-015 (Reference 8.3.1), SPC-DR-021 (Reference 8.3.2) and SPC-DR-038 (Reference 8.3.3) along with the new calculated values for the Rosemount 3154 series pressure transmitters, the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation main body. Therefore, the calibration interval for the Pressurizer Pressure - Low function instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, “Guidelines for Instrument Calibration Extension/Reduction Programs”.

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, “The Analysis of Instrument Drift”.

8.2.2 EM 3.3.4.1, Revision 2, “Instrument Setpoint/Uncertainty Calculations”.

8.3 Drift Calculations:

8.3.1 SPC-DR-015, Revision 0, “Drift Analysis of As-Found / As-Left Data for NUS Lead/Lag Unit TMD500-20/00/00/00-08-08-03 (VDC)”.

8.3.2 SPC-DR-021, Revision 0, “Drift Analysis of As-Found /As-Left for Rosemount Transmitters 1154GP9RC”.

8.3.3 SPC-DR-038, Revision 0, “Drift Analysis of As-Found/As-Left Data for NUS Bistable SAM503 (MA)”.

8.4 Setpoint Calculations:

8.4.1 SPC-RP-021, Revision 2A, “Unit 1 Pressurizer Low Pressure Reactor Trip - for SBLOCA Event”.

8.4.2 SPC-RP-022, Revision 2, “Unit 2 Pressurizer Low Pressure Reactor Trip - SBLOCA Event”.

8.4.3 SPC-RP-082, Revision 1A, “Unit 1 Pressurizer Low Pressure Reactor Trip - for non SBLOCA events”.

8.4.4 SPC-RP-083, Revision 0A, “Unit 2 Pressurizer Low Pressure Reactor Trip - for non SBLOCA events”.

8.5 Technical Specifications:

8.5.1 Unit 1, “NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE”

8.5.2 Unit 2, “NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE”

8.6 Surveillance Procedures:

8.6.1 SP 1002A, Revision 50, “Analog Protection System Calibration”

8.6.2 SP 1002B.1, Revision 4, “Reactor Protection and Control Transmitter Calibration/Inspection Pressurizer Pressure”

8.6.3 SP 1199B, Revision 8, “Overpressure Protection System Transmitter Calibration"

8.6.4 SP 2002A, Revision 51, “Analog Protection System Calibration”

8.6.5 SP 2002B.1, Revision 2, “Reactor Protection and Control Transmitter Calibration/Inspection Pressurizer Pressure”

8.6.6 SP 2199B, Revision 9, “Overpressure Protection System Transmitter Calibration”

8.7 Design Controlled Documents:

8.7.1 Vendor Technical Manual Number NX-20728-1, Revision 37, Rosemount Composite Manual.

8.7.2 DIT 601000002918-001, transmitting and containing AFAL_Instrumentation_R.03_Results.xlsx, last modified on 3/30/2021

8.7.3 ECR Document Number 601000001191, Revision 0, “Replace 2PT-429, 30, 31, 49, 1PT-429, 30, 31, 49”.

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Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Unit 1 and 2 Pressurizer High Pressure Reactor Trip Bistable instrument loops. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table. The listed instruments are found in Surveillance Procedures SP 1002A, SP 1002B.4, SP 2002A, and SP 2002B.4 (References 8.6.1, 8.6.2, 8.6.3, and 8.6.4).

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1PT-429	Rosemont	3154NG6R2F0E7
1PT-430	Rosemont	3154NG6R2F0E7
1PT-431	Rosemont	3154NG6R2F0E7
2PT-429	Rosemont	1154GP9RC
2PT-430	Rosemont	1154GP9RC*
2PT-431	Rosemont	1154GP9RC
1PC-429A	NUS INSTRUMENTS	SAM503-03
1PC-430A	NUS INSTRUMENTS	SAM503-03
1PC-431A	NUS INSTRUMENTS	SAM503-03
2PC-429A	NUS INSTRUMENTS	SAM503-03
2PC-430A	NUS INSTRUMENTS	SAM503-03
2PC-431A	NUS INSTRUMENTS	SAM503-03

*This instrument will be replaced with a Rosemount 3154NG6R2F0E7, and as such, it is analyzed as a Rosemount 3154NG6R2F0E7 in this calculation.

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 1 and 2 setpoint calculations SPC-RP-019 (Reference 8.4.1) and SPC-RP-020 (Reference 8.4.2) provide different values for the total loop error and subsequently different nominal trip setpoints and allowable values. Because of this, the design inputs in Section 4.0 and analysis in Section 6.0 are given separately for setpoint calculations SPC-RP-019 (Reference 8.4.1) and SPC-RP-020 (Reference 8.4.2).

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 1.1 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-021, "Drift Analysis of As-Found/As-Left Data for Rosemont Transmitters 1154GP9RC" (Reference 8.3.1) and SPC-DR-013, "Drift Analysis of As-Found/As-Left Data for NUS Bistable SAM503 (V)" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in SPC-RP-019 (Reference 8.4.1) and SPC-RP-020 (Reference 8.4.2). The data taken from each is summarized in the following Sections.

4.1.1 SPC-DR-021

The Foxboro Transmitter 1154GP9RC was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{transmitter} = \pm 1.264\%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{transmitter} = \pm 0\%\ Calibrated\ Span$$

4.1.2 SPC-DR-013

The NUS Bistable SAM503 (V) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.220\%\ Calibrated\ Span$$

$$DA\_Ext\_Bias_{bistable} = \pm 0\%\ Calibrated\ Span$$

4.2 Insufficient Drift Data for Rosemount 3154NG6R2F0E7 Transmitter

ECR Document Number 601000001191, Revision 0 (Reference 8.7.1) replaces existing Rosemount Transmitter 1154GP9RC with Rosemount Transmitter 3154NG6R2F0E7. Vendor Technical Manual NX-20728-1 (Reference 8.7.2) provides the new uncertainties for the replacement transmitters. This attachment incorporates the changes in uncertainty associated with this replacement for the following instruments: 1PT-429, 1PT-430, 1PT-431, and 2PT-430. The 3154N pressure transmitters which replace the 1154N transmitter were installed on 9/22/2020 per Design Input Transmittal 601000002918-001 (Reference 8.7.3). Because of the recent installation, the number of available data points is less than required to have a statistically valid pool for drift analysis, as defined in EM 3.3.4.2 Section 6.4.2 (Reference 8.2.2). As a result, no drift analysis was conducted for the 3154N pressure transmitters. Therefore, this Attachment will use vendor data to establish drift as described in Section 6.4.2 of EM 3.3.4.2

(Reference 8.2.2) for conditions of insufficient drift data due to new or replaced components. The manufacturer specifications are conservative with respect to the observed drift values and is extrapolated to a maximum calibration interval of 30 months for use in this setpoint analysis.

4.3 Setpoint/Uncertainty Calculations

The Pressurizer High Pressure Reactor Trip setpoint is evaluated in two setpoint calculations: SPC-RP-019, "Unit 1 Pressurizer High Pressure Reactor Trip" (Reference 8.4.1) and SPC-RP-020, "Unit 2 Pressurizer High Pressure Reactor Trip" (Reference 8.4.2). The process span, analytic limit and calculation of the total loop error given in both calculations is summarized below.

Form 1 of SPC-RP-019 (Reference 8.4.1) and SPC-RP-020 (Reference 8.4.2) provides the following information:

$$Process\ Span = 1700.0\ to\ 2500.0\ PSIG$$

$$Analytical\ Limit\ (AL) = 2410.0\ PSIG$$

Total loop error for a seismic event and potential loss of non-seismic HVAC for an increasing process is calculated using the following equations:

$$TLE\ (SRSSS)\ =\ \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{neg} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$TLE_{neg} = -TLE\ (SRSSS) - Bias_{neg}$$

Calculating the total loop error for Unit 1 (SPC-RP-019):

$$TLE\ (SRSSS) = [32.000\ (PSIG^2) + 25.191\ (PSIG^2) + 82.807\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.0784\ (PSIG^2) + 228.430\ (PSIG^2) + 900.000\ (PSIG^2) + 0\ (PSIG^2) + 225(PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{\frac{1}{2}} = \pm 38.646\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -38.646\ PSIG - 0\ PSIG = -38.646\ PSIG$$

Calculating the total loop error for Unit 2 (SPC-RP-020):

$$TLE\ (SRSSS) = [32.000\ (PSIG^2) + 25.191\ (PSIG^2) + 103.745\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.0784\ (PSIG^2) + 228.430\ (PSIG^2) + 900.000\ (PSIG^2) + 0\ (PSIG^2) + 225(PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{\frac{1}{2}} = \pm 38.916\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -38.916\ PSIG - 0\ PSIG = -38.916\ PSIG$$

The nominal trip setpoint (NTSP) and allowable value (AV) for an increasing process is calculated for using the following equations:

$$NTSP = AL + TLE_{neg}$$

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting in values for Unit 1 (SPC-RP-019):

$$NTSP = 2410.0\ PSIG - 38.646 = 2371.354$$

$$LD_R = \sqrt{32.0\ (PSIG^2) + 25.191(PSIG^2) + 82.807\ (PSIG^2) + 900.0(PSIG^2)} = 32.249\ PSIG$$

$$LD_{BP} = 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 2371.354\ PSIG + 32.249\ PSIG + 0\ PSIG = 2403.603\ PSIG$$

Substituting in values for Unit 2 (SPC-RP-020):

$$NTSP = 2410.0\ PSIG - 38.916 = 2371.084$$

$$LD_R = \sqrt{32.0\ (PSIG^2) + 25.191(PSIG^2) + 103.745\ (PSIG^2) + 900.0(PSIG^2)} = 32.572\ PSIG$$

$$LD_{BP} = 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 2371.084\ PSIG + 32.572\ PSIG + 0\ PSIG = 2403.656\ PSIG$$

4.4 Technical Specifications

The allowable value for the Reactor Coolant Flow – Low function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 2400\ PSIG$$

4.5 Calibration Procedures

The Unit 1 (SPC-RP-019) and Unit 2 (SPC-RP-020) actual plant setting (APS) and as found tolerance (AFT) are given as follows in SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.3) for the NUS model SAM503-03 bistables.

$$APS = 0.4350\ VDC$$

$$AFT = \pm 0.0020\ VDC$$

The actual plant setting (APS) and as found tolerance (AFT) are given in VDC and are converted into PSIG, the process unit using the process span.

$$Process\ Span = 2500.0\ PSIG - 1700.0\ PSIG = 800.0\ PSIG*$$

*The transmitter input span is 800 PSIG and is ranged including a head correction that does not affect the actual plant setting.

$$Bistable\ Input\ Span = 0.5000\ VDC - 0.1000\ VDC = 0.4000\ VDC$$

$$APS = \left(\frac{0.4350\ VDC - 0.1000\ VDC}{0.4000\ VDC} \times 800.0\ PSIG\right) + 1700.0 = 2370.0\ PSIG$$

$$AFT = \frac{0.0020\ VDC}{0.4000\ VDC} \times 800.0\ PSIG = 4.0\ PSIG$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

SPC-RP-019 (Reference 8.4.1) and SPC-RP-020 (Reference 8.4.2) provide different total loop errors and subsequently different nominal trip setpoints and allowable values. This attachment will analyze both Unit 1 and 2 values along with both the Rosemount 3154N and 1154 pressure transmitters.

Drift was evaluated for the NUS Bistables in drift calculation SPC-DR-013 (Reference 8.3.2), which is combined with the Rosemont transmitters' drift given by SPC-DR-021 (Reference 8.3.1) and vendor specifications to calculate total loop error (TLE), nominal trip setpoint (NTSP), and allowable value (AV).

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument as given in SPC-DR-021 (References 8.3.1) and SPC-DR-013 (Reference 8.3.2) is calculated in percent span. To interface with the equations and values taken from setpoint calculations SPC-RP-019 (Reference 8.4.1) and SPC-RP-020 (Reference 8.4.2), the drift data is converted into the process unit using the process span (Given in Section 4.3) below.

Rosemount Transmitter 1154GP9RC:

$$DA\_Ext\_Rand_{trans} = \pm 1.264\%\ Calibrated\ Span \times \frac{800.0\ PSIG}{100\%\ Span} = 10.112\ PSIG$$

$$DA\_Ext\_Bias_{trans} = 0\%\ Calibrated\ Span \frac{800.0\ PSIG}{100\ \%Span} = 0\ PSIG$$

NUS Bistable SAM503-03:

$$DA\_Ext\_Rand_{bistable} = \pm 0.220\%\ Calibrated\ Span \times \frac{800.0\ PSIG}{100\%\ Span} = 1.760\ PSIG$$

$$DA\_Ext\_Bias_{bistable} = +0\%\ Calibrated\ Span \times \frac{800.0\ PSIG}{100\ \%Span} = 0\ PSIG$$

6.2 Calculated Drift for Rosemount Transmitter 3154NG6R2F0E7:

Per Section 4.2, vendor specifications are used to calculate the extrapolated random drift tolerance for the Rosemont 3154N Transmitters currently installed for instruments 1PT-429, 1PT-430, 1PT-431, and 2PT-430. Technical Manual NX-20728-1 (Reference 8.7.2) provides the new uncertainties for accuracy (A) and drift (D_R) using Range Code 6 for the 3154N transmitter manufacturer specifications. Data included in Forms 1, 2, and 3 of SPC-DR-019 (Reference 8.4.1) and SPC-DR-020 (Reference 8.4.2) used to calculate the extrapolated drift tolerance is also given below. This is being calculated for the 30 moth calibration interval (CI).

$$Vendor\ Accuracy\ (va) = \pm 0.25\%\ of\ Calibrated\ Span\ (CS)$$

$$Vendor\ Drift\ (vd) = \pm(0.1\%\ URL + 0.1\%\ span)$$

$$Vendor\ Upper\ Range\ Limit\ (URL) = 4000\ PSIG$$

$$Process\ Span\ (PS) = 1700.0\ to\ 2500.0\ PSIG = 800\ PSIG$$

$$Calibrated\ Span\ (CS) = 1715.0\ to\ 2515.0\ PSIG = 800\ pSIG$$

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 30\ months$$

Substituting these values, the accuracy and drift are calculated as:

$$A = (0.25\%\ \text{Calibrated Span})\left(\frac{800\ \text{PSIG}}{100\%\ \text{Calibrated Span}}\right) = \pm 2.0\ PSIG$$

$$D_R = \left(\frac{30\ \text{Months}}{30\ \text{Months}}\right)\left((0.1\%\ \text{Span})\left(\frac{800\ \text{PSIG}}{100\%\ \text{Span}}\right) + (0.1\%)(4000\ PSIG)\right) = \pm 4.8\ PSIG$$

The Measurement and Test Equipment allowance value for the 3154N pressure transmitter is bounded by Calibration Procedures SP 1002B.1 and SP 2002B.1 (References 8.6.2 and 8.6.4), therefore the existing instrument M&TE value is used.

SPC-RP-019 (Reference 8.4.1) Section 5.2.3 gives the Measurement and Test Equipment allowance value (M) as:

$$M = \pm 6.9953\ PSIG$$

SPC-RP-020 (Reference 8.4.2) Section 5.2.3 gives the Measurement and Test Equipment allowance value (M) as:

$$M = \pm 8.3590\ PSIG$$

Using these values, the Extrapolated Analyzed Drift term (DA_Ext_Rand) can be calculated for Unit 1 and Unit 2 using the following equation.

$$DA\_Ext\_Rand_{trans} = \sqrt{A^2 + {D_R}^2 + M^2}$$

Substituting in values for Unit 1:

$$DA\_Ext\_Rand_{trans} = \sqrt{(2.0\ PSIG)^2 + (4.8\ PSIG)^2 + (6.9953\ PSIG)^2} = 8.7163\ \text{PSIG}$$

Substituting in values for Unit 2:

$$DA\_Ext\_Rand_{trans} = \sqrt{(2.0\ PSIG)^2 + (4.8\ PSIG)^2 + (8.3590\ PSIG)^2} = 9.8444\ \text{PSIG}$$

6.3 Total Loop Error (TLE)

The Unit 1 total loop error is calculated using the Extrapolated Analyzed Drift term for the NUS Bistable given in Section 6.1 and Rosemount 3154N transmitter calculated using vendor specifications in Section 6.2. The Unit 2 total loop error is calculated, for both the 1154N and 3154N transmitters. The Extrapolated Analyzed Drift term is given for the 1154N transmitter in

Section 6.1 and the 3154N transmitter in Section 6.2. These values are used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint analyzed in SPC-RP-019 (Reference 8.4.1) and SPC-RP-020 (Reference 8.4.2).

$$DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

$$TLE\ (SRSSS) = \left[DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$TLE_{neg} = -TLE\ (SRSSS) - Bias_{neg}$$

Calculating for the Unit 1 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$TLE\ (SRSSS) = [(8.7163\ \mathrm{PSIG})^2 + (1.760\ PSIG)^2 + 0\ (PSIG^2) + 0\ (PSIG^2) + 0(PSIG^2) + 0.0784\ (PSIG^2) + 228.430\ (PSIG^2) + 900.000\ (PSIG^2) + 0\ (PSIG^2) + 225.000\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{\frac{1}{2}} = \pm 37.849\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -37.849\ PSIG - 0\ PSIG = -37.849\ PSIG$$

Calculating for the Unit 2 loop including the NUS SAM503 Bistable and 1154N Transmitter:

$$TLE\ (SRSSS) = [(10.112\ \mathrm{PSIG})^2 + (1.760\ PSIG)^2 + 0\ (PSIG^2) + 0\ (PSIG^2) + 0(PSIG^2) + 0.0784\ (PSIG^2) + 228.430\ (PSIG^2) + 900.000\ (PSIG^2) + 0\ (PSIG^2) + 225.000\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{\frac{1}{2}} = \pm 38.195\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -38.195\ PSIG - 0\ PSIG = -38.195\ PSIG$$

Calculating for the Unit 2 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$TLE\ (SRSSS) = [(9.844\ \mathrm{PSIG})^2 + (1.760\ PSIG)^2 + 0\ (PSIG^2) + 0\ (PSIG^2) + 0(PSIG^2) + 0.0784\ (PSIG^2) + 228.430\ (PSIG^2) + 900.000\ (PSIG^2) + 0\ (PSIG^2) + 225.000\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{\frac{1}{2}} = \pm 38.125\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -38.125\ PSIG - 0\ PSIG = -38.125\ PSIG$$

6.4 Nominal Trip Setpoint (NTSP)

The nominal trip setpoint (NTSP) for an increasing process is calculated for using the following equation.

$$NTSP = AL + TLE_{neg}$$

Calculating for the Unit 1 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$NTSP = 2410.0\ PSIG - 37.849\ PSIG = 2372.151\ PSIG$$

Calculating for the Unit 2 loop including the NUS SAM503 Bistable and 1154N Transmitter:

$$NTSP = 2410.0\ PSIG - 38.195\ PSIG = 2371.805\ PSIG$$

Calculating for the Unit 2 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$NTSP = 2410.0\ PSIG - 38.125\ PSIG = 2371.875\ PSIG$$

6.5 Allowable Value (AV)

The allowable value for the Pressurizer High Pressure Reactor Trip is calculated using the NTSP and the Loop Drift using the equations shown below.

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BP} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBN}$$

$$AV = NTSP + LD_R + LD_{Bp}$$

Substituting in values for the Unit 1 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$LD_R = \sqrt{(8.7163\ PSIG)^2 + (1.760\ PSIG)^2 + (900.000\ PSIG^2)} = 31.290\ PSIG$$

$$LD_{BP} = 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 2372.151\ PSIG + 31.290\ PSIG + 0\ PSIG = 2403.441\ PSIG$$

Substituting in values for the Unit 2 loop including the NUS SAM503 Bistable and 1154N Transmitter:

$$LD_R = \sqrt{(10.112\ PSIG)^2 + (1.760\ PSIG)^2 + (900.000\ PSIG^2)} = 31.707\ PSIG$$

$$LD_{BP} = 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 2371.805\ PSIG + 31.707\ PSIG + 0\ PSIG = 2403.512\ PSIG$$

Substituting in values for the Unit 2 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$LD_R = \sqrt{(9.844\ PSIG)^2 + (1.760\ PSIG)^2 + (900.000\ PSIG^2)} = 31.623\ PSIG$$

$$LD_{BP} = 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 2371.875\ PSIG + 31.623\ PSIG +\ 0\ PSIG = 2403.498\ PSIG$$

6.6 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.4 and the AFT and APS values calculated in Section 4.5 the setpoint margin is evaluated below.

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

Calculating for the Unit 1 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$2372.151 \geq 2370.0\ PSIG + 4.0\ PSIG$$

$$2372.151\ PSIG \ngeq 2374.0\ PSIG$$

Calculating for the Unit 2 loop including the NUS SAM503 Bistable and 1154N Transmitter:

$$2371.805 \geq 2370.0\ \ PSIG + 4.0\ PSIG$$

$$2371.805\ PSIG \ngeq 2374.0\ PSIG$$

Calculating for the Unit 2 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$2371.875 \geq 2370.0\ \ PSIG + 4.0\ PSIG$$

$$2371.875\ PSIG \ngeq 2374.0\ PSIG$$

Sufficient margin does not exist between the calculated nominal trip setpoint and the actual plant setting.

Per directions in summary setpoint calculation main body, discretionary margin can be reduced to obtain acceptable setpoint margins. For this attachment, the discretionary margin (AFT) will be revised to 1 PSIG. The use of this revised margin will allow an acceptable setpoint margin as shown below.

Calculating for the Unit 1 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$2372.151 \geq 2370.0\ PSIG + 1.0\ PSIG$$

$$2372.151\ PSIG \geq 2371.0\ PSIG$$

Calculating for the Unit 2 loop including the NUS SAM503 Bistable and 1154N Transmitter:

$$2371.805 \geq 2370.0\ \ PSIG + 1.0\ PSIG$$

$$2371.805\ PSIG \geq 2371.0\ PSIG$$

Calculating for the Unit 2 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$2371.875 \geq 2370.0\ \ PSIG + 1.0\ PSIG$$

$$2371.875\ PSIG \geq 2371.0\ PSIG$$

6.7 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is evaluated using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2. First converting the calculated AV from Section 6.4 into percent process span, the AV is evaluated below.

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

$$AV_{Tech\ Spec} \leq 2400\ PSIG$$

Calculating for the Unit 1 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$AV_{Calc} = 2403.441\ PSIG$$

$$2400\ PSIG \leq 2403.441\ PSIG$$

Calculating for the Unit 2 loop including the NUS SAM503 Bistable and 1154N Transmitter:

$$AV_{Calc} = 2403.512\ PSIG$$

$$2400\ PSIG \leq 2403.512\ PSIG$$

Calculating for the Unit 2 loop including the NUS SAM503 Bistable and 3154N Transmitter:

$$AV_{Calc} = 2403.498\ PSIG$$

$$2400\ PSIG \leq 2403.498\ PSIG$$

7.0 Conclusions and Plant Impact

A new total loop error (TLE), nominal trip setpoint (NTSP), and allowable value (AV) were calculated using new calculated drift values for the Pressurizer High Pressure Reactor Trip instruments. The new calculated drift values are provided in drift calculations SPC-DR-021 (Reference 8.3.1) and SPC-DR-013 (Reference 8.3.2) and are calculated for the 3154N pressure transmitter using vendor specifications (Reference 8.7.2). With a reduced discretionary setpoint margin, the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation main body. Therefore, the calibration interval for the Pressurizer High Pressure Reactor Trip instruments can be extended to 30 months without impact to the subject setpoint calculations.

8.0 References

8.1 Industry Guidance

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs"

8.2 Engineering Manuals

8.2.1 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations"
8.2.2 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift"

8.3 Drift Calculations

8.3.1 SPC-DR-021, Revision 0, "Drift Analysis of As-Found/As-Left Data for Rosemont Transmitters 1154GP9RC"
8.3.2 SPC-DR-013, Revision 0, "Drift Analysis of As-Found/As-Left Data for NUS Bistable SAM503 (V)"

8.4 Setpoint Calculations

8.4.1 SPC-RP-019, Revision 0A, "Unit 1 Pressurizer High Pressure Reactor Trip"
8.4.2 SPC-RP-020, Revision 0A, "Unit 2 Pressurizer High Pressure Reactor Trip"

8.5 Technical Specifications

8.5.1 Unit 1, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE"
8.5.2 Unit 2, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE"

8.6 Surveillance Procedures

8.6.1 SP 1002A, Revision 50, "Analog Protection System Calibration"
8.6.2 SP 1002B.1, Revision 4, "Reactor Protection and Control Transmitter Calibration/Inspection Pressurizer Pressure"
8.6.3 SP 2002A, Revision 51, "Analog Protection System Calibration"
8.6.4 SP 2002B.1, Revision 2, "Reactor Protection and Control Transmitter Calibration/Inspection Pressurizer Pressure"

8.7 Design Control Documents

8.7.1 ECR Document Number 601000001191, Revision 0, "Replace 2PT-429, 30, 31, 49, 1PT-429, 30, 31, 49".
8.7.2 Northern States Power Company Technical Manual Number NX-20728-1, Revision 37, Rosemount 3154N
8.7.3 DIT 601000002918-001, transmitting and containing AFAL_Instrumentation_R.03_ Results.xlsx, last modified on 3/30/2021

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Table of Contents

1.0 PURPOSE

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for Units 1 and 2 Reactor Trip System Instrumentation instrument loops that perform reactor trips. This justification will provide input to the LAR being submitted to extend the surveillance intervals. This setpoint attachment considers the instruments listed in the following table listed which are found in Surveillance Procedures SP 1002A, SP 1002B.2, SP 2002A, and SP 2002B.2 (References 8.6.1, 8.6.2, 8.6.3, and 8.6.4) in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1LT-426	BARTON	764-351
1LC-426A	NUS	DAM503-03
1LT-427	BARTON	764-351
1LC-427A	NUS	DAM503-03
1LT-428	BARTON	764-351
1LC-428A	NUS	DAM503-03
2LT-426	BARTON	764-351
2TC-426A	NUS	DAM503-03
2LT-427	BARTON	764-351
2LC-427A	NUS	DAM503-03
2LT-428	BARTON	764-351
2LC-428A	NUS	DAM503-03

2.0 METHODOLOGY

See Summary Setpoint Calculation main body Section 2.0 for the general setpoint evaluation methodology.

3.0 ACCEPTANCE CRITERIA

See Summary Setpoint Calculation main body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 DESIGN INPUTS

4.1. DRIFT CALCULATIONS

This attachment uses data from drift calculations SPC-DR-001, "Drift Analysis of As-Found/As-Left Data for Barton Transmitter 764-351" (Reference 8.3.1) and SPC-DR-037, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (mA)" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each drift calculation is summarized in the following sections.

4.1.1 SPC-DR-001

The Barton Transmitter 764-351 was evaluated, and the following values were calculated:

$$DA\_Ext\_Rand_{transmitter} = \pm 1.855\%\ calibrated\ span\ (95\%/95\%\ Factor)$$

$$DA\_Ext\_Bias_{transmitter} = +0\%\ calibrated\ span\ (95\%/95\%\ Factor)$$

4.1.2 SPC-DR-037

The NUS Bistable DAM503-03 (mA) was evaluated, and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.0697\%\ calibrated\ span\ (95\%/95\%\ Factor)$$

$$DA\_Ext\_Bias_{bistable} = +0\%\ calibrated\ span\ (95\%/95\%\ Factor)$$

4.2 SETPOINT/UNCERTAINTY CALCULATIONS

The Reactor Trip System Instrumentation setpoint is evaluated in two setpoint calculations: SPC-RP-013, “U1 Pressurizer High Level Reactor Trip” (Reference 8.4.1) and SPC-RP-014, “U2 Pressurizer High Level Reactor Trip” (Reference 8.4.2). Pertinent information from each calculation for this evaluation is summarized in the following sections.

Form 1 of SPC-RP-013 (Reference 8.4.1) and SPC-RP-014 (Reference 8.4.2) provides the following information:

$$Process\ Span = 0\ to\ 100.0\ PCT$$

$$Analytical\ Limit\ (AL) = 100.0\ PCT$$

Total loop error (TLE) for a seismic event and potential subsequent loss of non-seismic HVAC is calculated using the following equations:

$$TLES\ (SRSSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLES_{neg} = -TLES\ (SRSSS) - Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-013), the TLE seismic is calculated as:

$$TLES\ (SRSSS) = [\ 0.5\ (PCT^2) + \ 4.0336\ (PCT^2) + 1.2521\ (PCT^2) + 0\ (PCT^2) + 0.21809\ (PCT^2) + 0\ (PCT^2) + 0.04623\ (PCT^2) + 1.795\ (PCT^2) + \ 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 25\ (PCT^2) + 0\ (PCT^2) + (1\ PCT)^2 + (0\ PCT)^2]^{\frac{1}{2}} = \pm 5.818\ PCT$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 4\ PCT = 4.0\ PCT$$

$$TLES_{neg} = -5.818\ PCT - 4.0\ PCT = -9.818\ PCT$$

After entering the data for Unit 2 (SPC-RP-014), the TLE seismic is calculated as:

$$TLES\ (SRSSS) = [\ 0.5\ (PCT^2) + 4.0336\ (PCT^2) + 1.2515\ (PCT^2) + 0\ (PCT^2) + 0.21809\ (PCT^2) + 0\ (PCT^2) + 0.04623\ (PCT^2) + 1.7950\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 25\ (PCT^2) + 0\ (PCT^2) + (0\ PCT)^2 + (1.0\ PCT)^2 + (0\ PCT)^2]^{\frac{1}{2}} = \pm 5.818\ PCT$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 4\ PCT = 4.0\ PCT$$

$$TLES_{neg} = -5.818\ PCT - 4.0\ PCT = -9.818\ PCT$$

The calculated loop error for Unit 1 and Unit 2 are identical. Therefore, the Unit 1 variables are chosen and will be used in Section 6 to calculate the new total loop error.

The nominal trip setpoint (NTSP) for Unit 1 is calculated for an increasing process using the following equation:

$$NTSP = AL + TLES_{neg}$$

$$NTSP = 100\ PCT - 9.818 = 90.182\ PCT$$

The allowable value (AV) for an increasing process is determined using the following equations in Section 5.6 of SPC-RP-013 (Reference 8.4.1):

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{0.5\ (PCT^2) + 4.0336\ (PCT^2) + 1.2521\ (PCT^2) + 0\ (PCT^2)} = 2.4053\ PCT$$

$$LD_{BP} = 0\ PCT + 0\ PCT = 0\ PCT$$

$$AV = 90.182\ PCT + 2.4053\ PCT + 0\ PCT = 92.588\ PCT$$

4.3 Technical Specification

The allowable value for the Reactor Trip System Instrumentation from Table 3.3.1-1, Function 9 Pressurizer Water Level – High is taken from the technical specification for Units 1 and 2 (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 90\%$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.3).

$$APS = 44.00\ mA$$

$$AFT = \pm 0.20\ mA$$

To interface with the equations, the APS and AFT values are converted into process units using the input span taken from Form 2 of SPC-RP-013 (Reference 8.4.1).

$$Input\ Span\ of\ Bistables = 10.0\ to\ 50.0\ mA$$

$$APS = \left(\frac{(44.0 - 10.0\ )mA}{40.0\ mA} \times 100.0\ PCT\right) = 85\ PCT$$

$$AFT = \frac{0.2\ mA}{40\ mA} \times 100.0\ PCT = 0.5\ PCT$$

5.0 ASSUMPTIONS

No assumptions were used for this function evaluation.

6.0 ANALYSIS

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent calibrated span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below:

Barton Transmitter 764-351:

$$DA\_Ext\_Rand_{trans} = \pm 1.855\ \%Span = \pm 1.855\ \%Span \times \frac{100\ PCT}{100\ \%Span} = \pm 1.855\ PCT$$

$$DA\_Ext\_Bias_{trans} = 0\ \%Span = 0\ \%Span \times \frac{100\ PCT}{100\ \%Span} = 0\ PCT$$

NUS Bistable DAM503-03:

$$DA\_Ext\_Rand_{bistable} = \pm 0.0697\ \%Span = \pm 0.0697\ \%Span \times \frac{100\ PCT}{100\ \%Span} = \pm 0.0697\ PCT$$

$$DA\_Ext\_Bias_{bistable} = +0\ \%Span = +0\ \%Span \times \frac{100\ PCT}{100\ \%Span} = +0\ PCT$$

6.2 Total Loop Error (TLE)

Instrument uncertainty from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$\left(DA\_Ext\_Rand_{trans}{}^{2} + DA\_Ext\_Rand_{bistable}{}^{2}\right) = A + D_R + M$$

New total loop error (TLE) under seismic conditions for Unit 1 is calculated using the following equations:

$$TLES\ (SRSSS) = \left[DA\_Ext\_Rand_{trans}{}^{2} + DA\_Ext\_Rand_{bistable}{}^{2} + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^{2} + PMA_{NR}{}^{2} + PC_{NR}{}^{2}\right]^{1/2}$$

$$TLES_{neg} = -TLES\ (SRSSS) - Bias_{neg}$$

After entering the data for Barton Transmitter 764-351 and NUS Bistable DAM503-03, the new TLE under seismic condition for Unit 1 is calculated as:

$$TLES\ (SRSSS) = [\ (1.855\ PCT)^2 + (0.0697\ PCT)^2 + 0\ (PCT^2) + 0.21809\ (PCT^2) + 0\ (PCT^2) + 0.04623\ (PCT^2) + 1.795\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 0\ (PCT^2) + 25\ (PCT^2) + 0\ (PCT^2) + (0\ PCT)^2 + (1\ PCT)^2 + (0\ PCT)^2]^{\frac{1}{2}} = \pm 5.613\ PCT$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 4\ PCT = 4.0\ PCT$$

$$TLES_{neg} = -5.613\ PCT - 4.000\ PCT = -9.613\ PCT$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from Section 4.2 and the new calculated TLE value from Unit 1, the nominal trip setpoint using the new Barton Transmitter 764-351 and NUS Bistable DAM503-03 drift values for Unit 1 are calculated below:

$$NTSP = AL + TLE_{neg} = 100.0\ PCT + (-9.613\ PCT) = 90.387\ PCT$$

6.4 Allowable Value (AV)

The allowable value for Pressurizer Water Level - High is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance for Units 1 and 2 as shown below:

$$Loop\ Drift\ (Random) LD_R = \sqrt{\left(DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2\right) + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the new allowable value is calculated as:

$$LD_R = \sqrt{((1.855\ PCT)^2 + (0.0697\ PCT)^2) + 0\ (PCT^2)} = 1.856\ PCT$$

$$LD_{BP} = 0\ PCT + 0\ PCT + 0\ PCT = 0\ PCT$$

$$AV = 90.387\ PCT + 1.856\ PCT + 0\ PCT = 92.243\ PCT$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation main body Section 3.1. Using the NTSP value calculated in Section 6.3, the AFT and APS values for the setpoint margin are evaluated below:

$$Acceptance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$NTSP \geq APS + AFT$$

$$90.387\ PCT \geq 85.0\ PCT + 0.5\ PCT$$

$$90.387\ PCT \geq 85.5\ PCT$$

The acceptance criterion is met for setpoint margin.

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation main body Section 3.2. Using the calculated AV in Section 6.4, the AV is evaluated below:

$$Acceptance\ Criteria\ (Increasing)\text{: } AV_{Tech\ Spec} \leq AV_{Calc}$$

$$AV_{Tech\ Spec} \leq 90\ PCT$$

$$AV_{Tech\ Spec} \leq AV_{Calc}$$

$$90\ PCT \leq 92.243\ PCT$$

The acceptance criterion is met for the allowable value.

7.0 CONCLUSIONS AND PLANT IMPACT

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-001 (Reference 8.3.1) and SPC-DR-037 (Reference 8.3.2) along with the new calculated values for the Barton 764-351 Transmitters and NUS DAM503-03 Bistables. The new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation main body. Therefore, the calibration interval for the Pressurizer Water Level - High instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 REFERENCES

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs"

8.2 Engineering Manuals**:**

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift"

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations

8.3 Drift Calculations:

8.3.1 SPC-DR-001, Revision 1, "Drift Analysis of As-Found/As-Left Data for Barton Transmitter 764-351"

8.3.2 SPC-DR-037, Revision 0, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (mA)"

8.4 Setpoint Calculations:

8.4.1 SPC-RP-013, Revision 1A, "U1 Pressurizer High Level Reactor Trip"

8.4.2 SPC-RP-014, Revision 0A, "U2 Pressurizer High Level Reactor Trip"

8.5 Technical Specifications:

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42) Amendment 230

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60) Amendment 218

8.6 Surveillance Procedures:

8.6.1 Surveillance Procedure SP 1002A, Rev. 50, "Analog Protection System Calibration"

8.6.2 Surveillance Procedure SP 1002B.2, Rev. 3, "Reactor Protection and Control Transmitter Calibration/Inspection Pressurizer Level"

8.6.3 Surveillance Procedure SP 2002A, Rev. 51, "Analog Protection System Calibration"

8.6.4 Surveillance Procedure SP 2002B.2, Rev. 3, "Reactor Protection and Control Transmitter Calibration/Inspection Pressurizer Level"

Prepared By:	Lisa Soderlind	Lisa Soderlind Digitally signed by Lisa Soderlind Date: 2021.07.14 12:59:09 -05'00' (Signature)	(Date)
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Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Safety Injection – High Containment Pressure instrument loops which perform reactor trips. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table which are found in Surveillance Procedures SP 1002A, SP 1002B.8, SP 2002A, and SP 2002B.8 (References 8.6.1, 8.6.2, 8.6.3, and 8.6.4) in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1PT-945	ROSEMOUNT / EMERSON ELEC	1154DP6RC
1PT-947	ROSEMOUNT / EMERSON ELEC	1154DP6RC
1PT-949	ROSEMOUNT / EMERSON ELEC	1154DP6RC
2PT-945	ROSEMOUNT / EMERSON ELEC	1154DP6RC
2PT-947	ROSEMOUNT / EMERSON ELEC	1154DP6RC
2PT-949	ROSEMOUNT / EMERSON ELEC	1154DP6RC
1PC-945A NUS	NUS INSTRUMENTS LLC	DAM503-03 (V)
1PC-947A NUS	NUS INSTRUMENTS LLC	DAM503-03 (V)
1PC-949A NUS	NUS INSTRUMENTS LLC	DAM503-03 (V)
2PC-945A NUS	NUS INSTRUMENTS LLC	DAM503-03 (V)
2PC-947A NUS	NUS INSTRUMENTS LLC	DAM503-03 (V)
2PC-949A NUS	NUS INSTRUMENTS LLC	DAM503-03 (V)

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 1 setpoint calculation (SPC-RP-031, Reference 8.4.1) provides values for temperature effect, radiation effect, and process element accuracy, which will be used in this calculation.

2.1 Missing Unit 2 Calculation

Per Table 1.1, the Unit 1 and 2 Containment Pressure transmitters and bistables are the same manufacturers and model numbers, therefore this calculation applies to both Units. Given that only the Unit 1 setpoint calculation exists (SPC-RP-031, Reference 8.4.1), the M&TE, Actual Plant Setpoint, and As-Found tolerance stated in Reference 8.4.1 are used for both Units. Per schematics XH-1-554 (Reference 8.7.1) and XH-1001-803 (Reference 8.7.2), the loop configurations for Unit 1 and 2 are the same.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-010 "Drift Analysis of As-Found /As -Left Data for NUS Bistable DAM503-03 (V)" (Reference 8.3.1) and SPC-DR-019 "Drift Analysis of As-Found /As -Left Data for Rosemount Transmitter 1154DP6RC – Auxiliary Building" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-010

The NUS Bistable DAM503-03 (V) was evaluated and the following values were calculated:

$$DA_{Ext_{Rand,\ bistable}} = \pm 0.1072\%\ Span$$

$$DA_{Ext_{Bias,\ bistable}} = +0.0095\%\ Span$$

4.1.2 SPC-DR-019

The Rosemount 1154DP6RC Transmitter was evaluated and the following values were calculated:

$$DA_{Ext_{Rand,\ trans}} = \pm 0.301\%\ calibrated\ span$$

$$DA_{Ext_{Bias,\ trans}} = 0\%\ calibrated\ span$$

4.2 Setpoint/Uncertainty Calculations

The containment pressure reactor trip setpoint is evaluated in one setpoint calculation: SPC-RP-031, "U1 Containment Pressure High Safeguard Actuation Setpoint" (Reference 8.4.1). Pertinent information from each calculation for this evaluation is summarized below:

Form 1 of SPC-RP-031 provides the following information:

$$Process\ Span = -2.0000\ to\ 30.000\ PSIG$$

$$Analytical\ Limit\ (AL) = 5.0000\ PSIG$$

Total loop error for a loss of non-seismic HVAC due to a seismic event is calculated using the following equations, given that this is an increasing setpoint (per Form 1 of Reference 8.4.1), the $Bias_{neg}$ is used to calculate total loop error (per Section 5.4 of Reference 8.4.1) since TLE_{neg} is needed to calculate nominal trip setpoint (NTSP) (per Section 5.5 of Reference 8.4.1):

$$TLE\ (SRSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bp} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

After entering the data from SPC-RP-031 (Reference 8.4.1), the total loop error is calculated:

$$TLE\ (SRSS) = [0.05120\ (PSIG^2) + 0.02904\ (PSIG^2) + 0.11984\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 4.7334e-05\ (PSIG^2) + 0.15810\ (PSIG^2) + 1.0000\ (PSIG^2) + 0\ (PSIG^2) + 0.25000\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{\frac{1}{2}} = 1.2682\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -1.2682\ PSIG - 0\ PSIG = -1.2682\ PSIG$$

Given that there is no Unit 2 setpoint calculation, the Unit 1 results are used in Section 6.0 to calculate the new total loop error.

Per Section 5.5 of Reference 8.4.1, the nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

Per Section 5.6 of Reference 8.4.1, the allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

4.3 Technical Specifications

The Allowable Value for the Safety Injection – High Containment Pressure function is taken from the technical specification for each Unit (Table 3.3.2-1 of References 8.5.1 and 8.5.2). The same value is used for both units:

$$AV \leq 4.0\ PSIG$$

4.4 Calibration Procedures

The Actual Plant Setting (APS) and As-Found Tolerance (AFT) are taken from setpoint calculation SPC-RP-031 (Reference 8.4.1) and surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.3).

APS is calculated as follows per Section 3.4 of Reference 8.4.1:

$$APS = \frac{plant\_setting - input\_min}{input\_span} \times process\_span + process\_span\_min$$

The plant_setting is 0.1690 VDC (Worksheet 21a of References 8.6.1 and 8.6.3), the input_min is 0.1 VDC (Section 3.4 of Reference 8.4.1), the input_span is 0.4 VDC (Section 3.4 of Reference 8.4.1), the process_span is 32.000 PSIG (Section 3.4 of Reference 8.4.1), and the process_span_min is -2.0000 PSIG (Section 3.4 of Reference 8.4.1).

Plugging these values in:

$$APS = \frac{0.1690\ VDC - 0.1\ VDC}{0.4\ VDC} \times 32.000\ PSIG + (-2.0000\ PSIG)$$

$$APS = 3.52\ PSIG$$

Per Worksheet 21a of References 8.6.1 and 8.6.3 and Form 2 of Reference 8.4.1, the AFT is ±0.0020 VDC.

Converting to process units (PSIG):

$$AFT_{PSIG} = \frac{AFT_{VDC}}{Span_{VDC}} \times Span_{PSIG}$$

AFT_{VDC} is ±0.0020 VDC, $Span_{VDC}$ is 0.4 VDC (Form 2 of Reference 8.4.1), and $Span_{PSIG}$ is 32 PSIG (Form 2 of Reference 8.4.1).

Plugging these values in:

$$AFT_{PSIG} = \frac{\pm 0.0020\ \text{VDC}}{0.4\ \text{VDC}} \times 32\ \text{PSIG}$$

$$AFT_{PSIG} = \pm 0.16\ PSIG$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below:

NUS Bistable DAM503-03 (V) (per Reference 8.3.1)

$$DA_{Ext_{Rand,\ bistable\,(V)}} = \pm 0.1072\%\,Span \times \frac{32.000\,PSIG}{100\%\,Span} = \pm 0.03430\,PSIG$$

$$DA_{Ext_{Bias,\ bistable\,(V)}} = +0.0095\%\,Span \times \frac{32.000\,PSIG}{100\%\,Span} = 0.00304\,PSIG$$

Rosemount 1154DP6RC (per Reference 8.3.2):

$$DA_{Ext_{Rand,\ trans}} = \pm 0.301\%\,calibrated\ span \times \frac{32.000\,PSIG}{100\%\,calibrated\ span} = \pm 0.0963\,PSIG$$

$$DA_{Ext_{Bias,\ trans}} = 0\%\,calibrated\ span \times \frac{32.000\,PSIG}{100\%\,calibrated\ span} = 0\,PSIG$$

6.2 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$DA_{Ext_{Rand,\ bistable\,(V)}}{}^2 + DA_{Ext_{Rand,\ trans}}{}^2 = A + D_R + M$$

$$TLE\ (SRSS) = \Big[DA_{Ext_{Rand,\ bistable\,(V)}}{}^2 + DA_{Ext_{Rand,\ trans}}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{1/2}$$

$$TLE\ (SRSS) = [(0.03430\,PSIG)^2 + (0.0963\,PSIG)^2 + 0\,(PSIG^2) + 0\,(PSIG^2) + 0(PSIG^2) + 4.7334e-05\,(PSIG^2) + 0.15810\,(PSIG^2) + 1.0000\,(PSIG^2) + 0\,(PSIG^2) + 0.25000\,(PSIG^2) + 0\,(PSIG^2) + (0\,PSIG)^2 + (0\,PSIG)^2 + (0\,PSIG)^2]^{\frac{1}{2}} = \pm 1.191\,PSIG$$

$$Bias_{neg} = DA_{Ext_{Bias,\ bistable\,(V)}} + DA_{Ext_{Bias,\ trans}} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = 0.00304\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0.00304\ PSIG$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

$$TLE_{neg} = -1.191\ PSIG - 0.00304\ PSIG = -1.194\ PSIG$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from Section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE_{neg} = 5.0000\ PSIG + (-1.194\ PSIG) = 3.806\ PSIG$$

6.4 Allowable Value (AV)

The allowable value for Safety Injection – High Containment Pressure is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{\left(DA_{Ext_{Rand,\ bistable\,(V)}}\right)^2 + \left(DA_{Ext_{Rand,\ trans}}\right)^2 + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = DA_{Ext_{Bias,\ bistable\,(V)}} + DA_{Ext_{Bias,\ trans}} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

$$LD_R = \sqrt{(0.03430\ PSIG)^2 + (0.0963\ PSIG)^2 + 1.0000\ (PSIG^2)} = 1.0052\ PSIG$$

$$LD_{BP} = 0.00304\ PSIG + 0\ PSIG + 0\ PSIG = 0.00304\ PSIG$$

$$AV = 3.806\ PSIG + 1.0052\ PSIG + 0.00304\ PSIG = 4.814\ PSIG$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values calculated in Section 4.4, the setpoint margin is evaluated below per Summary Setpoint Calculation Main Body Section 3.1:

$$Acceptance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$NTSP \geq APS + AFT$$

$$3.806\ PSIG \geq 3.52\ PSIG + 0.16\ PSIG$$

$$3.806\ PSI \geq 3.68\ PSIG$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

$$AV_{Tech\ Spec} \leq AV_{Calc}$$

$$4.0\ PSIG \leq 4.814\ PSIG$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-010 (Reference 8.3.1) and SPC-DR-019 (Reference 8.3.2), the new calculated values were found to be acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Safety Injection – High Containment Pressure instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, “Guidelines for Instrument Calibration Extension/Reduction Programs”.

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, “The Analysis of Instrument Drift”.

8.2.2 EM 3.3.4.1, Revision 2, “Instrument Setpoint/Uncertainty Calculations”.

8.3 Drift Calculations:

8.3.1 SPC-DR-010, Revision 0, “Drift Analysis of As-Found / As-Left Data for NUS Bistable DAM503-03 (V)”

8.3.2 SPC-DR-019, Revision 0, “Drift Analysis of As-Found /As -Left Data for Rosemount Transmitter 1154DP6RC – Auxiliary Building”

8.4 Setpoint Calculations:

8.4.1 SPC-RP-031, Revision 0A, "U1 Containment Pressure High Safeguard Actuation Setpoint".

8.5 Technical Specifications:

8.5.1 Unit 1, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE", Amendment 230

8.5.2 Unit 2, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE", Amendment 218

8.6 Surveillance Procedures:

8.6.1 SP 1002A, Revision 50, "Analog Protection System Calibration"

8.6.2 SP 1002B.8, Revision 3, "Reactor Protection and Control Transmitter Calibration/Inspection Containment Pressure"

8.6.3 SP 2002A, Revision 51, "Analog Protection System Calibration"

8.6.4 SP 2002B.8, Revision 1, "Reactor Protection and Control Transmitter Calibration/Inspection Containment Pressure"

8.7 Schematics

8.7.1 XH-1-554, Revision 075, "REV C-INSTRUMENT BLCK DIAG__1-R2, 1-W2, 1-B2, 1-Y2 (PRINT 4 COPIES FOR FOXBORO RACKS)"

8.7.2 XH-1001-803, Revision 075, "REV C-INSTRU BLCK DIAG-CONTAIN PRESS___2-R2, 2-W2, 2-B2, 2-Y2 (PRINT 4 COPIES FOR FOXBORO RACKS)"

Prepared By:	Corey Crawford	Corey R. Crawford Digitally signed by Corey R. Crawford Date: 2021.07.01 08:18:00 -04'00' (Signature)	(Date)
Reviewed By:	Dean Crumpacker	W. D. Crumpacker Digitally signed by W. D. Crumpacker Date: 2021.07.01 08:35:48 -05'00' (Signature)	(Date)

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1.0 PURPOSE

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for Units 1 and 2 Safety Injection Pressurizer Low Pressure instrument loops which are Engineered Safety Feature Actuation System (ESFAS) Instrumentation. This justification will provide input to the LAR being submitted to extend the surveillance intervals. This setpoint attachment considers the instruments listed in the following table listed which are found in Surveillance Procedures SP 1002A, SP 1002B.1, SP 2002A, and SP 2002B.1 (References 8.6.1, 8.6.2, 8.6.3, and 8.6.4) in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1PC-429C	NUS INSTRUMENTS LLC	DAM503-03
1PC-430E	NUS INSTRUMENTS LLC	DAM503-03
1PC-431G	NUS INSTRUMENTS LLC	DAM503-03
1PT-429	ROSEMOUNT	3154NG6R2F0E7
1PT-430	ROSEMOUNT	3154NG6R2F0E7
1PT-431	ROSEMOUNT	3154NG6R2F0E7
2PC-429C	NUS INSTRUMENTS LLC	DAM503-03
2PC-430E	NUS INSTRUMENTS LLC	DAM503-03
2PC-431G	NUS INSTRUMENTS LLC	DAM503-03
2PT-429	ROSEMOUNT	1154GP9RC
2PT-430	ROSEMOUNT	*1154GP9RC
2PT-431	ROSEMOUNT	1154GP9RC

*This instrument will be replaced for a Rosemount 3154NG6R2F0E7, and as such, it is analyzed as a Rosemount 3154NG6R2F0E7 in this attachment.

2.0 METHODOLOGY

See Summary Setpoint Calculation main body Section 2.0 for the general setpoint evaluation methodology.

3.0 ACCEPTANCE CRITERIA

See Summary Setpoint Calculation main body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 DESIGN INPUTS

ECR Document Number 601000001191, Revision 0 (Reference 8.7.2) replaces existing Rosemount Transmitter 1154GP9RC with Rosemount Transmitter 3154NG6R2F0E7. Vendor Technical Manual NX-20728-1 (Reference 8.7.3) provides the new uncertainties for the replacement transmitters.

4.1. DRIFT CALCULATIONS

This attachment uses data from drift calculations SPC-DR-010, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (V)" (Reference 8.3.1) and SPC-DR-021, "Drift Analysis of As-Found/As-Left Data for Rosemount Transmitter 1154GP9RC" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each drift calculation is summarized in the following sections.

4.1.1 SPC-DR-010

The NUS Bistable DAM503-03 (VDC) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%Span$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%Span$$

Please note there is not a negative bias for NUS Bistable DAM503-03 (VDC). Therefore, the negative bias for $DA\_Ext\_Bias_{bistable}$ is equal to Zero.

4.1.2 SPC-DR-021

The Rosemount Transmitter 1154GP9RC was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{trans} = \pm 1.264\ \%Span$$

$$DA\_Ext\_Bias_{trans} = 0\ \%Span$$

4.2 SETPOINT/UNCERTAINTY CALCULATIONS

The Safety Injection Pressurizer Low Pressure reactor trip setpoint is evaluated in two setpoint calculations: SPC-RP-053, "Pressurizer Lo Pressure SI" (Reference 8.4.1) and SPC-RP-054, "Unit 2 Pressurizer Lo Pressure SI" (Reference 8.4.2). Pertinent information from each calculation for this evaluation is summarized in the following sections.

Form 1 of SPC-RP-053 (Reference 8.4.1) and SPC-RP-054 (Reference 8.4.2) provides the following information:

$$Process\ Span = 1700.0\ to\ 2500.0\ PSIG$$

$$Analytical\ Limit\ (AL) = 1685.0\ PSIG$$

Total loop error (TLE) under accident conditions is calculated using the following equations:

$$TLE\ (SRSSA) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{AR} + R_{AR} + H_{AR} + S_R + READ + SPT_R + PEA_{AR}{}^2 + PMA_{AR}{}^2 + PC_{AR}{}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{ABp} + R_{ABp} + H_{ABp} + S_{Bp} + PEA_{ABp} + PMA_{ABp} + PC_{ABp} + IR_{Bp} + SPT_{Bp}$$

$$TLE_{pos} = TLE\ (SRSSA) + Bias_{pos}$$

After entering the data for Unit 1 (SPC-RP-053), the TLE accident is calculated as:

$$\begin{aligned} TLE\ (SRSSA) = {} & [\ 32.0\ (PSIG^2) + 25.191\ (PSIG^2) + 82.807\ (PSIG^2) + 0\ (PSIG^2) \\ & + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.07840\ (PSIG^2) + 225.39\ (PSIG^2) \\ & + 900\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) \\ & + 6241.0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} \\ & = \pm 86.640\ PSIG \end{aligned}$$

$$\begin{aligned} Bias_{pos} = {} & 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG \\ & + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 16.0\ PSIG \\ & + 0\ PSIG = 16.0\ PSIG \end{aligned}$$

$$TLE_{pos} = 86.640\ PSIG + 16.0\ PSIG = 102.64\ PSIG$$

After entering the data for Unit 2 (SPC-RP-054), the TLE accident is calculated as:

$$\begin{aligned} TLE\ (SRSSA) = {} & [16.0\ (PSIG^2) + 74.880\ (PSIG^2) + 18.863\ (PSIG^2) + 0\ (PSIG^2) \\ & + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.07840\ (PSIG^2) + 63.203\ (PSIG^2) \\ & + 900\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) \\ & + 6241.0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} \\ & = \pm 85.522\ PSIG \end{aligned}$$

$$\begin{aligned} Bias_{pos} = {} & 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG \\ & + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 16.0\ PSIG \\ & + 0\ PSIG = 16.0\ PSIG \end{aligned}$$

$$TLE_{pos} = 85.522\ PSIG + 16.0\ PSIG = 101.522\ PSIG$$

The Unit 1 variables provide the worst-case total loop error and will be used in Section 6 to calculate the new total loop error.

The nominal trip setpoint (NTSP) for Unit 1 is calculated for a decreasing process using the following equation:

$$NTSP = AL + TLE_{pos}$$

$$NTSP = 1685.0\ PSIG + 102.64\ PSIG = 1787.64\ PSIG$$

The allowable value (AV) for a decreasing process is determined using the following equations in Section 5.6 of SPC-RP-053 (Reference 8.4.1):

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = D_{BN} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{32.0\ (PSIG^2) + 25.191(PSIG^2) + 82.807(PSIG^2) + 900.0(PSIG^2)} = 32.249\ PSIG$$

$$LD_{BN} = 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 1787.64\ PSIG - 32.249\ PSIG - 0\ PSIG = 1755.39\ PSIG$$

Please note this attachment is to incorporate the changes in uncertainty associated with the replacement of the original Rosemount 1154 series pressure transmitters with new Rosemount 3154N series pressure transmitters in Section 6.0.

4.3 Technical Specification

The allowable value for the Safety Injection – Pressurizer Low Pressure from Table 3.3.2-1, Function 1d is taken from the technical specification for Units 1 and 2 (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 1760\ PSIG$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.3).

$$APS = 0.1650\ VDC$$

$$AFT = \pm 0.002\ VDC$$

To interface with the equations, the APS and AFT values are converted into process units using the input span taken from Form 2 of SPC-RP-053 (Reference 8.4.1).

$$Input\ Span\ of\ Bistables = 0.1000\ to\ 0.5000\ VDC$$

$$APS = 0.1650\ VDC = \left(\frac{(0.1650 - 0.1000)VDC}{0.4000\ VDC} \times 800.0\ PSIG\right) + (1700.0\ PSIG) = 1830.0\ PSIG$$

$$AFT = \frac{0.002\ VDC}{0.4000\ VDC} \times 800.0\ PSIG = 4.0\ PSIG$$

5.0 ASSUMPTIONS

No assumptions were used for this function evaluation.

6.0 ANALYSIS

SPC-RP-053 (Reference 8.4.1) and SPC-RP-054 (Reference 8.4.2) provide different total loop errors and subsequently different nominal trip setpoints and allowable values. This attachment will analyze both Unit 1 and 2 values along with both the Rosemount 3154N and 1154 pressure transmitters.

Drift was evaluated separately for the NUS Bistables using VDC in drift calculation SPC-DR-010 (Reference 8.3.1), which is combined with the transmitter's drift to calculate total loop error (TLE), nominal trip setpoint (NTSP), and allowable value (AV). The worst-case value is taken from the two to conservatively compare with the new calculated values.

This attachment is to incorporate the changes in uncertainty associated with the replacement of the original Rosemount 1154 series pressure transmitters with new Rosemount 3154N series pressure transmitters for the following instruments: 1PT-429, 1PT-430, 1PT-431, and 2PT-430. Since, the 3154N pressure transmitter has less than 10 data points and replaced the 1154 pressure transmitters on 9/22/2020 according to Design Input Transmittal 601000002918-001 (Reference 8.7.1), therefore per EM 3.3.4.2 (Reference 8.2.1), vendor data can be used to establish drift data (Reference 8.2.2). The manufacturer specifications are conservative with respect to the observed drift values and for this case, the manufacturer specification for drift would be extrapolated to a maximum calibration interval of 30 months for use in these setpoint calculations. The uncertainty associated with instruments 2PT-429 and 2PT-431 will come from the original Rosemount 1154 series pressure transmitters since these transmitters were not replaced.

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent (%) span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below:

NUS Bistable DAM503-03 (VDC):

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%Span = \pm 0.1072\ \%Span \times \frac{800.0\ PSIG}{100\ \%Span} = \pm 0.8576\ PSIG$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%Span = +0.0095\ \%Span \times \frac{800.0\ PSIG}{100\ \%Span} = +0.076\ PSIG$$

Please note there is not a negative bias for NUS Bistable DAM503-03 (VDC). Therefore, the negative bias for $DA\_Ext\_Bias_{bistable}$ is equal to Zero.

Rosemount Transmitter 1154GP9RC:

$$DA\_Ext\_Rand_{trans} = \pm 1.264\ \%Span\ = \pm 1.264\ \%Span \times \frac{800.0\ PSIG}{100\ \%Span} = \pm 10.112\ PSIG$$

$$DA\_Ext\_Bias_{trans} = 0\ \%Span = 0\%Span \times \frac{800.0\ PSIG}{100\ \%Span} = 0\ PSIG$$

6.2 Calculated Drift for Rosemount Transmitter 3154NG6R2F0E7:

Technical Manual NX-20728-1 (Reference 8.7.3) provides the new uncertainties for accuracy (A) and drift (D_R). Use Range Code 6 when looking at the 3154N transmitter manufacturer specifications.

$$Vendor\ Accuracy\ (va) = \pm 0.25\%\ of\ Calibrated\ Span\ (CS)$$

$$Vendor\ Drift\ (vd) = \pm(0.1\%\ URL + 0.1\%\ span)$$

$$URL = 4000.0\ PSIG$$

Form 1 and Form 2 of SPC-RP-053 (Reference 8.4.1) provides the following information:

$$Process\ Span\ (PS) = 1700.0\ to\ 2500.0\ PSIG$$

$$Calibrated\ Span\ (CS) = 1715.0\ to\ 2515.0\ PSIG$$

For this attachment, the interval is extended out to 30 months to satisfy the purpose of this project for extending the surveillance interval from 24 months to 30 months.

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 30\ months$$

Substituting these values, the accuracy and drift are calculated as:

$$A = \ (\mathrm{va}) \left(\frac{\mathrm{PS}}{\mathrm{CS}}\right) = \pm 2.0\ PSIG$$

$$D_R = \left(\frac{\mathrm{CI}}{\mathrm{DT}}\right) (\mathrm{vd}) \left(\frac{\mathrm{PS}}{\mathrm{CS}}\right) = \pm 4.8\ PSIG$$

See Section 5.2.3 of SPC-RP-053 (Reference 8.4.1) for obtaining Instrument Measurement and Test Equipment allowance value (M) under Device 1. The Measurement and Test Equipment allowance value for the 3154N pressure transmitter is bounded by Calibration Procedures SP 1002B.1 and SP 2002B.1 (References 8.6.2 and 8.6.4), therefore the existing instrument M&TE value is used.

$$M = \pm 6.9953\ PSIG$$

Substituting these values, the $DA\_Ext\_Rand_{trans}$ value is calculated as:

$$DA\_Ext\_Rand_{trans} = \sqrt{A^2 + {D_R}^2 + M^2}$$

$$DA\_Ext\_Rand_{trans} = \sqrt{(2.0\ PSIG)^2 + (4.8\ PSIG)^2 + (6.9953\ PSIG)^2}$$

$$DA\_Ext\_Rand_{trans} = 8.716\ PSIG$$

6.3 Total Loop Error (TLE)

Attachment Z uses Unit 1 and Unit 2 data for substituting these values in TLE, NTSP and AV equations. The 3154N transmitter manufacturer specifications are used to calculate and replace the instrument accuracy, drift, and measurement and test equipment for an updated evaluation of the loop setpoint for Units 1 and 2. Instrument drift from the referenced drift calculations for the NUS Bistables and 1154 pressure transmitters are used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint for Unit 2 using the methodology shown below:

$$\left({DA\_Ext\_Rand_{trans}}^2 + {DA\_Ext\_Rand_{bistable}}^2\right) = A + D_R + M$$

New total loop error (TLE) under accident conditions for Units 1 and 2 is calculated using the following equations:

$$TLE\ (SRSSA) = \left[\left({DA\_Ext\_Rand_{trans}}^2 + {DA\_Ext\_Rand_{bistable}}^2\right) + OPE_R + SPEZ_R + SPES_R + P_R + T_{AR} + R_{AR} + H_{AR} + S_R + SPT_R + READ + {PEA_{AR}}^2 + {PMA_{AR}}^2 + {PC_{AR}}^2\right]^{1/2}$$

$$Bias_{pos} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{ABp} + R_{ABp} + H_{ABp} + S_{Bp} + PEA_{ABp} + PMA_{ABp} + PC_{ABp} + IR_{Bp} + SPT_{Bp}$$

$$TLE_{pos} = TLE\ (SRSSA) + Bias_{pos}$$

After entering the data for Rosemount Transmitter 3154NG6R2F0E7 and NUS Bistable DAM503-03 (VDC), the new TLE under accident condition for Unit 1 is calculated as:

$$TLE\ (SRSSA) = [((8.716\ PSIG)^2 + (0.8576\ PSIG)^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.07840\ (PSIG^2) + 225.39\ (PSIG^2) + 900\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 6241.0\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} = \pm 86.2738\ PSIG$$

$$Bias_{pos} = 0\ PSIG + 0.076\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 16\ PSIG + 0\ PSIG = 16.076\ PSIG$$

$$TLE_{pos} = 86.2738\ PSIG + 16.076\ PSIG = 102.3498\ PSIG$$

After entering the data for Rosemount Transmitter 3154NG6R2F0E7 and NUS Bistable DAM503-03 (VDC), the new TLE under accident condition for Unit 2 is calculated as:

$$TLE\ (SRSSA) = [((8.716\ PSIG)^2 + (0.8576\ PSIG)^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.07840\ (PSIG^2) + 63.203\ (PSIG^2) + 900\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 6241.0\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} = \pm\ 85.3287\ PSIG$$

$$Bias_{pos} = 0\ PSIG + 0.076\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 16\ PSIG + 0\ PSIG = 16.076\ PSIG$$

$$TLE_{pos} = 85.3287\ PSIG + 16.076\ PSIG = 101.4047\ PSIG$$

After entering the data for Rosemount Transmitter 1154GP9RC and NUS Bistable DAM503-03 (VDC), the new TLE under accident condition for Unit 2 is calculated as:

$$TLE\ (SRSSA) = [((10.112\ PSIG)^2 + (0.8576\ PSIG)^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.07840\ (PSIG^2) + 63.203\ (PSIG^2) + 900\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 6241.0\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} = \pm\ 85.4826\ PSIG$$

$$Bias_{pos} = 0\ PSIG + 0.076\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 16\ PSIG + 0\ PSIG = 16.076\ PSIG$$

$$TLE_{pos} = 85.4826\ PSIG + 16.076\ PSIG = 101.5586\ PSIG$$

6.4 Nominal Trip Setpoint (NTSP)

Using the equations from Section 4.2 and the new calculated TLE value from Unit 1, the nominal trip setpoint using the new Rosemount Transmitter 3154NG6R2F0E7 and NUS Bistable DAM503-03 (VDC) drift values for Unit 1 are calculated below:

$$NTSP = AL + TLE_{pos} = 1685.0\ PSIG + 102.3498\ PSIG = 1787.3498\ PSIG$$

Using the equations from Section 4.2 and the new calculated TLE value from Unit 2, the nominal trip setpoint using the new Rosemount Transmitter 3154NG6R2F0E7 and NUS Bistable DAM503-03 (VDC) drift values for Unit 2 are calculated below:

$$NTSP = AL + TLE_{pos} = 1685.0\ PSIG + 101.4047\ PSIG = 1786.4047\ PSIG$$

After entering the data, the nominal trip setpoint using the Rosemount Transmitter 1154GP9RC and NUS Bistable DAM503-03 (VDC) drift values for Unit 2 are calculated below:

$$NTSP = AL + TLE_{pos} = 1685.0\ PSIG + 101.5586\ PSIG = 1786.5586\ PSIG$$

6.5 Allowable Value (AV)

The allowable value for Safety Injection – Pressurizer Low Pressure is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance for Units 1 and 2 as shown below:

$$Loop\ Drift\ (Random) LD_R = \sqrt{\left(DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2\right) + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Substituting these values, the new allowable value for the new Rosemount Transmitter 3154NG6R2F0E7 and NUS Bistable DAM503-03 (VDC) for Unit 1 are calculated as:

$$LD_R = \sqrt{((8.716\ PSIG)^2 + (0.8576\ PSIG)^2) + 900\ (PSIG^2)} = 31.2523\ PSIG$$

$$LD_{BN} = 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 1787.3498\ PSIG - 31.2523\ PSIG - 0\ PSIG = 1756.0975\ PSIG$$

Substituting these values, the new allowable value for the new Rosemount Transmitter 3154NG6R2F0E7 and NUS Bistable DAM503-03 (VDC) for Unit 2 are calculated as:

$$LD_R = \sqrt{((8.716\ PSIG)^2 + (0.8576\ PSIG)^2) + 900\ (PSIG^2)} = 31.2523\ PSIG$$

$$LD_{BN} = 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 1786.4047\ PSIG - 31.2523\ PSIG - 0\ PSIG = 1755.1524\ PSIG$$

Substituting these values, the new allowable value for the Rosemount Transmitter 1154GP9RC and NUS Bistable DAM503-03 (VDC) drift values for Unit 2 are calculated below:

$$LD_R = \sqrt{((10.112\ PSIG)^2 + (0.8576\ PSIG)^2) + 900\ (PSIG^2)} = 31.6699\ PSIG$$

$$LD_{BN} = 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 1786.5586\ PSIG - 31.6699\ PSIG - 0\ PSIG = 1754.8887\ PSIG$$

6.6 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation main body Section 3.1. Using the NTSP value calculated in Section 6.4, the AFT and APS values for the setpoint margin are evaluated below:

$$Accetpance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

<u>Using 3154N Transmitter and Bistable (VDC) from Unit 1:</u>

$$NTSP \leq APS - AFT$$

$$1787.3498\ PSIG \leq 1830.0\ PSIG - \ 4.0\ PSIG$$

$$1787.3498\ PSIG \leq 1826.0\ PSIG$$

<u>Using 3154N Transmitter and Bistable (VDC) from Unit 2:</u>

$$NTSP \leq APS - AFT$$

$$1786.4047\ PSIG \leq 1830.0\ PSIG - \ 4.0\ PSIG$$

$$1786.4047\ PSIG \leq 1826.0\ PSIG$$

<u>Using 1154 Transmitter and Bistable (VDC) from Unit 2:</u>

$$NTSP \leq APS - AFT$$

$$1786.5586\ PSIG \leq 1830.0\ PSIG - \ 4.0\ PSIG$$

$$1786.5586\ PSIG \leq 1826.0\ PSIG$$

6.7 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation main body Section 3.2. Using the calculated AV in Section 6.5, the AV is evaluated below:

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

The AV taken from the Unit 1 and Unit 2 Technical Specifications is shown below:

$$AV_{Tech\ Spec} \geq 1760\ PSIG$$

Using 3154N Transmitter and Bistable (VDC) from Unit 1:

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$1760\ PSIG \geq 1756.0975\ PSIG$$

Using 3154N Transmitter and Bistable (VDC) from Unit 2:

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$1760\ PSIG \geq 1755.1524\ PSIG$$

Using 1154 Transmitter and Bistable (VDC) from Unit 2:

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$1760\ PSIG \geq 1754.8887\ PSIG$$

7.0 CONCLUSIONS AND PLANT IMPACT

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-010 (Reference 8.3.1) and SPC-DR-021 (Reference 8.3.2) along with the new calculated values for the Rosemount 3154N and 1154 series pressure transmitters, the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation main body. Therefore, the calibration interval for the Safety Injection Pressurizer Low Pressure function instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals**:**

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-010, Revision 0, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (V)".

8.3.2 SPC-DR-021, Revision 0, "Drift Analysis of As-Found/As-Left Data for Rosemount Transmitter 1154GP9RC".

8.4 Setpoint Calculations:

8.4.1 SPC-RP-053, Revision 1A, "Pressurizer Lo Pressure SI".

8.4.2 SPC-RP-054, Revision 0, "Unit 2 Pressurizer Lo Pressure SI".

8.5 Technical Specifications:

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42) Amendment 230.

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60) Amendment 218.

8.6 Surveillance Procedures:

8.6.1 Surveillance Procedure SP 1002A, Rev. 50, "Analog Protection System Calibration".

8.6.2 Surveillance Procedure SP 1002B.1, Rev. 4, "Reactor Protection and Control Transmitter Calibration/Inspection Pressurizer Pressure".

8.6.3 Surveillance Procedure SP 2002A, Rev. 51, "Analog Protection System Calibration".

8.6.4 Surveillance Procedure SP 2002B.1, Rev. 2, "Reactor Protection and Control Transmitter Calibration/Inspection Pressurizer Pressure".

8.7 Design Control Documents:

8.7.1 DIT 601000002918-001, transmitting and containing AFAL_Instrumentation_R.03_Results.xlsx, last modified on 3/30/2021

8.7.2 ECR Document Number 601000001191, Revision 0, "Replace 2PT-429, 30, 31, 49, 1PT-429, 30, 31, 49".

8.7.3 Northern States Power Company Technical Manual Number NX-20728-1, Revision 37, Rosemount 3154N.

Prepared By:	**Victor S. D'Amore**	Digitally signed by Victor S. D'Amore Date: 2021.07.01 10:13:20 -07'00' **(Signature)**	**(Date)**
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1.0 PURPOSE

The purpose of this calculation is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation of the *Safety Injection - Steam Line Low Pressure* Function 1(e) in Technical Specification Table 3.3.2-1. This justification will provide input to the LAR being submitted to extend the surveillance intervals. This setpoint attachment considers the instruments listed in Table 1.1 below (References 8.6.1, 8.6.2, 8.6.3, 8.6.4, and 8.6.5).

Table 1.1: Instruments

Instrument Tag No.	Manufacturer	Model No.
1PC-468A	NUS INSTRUMENTS LLC	DAM503-03
1PC-469A	NUS INSTRUMENTS LLC	DAM503-03
1PC-478A	NUS INSTRUMENTS LLC	DAM503-03
1PC-479A	NUS INSTRUMENTS LLC	DAM503-03
1PC-482A	NUS INSTRUMENTS LLC	DAM503-03
1PC-483A	NUS INSTRUMENTS LLC	DAM503-03
1PM-468A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
1PM-469A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
1PM-478A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
1PM-479A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
1PM-482A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
1PM-483A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
1PT-468	ROSEMOUNT	1154GP9RC
2PC-468A	NUS INSTRUMENTS LLC	DAM503-03
2PC-469A	NUS INSTRUMENTS LLC	DAM503-03
2PC-478A	NUS INSTRUMENTS LLC	DAM503-03
2PC-479A	NUS INSTRUMENTS LLC	DAM503-03
2PC-482A	NUS INSTRUMENTS LLC	DAM503-03
2PC-483A	NUS INSTRUMENTS LLC	DAM503-03
2PM-468A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
2PM-469A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
2PM-478A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
2PM-479A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
2PM-482A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
2PM-483A	NUS INSTRUMENTS LLC	TMD500-20/00/00/00-08-08-03
2PT-468	ROSEMOUNT	3154NG5R2F0E7

2.0 METHODOLOGY

See Summary Setpoint Calculation Main Body section 2.0 for general setpoint evaluation methodology.

3.0 ACCEPTANCE CRITERIA

See Summary Setpoint Calculation Main Body section 3.0 for setpoint evaluation acceptance criteria.

4.0 DESIGN INPUT

Work Order 502517 (Reference 8.7.1) replaces 2PT-468, Unit 2 Rosemount Transmitter 1154GP9RC, with Rosemount Transmitter 3154NG6R2F0E7. Vendor Technical Manual NX-20728-1 (Reference 8.1.2) provides the new uncertainties for the replaced transmitter.

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-037, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (mA)" (Reference 8.3.1), SPC-DR-015, "Drift Analysis of As-Found/As-Left Data for NUS Lead/Lag Unit TMD500-20/00/00/00-08-08-03 (VDC)" (Reference 8.3.2), and SPC-DR-020, "Drift Analysis of As-Found/As-Left Data for Rosemount Transmitter 1154GP9 – Aux Building" (Reference 8.3.3). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. Data taken from each drift calculation is summarized in sections 4.1.1, 4.1.2, and 4.1.3 below.

4.1.1 SPC-DR-037

The NUS Bistable DAM503-03 (mA) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.0697\%CS$$

$$DA\_Ext\_Bias_{bistable} = \pm 0\%CS$$

4.1.2 SPC-DR-015

The NUS Lead/Lag Time Domain Module TMD500-20/00/00/00-08-08-03 (VDC) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{tmd} = \pm 0.324\%CS$$

$$DA\_Ext\_Bias_{tmd} = \pm 0\%CS$$

4.1.3 SPC-DR-020

The Rosemount Transmitter 1154GP9RC was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{trans} = \pm 0.225\%CS$$

$$DA\_Ext\_Bias_{trans} = +0.030\%CS$$

4.2 Setpoint/Uncertainty Calculations

The steam line loop A-1 low-low pressure SI actuation bistable setpoint is evaluated in two setpoint calculations: SPC-RP-059, "Unit 1 Steamline Loop A-1 Low-Low Pressure SI Actuation Bistable Setpoint" (Reference 8.4.1) and SPC-RP-060, "Unit 2 Steamline Loop

A-1 Low-Low Pressure SI Actuation Bistable Setpoint" (Reference 8.4.2). Form 1 of SPC-RP-059 and SPC-RP-060 provides the following:

$$Process\ Span = 0\ to\ 1400.0\ PSIG$$

$$Analytical\ Limit\ (AL) = 485.00\ PSIG$$

Per SPC-RP-059 and SPC-RC-060 the total loop error (TLE) under seismic conditions and potential subsequent loss of non-seismic HVAC is calculated as follows:

$$TLE_{pos} = +TLE\ (SRSSS) + Bias_{pos}$$

$$TLE_{neg} = -TLE\ (SRSSS) - Bias_{neg}$$

where,

$$TLE\ (SRSSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R \quad + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} \ + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NBNn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

Unit 1

Substituting data from SPC-RP-059 (Unit 1), the TLE under seismic conditions and potential subsequent loss of non-seismic HVAC is calculated as follows:

$$TLE\ (SRSSS) = [147.00\ (PSIG^2) + 48.326\ (PSIG^2) + 422.19\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.0906\ (PSIG^2) + 265.17\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 225.00\ (PSIG^2) + 0\ (PSIG)^2 + 0\ (PSIG)^2 + 0\ (PSIG)^2 + 0\ (PSIG)^2]^{\frac{1}{2}} = \pm 33.283\ PSIG$$

$$Bias_{pos} = \ 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG \ + 0\ PSIG = 0\ PSIG$$

$$TLE_{pos} = \ +33.283\ PSIG + 0\ PSIG = \ +33.283\ PSIG$$

$$TLE_{neg} = -33.283\ PSIG - 0\ PSIG \ = -33.283\ PSIG$$

The nominal trip setpoint (NTSP) for Unit 1 is calculated for a decreasing process using the following equation:

$$NTSP = AL + TLE_{pos}$$

Substituting above values,

$$NTSP = 485.00\ PSIG + 33.283\ PSIG = 518.28\ PSIG$$

The allowable value (AV) for a decreasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = D_{BN} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Substituting above values, the allowable value for Unit 1 is calculated below.

$$LD_R = \sqrt{147.00\ (PSIG^2) + 48.326(PSIG^2) + 422.19(PSIG^2) + 0(PSIG^2)}$$

$$= 24.850\ PSIG$$

$$LD_{BN} = 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 518.28\ PSIG - 24.850\ PSIG - 0\ PSIG = 493.43\ PSIG$$

Unit 2

Substituting data from SPC-RP-060 (Unit 2), the TLE under seismic conditions and potential subsequent loss of non-seismic HVAC is calculated as follows:

$$\begin{aligned} TLE\ (SRSSS) = [&147.00\ (PSIG^2) + 48.326\ (PSIG^2) + 422.07\ (PSIG^2) + 0\ (PSIG^2) \\ &+ 0\ (PSIG^2) + 0\ (PSIG^2) + 0.0906\ (PSIG^2) + 493.61\ (PSIG^2) \\ &+ 0\ (PSIG^2) + 0\ (PSIG^2) + 225.00\ (PSIG^2) + 0\ (PSIG)^2 + 0\ (PSIG)^2 \\ &+ 0\ (PSIG)^2 + 0\ (PSIG)^2]^{\frac{1}{2}} = \pm 36.553\ PSIG \end{aligned}$$

$$\begin{aligned} Bias_{pos} = &\ 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG \\ &+ 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG \end{aligned}$$

$$TLE_{pos} = +36.553\ PSIG + 0\ PSIG = +36.553\ PSIG$$

$$TLE_{neg} = -36.553\ PSIG - 0\ PSIG = -36.553\ PSIG$$

The nominal trip setpoint (NTSP) for Unit 2 is calculated for a decreasing process using the following equation:

$$NTSP = AL + TLE_{pos}$$

Substituting above values,

$$NTSP = 485.00\ PSIG + 36.553\ PSIG = 521.55\ PSIG$$

The allowable value (AV) for a decreasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias) LD_{BN} = D_{BN} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Substituting above values, the allowable value for Unit 2 is calculated below.

$$LD_R = \sqrt{147.00\ (PSIG^2) + 48.326(PSIG^2) + 422.07(PSIG^2) + 0(PSIG^2)}$$

$$= 24.847\ PSIG$$

$$LD_{BN} = 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 521.55\ PSIG - 24.847\ PSIG - 0\ PSIG = 496.703\ PSIG$$

4.3 Technical Specifications

The allowable value for the *Safety Injection – Steam Line Low Pressure* is taken from Table 3.3.2-1, Function 1(e) of the Unit 1 and Unit 2 technical specifications (References 8.5.1 and 8.5.2). The same allowable value is used for both units and is shown below.

$$AV \geq 500\ PSIG$$

4.4 Calibration Procedures

The Actual Plant Setpoint (APS) and As-Found Tolerance (AFT) are taken from SP 1002A and SP 2002A (References 8.6.1 and 8.6.2). The current plant setting for the bistables is 25.15 mA with a tolerance of ±0.20 mA. Per SP 1002B.5 and SP 2002B.5 (References 8.6.4 and 8.6.5), the transmitter span is 1400 PSIG with an output of 0.1 to 0.5 VDC. The lead/lag modules convert the 0.1 to 0.5 VDC transmitter voltage output to an equivalent 10 to 50mA input to the bistable. Therefore, the current plant setting in terms of PSIG is:

$$APS\ (PSIG) = \left[\frac{25.15\ mA - 10\ mA}{50\ mA - 10\ mA}\right] 1400 = 530.25\ PSIG$$

$$AFT + (PSIG) = \left[\frac{25.35\ mA - 10\ mA}{50\ mA - 10\ mA}\right] 1400 = +537.25\ PSIG$$

$$AFT - (PSIG) = \left[\frac{24.95\ mA - 10\ mA}{50\ mA - 10\ mA}\right] 1400 = -523.25\ PSIG$$

$$APS = 530.25\ PSIG$$

$$AFT = \pm 7\ PSIG$$

5.0 ASSUMPTIONS

No assumptions were used for this Technical Specification function evaluation.

6.0 ANALYSIS

SPC-RP-059 (Reference 8.4.1) and SPC-RP-060 (Reference 8.4.2) provide different total loop errors and subsequently different nominal trip setpoints and allowable values. This attachment will analyze both Unit 1 and 2 values along with both the Rosemount 3154N and 1154 pressure transmitters.

This attachment incorporates the changes in uncertainty associated with the replacement of the original Rosemount 1154 series pressure transmitter with new Rosemount 3154N series pressure transmitter for 2PT-468. The 3154N pressure transmitter has less than 10 data points and replaced the 1154 pressure transmitter on 10/24/2015 per Work Order 502517 (Reference 8.7.1). As such, vendor data can be used to establish drift data per section 6.4.2.1 of EM 3.3.4.2 (Reference 8.2.1). The vendor drift specification will be extrapolated to a maximum calibration interval of 30 months for use in the setpoint calculations. The uncertainty associated with 1PT-468 will be based on the original Rosemount 1154 series pressure transmitters still in service.

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1, 8.3.2, and 8.3.3 using % calibrated span (%CS). To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units below, using the process span stated in section 4.2.

Rosemount Transmitter 1154GP9RC

$$DA\_Ext\_Rand_{trans} = \pm 0.225\%CS = \pm 0.225\%CS \times \frac{1400\ PSIG}{100\%CS} = \pm 3.15\ PSIG$$

$$DA\_Ext\_Bias_{trans} = +0.030\%CS = +0.030\%CS \times \frac{1400\ PSIG}{100\%CS} = +0.42\ PSIG$$

NUS Bistable DAM503-03 (mA)

$$DA\_Ext\_Rand_{bistable} = \pm 0.0697\%CS = \pm 0.0697\%CS \times \frac{1400\ PSIG}{100\%CS}$$

$$= \pm 0.9758\ PSIG$$

NUS Time Domain Module TMD500-20/00/00/00-08-08-03 (VDC)

$$DA\_Ext\_Rand_{tmd} = \pm 0.324\%CS = \pm 0.324\%CS \times \frac{1400\ PSIG}{100\%CS}$$

$$= \pm 4.536\ PSIG$$

6.2 Calculated Drift for Rosemount Transmitter 3154NG6R2F0E7

Technical Manual NX-20728-1 (Reference 8.1.2) provides the new uncertainties for accuracy (A) and drift (D_R). Range Code 5 characteristics is used when applying the 3154N transmitter manufacturer specifications.

$$Vendor\ Accuracy\ (va) = \pm 0.20\%\ of\ Calibrated\ Span\ (CS)$$

$$Vendor\ Drift\ (vd) = \pm(0.1\%\ URL + 0.1\%\ span)$$

Form 1 and Form 2 of SPC-RP-060 (Reference 8.4.2) provides the following:

$$Process\ Span\ (PS) = 0.0\ to\ 1400.0\ PSIG$$

$$Calibrated\ Span\ (CS) = 2.0\ to\ 1402.0\ PSIG$$

The accuracy and drift are calculated using the following equations:

$$A = (\text{va})\left(\frac{\text{CS}}{100\%\text{CS}}\right)$$

$$D_R = \left(\frac{\text{CI}}{\text{DT}}\right)(\text{vd})\left(\frac{\text{PS}}{\text{CS}}\right)$$

where,

$$Calibration\ Interval\ (CI) = 30\ months$$

$$Drift\ Time\ (DT) = 30\ months$$

Substituting above values,

$$A = (\pm 0.20\% CS)\left(\frac{1400\ \text{PSIG}}{100\ \%\text{CS}}\right) = \pm 2.8\ PSIG$$

$$D_R = \left(\frac{30mo.}{30mo.}\right)\left(\left(0.1\% * \left(\frac{1400\ \text{PSIG}}{100\%\text{CS}}\right)\right) + \left(0.1\% * \left(\frac{1400\ \text{PSIG}}{100\%\text{CS}}\right)\right)\right)\left(\frac{1400\ \text{PSIG}}{1400\ \text{PSIG}}\right)$$

$$= \pm 2.8\ PSIG$$

Per SPC-RP-060 (Reference 8.4.2),

$$M = \pm 10.529\ PSIG$$

$DA\_Ext\_Rand_{trans}$ is calculated as follows:

$$DA\_Ext\_Rand_{trans} = \sqrt{A^2 + {D_R}^2 + M^2}$$

Substituting above values,

$$DA\_Ext\_Rand_{trans} = \sqrt{(2.8\ PSIG)^2 + (2.8\ PSIG)^2 + (10.529\ PSIG)^2}$$

$$= 11.249\ PSIG$$

6.3 Total Loop Error (TLE)

For Unit 1, Instrument drift from the section 4.1 drift calculations for the NUS Bistables, Time Domain Modules and Rosemount 1154 Pressure Transmitter are used to replace the instrument accuracy, drift, and measurement and test equipment for an updated evaluation of the TLE. The methodology is shown below.

For Unit 2, instrument drift from the section 4.1 drift calculations for the NUS Bistables and Time Domain Modules, and the drift specification for Rosemount 3154N transmitter are used to calculate and replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the TLE. The methodology is shown below.

$$\left(DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{tmd}{}^2 + DA\_Ext\_Rand_{bistable}{}^2\right) = A + D_R + M$$

The updated TLE for Units 1 and 2 is calculated for a seismic event and potential subsequent loss of non-seismic HVAC using the following equations:

$$TLE_{pos} = TLE\ (SRSSS) + Bias_{pos}$$

where,

$$TLE\ (SRSSS) = \Big[\left(DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{tmd}{}^2 + DA\_Ext\_Rand_{bistable}{}^2\right) + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{1/2}$$

$$Bias_{pos} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{tmd} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

Unit 1

Substituting the data for Rosemount Transmitter 1154GP9RC, NUS TMD500 and NUS Bistable DAM503-03 (mA), the new TLE under a seismic event and potential subsequent loss of non-seismic HVAC condition for Unit 1 is calculated below.

$$TLE\ (SRSSS) = [((3.15\ PSIG)^2 + (4.536\ PSIG)^2 + (0.9758\ PSIG)^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.0906\ (PSIG^2) + 265.17\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 225.00\ (PSIG^2) + 0\ (PSIG)^2 + 0\ (PSIG)^2 + 0\ (PSIG)^2 + 0\ (PSIG)^2]^{\frac{1}{2}} = \pm 22.841\ PSIG$$

$$Bias_{pos} = 0.42\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = +0.42\ PSIG$$

$$TLE_{pos} = +22.841\ PSIG + 0.42\ PSIG = +23.261\ PSIG$$

<u>Unit 2</u>

Substituting the data for Rosemount Transmitter 3154NG6R2F0E7, NUS TMD500 and NUS Bistable DAM503-03 (mA), the new TLE under a seismic event and potential subsequent loss of non-seismic HVAC condition for Unit 2 is calculated below.

$$TLE\ (SRSSS) = [((11.249\ PSIG)^2 + (4.536\ PSIG)^2 + (0.9758\ PSIG)^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.0906\ (PSIG^2) + 493.61\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 225.00\ (PSIG^2) + 0\ (PSIG)^2 + 0\ (PSIG)^2 + 0\ (PSIG)^2 + 0\ (PSIG)^2]^{\frac{1}{2}} = \pm 29.441\ PSIG$$

$$Bias_{pos} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{pos} = 29.441\ PSIG + 0\ PSIG = +29.441\ PSIG$$

6.4 Nominal Trip Setpoint (NTSP)

Using the equations from Section 4.2 and the new calculated TLE value from Unit 1, the new nominal trip setpoint using the Rosemount Transmitter 1154GP9RC, NUS TMD500 and NUS Bistable DAM503-03 (mA) drift values for Unit 1 are calculated below.

$$NTSP = AL + TLE_{pos} = 485.0\ PSIG + 23.261\ PSIG = 508.261\ PSIG$$

Using the equations from Section 4.2 and the new calculated TLE value from Unit 2, the new nominal trip setpoint using the Rosemount Transmitter 3154NG6R2F0E7, NUS TMD500 and NUS Bistable DAM503-03 (mA) drift values for Unit 2 are calculated below.

$$NTSP = AL + TLE_{pos} = 485\ PSIG + 29.441\ PSIG = 514.441\ PSIG$$

6.5 Allowable Value (AV)

The allowable value for *Safety Injection - Steam Line Low Pressure* is calculated using the new NTSP and the new Loop Drift is calculated replacing the instrument accuracy, drift, and measurement and test equipment allowance for Units 1 and 2 as shown below:

$$LD_R = \sqrt{\left(DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{tmd}{}^2 + DA\_Ext\_Rand_{bistable}{}^2\right) + R_{NR}}$$

$$LD_{BN} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{tmd} + DA\_Ext\_Bias_{bistable} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Unit 1

Substituting the above values, the new allowable value for the Rosemount Transmitter 1154GP9RC, NUS TMD500 and NUS Bistable DAM503-03 (VDC) is calculated below.

$$LD_R = \sqrt{((3.15\ PSIG)^2 + (4.536\ PSIG)^2 + (0.9758\ PSIG)^2) + 0\ (PSIG^2)}$$

$$= 5.608\ PSIG$$

$$LD_{BN} = 0.42\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0.42\ PSIG$$

$$AV = 508.261\ PSIG - 5.608 - 0.42\ PSIG = 502.233\ PSIG$$

Unit 2

Substituting the above values, the new allowable value for the new Rosemount Transmitter 3154NG6R2F0E7, TMD500 and NUS Bistable DAM503-03 (VDC) is calculated below.

$$LD_R = \sqrt{((11.249\ PSIG)^2 + (4.536\ PSIG)^2 + (0.9758\ PSIG)^2) + 0\ (PSIG^2)}$$

$$= 12.168\ PSIG$$

$$LD_{BN} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 514.441\ PSIG - 12.168\ PSIG - 0\ PSIG = 502.73\ PSIG$$

6.6 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation main body Section 3.1. Using the NTSP value calculated in Section 6.4, the AFT and APS values for the setpoint margin are evaluated below:

$$Accetpance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

Using 1154 Transmitter, TMD500 and Bistable (mA) from Unit 1:

$$NTSP \leq APS - AFT$$

$$508.261\ PSIG \leq 530.25\ PSIG - 7\ PSIG$$

$$508.261\ PSIG \leq 523.25\ PSIG$$

Using 3154N Transmitter, TMD500 and Bistable (mA) from Unit 2:

$$NTSP \leq APS - AFT$$

$$514.441\ PSIG \leq 530.25\ PSIG - 7\ PSIG$$

$$514.441\ PSIG \leq 523.25\ PSIG$$

Based on the above, sufficient margin exist between the calculated Nominal Trip Setpoint and the Actual Plant Setpoint.

6.7 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation main body Section 3.2. Using the calculated AV in Section 6.5, the AV is evaluated below:

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

The AV taken from the Unit 1 and Unit 2 Technical Specifications is shown below:

$$AV_{Tech\ Spec} \geq 500\ PSIG$$

Unit 1 1154 Transmitter, TMD500 and NUS Bistable DAM503-03:

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$500\ PSIG \geq 502.233\ PSIG$$

Unit 2 3154N Transmitter, TMD500 and NUS Bistable DAM503-03:

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$500\ PSIG \geq 502.73\ PSIG$$

The Allowable Value acceptance criteria is not met for Unit 1 and Unit 2 Technical Specifications Table 3.3.2-1 Function 1(e).

7.0 CONCLUSIONS AND PLANT IMPACT

A new total loop error (TLE), nominal trip setpoint (NTSP), and allowable value (AV) were calculated using the new calculated drift values provided in drift calculations SPC-DR-037 (Reference 8.3.1), SPC-DR-015 (Reference 8.3.2) and SPC-DR-020 (Reference 8.3.3), and using the new calculated values for the Rosemount 3154N pressure transmitter.

For both Unit 1 and Unit 2:

- Sufficient margin exists between the new calculated NTSP and actual plant setting (APS).
- The new calculated AV did not meet section 6.7 acceptance criteria.

Recommendation: A Technical Specification AV ≥ to 503 PSIG to meet section 6.7 acceptance criteria is required.

8.0 REFERENCES

8.1 Industry Guidance and Design Input References

8.1.1 EPRI REPORT TR-103335, REVISION 2, "GUIDELINES FOR INSTRUMENT CALIBRATION EXTENSION/REDUCTION PROGRAMS".

8.1.2 NORTHERN STATES POWER COMPANY TECHNICAL MANUAL NUMBER NX-20728-1, REVISION 37, ROSEMOUNT 3154N

8.2 Engineering Manuals

8.2.1 EM 3.3.4.2, REVISION 1, "THE ANALYSIS OF INSTRUMENT DRIFT".

8.2.2 EM 3.3.4.1, REVISION 2, "INSTRUMENT SETPOINT/UNCERTAINTY CALCULATIONS".

8.3 Drift Calculations

8.3.1 SPC-DR-037, REVISION 0, "DRIFT ANALYSIS OF AS-FOUND/AS-LEFT DATA FOR NUS BISTABLE DAM503-03 (MA)".

8.3.2 SPC-DR-015, REVISION 0, "DRIFT ANALYSIS OF AS-FOUND/AS-LEFT DATA FOR NUS LEAD /LAG UNIT TMD500-20/00/00/00-08-08-03 (VDC)".

8.3.3 SPC-DR-020, REVISION 0, "DRIFT ANALYSIS OF AS-FOUND/AS-LEFT DATA FOR ROSEMOUNT TRANSMITTER 1154GP9 – AUX BUILDING".

8.4 Setpoint Calculations

8.4.1 SPC-RP-059, REVISION 1A, "UNIT 1 STEAMLINE LOOP A-1 LOW-LOW PRESSURE SI ACTUATION BISTABLE SETPOINT"

8.4.2 SPC-RP-060, REVISION 1, "UNIT 2 STEAMLINE LOOP A-1 LOW-LOW PRESSURE SI ACTUATION BISTABLE SETPOINT"

8.5 Technical Specifications

8.5.1 UNIT 1, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE"

8.5.2 UNIT 2, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE"

8.6 Surveillance Procedures

8.6.1 SP 1002A, REVISION 50, "ANALOG PROTECTION SYSTEM CALIBRATION"

8.6.2 SP 2002A, REVISION 51, "ANALOG PROTECTION SYSTEM CALIBRATION"

8.6.3 SP 2003, REVISION 81, "ANALOG PROTECTION FUNCTIONAL TEST"

8.6.4 SP 1002B.5, REVISION 3, "REACTOR PROTECTION AND CONTROL TRANSMITTER CALIBRATION/INSEPCTION STEAM GENERATOR PRESSURE"

8.6.5 SP 2002B.5, REVISION 3, "REACTOR PROTECTION AND CONTROL TRANSMITTER CALIBRATION/INSEPCTION STEAM GENERATOR PRESSURE"

8.7 Work Orders

8.7.1 WO# 502517, 10/24/2015

Prepared By:	Timothy Godsell	Timothy Godsell Digitally signed by Timothy Godsell DN: cn=Timothy Godsell, o=Sargent & Lundy, ou, email=timothy.a.godsell@sargentlundy.com, c=US Date: 2021.06.28 14:41:25 -05'00' (Signature)	(Date)
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1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 containment spray high-high containment pressure instrument loops. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1PC-945B	NUS INSTRUMENTS LLC	DAM503-03
1PC-946B	NUS INSTRUMENTS LLC	DAM503-03
1PC-947B	NUS INSTRUMENTS LLC	DAM503-03
1PC-948B	NUS INSTRUMENTS LLC	DAM503-03
1PC-949B	NUS INSTRUMENTS LLC	DAM503-03
1PC-950B	NUS INSTRUMENTS LLC	DAM503-03
2PC-945B	NUS INSTRUMENTS LLC	DAM503-03
2PC-946B	NUS INSTRUMENTS LLC	DAM503-03
2PC-947B	NUS INSTRUMENTS LLC	DAM503-03
2PC-948B	NUS INSTRUMENTS LLC	DAM503-03
2PC-449B	NUS INSTRUMENTS LLC	DAM503-03
2PC-450B	NUS INSTRUMENTS LLC	DAM503-03
1PT-945	ROSEMOUNT / EMERSON ELEC	1154DP6RC
1PT-946	ROSEMOUNT / EMERSON ELEC	1154DP6RC
1PT-947	ROSEMOUNT / EMERSON ELEC	1154DP6RC
1PT-948	ROSEMOUNT / EMERSON ELEC	1154DP6RC
1PT-949	ROSEMOUNT / EMERSON ELEC	1154DP6RC
1PT-950	ROSEMOUNT / EMERSON ELEC	1154DP6RC
2PT-945	ROSEMOUNT / EMERSON ELEC	1154DP6RC
2PT-946	ROSEMOUNT / EMERSON ELEC	1154DP6RC
2PT-947	ROSEMOUNT / EMERSON ELEC	1154DP6RC
2PT-948	ROSEMOUNT / EMERSON ELEC	1154DP6RC
2PT-949	ROSEMOUNT / EMERSON ELEC	1154DP6RC
2PT-950	ROSEMOUNT / EMERSON ELEC	1154DP6RC

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Containment Spray – High-High Containment Pressure functions has two channels calculated in SPC-RP-035 (Channel I, Reference 8.4.1) and SPC-RP-037 (Channel II, Reference 8.4.2). The setpoint calculations present different process spans, instrument accuracies, bistable drift, temperature effects, and loop power supply effects for each channel. The update drift values used in this attachment are compared against each set of values.

This calculation applies to all six Containment Spray – High-High Containment Pressure instrument loops for both units. Per Reference 8.7.1, all components in this evaluation are of the same make and model for both bistables and transmitters. The Unit 1 and Unit 2 Containment Spray – High-High Containment Pressure functions are calibrated with the same M&TE, configured to the same plant setpoints, and have the same as-found tolerances (References 8.6.1, 8.6.2, 8.6.3, and 8.6.4).

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-010, “Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03” (Reference 8.3.1) and SPC-DR-019, “Drift Analysis of As-Found/As-Left Data for Rosemount Transmitter 1154DP6RC – Auxiliary Building” (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-010

The NUS Bistable DAM503-03 was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%Span$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%Span$$

4.1.2 SPC-DR-019

The Rosemount Transmitter 1154DP6RC was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{trans} = \pm 0.301\ \%Span$$

$$DA\_Ext\_Bias_{trans} = \pm 0\ \%Span$$

4.2 Setpoint/Uncertainty Calculations

The containment spray high-high containment pressure setpoint is evaluated in two setpoint calculations: SPC-RP-035, “U1 Containment High High Pressure Containment Spray Actuation Bistable -2 to 30 PSIG Loop Spans” (Reference 8.4.1) and SPC-RP-037, “Containment Pressure Hi-Hi Containment Spray Actuation Bistable Setpoint” (Reference 8.4.2). Pertinent information from each calculation for this evaluation is summarized below:

Form 1 of SPC-RP-035 (Reference 8.4.1) provides the following information:

$$Process\ Span = -2\ to\ 30\ PSIG$$

$$Analytical\ Limit\ (AL) = 24\ PSIG$$

Form 1 of SPC-RP-037 (Reference 8.4.2) provides the following information:

$$Process\ Span = -4\ to\ 60\ PSIG$$

$$Analytical\ Limit\ (AL) = 24\ PSIG$$

Form 2 of SPC-RP-035 (Refence 8.4.1) and SPC-RP-037 (Reference 8.4.2) provides the following instrument output span for the transmitters:

$$Output\ Span = 0.1\ to\ 0.5\ VDC$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS)\ =\ \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{neg} = -TLE\ (SRSS)\ -\ Bias_{neg}$$

After entering the data for SPC-RP-035, the total loop error is calculated as:

$$TLE\ (SRSS) = [0.0512\ (PSIG^2) + 0.02904\ (PSIG^2) + 0.11984\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.000047334\ (PSIG^2) + 0.1581\ (PSIG^2) + 1.0\ (PSIG^2) + 0\ (PSIG^2) + 0.25\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} = \pm 1.2682\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -1.2682\ PSIG\ -\ 0\ PSIG = -1.2682\ PSIG$$

After entering the data for SPC-RP-037, the total loop error is calculated as:

$$TLE\ (SRSS) = [0.2048\ (PSIG^2) + 0.03936\ (PSIG^2) + 0.64517\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.00018934\ (PSIG^2) + 0.28558\ (PSIG^2) + 1.0\ (PSIG^2) + 0\ (PSIG^2) + 0.25\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} = \pm 1.5573\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -1.5573\ PSIG -\ 0\ PSIG = -1.5573\ PSIG$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

The allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

4.3 Technical Specifications

The allowable value for the Containment Spray – High-High Containment Pressure function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 23\ PSIG$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.3).

Containment Pressure Channel I:

$$APS = 0.4065\ VDC$$

$$AFT = \pm 0.0020\ VDC$$

Containment Pressure Channel II:

$$APS = 0.2628\ VDC$$

$$AFT = \pm 0.0020\ VDC$$

The APS for each channel is converted into process units (PSIG) in calculations SPC-RP-035 (Reference 8.4.1) and SPC-RP-037 (Reference 8.4.2):

Containment Pressure Channel I:

$$APS = 22.52\ PSIG$$

Containment Pressure Channel II:

$$APS = 22.048\ PSIG$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span for both the Containment Pressure Channel I and Channel II instruments (See Sections 4.2) below:

Containment Pressure Channel I (SPC-RP-035):

NUS Bistable DAM503-03 (VDC):

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%Span\ = \pm 0.1072\ \%Span \times \frac{32.0\ PSIG}{100\ \%Span} = 0.03430\ PSIG$$

$$DA\_Ext\_Bias_{bistable} = \pm 0.0095\ \%Span\ = \pm 0.0095\ \%Span \times \frac{32.0\ PSIG}{100\ \%Span} = 0.00304\ PSIG$$

Rosemount Transmitter 1154DP6RC:

$$DA\_Ext\_Rand_{trans} = \pm 0.301\ \%Span\ = \pm 0.301\ \%Span \times \frac{32.0\ PSIG}{100\ \%Span} = 0.09632\ PSIG$$

Containment Pressure Channel II (SPC-RP-037):

NUS Bistable DAM503-03 (VDC):

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%Span\ = \pm 0.1072\ \%Span \times \frac{64.0\ PSIG}{100\ \%Span} = 0.06861\ PSIG$$

$$DA\_Ext\_Bias_{bistable} = \pm 0.0095\ \%Span\ = \pm 0.0095\ \%Span \times \frac{64.0\ PSIG}{100\ \%Span} = 0.00608\ PSIG$$

Rosemount Transmitter 1154DP6RC:

$$DA\_Ext\_Rand_{trans} = \pm 0.301\ \%Span\ = \pm 0.301\ \%Span \times \frac{64.0\ PSIG}{100\ \%Span} = 0.19264\ PSIG$$

The as-found tolerance is provided in References 8.6.1 and 8.6.3 in VDC. Using the process span and instrument output span from Section 4.2, the tolerance is converted into PSIG below for each channel:

For Channel I:

$$AFT = \pm 0.0020\,VDC = \pm 0.0020\,VDC \times \frac{32.0\,PSIG}{0.40\,VDC} = 0.16\,PSIG$$

For Channel II:

$$AFT = \pm 0.0020\,VDC = \pm 0.0020\,VDC \times \frac{64.0\,PSIG}{0.40\,VDC} = 0.32\,PSIG$$

6.2 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

For Channel I:

$$TLE\ (SRSS) = \left[DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$TLE\ (SRSS) = [(0.09632\,PSIG)^2 + (0.03430\,PSIG)^2 + 0\,(PSIG^2) + 0\,(PSIG^2) + 0(PSIG^2) + 0.000047334\,(PSIG^2) + 0.1581\,(PSIG^2) + 1.0\,(PSIG^2) + 0\,(PSIG^2) + 0.25\,(PSIG^2) + 0\,(PSIG^2) + (0\,PSIG)^2 + (0\,PSIG)^2 + (0\,PSIG)^2]^{1/2} = \pm 1.1910\,PSIG$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans(neg)} + DA\_Ext\_Bias_{bistable(neg)} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = 0\,PSIG + 0\,PSIG + 0\,PSIG + 0\,PSIG + 0\,PSIG + 0\,PSIG + 0\,PSIG + 0\,PSIG + 0\,PSIG + 0\,PSIG + 0\,PSIG + 0\,PSIG + 0\,PSIG = 0\,PSIG$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

$$TLE_{neg} = -1.1910\,PSIG - 0\,PSIG = -1.1910\,PSIG$$

For Channel II:

$$TLE\ (SRSS) = \left[DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$TLE\ (SRSS) = [(0.19264\,PSIG)^2 + (0.06861\,PSIG)^2 + 0\,(PSIG^2) + 0\,(PSIG^2) + 0(PSIG^2) + 0.00018934\,(PSIG^2) + 0.28558\,(PSIG^2) + 1.0\,(PSIG^2) + 0\,(PSIG^2) + 0.25\,(PSIG^2) + 0\,(PSIG^2) + (0\,PSIG)^2 + (0\,PSIG)^2 + (0\,PSIG)^2]^{1/2} = \pm 1.2560\,PSIG$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans(neg)} + DA\_Ext\_Bias_{bistable(neg)} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

$$TLE_{neg} = -1.2560\ PSIG - 0\ PSIG = -1.2560\ PSIG$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

For Channel I:

$$NTSP = AL + TLE_{neg} = 24\ PSIG - 1.1910\ PSIG = 22.809\ PSIG$$

For Channel II:

$$NTSP = AL + TLE_{neg} = 24\ PSIG - 1.2560\ PSIG = 22.744\ PSIG$$

6.4 Allowable Value (AV)

The allowable value Containment Spray – High-High Containment Pressure is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (\text{Positive } Bias)\ LD_{BP} = DA\_Ext\_Bias_{trans(pos)} + DA\_Ext\_Bias_{bistable(pos)} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

For Channel I:

$$LD_R = \sqrt{(0.09632\ PSIG)^2 + (0.03430\ PSIG)^2 + 1.0\ (PSIG^2)} = 1.0052\ PSIG$$

$$LD_{BP} = 0\ PSIG + 0.00304\ PSIG + 0\ PSIG = 0.00304\ PSIG$$

$$AV = 22.809\ PSIG + 1.0052\ PSIG + 0.00304\ PSIG = 23.817\ PSIG$$

For Channel II:

$$LD_R = \sqrt{(0.19264\ PSIG)^2 + (0.06861\ PSIG)^2 + 1.0\ (PSIG^2)} = 1.0207\ PSIG$$

$$LD_{BP} = 0\ PSIG + 0.00608\ PSIG + 0\ PSIG = 0.00608\ PSIG$$

$$AV = 22.744\ \ PSIG + 1.0207\ PSIG +\ 0.00608\ PSIG = 23.771\ PSIG$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values the setpoint margin is evaluated below:

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

For Channel I:

$$NTSP \geq APS + AFT$$

$$22.809\ PSIG \geq 22.52\ PSIG + 0.16\ PSIG$$

$$22.809\ PSIG \geq 22.68\ PSIG$$

For Channel II:

$$NTSP \geq APS + AFT$$

$$22.744\ PSIG \geq 22.048\ PSIG + 0.32\ PSIG$$

$$22.744\ PSIG \geq 22.368\ PSIG$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2. The AV is evaluated below:

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

For Channel I:

$$AV_{Tech\ Spec} \leq AV_{Calc}$$

$$23\ PSIG \leq 23.817\ PSIG$$

For Channel II:

$$AV_{Tech\ Spec} \leq AV_{Calc}$$

$$23\ PSIG \leq 23.771\ PSIG$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-010 (Reference 8.3.1) and SPC-DR-019 (Reference 8.3.2), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Containment Spray – High-High Containment Pressure instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, “Guidelines for Instrument Calibration Extension/Reduction Programs”.

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, “The Analysis of Instrument Drift”.

8.2.2 EM 3.3.4.1, Revision 2, “Instrument Setpoint/Uncertainty Calculations”.

8.3 Drift Calculations:

8.3.1 SPC-DR-010, Revision 0, “Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-3 (V)”.

8.3.2 SPC-DR-019, Revision 0, “Drift Analysis of As-Found/As-Left Data for Rosemount Transmitter 1154DP6RC”.

8.4 Setpoint Calculations:

8.4.1 SPC-RP-035, Revision 0A, “U1 Containment High High Pressure Containment Spray Actuation Bistable Setpoint -2 to 30 PSIG Loop Spans”.

8.4.2 SPC-RP-037, Revision 0A, “Containment Pressure Hi-Hi Containment Spray Actuation Bistable Setpoint”.

8.5 Technical Specifications:

8.5.1 Unit 1, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE", Amendment 230.

8.5.2 Unit 2, "NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE", Amendment 218.

8.6 Surveillance Procedures:

8.6.1 SP 1002A, Revision 50, "Analog Protection System Calibration".

8.6.2 SP 1002B.8, Revision 3, "Reactor Protection and Control Transmitter Calibration/Inspection Containment Pressure".

8.6.3 SP 2002A, Revision 51, "Analog Protection System Calibration".

8.6.4 SP 2002B.8, Revision 1, "Reactor Protection and Control Transmitter Calibration/Inspection Containment Pressure".

8.7 SAP Database

8.7.1 Data Pulled from Prairie Island's SAP Database (January – February 2021).

Prepared By:	Corey Crawford	Corey R. Crawford Digitally signed by Corey R. Crawford Date: 2021.06.28 11:18:03 -04'00' (Signature)	(Date)
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1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for Units 1 and 2 Steam Line Isolation - High-High Containment Pressure instrument loops which are Engineered Safety Feature Actuation System (ESFAS) Instrumentation. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table listed which are found in Surveillance Procedures SP 1002A, SP 1002B.8, SP 2002A, and SP 2002B.8 (References 8.6.1, 8.6.2, 8.6.3, and 8.6.4) in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1PC-946A/B	NUS INSTRUMENTS LLC	DAM503-03
1PC-948A/B	NUS INSTRUMENTS LLC	DAM503-03
1PC-950A/B	NUS INSTRUMENTS LLC	DAM503-03
1PT-946	ROSEMOUNT	1154DP6RC
1PT-948	ROSEMOUNT	1154DP6RC
1PT-950	ROSEMOUNT	1154DP6RC
2PC-946A/B	NUS INSTRUMENTS LLC	DAM503-03
2PC-948A/B	NUS INSTRUMENTS LLC	DAM503-03
2PC-950A/B	NUS INSTRUMENTS LLC	DAM503-03
2PT-946	ROSEMOUNT	1154DP6RC
2PT-948	ROSEMOUNT	1154DP6RC
2PT-950	ROSEMOUNT	1154DP6RC

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

2.1 Missing Unit 2 Calculation

Per Table 1.1, the Unit 1 and 2 Containment High-High Pressure Main Steam Isolation bistables and pressure transmitters are the same manufacturers and model numbers (Reference 8.7.1), therefore this calculation applies to both Units. Per References 8.6.1 through 8.6.4, the Unit 1 and Unit 2 Containment High-High Pressure Main Steam Isolation function is calibrated with the same M&TE, which are also configured to the same actual plant setpoint and have the same as-found tolerances. After a review of schematics XH-1-569 and XH-1001-808-2 (References 8.8.1 and 8.8.2), the loop configurations for Unit 1 and 2 are the same.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-010, "Drift Analysis of As Found / As-Left Data for NUS Bistable DAM503-03 (V)" (Reference 8.3.1) and SPC-DR-019, "As-Found / As -Left Data for Rosemount Transmitter 1154DP6RC – Auxiliary Building" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculation. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-010

The NUS Bistable DAM503-03 (VDC) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%Span$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%Span$$

4.1.2 SPC-DR-019

The Rosemount Transmitter 1154DP6RC was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{trans} = \pm 0.301\ \%Calibrated\ Span$$

$$DA\_Ext\_Bias_{trans} = 0\ \%Calibrated\ Span$$

4.2 Setpoint/Uncertainty Calculations

The Steam Line Isolation - High-High Containment Pressure ESFAS setpoint is evaluated in setpoint calculation: SPC-RP-033, "U1 Containment High-High Pressure Main Steam Isolation Bistable Setpoint" (Reference 8.4.1). Pertinent information from this evaluation is summarized below:

Form 1 of SPC-RP-033 (Reference 8.4.1) provides the following information:

$$Process\ Span = -4.000\ to\ 60.000\ PSIG$$

$$Analytical\ Limit\ (AL) = 18.000\ PSIG$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-033), the total loop error is calculated as:

$$\begin{aligned} TLE\ (SRSS) = {} & [0.20480\ (PSIG^2) + 0.03936\ (PSIG^2) + 0.64517\ (PSIG^2) \\ & + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.00018934\ (PSIG^2) \\ & + 0.28558\ (PSIG^2) + 1.000\ (PSIG^2) + 0\ (PSIG^2) + 0.2500\ (PSIG^2) \\ & + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} \\ & = \pm 1.5573\ PSIG \end{aligned}$$

$$Bias_{pos} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{pos} = 1.5573\ PSIG + 0\ PSIG = 1.5573\ PSIG$$

$$TLE_{neg} = -1.5573\ PSIG - 0\ PSIG = -1.5573\ PSIG$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

$$NTSP = 18.000\ PSIG + (-1.5573)\ PSIG = 16.443\ PSIG$$

The allowable value (AV) for an increasing process is determined using the following equations below. The negative bias equations are not utilized for an increasing process.

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{0.20480\ (PSIG^2) + 0.03936\ (PSIG^2) + 0.64517(PSIG^2) + 1.0000\ (PSIG^2)} = 1.3745\ PSIG$$

$$LD_{BP} = 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$AV = 16.4427\ PSIG + 1.3745\ PSIG + 0\ PSIG = 17.817\ PSIG$$

4.3 Technical Specifications

The allowable value for the Steam Line Isolation – High-High Containment Pressure from Table 3.3.2-1, Function 4c is taken from the technical specification for Units 1 and 2 (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 17.0\ PSIG$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.3).

$$APS = 0.2252\ VDC$$

$$AFT = \pm 0.002\ VDC$$

To interface with the equations, the APS and AFT values are converted into process units using the input span taken from Form 2 of SPC-RP-033 (Reference 8.4.1).

$$Input\ Span\ of\ Bistables = 0.1000\ to\ 0.5000\ VDC$$

$$APS = 0.2252\ VDC = \left(\frac{(0.2252 - 0.1000)VDC}{0.4000\ VDC} \times 64.0\ PSIG\right) + (-4.0\ PSIG) = 16.0320\ PSIG$$

$$AFT = \frac{0.002\ VDC}{0.4000\ VDC} \times 64.0\ PSIG = 0.320\ PSIG$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent (%) span. After examining SPC-DR-010 and SPC-DR-019, percent span is equal to percent calibrated span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below:

NUS Bistable DAM503-03 (VDC):

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%Span = \pm 0.1072\ \%Span \times \frac{64.0\ PSIG}{100\ \%Span} = \pm 0.0686\ PSIG$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%Span = +0.0095\ \%Span \times \frac{64.0\ PSIG}{100\ \%Span} = +0.0061\ PSIG$$

Rosemount Transmitter: 1154DP6RC

$$DA\_Ext\_Rand_{trans} = \pm 0.301\ \%Calibrated\ Span = \pm 0.301\ \%Calibrated\ Span \times \frac{64.0\ PSIG}{100\ \%Span} = \pm 0.193\ PSIG$$

$$DA\_Ext\_Bias_{trans} = 0\ \%Calibrated\ Span = 0\ \%Calibrated\ Span \times \frac{64.0\ PSIG}{100\ \%Span} = 0\ PSIG$$

6.2 Total Loop Error (TLE)

This attachment uses the Unit 1 data from SPC-RP-033 (Reference 8.4.1) which calculates the total loop error for both units, since Unit 2 setpoint calculation does not exist. Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$(DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2) = A + D_R + M$$

New total loop error (TLE) under seismic event and potential loss of non-seismic HVAC for Units 1 and 2 is calculated using the following equations:

$$TLE\ (SRSS) = \left[DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$TLE\ (SRSS) = [\ (0.193\ PSIG)^2 + \ (0.0686\ PSIG)^2 + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0.00018934\ (PSIG^2) + 0.28558\ (PSIG^2) + 1.000\ (PSIG^2) + 0\ (PSIG^2) + 0.2500\ (PSIG^2) + 0\ (PSIG^2) + (0\ PSIG)^2 + (0\ PSIG)^2 + (0\ PSIG)^2]^{1/2} = \pm 1.2561\ PSIG$$

$$Bias_{pos} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ PSIG + 0.0061\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0.0061\ PSIG$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + \ 0\ PSIG = 0\ PSIG$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLE_{pos} = 1.2561\ PSIG + 0.0061\ PSIG = 1.2622\ PSIG$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

$$TLE_{neg} = -1.2561\ PSIG - 0\ PSIG = -1.2561\ PSIG$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from Section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE_{neg}$$

$$18.000\ PSIG + (-1.2561)\ PSIG = \ 16.7439\ PSIG$$

6.4 Allowable Value (AV)

The allowable value for Steam Line Isolation – High-High Containment Pressure is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{(0.193\ PSIG)^2 + (0.0686\ PSIG)^2 + 1.000\ (PSIG^2)} = 1.0208 PSIG$$

$$LD_{BP} = 0\ PSIG\ + 0.0061\ PSIG + 0\ PSIG = 0.0061\ PSIG$$

$$AV = 16.7439\ PSIG + 1.0208\ PSIG + 0.0061\ PSIG = 17.7708\ PSIG$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values the setpoint margin is evaluated below:

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$NTSP \geq APS + AFT$$

$$16.7439\ PSIG \geq 16.0320\ PSIG + 0.320\ PSIG$$

$$16.7439\ PSIG \geq 16.3520\ PSIG$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

The AV taken from the Unit 1 and Unit 2 Technical Specifications is shown below:

$$AV_{Tech\ Spec} \leq AV_{Calc}$$

$$17.0\ PSIG \leq 17.7708\ PSIG$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-010 (Reference 8.3.1) and SPC-DR-019 (Reference 8.3.2), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Steam Line Isolation – High-High Containment Pressure instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals**:**

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-010, Revision 0, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (V)".

8.3.2 SPC-DR-019, Revision 0, "As-Found / As -Left Data for Rosemount Transmitter 1154DP6RC– Auxiliary Building".

8.4 Setpoint Calculation:

8.4.1 SPC-RP-033, Revision 0, "U1 Containment High-High Pressure Main Steam Line Isolation Bistable Setpoint".

8.5 Technical Specifications:

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42) Amendment 230.

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60) Amendment 218.

8.6 Surveillance Procedures:

8.6.1 Surveillance Procedure SP 1002A, Rev. 50, "Analog Protection System Calibration".

8.6.2 Surveillance Procedure SP 1002B.8, Rev. 3, "Reactor Protection and Control Transmitter Calibration/Inspection Steam Containment Pressure".

8.6.3 Surveillance Procedure SP 2002A, Rev. 51,"Analog Protection System Calibration".

8.6.4 Surveillance Procedure SP 2002B.8, Rev. 1, "Reactor Protection and Control Transmitter Calibration/Inspection Containment Pressure".

8.7 SAP Database:

8.7.1 Instrument Data from Prairie Island's SAP Database (January – February 2021).

8.8 Schematics:

8.8.1 XH-1-569, Rev. 77, "Interconnection Wiring Diagram Rack 1W2 Reactor Protection System"

8.8.2 XH-1001-808-2, Rev. 77, "Interconnection Wiring Diagram Rack 2W2 Reactor Protection System"

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Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 High Steam Flow instruments which perform the Engineered Safety Feature Actuation System (ESFAS) function of steam line isolation. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1FC-464A/B	NUS INSTRUMENTS	DAM503-03
1FC-465A/B	NUS INSTRUMENTS	DAM503-03
1FC-474A/B	NUS INSTRUMENTS	DAM503-03
1FC-475A/B	NUS INSTRUMENTS	DAM503-03
1FT-464	ROSEMOUNT	3154ND4R
1FT-465	ROSEMOUNT	3154ND4R
1FT-474	ROSEMOUNT	3154ND4R
1FT-475	ROSEMOUNT	3154ND4R
2FC-464A/B	NUS INSTRUMENTS	DAM503-03
2FC-465A/B	NUS INSTRUMENTS	DAM503-03
2FC-474A/B	NUS INSTRUMENTS	DAM503-03
2FC-475A/B	NUS INSTRUMENTS	DAM503-03
2FT-464	ROSEMOUNT	3154ND4R
2FT-465	ROSEMOUNT	3154ND4R
2FT-474	ROSEMOUNT	3154ND4R
2FT-475	ROSEMOUNT	3154ND4R

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 1 and 2 setpoint calculations SPC-RP-055 (Reference 8.4.1) and SPC-RP-056 (Reference 8.4.2) provide different values for the process span and resulting values calculated using the process span. Because of this, the design inputs in Section 4.0 and analysis in Section 6.0 are given separately for setpoint calculations SPC-RP-055 (Reference 8.4.1) and SPC-RP-056 (Reference 8.4.2).

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-010, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (V)" (Reference 8.3.1) and SPC-DR-023, "As-Found/As-Left Data for Rosemount Transmitter 3154ND4R" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-010

The NUS Bistable DAM503-03 (VDC) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%Span$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%Span$$

4.1.2 SPC-DR-023

The Rosemount Transmitter 3154ND4R was evaluated and the following values were calculated for the Unit 1 transmitters:

$$DA\_Ext\_Rand_{trans} = \pm 20.089\ INWC$$

$$DA\_Ext\_Bias_{trans} = 0\ INWC$$

The following values were calculated for the Unit 2 transmitters:

$$DA\_Ext\_Rand_{trans} = \pm 16.545\ INWC$$

$$DA\_Ext\_Bias_{trans} = 0\ INWC$$

4.2 Setpoint/Uncertainty Calculations

The steam line isolation high flow ESFAS setpoint is evaluated in two setpoint calculations: SPC-RP-055, "UNIT 1 MAIN STEAM HIGH FLOW SETPOINT – MSIV CLOSURE LOGIC INPUT" (Reference 8.4.1) and SPC-RP-056, "Unit 2 Main Steam High Flow Setpoint – MSIV Closure Logic Input" (Reference 8.4.2). Pertinent information from each calculation for this evaluation is summarized below:

Form 1 of SPC-RP-055 (Reference 8.4.1) provides the following information for Unit 1:

$$Process\ Span = 0\ to\ 1413.1\ INWC$$

$$Analytical\ Limit\ (AL) = 64.148\ INWC$$

Form 1 of SPC-RP-056 (Reference 8.4.2) provides the following information for Unit 2:

$$Process\ Span = 0\ to\ 1455.8\ INWC$$

$$Analytical\ Limit\ (AL) = 59.586\ INWC$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS)\ =\ \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

Unit 1 Total Loop Error:

After entering the data for Unit 1 (SPC-RP-055), the total loop error is calculated as:

$$TLE\ (SRSS) = [99.200\ (INWC^2) + 101.293\ (INWC^2) + 365.51\ (INWC^2) + 0\ (INWC^2) + 4.5886\ (INWC^2) + 0.53044\ (INWC^2) + 0.09230\ (INWC^2) + 182.65\ (INWC^2) + 0\ (INWC^2) + 0\ (INWC^2) + 621.85\ (INWC^2) + 0\ (INWC^2) + (26.298\ INWC)^2 + (0\ INWC)^2 + (14.131\ INWC)^2]^{\frac{1}{2}} = \pm 47.613\ INWC$$

$$Bias_{pos} = 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC = 0\ INWC$$

$$Bias_{neg} = 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC - 34.056\ INWC + 0\ INWC + 19.995\ INWC = -14.061\ INWC$$

$$TLE_{pos} = 47.613\ INWC + 0\ INWC = 47.613\ INWC$$

$$TLE_{neg} = -47.613\ INWC + 14.061\ INWC = -33.552\ INWC$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

$$NTSP = 64.148\ INWC - 33.552\ INWC = 30.596\ INWC$$

The allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{Bp} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{99.200\ (INWC^2) + 101.293\ (INWC^2) + 365.51\ (INWC^2) + 0\ (INWC^2)} = 23.791\ INWC$$

$$LD_{BP} = 0\ INWC + 0\ INWC = 0\ INWC$$

$$AV = 30.596\ INWC + 23.791\ INWC + 0\ INWC = 54.387\ INWC$$

Unit 2 Total Loop Error:

After entering the data for Unit 2 (SPC-RP-056), the total loop error is calculated as:

$$TLE\ (SRSS) = [105.03\ (INWC^2) + 68.263\ (INWC^2) + 238.35\ (INWC^2) + 0\ (INWC^2) + 3.6001\ (INWC^2) + 0.44108\ (INWC^2) + 0.09797\ (INWC^2) + 83.413\ (INWC^2) + 0\ (INWC^2) + 0\ (INWC^2) + 622.74\ (INWC^2) + 0\ (INWC^2) + (22.230\ INWC)^2 + (0\ INWC)^2 + (0\ INWC)^2]^{\frac{1}{2}} = \pm 40.201\ INWC$$

$$Bias_{pos} = 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC = 0\ INWC$$

$$Bias_{neg} = 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC - 60.925\ INWC + 56.776\ INWC = -4.149\ INWC$$

$$TLE_{pos} = 40.201\ INWC + 0\ INWC = 40.201\ INWC$$

$$TLE_{neg} = -40.201\ INWC + 4.149\ INWC = -36.052\ INWC$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

$$NTSP = 59.586\ INWC - 36.052\ INWC = 23.534\ INWC$$

The allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{Bp} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{105.03\ (INWC^2) + 68.263\ (INWC^2) + 238.35\ (INWC^2) + 0\ (INWC^2)} = 20.289\ INWC$$

$$LD_{BP} = 0\ INWC + 0\ INWC = 0\ INWC$$

$$AV = 23.534\ INWC + 20.289\ INWC + 0\ INWC = 43.823\ INWC$$

4.3 Technical Specifications

The allowable value for the Steam Flow - High from Table 3.3.2-1, Function 4d is taken from the technical specification for Units 1 and 2 (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 9.18E5\,\frac{lb}{hr}\,at\ 1005\ psig$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.2).

$$APS = 0.1051\ VDC$$

$$AFT = \pm 0.0020\ VDC$$

Unit 1 Actual Plant Setting and As Found Tolerance:

To interface with the equations, the APS and AFT values are converted into process units using the input span taken from Form 1 of SPC-RP-055 (Reference 8.4.1):

$$Input\ Span\ of\ Bistables = 0.1000\ to\ 0.5000\ VDC$$

$$APS = 0.1051\ VDC = \frac{(0.1051 - 0.1000)\ VDC}{(0.5000 - 0.1000)\ VDC} \times 1413.1\ INWC = 18.017\ INWC$$

$$AFT = \frac{0.002\ VDC}{(0.5000 - 0.1000)\ VDC} \times 1413.1\ INWC = 7.066\ INWC$$

Unit 2 Actual Plant Setting and As Found Tolerance:

To interface with the equations, the APS and AFT values are converted into process units using the input span taken from Form 1 of SPC-RP-056 (Reference 8.4.2):

$$Input\ Span\ of\ Bistables = 0.1000\ to\ 0.5000\ VDC$$

$$APS = 0.1051\,VDC = \frac{(0.1051 - 0.1000)\,VDC}{(0.5000 - 0.1000)\,VDC} \times 1455.8\,INWC = 18.561\,INWC$$

$$AFT = \frac{0.002\,VDC}{(0.5000 - 0.1000)\,VDC} \times 1455.8\,INWC = 7.279\,INWC$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for the NUS bistables was calculated in Reference 8.3.1 using percent (%) span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below. Because the manufacturer specifications for the Rosemount transmitters are conversative with respect to the observed drift values, the manufacturer drift computation in Section 7.2.1 of Reference 8.3.2 is used. The NUS bistable drift data is converted for Unit 1 and Unit 2 separately, as they have different process spans.

Unit 1 NUS Bistable DAM503-03 (VDC):

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\,\%Span = \pm 0.1072\,\%Span \times \frac{1413.1\,INWC}{100\,\%Span} = \pm 1.515\,INWC$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\,\%Span = +0.0095\,\%Span \times \frac{1413.1\,INWC}{100\,\%Span} = +0.134\,INWC$$

Unit 2 NUS Bistable DAM503-03 (VDC):

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\,\%Span = \pm 0.1072\,\%Span \times \frac{1455.8\,INWC}{100\,\%Span} = \pm 1.561\,INWC$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\,\%Span = +0.0095\,\%Span \times \frac{1455.8\,INWC}{100\,\%Span} = +0.138\,INWC$$

6.2 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$(DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2) = A + D_R + M$$

Unit 1 Total Loop Error:

New total loop error (TLE) under seismic event and potential loss of non-seismic HVAC for Unit 1 is calculated using the following equations:

$$TLE\ (SRSS) = \left[DA\_Ext\_Rand_{trans}{}^{2} + DA\_Ext\_Rand_{bistable}{}^{2} + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^{2} + PMA_{NR}{}^{2} + PC_{NR}{}^{2}\right]^{1/2}$$

$$TLE\ (SRSS) = [(20.089\ INWC)^2 + (1.515\ INWC)^2 + 0\ (INWC^2) + 4.5886(INWC^2) + 0.53044\ (INWC^2) + 0.09230\ (INWC^2) + 182.65\ (INWC^2) + 0\ (INWC^2) + 0\ (INWC^2) + 621.85\ (INWC^2) + 0\ (INWC^2) + (26.298\ INWC)^2 + (0\ INWC)^2 + (14.131\ INWC)^2]^{\frac{1}{2}} = \pm 45.900\ INWC$$

$$Bias_{pos} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ INWC + 0.134\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0.\ INWC + 0\ INWC = 0.134\ INWC$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = +0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC - 34.056\ INWC + 19.995\ INWC = -14.061\ INWC$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

$$TLE_{neg} = -45.900\ INWC + 14.061\ INWC = -31.839\ INWC$$

Unit 2 Total Loop Error:

New total loop error (TLE) under seismic event and potential loss of non-seismic HVAC for Unit 2 is calculated using the following equations:

$$TLE\ (SRSS) = \left[DA\_Ext\_Rand_{trans}{}^{2} + DA\_Ext\_Rand_{bistable}{}^{2} + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^{2} + PMA_{NR}{}^{2} + PC_{NR}{}^{2}\right]^{1/2}$$

$$TLE\ (SRSS) = [(16.545\ INWC)^2 + (1.561\ INWC)^2 + 0\ (INWC^2) + 3.6001(INWC^2) + 0.44108\ (INWC^2) + 0.09797\ (INWC^2) + 83.413\ (INWC^2) + 0\ (INWC^2) + 0\ (INWC^2) + 622.74\ (INWC^2) + 0\ (INWC^2) + (22.230\ INWC)^2 + (0\ INWC)^2 + (0\ INWC)^2]^{\frac{1}{2}} = \pm 38.479\ INWC$$

$$Bias_{pos} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ INWC + 0.138\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0.\ INWC + 0\ INWC = 0.138\ INWC$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = +0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC - 60.925\ INWC + 56.776\ INWC = -4.149\ INWC$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

$$TLE_{neg} = -38.479\ INWC + 4.149\ INWC = -34.330\ INWC$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

Unit 1 Nominal Trip Setpoint:

$$NTSP = AL + TLE_{neg} = 64.148\ INWC - 31.839\ INWC = 32.309\ INWC$$

Unit 2 Nominal Trip Setpoint:

$$NTSP = AL + TLE_{neg} = 59.586\ INWC - 34.330\ INWC = 25.256\ INWC$$

6.4 Allowable Value (AV)

The allowable value for Steam Flow – High is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

Unit 1 Allowable Value:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{(20.089\ INWC)^2 + (1.515\ INWC)^2 + 0\ (INWC^2)} = 20.146\ INWC$$

$$LD_{BP} = 0\ INWC + 0.134\ INWC + 0\ INWC = 0.134\ INWC$$

$$AV = 32.309\ INWC + 20.146\ INWC + 0.134\ INWC = 52.589\ INWC$$

Unit 2 Allowable Value:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{(16.545\ INWC)^2 + (1.561\ INWC)^2 + 0\ (INWC^2)} = 16.618\ INWC$$

$$LD_{BP} = 0\ INWC + 0.138\ INWC + 0\ INWC = 0.138\ INWC$$

$$AV = 25.256\ INWC + 16.618\ INWC + 0.138\ INWC = 42.012\ INWC$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values the setpoint margin is evaluated below:

Unit 1 Setpoint Margin:

$$Acceptance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$32.309\ INWC > 18.017\ INWC + 7.066\ INWC$$

$$32.309\ INWC > 25.083\ INWC$$

Because the NTSP is greater than the sum of APS and AFT, the setpoint margin acceptance criteria is passed for the Unit 1 instruments.

Unit 2 Setpoint Margin:

$$Acceptance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$25.256\ INWC \ngeq 18.561\ INWC + 7.279\ INWC$$

$$25.256\ INWC \ngeq 25.840\ INWC$$

Sufficient margin does not exist between the calculated NTSP and the APS. Per the Summary Setpoint Calculation Main Body, the discretionary margin can be reduced to obtain acceptable setpoint margins. For the Steam Line Isolation High Steam Flow function, the discretionary margin will be reduced from the AFT value of 7.279 INWC to 6.695 INWC. The reduced margin is shown below:

$$25.256\ INWC \geq 18.561\ INWC + 6.695\ INWC$$

$$25.256\ INWC \geq 25.256\ INWC$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2. The AV calculated in Section 6.4 is converted to $\frac{lb}{hr}\, at\ 1005\ psig$, per the conversion formula from Attachment 1 of SPC-DR-055 (Reference 8.4.1) and SPC-DR-056 (Reference 8.4.2).

Unit 1 Allowable Value:

$$AVflow = \sqrt{\frac{AVdp}{StmDP\_mxOut}} * \frac{Alya}{StmFlowya_{mxIn}} * StmFlow\_mxIn * \sqrt{\frac{p1020}{p750}}$$

$$52.589\ INWC = \sqrt{\frac{52.589\ INWC}{1413.1\ INWC}} * \frac{0.953}{0.954} * 4470000\,\frac{lb}{hr} * \sqrt{\frac{2.29}{1.64}}$$

$$= 1.018E6\,\frac{lb}{hr}\, at\ 1005\ psig$$

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \le AV_{Calc}$$

The AV taken from the Unit 1 and Unit 2 Technical Specifications is shown below:

$$AV_{Tech\ Spec} \le AV_{Calc}$$

$$9.18E5\,\frac{lb}{hr}\, at\ 1005\ psig \ \le 1.018E6\,\frac{lb}{hr}\, at\ 1005\ psig$$

Because the calculation Allowable Value is greater than the Allowable Value in the tech spec, the allowable value acceptance criteria is passed for Unit 1.

Unit 2 Allowable Value:

$$AVflow = \sqrt{\frac{AVdp}{StmDP\_mxOut}} * \frac{Alya}{StmFlowya_{mxIn}} * StmFlow\_mxIn * \sqrt{\frac{p1020}{p750}}$$

$$42.012\ INWC = \sqrt{\frac{42.012\ INWC}{1451.9\ INWC}} * \frac{0.999}{0.974} * 4470000\,\frac{lb}{hr} * \sqrt{\frac{2.29}{1.64}}$$

$$= 9.216E5\,\frac{lb}{hr}\, at\ 1005\ psig$$

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \le AV_{Calc}$$

The AV taken from the Unit 1 and Unit 2 Technical Specifications is shown below:

$$AV_{Tech\ Spec} \le AV_{Calc}$$

$$9.18E5\frac{lb}{hr}at\ 1005\ psig\ \leq 9.216E5\frac{lb}{hr}at\ 1005\ psig$$

Because the calculation Allowable Value is greater than the Allowable Value in the tech spec, the allowable value acceptance criteria is passed for Unit 2.

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-010 (Reference 8.3.1) and SPC-DR-023 (Reference 8.3.2), both the allowable value acceptance criteria and the setpoint margin acceptance criteria are passed for Unit 1. Therefore, the calibration interval for the Unit 1 Steam Line Isolation flow instruments can be extended from 24 months to 30 months.

For Unit 2, the allowable value acceptance criteria is passed but the setpoint margin acceptance criteria does not pass. After reducing the discretionary margin, the updated calculated allowable value and setpoint were found to be acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Unit 2 Steam Line Isolation High Steam Flow instruments can be extended to 30 months without impact to the subject setpoint and allowable value, provided the existing AFT is reduced as indicated in Section 6.5.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals**:**

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-010, Revision 0, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (V)".

8.3.2 SPC-DR-023, Revision 1, "As-Found/As-Left Data for Rosemount Transmitter 3154ND4R".

8.4 Setpoint Calculations:

8.4.1 SPC-RP-055, Revision 2C, "UNIT 1 MAIN STEAM HIGH FLOW SETPOINT – MSIV CLOSURE LOGIC INPUT".

8.4.2 SPC-RP-056, Revision 0A, "Unit 2 Main Steam High Flow Setpoint – MSIV Closure Logic Input".

8.5 Technical Specifications:

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42) Amendment 230.

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60) Amendment 218.

8.6 Surveillance Procedures:

8.6.1 Surveillance Procedure SP 1002A, Rev. 50, "Analog Protection System Calibration".

8.6.2 Surveillance Procedure SP 2002A, Rev. 51, "Analog Protection System Calibration".

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Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Steam Line Isolation function of the Engineered Safety Feature Actuation System (ESFAS). This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1TC-401A/D	NUS	DAM503-03
1TC-402A/D	NUS	DAM503-03
1TC-403A/D	NUS	DAM503-03
1TC-404A/D	NUS	DAM503-03
2TC-401A/D	NUS	DAM503-03
2TC-402A/D	NUS	DAM503-03
2TC-403A/D	NUS	DAM503-03
2TC-404A/D	NUS	DAM503-03
1TT-401A	NUS	RTL501-3/13 C-011
1TT-401B	NUS	RTL501-3/13 C-011
1TT-402A	NUS	RTL501-3/13 C-011
1TT-402B	NUS	RTL501-3/13 C-011
1TT-403A	NUS	RTL501-3/13 C-011
1TT-403B	NUS	RTL501-3/13 C-011
1TT-404A	NUS	RTL501-3/13 C-011
1TT-404B	NUS	RTL501-3/13 C-011
2TT-401A	NUS	RTL501-3/13 C-011
2TT-401B	NUS	RTL501-3/13 C-011
2TT-402A	NUS	RTL501-3/13 C-011
2TT-402B	NUS	RTL501-3/13 C-011
2TT-403A	NUS	RTL501-3/13 C-011
2TT-403B	NUS	RTL501-3/13 C-011
2TT-404A	NUS	RTL501-3/13 C-011
2TT-404B	NUS	RTL501-3/13 C-011
1TM-401BB	NUS	TMD500-20/00/00/00-08-08-03
1TM-402BB	NUS	TMD500-20/00/00/00-08-08-03
1TM-403BB	NUS	TMD500-20/00/00/00-08-08-03
1TM-404BB	NUS	TMD500-20/00/00/00-08-08-03
2TM-401BB	NUS	TMD500-20/00/00/00-08-08-03
2TM-402BB	NUS	TMD500-20/00/00/00-08-08-03
2TM-403BB	NUS	TMD500-20/00/00/00-08-08-03
2TM-404BB	NUS	TMD500-20/00/00/00-08-08-03
1TE-401A	RDF	21450

1TE-401B	RDF	21450
1TE-402A	RDF	21450
1TE-402B	RDF	21450
1TE-403A	RDF	21450
1TE-403B	RDF	21450
1TE-404A	RDF	21450
1TE-404B	RDF	21450
2TE-401A	ULTRA ELECTRONICS, NSPI	N9355E-2A-20
2TE-401B	ULTRA ELECTRONICS, NSPI	N9355E-2A-20
2TE-402A	ULTRA ELECTRONICS, NSPI	N9355E-2A-20
2TE-402B	ULTRA ELECTRONICS, NSPI	N9355E-2A-20
2TE-403A	ULTRA ELECTRONICS, NSPI	N9355E-2A-20
2TE-403B	ULTRA ELECTRONICS, NSPI	N9355E-2A-20
2TE-404A	ULTRA ELECTRONICS, NSPI	N9355E-2A-20
2TE-404B	ULTRA ELECTRONICS, NSPI	N9355E-2A-20

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The NTSP and AV values are calculated separately for Units 1 and 2.

Assumption 6 in SPC-RC-077 (Reference 8.4.1) states that a -0.5 DEG F fixed biased negative error of known magnitude is assumed for any temperature differences between the RCS and the RTD bypass loops. For added conservatism, the fixed biased negative error was not utilized in the setpoint calculations. In this attachment, this conservatism will be reduced so that the allowable value acceptance criterion for Unit 1 can be met. An identical assumption is also in the Unit 2 calculation (Assumption 9 in SPC-RC-078, Rev. 0A, Reference 8.4.2), but the fixed biased negative error will not be applied to Unit 2 until a minor revision is developed.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-012, "Drift Analysis of As-Found / As-Left Data for NUS R/V Converter RTL501" (Reference 8.3.1), SPC-DR-016, "Drift Analysis of As-Found /As -Left Data for NUS Lead /Lag Unit TMD500-20/00/00/00-08-08-03 IDS D-009" (Reference 8.3.2), and SPC-DR-037, "Drift Analysis of As-Found / As-Left Data for NUS Bistable DAM503-03 (mA)" (Reference 8.3.3). These three calculations establish the instrument drift of the instruments used in the setpoint calculations. The drift for the RTDs, however, is the value in Section 5.2.2 of SPC-RP-078 Rev. 0A (Reference 8.4.2). The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-012

The NUS Converter RTL501 was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{Converter} = \pm 0.201\ \%\ calibrated\ span\ (95\%/95\%\ Factor)$$

$$DA\_Ext\_Bias_{Converter} = \pm 0\ \%\ calibrated\ span\ (95\%/95\%\ Factor)$$

4.1.2 SPC-DR-016

The NUS Lead/Lag Unit TMD500 was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{LeadLag} = \pm 0.367\ \%\ calibrated\ span\ (95\%/95\%\ Factor)$$

$$DA\_Ext\_Bias_{LeadLag} = +0.080\ \%\ calibrated\ span\ (95\%/95\%\ Factor)$$

4.1.3 SPC-DR-037

The NUS Bistable DAM503-03 was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.0697\ \%\ span\ (95\%/95\%\ Factor)$$

$$DA\_Ext\_Bias_{bistable} = \pm 0\ \%\ span\ (95\%/95\%\ Factor)$$

4.2 Setpoint/Uncertainty Calculations

The Steam Line Isolation – Coincident with Low-Low Tavg engineered safety function setpoint is evaluated in two setpoint calculations: SPC-RP-077, "U1 RCS Low-Low Tavg Bistable Setpoint – Input to MSIV" (Reference 8.4.1) and SPC-RP-078, "Unit 2 RCS Low-Low Tavg Bistable Setpoint – Input to MSIV" (Reference 8.4.2). Pertinent information from each calculation for this evaluation is summarized below:

Form 1 of SPC-RP-077 (Reference 8.4.1) and SPC-RP-078 (Reference 8.4.2) provides the following information:

$$Process\ Span = 520\ to\ 620\ DEG\ F$$

Unit 1: $Analytical\ Limit\ (AL) = 535\ DEG\ F$

Unit 2: $Analytical\ Limit\ (AL) = 530\ DEG\ F$

Section 3.6 of SPC-RC-077, Rev. 1 (Reference 8.4.1) discusses a fixed biased negative error that was not numerically applied to the calculation of loop error to be conservative. As described in Section 2.0, this value will be added to the $TLES_{pos}$ value below to reduce conservatism and retrieve extra margin.

$$\text{Fixed Biased Negative Error} = -0.5\ DEG\ F$$

Total loop error for a seismic event and potential subsequent loss of non-seismic HVAC is calculated using the following equations:

$$TLES\ (SRSSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$TLES_{pos} = TLES\ (SRSSS) + Bias_{pos}$$

After entering the data for Unit 1 (SPC-RP-077), the total loop error is calculated as:

$$TLES\ (SRSSS) = [0.76778\ (DEG\ F^2) + 0.03868\ (DEG\ F^2) + 1.1893\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 1.8078\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + (0\ DEG\ F^2\ ) + (0\ DEG\ F)^2 + (0\ DEG\ F)^2]^{\frac{1}{2}} = \pm 1.9503\ DEG\ F$$

$$Bias_{pos} = 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F = 0\ DEG\ F$$

$$TLES_{pos} = 1.9503\ DEG\ F + 0\ DEG\ F = 1.9503\ DEG\ F$$

After entering the data for Unit 2 (SPC-RP-078), the total loop error is calculated as:

$$TLES\ (SRSSS) = [0.76778\ (DEG\ F^2) + 0.14972\ (DEG\ F^2) + 1.1794\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 1.4643\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + (0\ DEG\ F)^2 + (0\ DEG\ F)^2 + (0\ DEG\ F)^2]^{\frac{1}{2}} = \pm 1.8871\ DEG\ F$$

$$Bias_{pos} = 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F = 0\ DEG\ F$$

$$TLE_{pos} = 1.8871\ DEG\ F + 0\ DEG\ F = 1.8871\ DEG\ F$$

The nominal trip setpoint (NTSP) is calculated for a decreasing process using the following equation:

$$NTSP = AL + TLE_{pos}$$

The allowable value (AV) for a decreasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = D_{BN} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

4.3 Technical Specifications

The allowable value for the Steam Line Isolation High Steam Flow is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 536\ DEG\ F$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.2).

$$APS = 18.20\ mA_{DC}$$

$$AFT = \pm 0.2\ mA_{DC}$$

To interface with the equations, the APS and AFT values are converted into process units using the input span taken from Surveillance Procedures 1002A and 2002A (Reference 8.6.1 and 8.6.2).

$$Input\ Span\ of\ Bistables = 10\ mA_{DC}\ to\ 50\ mA_{DC}$$

$$APS = 18.20\ mA_{DC} \times \left(\frac{(18.20 - 10.00)\ mA_{DC}}{40.00\ mA_{DC}} \times 100\ DEG\ F\right) + 520\ DEG\ F = 540.5\ DEG\ F$$

$$AFT = \frac{0.2\ mA_{DC}}{40.00\ mA_{DC}} \times 100\ DEG\ F = 0.5\ DEG\ F$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1, 8.3.2, and 8.3.3 using percent calibrated span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Sections 4.2) below.

NUS Converter RTL501:

$$DA\_Ext\_Rand_{Converter} = \pm 0.201\ \%Span = \pm 0.201\ \%Span \times \frac{150\ DEG\ F}{100\ \%Span} = 0.3015\ DEG\ F$$

NUS Lead/Lag Unit TMD500:

$$DA\_Ext\_Rand_{LeadLag} = \pm 0.367\ \%\ Span = \pm 0.367\ \%\ Span \times \frac{100\ DEG\ F}{100\ \%Span} = 0.367\ DEG\ F$$

$$DA\_Ext\_Bias_{LeadLag} = +0.080\ \%\ Span = +0.080\ \%\ Span \times \frac{100\ DEG\ F}{100\ \%Span} = 0.080\ DEG\ F$$

NUS Bistable DAM503-03:

$$DA\_Ext\_Rand_{Bistable} = \pm 0.0697\ \%Span \times \frac{100\ DEG\ F}{100\ \%Span} = 0.0697\ DEG\ F$$

6.2 Calculated Uncertainty for Loop RTDs

6.2.1 Unit 1 RTD Uncertainty

Section 5.2.1 of SPC-RC-077, Rev. 1A (Reference 8.4.1) provides the 30-month-Extrapolated Vendor Drift, Accuracy, and Instrument M&TE for the Unit 1 RTD devices.

$$d = \pm 0\ DEG\ F$$

$$a = \pm 0.1333\ DEG\ F$$

$$m = \pm 0\ DEG\ F$$

Calculating the $Uncertainty\_Ext\_Rand_{RTD}$ value for Unit 1 is as follows:

$$Uncertainty\_Ext\_Rand_{RTD1} = \sqrt{a^2 + d^2 + m^2}$$

$$Uncertainty\_Ext\_Rand_{RTD1} = \sqrt{(0.1333\ DEG\ F)^2 + (0\ DEG\ F)^2 + (0\ DEG\ F)^2}$$

$$Uncertainty\_Ext\_Rand_{RTD1} = 0.1333\ DEG\ F$$

6.2.2 Unit 2 RTD Uncertainty

Section 5.2.2 of SPC-RC-078, Rev. 0A (Reference 8.4.2) provides an extrapolated vendor drift value of 0.3333 DEG F for the Unit 2 RTDs and shows that this value is extrapolated out to 30 months from vendor data.

$$d = \pm 0.3333\ DEG\ F$$

Section 5.2.1 and Section 5.2.3 of SPC-RC-078, Rev. 0 (Reference 8.4.2) provides the Accuracy and Instrument M&TE, respectively.

$$a = \pm 0.1333\ DEG\ F$$

$$m = \pm 0\ DEG\ F$$

Calculating the $Uncertainty\_Ext\_Rand_{RTD}$ value for Unit 2 is as follows:

$$Uncertainty\_Ext\_Rand_{RTD2} = \sqrt{a^2 + d^2 + m^2}$$

$$Uncertainty\_Ext\_Rand_{RTD2} = \sqrt{(0.1333\ DEG\ F)^2 + (0.3333\ DEG\ F)^2 + (0\ DEG\ F)^2}$$

$$Uncertainty\_Ext\_Rand_{RTD2} = 0.3590\ DEG\ F$$

6.3 Total Loop Error (TLE)

6.3.1 Unit 1 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$Uncertainty\_Ext\_Rand_{RTD1}{}^2 + DA\_Ext\_Rand_{Converter}{}^2 + DA\_Ext\_Rand_{LeadLag}{}^2 + DA\_Ext\_Rand_{Bistable}{}^2 = A + D_R + M$$

$$TLES\ (SRSSS) = \Big[Uncertainty\_Ext\_Rand_{RTD1}{}^2 + DA\_Ext\_Rand_{Converter}{}^2 + DA\_Ext\_Rand_{LeadLag}{}^2 + DA\_Ext\_Rand_{Bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{1/2}$$

$$TLES\ (SRSSS) = [(0.1333\ DEG\ F)^2 + (0.3015\ DEG\ F)^2 + (0.367\ DEG\ F)^2 + (0.0697\ DEG\ F)^2 + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 1.8078\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + (0\ DEG\ F)^2 + (0\ DEG\ F)^2]^{\frac{1}{2}} = \pm 1.434\ DEG\ F$$

$$Bias_{pos} = Uncertainty\_Ext\_Bias_{RTD1} + DA\_Ext\_Bias_{Converter} + DA\_Ext\_Bias_{LeadLag} + DA\_Ext\_Bias_{Bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ DEG\ F + 0\ DEG\ F + 0.080\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F = 0.080\ DEG\ F$$

$$TLES_{pos} = TLES\ (SRSSS) + Bias_{pos} - 0.5\ DEG\ F$$

$$TLEs_{pos} = 1.434\ DEG\ F + 0.080\ DEG\ F - 0.5\ DEG\ F = 1.014\ DEG\ F$$

6.3.2 Unit 2 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$Uncertainty\_Ext\_Rand_{RTD2}{}^2 + DA\_Ext\_Rand_{Converter}{}^2 + DA\_Ext\_Rand_{LeadLag}{}^2 + DA\_Ext\_Rand_{Bistable}{}^2 = A + D_R + M$$

$$TLES\ (SRSSS) = \Big[Uncertainty\_Ext\_Rand_{RTD2}{}^2 + DA\_Ext\_Rand_{Converter}{}^2 + DA\_Ext\_Rand_{LeadLag}{}^2 + DA\_Ext\_Rand_{Bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{1/2}$$

$$TLES\ (SRSSS) = [(0.359\ DEG\ F)^2 + (0.3015\ DEG\ F)^2 + (0.367\ DEG\ F)^2 + (0.0697\ DEG\ F)^2 + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 1.4643\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + 0\ (DEG\ F^2) + (0\ DEG\ F)^2 + (0\ DEG\ F)^2]^{\frac{1}{2}} = \pm 1.350\ DEG\ F$$

$$Bias_{pos} = Uncertainty\_Ext\_Bias_{RTD2} + DA\_Ext\_Bias_{Converter} + DA\_Ext\_Bias_{LeadLag} + DA\_Ext\_Bias_{Bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ DEG\ F + 0\ DEG\ F + 0.080\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F = 0.080\ DEG\ F$$

$$TLES_{pos} = TLES\ (SRSSS) + Bias_{pos}$$

$$TLES_{pos} = 1.350\ DEG\ F + 0.080\ DEG\ F = 1.430\ DEG\ F$$

6.4 Nominal Trip Setpoint (NTSP)

6.4.1 Unit 1 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE_{pos} = 535\ DEG\ F + 1.014\ DEG\ F = 536.014\ DEG\ F$$

6.4.2 Unit 2 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE_{pos} = 530\ DEG\ F + 1.430\ DEG\ F = 531.43\ DEG\ F$$

6.5 Allowable Value (AV)

6.5.1 Unit 1 Allowable Value (AV)

The allowable value for Steam Line Isolation Coincident with Low-Low Tavg Unit 1 is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = (Uncertainty\_Ext\_Rand_{RTD1}{}^2 + DA\_Ext\_Rand_{Converter}{}^2 + DA\_Ext\_Rand_{LeadLag}{}^2 + DA\_Ext\_Rand_{Bistable}{}^2 + R_{NR})^{1/2}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = Uncertainty\_Ext\_Bias_{RTD1} + DA\_Ext\_Bias_{Converter} + DA\_Ext\_Bias_{LeadLag} + DA\_Ext\_Bias_{Bistable} + R_{NBN}$$

$$AV = NTSP_{DEG\ F} - LD_{R\ DEG\ F} - LD_{BN\ DEG\ F}$$

$$LD_R = ((0.1333)^2 + (0.3015\ DEG\ F)^2 + (0.367\ DEG\ F)^2 + (0.0697\ DEG\ F)^2 + 0)^{1/2} = 0.4982\ DEG\ F$$

$$LD_{BN} = 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F = 0\ DEG\ F$$

$$AV = 536.014\ DEG\ F - 0.4982\ DEG\ F - 0\ DEG\ F = 535.516\ DEG\ F$$

6.5.2 Unit 2 Allowable Value (AV)

The allowable value for Steam Line Isolation Coincident with Low-Low Tavg Unit 2 is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = (Uncertainty\_Ext\_Rand_{RTD2}{}^2 + DA\_Ext\_Rand_{Converter}{}^2 + DA\_Ext\_Rand_{LeadLag}{}^2 + DA\_Ext\_Rand_{Bistable}{}^2 + R_{NR})^{1/2}$$

$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = Uncertainty\_Ext\_Bias_{RTD2} + DA\_Ext\_Bias_{Converter} + DA\_Ext\_Bias_{LeadLag} + DA\_Ext\_Bias_{Bistable} + R_{NBN}$

$$AV = NTSP_{DEG\ F} - LD_{R\ DEG\ F} - LD_{BN\ DEG\ F}$$

$$LD_R = ((0.359\ DEG\ F)^2 + (0.3015\ DEG\ F)^2 + (0.367\ DEG\ F)^2 + (0.0697\ DEG\ F)^2 + 0)^{1/2} = 0.5994\ DEG\ F$$

$$LD_{BN} = 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F + 0\ DEG\ F = 0\ DEG\ F$$

$$AV = 531.43\ DEG\ F - 0.5994\ DEG\ F - 0\ DEG\ F = 530.831\ DEG\ F$$

6.6 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.4 and the AFT and APS values the setpoint margin is evaluated below for Units 1 and 2 separately:

6.6.1 Unit 1 Setpoint Margin

$$Acceptance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

$$NTSP \leq APS - AFT$$

$$536.014\ DEG\ F \leq 540.5\ DEG\ F - 0.5\ DEG\ F$$

$$536.014\ DEG\ F \leq 540.0\ DEG\ F$$

The acceptance criterion is met for Unit 1 setpoint margin.

6.6.2 Unit 2 Setpoint Margin

$$Acceptance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

$$NTSP \leq APS - AFT$$

$$531.43\ DEG\ F \leq 540.5\ DEG\ F - 0.5\ DEG\ F$$

$$531.43\ DEG\ F \leq 540.0\ DEG\ F$$

The acceptance criterion is met for Unit 2 setpoint margin.

6.7 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

6.7.1 Unit 1 Allowable Value Acceptance

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

$$AV_{Calc} = 535.516\ DEG\ F$$

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$536\ DEG\ F \geq 535.516\ DEG\ F$$

The acceptance criterion is met for the Unit 1 allowable value.

6.7.2 Unit 2 Allowable Value Acceptance

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

$$AV_{Calc} = 530.831\ DEG\ F$$

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$536\ DEG\ F \geq 530.831\ DEG\ F$$

The acceptance criterion is met for the Unit 2 allowable value.

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the RTD uncertainty value calculated in Section 6.2 and the new calculated drift values provided in drift calculations SPC-DR-012 (Reference 8.3.1), SPC-DR-016 (Reference 8.3.2), and SPC-DR-037 (Reference 8.3.3), the new calculated values were found to be acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Steam Line Isolation – Coincident with Low-Low Tavg Function instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-012, Revision 0, "Drift Analysis of As-Found / As-Left Data for NUS R/V Converter RTL501"

8.3.2 SPC-DR-016, Revision 0, "Drift Analysis of As-Found /As -Left Data for NUS Lead /Lag Unit TMD500-20/00/00/00-08-08-03 IDS D-009"

8.3.3 SPC-DR-037, Revision 0, "Drift Analysis of As-Found / As-Left Data for NUS Bistable DAM503-03 (mA)"

8.4 Setpoint Calculations:

8.4.1 SPC-RP-077, Revision 1A, "U1 RCS Low-Low Tavg Bistable Setpoint – Input to MSIV".

8.4.2 SPC-RP-078, Revision 0A, "Unit 2 RCS Low-Low Tavg Bistable Setpoint – Input to MSIV".

8.5 Technical Specifications:

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1 Renewed Facility Operating License (No. DPR-42), Amendment 230.

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60), Amendment 218.

8.6 Surveillance Procedures:

8.6.1 SP 1002A, Revision 50, “Analog Protection System Calibration”

8.6.2 SP 2002A, Revision 51, “Analog Protection System Calibration”

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1.0 Purpose

The purpose of this calculation is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation of the Steamline High-High Steam Flow Isolation instrument loops. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed Table 1.1 below.

Table 1.1: Instruments

Instrument Number	Manufacturer	Model
1FT-464	Rosemount	3154ND4R
1FT-465	Rosemount	3154ND4R
1FT-474	Rosemount	3154ND4R
1FT-475	Rosemount	3154ND4R
2FT-464	Rosemount	3154ND4R
2FT-465	Rosemount	3154ND4R
2FT-474	Rosemount	3154ND4R
2FT-475	Rosemount	3154ND4R
1FC-464A/B	NUS Instruments	DAM503-03
1FC-465A/B	NUS Instruments	DAM503-03
1FC-474A/B	NUS Instruments	DAM503-03
1FC-475A/B	NUS Instruments	DAM503-03
2FC-464A/B	NUS Instruments	DAM503-03
2FC-465A/B	NUS Instruments	DAM503-03
2FC-474A/B	NUS Instruments	DAM503-03
2FC-475A/B	NUS Instruments	DAM503-03

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 1 and 2 setpoint calculations SPC-RP-057 (Reference 8.4.1) and SPC-RP-058 (Reference 8.4.2) provide different values for the process span and resulting values calculated using the process span. Because of this, the design inputs in Section 4.0 and analysis in Section 6.0 are given separately for setpoint calculations SPC-RP-057 (Reference 8.4.1) and SPC-RP-058 (Reference 8.4.2).

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-010, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (V)" (Reference 8.3.1) and SPC-DR-023, "As-Found/As-Left Data for Rosemount Transmitter 3154ND4R" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each is summarized in the following Sections:

4.1.1 SPC-DR-010

The NUS Bistable DAM503-03 (VDC) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%\ Span$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%\ Span$$

4.1.2 SPC-DR-023

The Rosemount Transmitter 3154ND4R was evaluated and the following values were calculated for the Unit 1 transmitters:

$$DA\_Ext\_Rand_{trans} = \pm 20.089\ INWC$$

$$DA\_Ext\_Bias_{trans} = 0\ INWC$$

The following values were calculated for the Unit 2 transmitters:

$$DA\_Ext\_Rand_{trans} = \pm 16.545\ INWC$$

$$DA\_Ext\_Bias_{trans} = 0\ INWC$$

4.2 Setpoint/Uncertainty Calculations

The Steamline High-High Steam Flow Bistable setpoint is evaluated in two setpoint calculations: SPC-RP-057, Unit 1 Main Steam Flow High High (Reference 8.4.1) and SPC-RP-058, Unit 2 Main

Steam Flow High High (Reference 8.4.2). Pertinent information from each calculation is summarized below:

Form 1 of SPC-RP-057 (Reference 8.4.1) provides the following information:

$$Process\ Span = 0\ to\ 1413.1\ INWC$$

$$Analytical\ Limit\ (AL) = 1629.2\ INWC$$

Form 1 of SPC-RP-058 (Reference 8.4.2) provides the following information:

$$Process\ Span = 0\ to\ 1455.8\ INWC$$

$$Analytical\ Limit\ (AL) = 1677.7\ INWC$$

Total loop error (TLE) for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations for an increasing process. For an increasing process the negative bias and subsequent negative total loop error are used to calculate the nominal trip setpoint. Therefore, while SPC-RP-057 (Reference 8.4.1) and SPC-RP-058 (Reference 8.4.2) include calculations for both positive and negative bias and total loop error, only the negative bias and total loop error are calculated below.

$$TLE\ (SRSSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{neg} = -TLE\ (SRSSS) - Bias_{neg}$$

Substituting in values for Unit 1 (SPC-RP-057), the total loop error is calculated as:

$$\begin{aligned} TLE\ (SRSSS) = {} & [99.200\ (INWC^2) + 101.293\ (INWC^2) + 365.510\ (INWC^2) + 0\ (INWC^2) \\ & + 4.5886\ (INWC^2) + 0.53044\ (INWC^2) + 0.0923\ (INWC^2) \\ & + 173.170\ (INWC^2) + 0\ (INWC^2) + 0\ (INWC^2) + 621.850\ (INWC^2) \\ & + 0\ (INWC^2) + (26.298\ INWC)^2 + (0\ INWC)^2 + (0\ INWC)^2]^{\frac{1}{2}} \\ & = \pm 45.363\ INWC \end{aligned}$$

$$\begin{aligned} Bias_{neg} = {} & 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC \\ & + 0\ INWC + 0\ INWC + 0\ INWC - 34.056\ INWC + 49.996\ INWC \\ & = 15.940\ INWC \end{aligned}$$

$$TLE_{neg} = -45.363\ INWC - 15.940\ INWC = -61.303\ PSIG$$

Substituting in values for Unit 2 (SPC-RP-058), the total loop error is calculated as:

$$\begin{aligned} TLE\ (SRSSS) = {} & [105.030\ (INWC^2) + 68.263\ (INWC^2) + 238.350\ (INWC^2) + 0\ (INWC^2) \\ & + 3.5154\ (INWC^2) + 0.4307\ (INWC^2) + 0.09797\ (INWC^2) \\ & + 83.413\ (INWC^2) + 0\ (INWC^2) + 0\ (INWC^2) + 622.75\ (INWC^2) \\ & + 0\ (INWC^2) + (22.230\ INWC)^2 + (0\ INWC)^2 + (0\ INWC)^2]^{\frac{1}{2}} \\ & = \pm 40.200\ INWC \end{aligned}$$

$$Bias_{neg} = 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC - 61.508\ INWC + 50.953\ INWC = -10.555\ INWC$$

$$TLE_{neg} = -40.200\ INWC + 10.555\ INWC = -29.645\ INWC$$

The nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

Substituting values for Unit 1 (SPC-RP-057, Reference 8.4.1), the nominal trip setpoint is calculated as:

$$NTSP = 1629.2\ INWC - 61.303\ INWC = 1567.897\ INWC$$

Substituting values for Unit 2 (SPC-RP-058, Reference 8.4.2), the nominal trip setpoint is calculated as:

$$NTSP = 1677.7\ INWC - 29.645\ INWC = 1648.055$$

The allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting values for Unit 1 (SPC-RP-057, Reference 8.4.1), the allowable value is calculated as:

$$LD_R = \sqrt{99.200\ (INWC^2) + 101.293\ (INWC^2) + 365.510\ (INWC^2) + 0\ (INWC^2)} = 23.791\ INWC$$

$$LD_{BP} = 0\ INWC + 0\ INWC = 0\ INWC$$

$$AV = 1567.897\ INWC + 23.791\ INWC + 0\ INWC = 1591.688\ INWC$$

Substituting values for Unit 2 (SPC-RP-058, reference 8.4.2), the allowable value is calculated as:

$$LD_R = \sqrt{105.03\ (INWC^2) + 68.263\ (INWC^2) + 238.35\ (INWC^2) + 0\ (INWC^2)} = 20.289\ INWC$$

$$LD_{BP} = 0\ INWC + 0\ INWC = 0\ INWC$$

$$AV = 1648.055\ INWC + 20.289\ INWC + 0\ INWC = 1668.344\ INWC$$

4.3 Technical Specifications

The allowable value for the High-High Steam Flow function is taken from the technical specification for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \le 4.5E6 \frac{lb}{hr}\ at\ 735\ psig$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.3).

$$APS = 0.4942\ VDC$$

$$AFT = \pm 0.0020\ VDC$$

To interface with the equations, the APS and AFT values are converted into process units using the input spans taken from Form 2 of SPC-RP-057 (Reference 8.4.1) and SPC-RP-058 (Reference 8.4.2):

Calculating for Unit 1 (SPC-RP-057):

$$Transmitter\ Input\ Span = 1413.1\ INWC - 0\ INWC = 1413.1\ INWC$$

$$Bistable\ Input\ Span = 0.5000\ VDC - 0.1000\ VDC = 0.4000\ VDC$$

$$APS = \frac{0.4942\ VDC - 0.1000\ VDC}{0.4000\ VDC} \times 1413.1\ INWC = 1392.610\ INWC$$

$$AFT = \frac{0.0020\ VDC}{0.4000\ VDC} \times 1413.1\ INWC = 7.066\ INWC$$

Calculating for Unit 2 (SPC-RP-058):

$$Transsmitter\ Input\ Span = 1455.8\ INWC - 0\ INWC = 1455.8\ INWC$$

$$Bistable\ Input\ Span = 0.5000\ VDC - 0.1000\ VDC = 0.4000\ VDC$$

$$APS = \frac{0.4942\ VDC - 0.1000\ VDC}{0.4000\ VDC} \times 1455.8\ INWC = 1434.691\ INWC$$

$$AFT = \frac{0.0020\ VDC}{0.4000\ VDC} \times 1455.8\ INWC = 7.279\ INWC$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

As shown in Section 4.2, SPC-RP-057 (Reference 8.4.1) and SPC-RP-058 (Reference 8.4.2) provide different process spans and total loop errors and subsequently different nominal trip setpoints and allowable values. As a result, this attachment analyzes the Unit 1 and Unit 2 instrument loops separately.

6.1 Unit Conversion

The total extrapolated drift tolerance interval of the NUS Bistable given in Section 4.1 is calculated in percent span. To interface with the equations and values taken from setpoint calculations SPC-RP-057 (Reference 8.4.1) and SPC-RP-058 (Reference 8.4.2), the drift data is converted into the process unit using the process span given in Section 4.4 below.

Converting the Bistable extrapolated analyzed drift term for Unit 1 (SPC-RP-057):

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\%\ Span \times \frac{1413.1\ INWC}{100\%\ Span} = \pm 1.515\ INWC$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\%\ Span \times \frac{1413.1\ INWC}{100\ \%\ Span} = +0.134\ INWC$$

Converting the NUS Bistable extrapolated analyzed drift term for Unit 2 (SPC-RP-058):

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\%\ Span \times \frac{1455.8\ INWC}{100\%\ Span} = \pm 1.561\ INWC$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\%\ Span \times \frac{1455.8\ INWC}{100\ \%\ Span} = +0.138\ INWC$$

6.2 Total Loop Error (TLE)

The total loop error is calculated using the Extrapolated Analyzed Drift terms of the NUS bistable and Rosemount transmitter (Calculated in Section 6.1). These values replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoints using the equations given below.

$$DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 = A + D_R + M$$

$$TLE\ (SRSSS) = \left[DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

The values for Unit 1 are substituted into the equations below. Consistent with Assumption 14 of SPC-RP-057 (Reference 5.4.1) the Bistable positive bias is entered as a negative in the bias negative calculation.

$$TLE\ (SRSSS) = [(20.089\ INWC)^2 + (1.515\ INWC)^2 + 0\ (INWC^2) + 4.5886\ (INWC^2) + 0.53044\ (INWC^2) + 0.0923\ (INWC^2) + 173.170\ (INWC^2) + 0\ (INWC^2) + 0\ (INWC^2) + 621.850\ (INWC^2) + 0\ (INWC^2) + (26.298\ INWC)^2 + (0\ INWC)^2 + (0\ INWC)^2]^{\frac{1}{2}} = \pm 43.562\ INWC$$

$$Bias_{neg} = 0\ INWC - 0.134\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC - 34.056\ INWC + 49.996\ INWC = 15.806\ INWC$$

$$TLE_{neg} = -43.562\ INWC - 15.806\ INWC = -59.368\ INWC$$

The values for Unit 2 are substituted into the equations below. Consistent with Assumption 11 of SPC-RP-058 (Reference 5.4.2) the Bistable positive bias is entered as a negative in the bias negative calculation.

$$TLE\ (SRSSS) = [(16.545\ INWC)^2 + (1.561\ INWC)^2 + 0\ (INWC^2) + 3.5154\ (INWC^2) + 0.4307\ (INWC^2) + 0.09797\ (INWC^2) + 83.413\ (INWC^2) + 0\ (INWC^2) + 0\ (INWC^2) + 622.75\ (INWC^2) + 0\ (INWC^2) + (22.230\ INWC)^2 + (0\ INWC)^2 + (0\ INWC)^2]^{\frac{1}{2}} = \pm 38.478\ INWC$$

$$Bias_{neg} = 0\ INWC - 0.138\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC + 0\ INWC - 61.508\ INWC + 50.953\ INWC = -10.693\ INWC$$

$$TLE_{neg} = -38.478\ INWC + 10.693\ INWC = -27.785\ INWC$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equation from Section 4.2 and the new calculated TLE values for Unit 1 and Unit 2, the nominal trip setpoint is calculated below.

$$NTSP = AL + TLE_{neg}$$

Calculating for Unit 1 (SPC-RP-057):

$$NTSP = AL + TLE_{neg} = 1629.2\ INWC - 59.368\ INWC = 1569.832\ INWC$$

Calculating for Unit 2 (SPC-RP-058):

$$NTSP = AL + TLE_{neg} = 1677.7\ INWC - 27.785\ INWC = 1649.915\ INWC$$

6.4 Allowable Value (AV)

The allowable value for the low power reactor trip is calculated using the NTSP calculated in Section 6.3 and the Loop Drift calculated using the equations shown below.

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias)\ LD_{BP} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBN}$$

$$AV = NTSP + LD_R + LD_{Bp}$$

Calculating for Unit 1 (SPC-RP-057):

$$LD_R = \sqrt{(20.089\ INWC)^2 + (1.515\ INWC)^2 + (0\ INWC)} = 20.146\ INWC$$

$$LD_{BP} = 0\ INWC + 0.134\ INWC + 0\ INWC = 0.134\ INWC$$

$$AV = 1569.832\ INWC + 20.146\ INWC + 0.134\ PSIG = 1590.112\ INWC$$

Calculating for Unit 2 (SPC-RP-058):

$$LD_R = \sqrt{(16.545\ INWC)^2 + (1.561\ INWC)^2 + (0\ INWC)} = 16.618\ INWC$$

$$LD_{BP} = 0\ INWC + 0.138\ INWC + 0\ INWC = +0.138\ INWC$$

$$AV = 1649.915\ INWC + 16.618\ INWC + 0.138\ INWC = 1666.671\ INWC$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values calculated in Section 4.4 the setpoint margin is evaluated below.

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

Substituting in values for Unit 1 (SPC-RP-057):

$$1569.832\ INWC \geq 1392.610\ INWC + 7.066\ INWC$$

$$1569.832\ INWC \geq 1399.676\ INWC$$

Substituting in values for Unit 2 (SPC-RP-058):

$$1649.915\ INWC \geq 1434.691\ INWC + 7.279\ INWC$$

$$1649.915\ INWC \geq 1441.970$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is evaluated using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2. To compare with the Technical Specification given in Section 4.3 the Allowable Value calculated in Section 6.4 is converted to lb/hr at 735 psig using the formula and values given in Attachment AA, AB, AC and AD of SPC-DR-057 (Reference 8.4.1) and Attachment 1 of SPC-DR-058 (Reference 8.4.2).

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

$$AV_{calc} = \sqrt{\frac{AVdp}{StmDP\_mxOut}} * \frac{Alya}{StmFlowY\_mxIn} * StmFlow\_mxIn * \sqrt{\frac{p750}{p750}}$$

Allowable value for Unit 1 (SPC-RP-057):

$$AV_{calc} = \sqrt{\frac{1590.112\ INWC}{1413.1\ INWC}} * \frac{0.946}{0.954} * 4470000\,\frac{lb}{hr} * \sqrt{\frac{1.64}{1.64}}$$

$$AV_{Calc} = 4.70E6\ \frac{lb}{hr}\ at\ 735\ psig$$

$$4.5E6\,\frac{lb}{hr}\ at\ 735\ psig \leq 4.70E6\ \frac{lb}{hr}\ at\ 735\ psig$$

Allowable value for Unit 2 (SPC-RP-058):

$$AV_{calc} = \sqrt{\frac{1649.915\ INWC}{1451.9\ INWC}} * \frac{0.945}{0.954} * 4470000\,\frac{lb}{hr} * \sqrt{\frac{1.64}{1.64}}$$

$$AV_{Calc} = 4.74E6\ \frac{lb}{hr}\ at\ 735\ psig$$

$$4.5E6 \frac{lb}{hr}\ at\ 735\ psig \leq 4.74E6\ \frac{lb}{hr}\ at\ 735\ psig$$

7.0 Conclusions and Plant Impact

A new total loop error (TLE), nominal trip setpoint (NTSP), and allowable value (AV) were calculated using new calculated drift values for the instruments in the Steamline High-High Steam Flow instrument loops. The new calculated drift values are provided in drift calculation SPC-DR-010 (Reference 8.3.1) and SPC-DR-023 (Reference 8.3.2). The new calculated nominal trip setpoint (NTSP), and allowable value (AV) were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Steamline High-High Steam Flow instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs"

8.2 Engineering Manuals

8.2.1 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations"

8.2.2 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift"

8.3 Drift Calculations

8.3.1 SPC-DR-010, Revision 0, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (V)"

8.3.2 SPC-DR-023, Revision 0, "As-Found/As-Left Data for Rosemount Transmitter 3154ND4R".

8.4 Setpoint Calculations

8.4.1 SPC-RP-057, Revision 2D, "Unit 1 Main Steam Flow High High"

8.4.2 SPC-RP-058, Revision 0A, "Unit 2 Main Steam Flow High High"

8.5 Technical Specifications

8.5.1 Northern States Power Company Docket No. 50-282 Prairie Island Nuclear Generating Plant, Unit 1 Renewed Facitlity Operating License (No. DPR-42) Amendment 230

8.5.2 Northern States Power Company Docket No. 50-306 Prairie Island Nuclear Generating Plant, Unit 2 Renewed Facitlity Operating License (No. DPR-60) Amendment 218

8.6 Surveillance Procedures

8.6.1 SP 1002A, Revision 50, "Analog Protection System Calibration"

8.6.2 SP 1002B.6, Revision 1, "Reactor Protection and Control Transmitter Calibration/Inspection- Steam Flow"

8.6.3 SP 2002A, Revision 51, "Analog Protection System Calibration"

8.6.4 SP 2002B.6, Revision 0, "Reactor Protection and Control Transmitter Calibration/Inspection – Steam Flow"

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Table of Contents

1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 and 2 Feedwater Isolation High-High Steam Generator (SG) Water Level instrument loops which perform turbine trips. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1LC-461A	NUS	DAM503-03 (V)
1LC-462B	NUS	DAM503-03 (V)
1LC-463D	NUS	DAM503-03 (V)
1LC-471A	NUS	DAM503-03 (V)
1LC-472B	NUS	DAM503-03 (V)
1LC-473D	NUS	DAM503-03 (V)
2LC-461A	NUS	DAM503-03 (V)
2LC-462B	NUS	DAM503-03 (V)
2LC-463D	NUS	DAM503-03 (V)
2LC-471A	NUS	DAM503-03 (V)
2LC-472B	NUS	DAM503-03 (V)
2LC-473D	NUS	DAM503-03 (V)
1LT-461	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-462	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-463	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-471	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-472	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-473	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-461	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-462	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-463	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-471	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-472	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-473	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

The Unit 1 and 2 setpoint calculations provided different values for measurement and test equipment allowance, temperature effect, static pressure effect span, and seismic effect. The Unit variables which provides the greatest total loop error will be used in this calculation to conservatively bound the worst case.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-010, “Drift Analysis of As-Found / As-Left Data for NUS Bistable DAM503-03 (V)” (Reference 8.3.1) and SPC-DR-022, “Drift Analysis of As-Found/As-Left Data for Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2” (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-010

The NUS Bistable DAM503-03 (V) was evaluated and the following values were calculated:

$$DA_{Ext_{Rand}\,bistable} = \pm 0.1072\ \%Span$$

$$DA_{Ext_{Bias}\,bistable} = +0.0095\ \%Span$$

4.1.2 SPC-DR-022

The Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2 was evaluated and the following values were calculated:

$$DA_{Ext_{Rand\,trans}} = \pm 0.520\ \%Span$$

$$DA_{Ext_{Bias\,trans}} = -0.086\ \%Span$$

4.2 Setpoint/Uncertainty Calculations

The Feedwater Isolation High-High Steam Generator (SG) Water Level turbine trip setpoint is evaluated in two setpoint calculations: SPC-RP-025, "U1 Steam Generator Hi-Hi Level Feedwater Isolation Setpoint" (Reference 8.4.1) and SPC-RP-026, "Unit 2 Steam Generator Hi-Hi Level Feedwater Isolation Setpoint" (Reference 8.4.2). Pertinent information from each calculation for this evaluation is summarized below:

Section 4.1, Form 1 of SPC-RP-025 (Reference 8.4.1) and SPC-RP-026 (Reference 8.4.2) provides the following information given that this is an increasing setpoint (per Form 1 of Reference 8.4.1 and 8.4.2), the $Bias_{neg}$ (per Section 5.4 of Reference 8.4.1 and 8.4.2) is used to calculate total loop error since TLE_{neg} is needed (per Section 5.5 of Reference 8.4.1 and 8.4.2)::

$$Process\ Span = 0\ to\ 100\ PCT$$

$$Analytical\ Limit\ (AL) = 100\ PCT$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{\frac{1}{2}}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

After entering the data for Unit 1 (SPC-RP-025), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.5(PCT^2) + 0.1458(PCT^2) + 1.2951(PCT^2) + 0(PCT^2) + 0.065(PCT^2) + 0.1319(PCT^2) + 0(PCT^2) + 0.332(PCT^2) + 0.345(PCT^2) + 0(PCT^2) + 5.5103(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0.00026(PCT^2)]^{\frac{1}{2}} = \pm 2.8854\ PCT$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 1.6100\ PCT = 1.6100\ PCT$$

$$TLE_{neg} = -2.8854\ PCT - 1.6100\ PCT = -4.4954\ PCT$$

After entering the data for Unit 2 (SPC-RP-026), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.5(PCT^2) + 0.1458(PCT^2) + 1.2955(PCT^2) + 0(PCT^2) + 0.065(PCT^2) + 0.1321(PCT^2) + 0(PCT^2) + 0.2841(PCT^2) + 0.345(PCT^2) + 0(PCT^2) + 5.5206(PCT^2) + 0(PCT^2) + 0(PCT^2) + 2.53E^{-04}(PCT^2) + 0(PCT^2)]^{\frac{1}{2}} = \pm 2.8789\ PCT$$

$$Bias_{neg} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 1.59\ PCT + 0\ PCT = 1.59\ PCT$$

$$TLE_{neg} = -2.8789\ PCT - 1.59\ PCT = -4.4689\ PCT$$

The Unit 1 variables provide the worst-case total loop error and will be used in Section 6 to calculate the new total loop error.

Per Section 5.5 of Reference 8.4.1, the nominal trip setpoint (NTSP) is calculated for an increasing process using the following equation:

$$NTSP = AL + TLE_{neg}$$

$$NTSP = 100\ PCT + (-4.4954\ PCT) = 95.505\ PCT$$

Per Section 5.6 of Reference 8.4.1, the allowable value (AV) for an increasing process is determined using the following equations:

$$Loop\ Drift\ (Random) LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias) LD_{BP} = D_{BP} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

Substituting these values, the allowable value is calculated as:

$$Loop\ Drift\ (Random) LD_R = \sqrt{0.5(PCT^2) + 0.1458(PCT^2) + 1.2951(PCT^2) + 0.345(PCT^2)} = 1.5119\ PCT$$

$$Loop\ Drift\ (Positive\ Bias) LD_{BP} = 0\ PCT + 0\ PCT = 0\ PCT$$

$$AV = 95.505\ PCT + 1.5119\ PCT + 0\ PCT = 97.017\ PCT$$

4.3 Technical Specifications

The allowable value for the Feedwater Isolation High-High Steam Generator (SG) Water Level function is taken from the technical specification for each unit (Table 3.3.2-1 of References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \leq 90\%$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.2).

$$APS = \left(\frac{0.3680\ V_{DC} - 0.1\ V_{DC}}{0.4\ V_{DC}}\right) * 100\ PCT + 0\ PCT = 67.00\ PCT$$

$$AFT = \pm\left(\frac{0.002\ V_{DC}}{.4\ V_{DC}}\right) * 100\ PCT = \pm 0.5\ PCT$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Sections 4.2) below:

NUS Bistable DAM503-03 (V) (per Reference 8.3.1):

$$DA_{Ext_{Rand}bistable} = \pm 0.1072\ \%Span = \pm 0.1072\ \%Span * \frac{100\ PCT}{100\ \%Span} = \pm 0.1072\ PCT$$

$$DA_{Ext_{Bias}bistable} = +0.0095\ \%Span = +0.0095\ \%Span * \frac{100\ PCT}{100\ \%Span} = +0.0095\ PCT$$

Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2 (per Reference 8.3.2):

$$DA_{Ext_{Rand}trans} = \pm 0.520\ \%Span = \pm 0.520\ \%Span * \frac{100\ PCT}{100\ \%Span} = \pm 0.520\ PCT$$

$$DA_{Ext_{Bias}trans} = -0.086\ \%Span = -0.086\ \%Span * \frac{100\ PCT}{100\ \%Span} = -0.086\ PCT$$

6.2 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$DA_{Ext_{Rand}\,trans}{}^2 + DA_{Ext_{Rand}\,bistable}{}^2 = A + D_R + M$$

$$TLE\ (SRSS) = \Big[DA_{Ext_{Rand}\,trans}{}^2 + DA_{Ext_{Rand}\,bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\Big]^{\frac{1}{2}}$$

$$TLE\ (SRSS) = [(0.520\ PCT)^2 + (0.1072\ PCT)^2 + 0(PCT^2) + 0.065(PCT^2) + 0.1319(PCT^2) + 0(PCT^2) + 0.332(PCT^2) + 0.345(PCT^2) + 0(PCT^2) + 5.5103(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0(PCT^2) + 0.00026(PCT^2)]^{\frac{1}{2}} = \pm 2.5819\ PCT$$

$$Bias_{neg} = DA_{Ext_{Bias}\,trans} + DA_{Ext_{Bias}\,bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = 0.086\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 1.6100\ PCT = 1.6960\ PCT$$

$$TLE_{neg} = -TLE\ (SRSS) - Bias_{neg}$$

$$TLE_{neg} = -2.5819\ PCT - 1.6960\ PCT = -4.2779\ PCT$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE_{neg} = 100\ PCT + (-4.2779\ PCT) = 95.7221\ PCT$$

6.4 Allowable Value (AV)

The allowable value for Feedwater Isolation High-High Steam Generator (SG) Water Level is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random) LD_R = \sqrt{DA_{Ext_{Rand}\,trans}{}^2 + DA_{Ext_{Rand}\,bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Positive\ Bias) LD_{BP} = DA_{Ext_{Bias}\,trans} + DA_{Ext_{Bias}\,bistable} + R_{NBP}$$

$$AV = NTSP + LD_R + LD_{BP}$$

$$LD_R = \sqrt{(0.520\ PCT)^2 + (0.1072\ PCT)^2 + 0.345(PCT^2)} = 0.7918\ PCT$$

$$LD_{BP} = 0\ PCT + 0.0095\ PCT + 0\ PCT = 0.0095\ PCT$$

$$AV = 95.7221\ PCT + 0.7918\ PCT + 0.0095\ PCT = 96.5234\ PCT$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values the setpoint margin is evaluated below:

$$Accetpance\ Criteria\ (Increasing): NTSP \geq APS + AFT$$

$$NTSP \geq APS + AFT$$

$$95.7221\% \geq 67.00\% + 0.5\%$$

$$95.7221\% \geq 67.5\%$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for an increasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2. The AV is evaluated below:

$$Acceptance\ Criteria\ (Increasing): AV_{Tech\ Spec} \leq AV_{Calc}$$

$$AV_{Tech\ Spec} \leq AV_{Calc}$$

$$90\% \leq 96.5234\%$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-010 (Reference 8.3.1) and SPC-DR-022 (Reference 8.3.2), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Feedwater Isolation High-High Steam Generator (SG) Water Level instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, Guidelines for Instrument Calibration Extension/Reduction Programs

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, The Analysis of Instrument Drift

8.2.2 EM 3.3.4.1, Revision 2, Instrument Setpoint/Uncertainty Calculations

8.3 Drift Calculations:

8.3.1 SPC-DR-010, Revision 0, Drift Analysis of As-Found / As-Left Data for NUS Bistable DAM503-03 (V)

8.3.2 SPC-DR-022, Revision 0, Drift Analysis of As-Found/As-Left Data for Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2

8.4 Setpoint Calculations:

8.4.1 SPC-RP-025, Revision 2D, U1 Steam Generator Hi-Hi Level Feedwater Isolation Setpoint

8.4.2 SPC-RP-026, Revision 1A, Unit 2 Steam Generator Hi-Hi Level Feedwater Isolation Setpoint

8.5 Technical Specifications:

8.5.1 Unit 1, Northern States Power Company Docket NO. 50-282 Prairie Island Nuclear Generating Plant, Unit 1 Renewed Facility Operating License, Amendment 230

8.5.2 Unit 2, Northern States Power Company Docket NO. 50-306 Prairie Island Nuclear Generating Plant, Unit 2 Renewed Facility Operating License, Amendment 218

8.6 Surveillance Procedures:

8.6.1 SP 1002A, Revision 50, Analog Protection System Calibration

8.6.2 SP 2002A, Revision 51, Analog Protection System Calibration

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1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for Units 1 and 2 Auxiliary Feedwater - Low-Low SG Water Level instrument loops which are Engineered Safety Feature Actuation System (ESFAS) Instrumentation. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table listed which are found in Surveillance Procedures SP 1002A, SP 1002B.4, SP 2002A, and SP 2002B.4 (References 8.6.1, 8.6.2, 8.6.3, and 8.6.4) in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
1LC-461B	NUS INSTRUMENTS LLC	DAM503-03
1LC-462A	NUS INSTRUMENTS LLC	DAM503-03
1LC-463C	NUS INSTRUMENTS LLC	DAM503-03
1LC-471B	NUS INSTRUMENTS LLC	DAM503-03
1LC-472A	NUS INSTRUMENTS LLC	DAM503-03
1LC-473C	NUS INSTRUMENTS LLC	DAM503-03
1LT-461	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-462	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-463	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-471	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-472	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
1LT-473	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LC-461B	NUS INSTRUMENTS LLC	DAM503-03
2LC-462A	NUS INSTRUMENTS LLC	DAM503-03
2LC-463C	NUS INSTRUMENTS LLC	DAM503-03
2LC-471B	NUS INSTRUMENTS LLC	DAM503-03
2LC-472A	NUS INSTRUMENTS LLC	DAM503-03
2LC-473C	NUS INSTRUMENTS LLC	DAM503-03
2LT-461	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-462	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-463	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-471	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-472	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2
2LT-473	ROSEMOUNT	3152ND-2-A-2-F3-E-3-Q8-W2

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-010, "Drift Analysis of As Found / As-Left Data for NUS Bistable DAM503-03 (V)" (Reference 8.3.1) and SPC-DR-022, "As-Found / As -Left Data for Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2– Containment Building" (Reference 8.3.2). These calculations evaluate the instrument drift of the instruments used in the setpoint calculations. The data taken from each is summarized in the following sections:

4.1.1 SPC-DR-010

The NUS Bistable DAM503-03 (VDC) was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%Span$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%Span$$

4.1.2 SPC-DR-022

The Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2 was evaluated and the following values were calculated:

$$DA\_Ext\_Rand_{trans} = \pm 0.520\ \%Span$$

$$DA\_Ext\_Bias_{trans} = -0.086\%Span$$

4.2 Setpoint/Uncertainty Calculations

The Steam Generator Lo-Lo Level ESFAS setpoint is evaluated in two setpoint calculations: SPC-RP-015, "UNIT 1 Steam Generator Lo-Lo Level Reactor Trip" (Reference 8.4.1) and SPC-RP-016, "UNIT 2 Steam Generator Lo-Lo Level Reactor Trip (Reference 8.4.2). Pertinent information from each calculation for this evaluation is summarized below:

Form 1 of SPC-RP-015 (Reference 8.4.1) and SPC-RP-016 (Reference 8.4.2) provides the following information:

$$Process\ Span = 0\ to\ 100\ PCT$$

$$Analytical\ Limit\ (AL) = 0\ PCT$$

Total loop error for a seismic event and potential loss of non-seismic HVAC is calculated using the following equations:

$$TLE\ (SRSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{1/2}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

After entering the data for Unit 1 (SPC-RP-015), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.50000\ (PCT^2) + 0.1458\ (PCT^2) + 1.2951\ (PCT^2) + 0\ (PCT^2) + 0.065\ (PCT^2) + 0.1319\ (PCT^2) + 0\ (PCT^2) + 0.332\ (PCT^2) + 0.345\ (PCT^2) + 0\ (PCT^2) + 5.5103\ (PCT^2) + 0\ (PCT^2) + (0\ PCT)^2 + (0\ PCT)^2 + (0\ PCT)^2]^{1/2} = \pm 2.8853\ PCT$$

$$Bias_{pos} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0.4394\ PCT + 0.37\ PCT + 0.43809\ PCT = 0.85321\ PCT$$

$$TLE_{pos} = 2.8853\ PCT + 0.85321\ PCT = 3.7385\ PCT$$

After entering the data for Unit 2 (SPC-RP-016), the total loop error is calculated as:

$$TLE\ (SRSS) = [0.50000\ (PCT^2) + 0.1458\ (PCT^2) + 1.2955\ (PCT^2) + 0\ (PCT^2) + 0.065\ (PCT^2) + 0.1321\ (PCT^2) + 0\ (PCT^2) + 0.2841\ (PCT^2) + 0.345\ (PCT^2) + 0\ (PCT^2) + 5.5206\ (PCT^2) + 0\ (PCT^2) + (0\ PCT)^2 + (0\ PCT)^2 + (0\ PCT)^2]^{1/2} = \pm 2.8789\ PCT$$

$$Bias_{pos} = 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0.47242\ PCT + 0.39\ PCT + 0.56404\ PCT = 1.4265\ PCT$$

$$TLE_{pos} = 2.8789\ PCT + 1.4265\ PCT = 4.3054\ PCT$$

The Unit 2 variables provide the worst-case total loop error and will be used in Section 6 to calculate the new total loop error.

The nominal trip setpoint (NTSP) is calculated for a decreasing process using the following equation:

$$NTSP = AL + TLE_{pos}$$

$$NTSP = 0\ PCT + 4.3054\ PCT = 4.3054\ PCT$$

The allowable value (AV) for a decreasing process is determined using the following equations:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{A + D_R + M + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = D_{BN} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{0.5\ (PCT^2) + 0.1458\ (PCT^2) + 1.2955\ (PCT^2) + 0.345\ (PCT^2)} = 1.5121\ PCT$$

$$LD_{BN} = 0\ PCT + 0\ PCT = 0\ PCT$$

$$AV = 4.3054\ PCT - 1.5121\ PCT - 0\ PCT = 2.7933\ PCT$$

4.3 Technical Specifications

The allowable value for the Steam Generator (SG) Water Level - Low-Low from Table 3.3.2-1, Function 6b is taken from the technical specification for Units 1 and 2 (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 11.3\%$$

4.4 Calibration Procedures

The actual plant setting (APS) and as found tolerance (AFT) are taken from surveillance procedures SP 1002A (Reference 8.6.1) and SP 2002A (Reference 8.6.3).

$$APS = 0.1520\ VDC$$

$$AFT = \pm 0.002\ VDC$$

The actual plant setting (APS) for the 2LC-472A NUS Bistable DAM503-03 (VDC) from SP 2002A (Reference 8.6.3) is different from the other 11 NUS Bistables.

$$APS_{2LC-472A} = 0.1540\ VDC$$

To interface with the equations, the APS and AFT values are converted into process units using the input span taken from Form 2 of SPC-RP-015 (Reference 8.4.1) and SPC-RP-016 (Reference 8.4.2):

$$Input\ Span\ of\ Bistables = 0.1000\ to\ 0.5000\ VDC$$

$$APS = 0.1520\ VDC = \frac{(0.1520 - 0.1000) VDC}{.4000\ VDC} \times 100\ PCT = 13.0\ PCT$$

$$APS_{2LC-472A} = 0.1540\ VDC = \frac{(0.1540 - 0.1000) VDC}{.4000\ VDC} \times 100\ PCT = 13.5\ PCT$$

$$AFT = \frac{0.002\ VDC}{.4000\ VDC} \times 100\ PCT = 0.5\ PCT$$

5.0 Assumptions

No assumptions were used for this function evaluation.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent (%) span. To interface with the equations and values taken from the setpoint calculations, the drift data is converted into process units using the process span (See Section 4.2) below:

NUS Bistable DAM503-03 (VDC):

$$DA\_Ext\_Rand_{bistable} = \pm 0.1072\ \%Span = \pm 0.1072\ \%Span \times \frac{100.0\ PCT}{100\ \%Span} = \pm 0.1072\ PCT$$

$$DA\_Ext\_Bias_{bistable} = +0.0095\ \%Span = +0.0095\ \%Span \times \frac{100.0\ PCT}{100\ \%Span} = +0.0095\ PCT$$

Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2:

$$DA\_Ext\_Rand_{trans} = \pm 0.520\ \%Span = \pm 0.520\ \%Span \times \frac{100.0\ PCT}{100\ \%Span} = \pm 0.520\ PCT$$

$$DA\_Ext\_Bias_{trans} = -0.086\ \%Span = -0.086\ \%Span \times \frac{100.0\ PCT}{100\ \%Span} = -0.086\ PCT$$

6.2 Total Loop Error (TLE)

This attachment uses the Unit 2 data for substituting these values, since Unit 2 provides the worst-case total loop error. Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$(DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2) = A + D_R + M$$

New total loop error (TLE) under seismic event and potential loss of non-seismic HVAC for Unit 2 is calculated using the following equations:

$$TLE\ (SRSS) = \left[DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$\begin{aligned} TLE\ (SRSS) = {} & [(0.520\ PCT)^2 + (0.1072\ PCT)^2 + 0\ (PCT^2) + 0.065\ (PCT^2) \\ & + 0.1321\ (PCT^2) + 0\ (PCT^2) + 0.2841\ (PCT^2) + 0.345\ (PCT^2) + 0\ (PCT^2) \\ & + 5.5206\ (PCT^2) + 0\ (PCT^2) + (0\ PCT)^2 + (0\ PCT)^2 + (0\ PCT)^2]^{1/2} \\ = {} & \pm 2.5746\ PCT \end{aligned}$$

$$Bias_{pos} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{BP} + T_{NSBp} + R_{NBp} + H_{NSBp} + S_{Bp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp}$$

$$Bias_{pos} = 0\ PCT + 0.0095\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0.47242\ PCT + 0.39\ PCT + 0.56404\ PCT = 1.43596\ PCT$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

$$Bias_{neg} = (-0.086\ PCT) + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT + 0\ PCT = -0.086\ PCT$$

$$TLE_{pos} = TLE\ (SRSS) + Bias_{pos}$$

$$TLE_{pos} = 2.5746\ PCT + 1.43596\ PCT = 4.01056\ PCT$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from Section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE_{pos} = 0\ PCT + 4.01056\ PCT = 4.01056\ PCT$$

6.4 Allowable Value (AV)

The allowable value for Steam Generator (SG) Water Level – Low-Low is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$Loop\ Drift\ (Random)\ LD_R = \sqrt{DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{bistable}{}^2 + R_{NR}}$$

$$Loop\ Drift\ (Negative\ Bias)\ LD_{BN} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + R_{NBN}$$

$$AV = NTSP - LD_R - LD_{BN}$$

Substituting these values, the allowable value is calculated as:

$$LD_R = \sqrt{(0.520\ PCT)^2 + (0.1072\ PCT)^2 + 0.345\ (PCT^2)} = 0.79176\ PCT$$

$$LD_{BN} = (-0.086\ PCT) + 0\ PCT + 0\ PCT = -0.086\ PCT$$

$$AV = 4.01056\ PCT - 0.79176\ PCT - (-0.086)\ PCT = 3.3048\ PCT$$

6.5 Setpoint Margin

The setpoint margin acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.1. Using the NTSP value calculated in Section 6.3 and the AFT and APS values, the setpoint margin is evaluated below:

$$Accetpance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

$$NTSP \leq APS - AFT$$

$$4.01056\ PCT \leq 13\ PCT - 0.5\ PCT$$

$$4.01056\ PCT \leq 12.5\ PCT$$

Using the APS and AFT values for the 2LC-472A NUS Bistable from Section 4.4 and using the NTSP value calculated in Section 6.3, the setpoint margin is evaluated below.

$$Accetpance\ Criteria\ (Decreasing): NTSP \leq APS - AFT$$

$$NTSP \leq APS - AFT$$

$$4.01056\ PCT \leq 13.5\ PCT - 0.5\ PCT$$

$$4.01056\ PCT \leq 13\ PCT$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

The AV taken from the Unit 1 and Unit 2 Technical Specifications is shown below:

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$11.3\% \geq 3.3048\%$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-010 (Reference 8.3.1) and SPC-DR-022 (Reference 8.3.2), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for the Auxiliary Feedwater - Low-Low SG Water Level instruments can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals**:**

8.2.1 EM 3.3.4.2, Revision 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Revision 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations:

8.3.1 SPC-DR-010, Revision 0, "Drift Analysis of As-Found/As-Left Data for NUS Bistable DAM503-03 (V)".

8.3.2 SPC-DR-022, Revision 0, "As-Found / As -Left Data for Rosemount Transmitter 3152ND-2-A-2-F3-E-3-Q8-W2– Containment Building".

8.4 Setpoint Calculations:

8.4.1 SPC-RP-015, Revision 6, "UNIT 1 Steam Generator Lo-Lo Level Reactor Trip".

8.4.2 SPC-RP-016, Revision 5, "UNIT 2 Steam Generator Lo-Lo Level Reactor Trip".

8.5 Technical Specifications:

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42) Amendment 230.

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60) Amendment 218.

8.6 Surveillance Procedures:

8.6.1 Surveillance Procedure SP 1002A, Rev. 50, "Analog Protection System Calibration".

8.6.2 Surveillance Procedure SP 1002B.4, Rev. 3, "Reactor Protection and Control Transmitter Calibration/Inspection Steam Generator Level".

8.6.3 Surveillance Procedure SP 2002A, Rev. 51, "Analog Protection System Calibration".

8.6.4 Surveillance Procedure SP 2002B.4, Rev. 6, "Reactor Protection and Control Transmitter Calibration/Inspection Steam Generator Level".

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1.0 Purpose

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact the plant operation for the Units 1 Buses 11 and 12 and Unit 2 Buses 21 and 22 Undervoltage Relays which perform lockout 4.16KV Supply Breaker Trips, Reactor Coolant Pumps Trips, Feedwater Pump trips and possible reactor trips. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in the following table:

Table 1.1: Affected Instrumentation

Instrument Number	Manufacturer	Model
27A/B11	ASCO	214B111
27A/B12	ASCO	214B111
27A/B21	ASCO	214B111
27A/B22	ASCO	214B111
27B/B11	ASCO	214B111
27B/B12	ASCO	214B111
27B/B21	ASCO	214B111
27B/B22	ASCO	214B111

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

3.0 Acceptance Criteria

See Summary Setpoint Calculation Main Body Section 3.0 for setpoint evaluation acceptance criteria.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-031, “Drift Analysis of As-Found/As-Left Data for ASCO Valve Undervoltage Relay 214B111” (Reference 8.3.1). This calculation evaluates the instrument drift of the instruments used in the setpoint calculation. The data taken from the calculation is summarized in the following sections:

4.1.1 SPC-DR-031

The ASCO Relay 214B111 was evaluated and the following Drift Tolerance Interval value was calculated:

$$DA\_Ext\_Rand \quad = \pm 0.756\, VAC$$

$$DA\_Ext\_Bias = 0\, VAC$$

Converting the drift into percent nominal voltage and squaring so that it can be applied in Section 6.0 as follows:

$$D = \left[\left(\frac{0.756}{120.09}\right)x100\right]^2 = 0.40\%$$

(120.09 is the nominal voltage seen by the undervoltage relay per reference 8.4.1 Section 4.1)

4.2 Setpoint/Uncertainty Calculations

The undervoltage relay trip setpoint for the 4.16KV, non-safeguards distribution buses is evaluated in setpoint calculation SPC-EA-0008, "4.16KV Non-Safeguards Buses 11, 12, 21 and 22 Undervoltage Relay Setpoint" (Reference 8.4.1). Pertinent information from this calculation for this evaluation is summarized below:

Sections 1.4.1 and 5.3 of SPC-EA-0008 (Reference 8.4.1) provides the following information:

$$Actual\ Trip\ Setpoint\ (ATSP) = 77.86\%\ (93.5\, VAC)$$

$$Analytical\ Limit\ (AL) = 75\%\ (90.07\, VAC)$$

Total loop error is calculated using the following equations (Reference 8.4.1 Section 5.2):

$$TLE\ (SRSS) = \ [A + D + M + SPE + R + T + H + P + PCR]^{\frac{1}{2}} + PCN$$

After entering the data for Unit 1 (SPC-EA-0008), the total loop error is calculated as:

$$TLE\ (SRSS) = \ [0.09 + 0.839 + 0 + 0 + 0 + 0 + 0 + 0 + 0]^{\frac{1}{2}} + 0$$

$$TLE\ (SRSS) = \ 0.96\%$$

The accuracy allowance of 0.09 is the square of the potential transformer accuracy of ±0.3% (Reference 8.4.1 Section 5.1.1)

The nominal trip setpoint (NTSP) is calculated for the undervoltage relay using the following equation (Reference 8.4.1 Section 5.3):

$$NTSP = AL + TLE$$

The allowable value (AV) for the undervoltage relay is determined using the following equations (Reference 8.4.1 Section 5.2):

$$Loop\ Drift\ (LD) = \sqrt{A + D + M}$$

$$AV = NTSP - LD$$

4.3 Technical Specifications

The allowable value for the Undervoltage Relays on 4.16 KV Buses 11 and 12 (21 and 22) is taken from the technical specification table 3.3.2-1 for each unit (References 8.5.1 and 8.5.2). The same value is used for both units.

$$AV \geq 76\% \text{ rated bus voltage}$$

$$AV \geq 120.09\, VAC\ x\ 76\% = 91.27\, VAC$$

4.4 Calibration Procedures

The actual trip setpoint (ATSP) and as found tolerance (AFT) are taken from surveillance procedures SP 1014 (Reference 8.6.1) and SP 2014 (Reference 8.6.2).

$$ATSP = 77.86\%\ (93.5\, VAC)$$

$$AFT = \pm 0.83\%\ (\pm 1\, VAC)$$

5.0 Assumptions

5.1. Cable power losses for the instrument loops in question are negligible (Reference 8.4.1)

6.0 Analysis

6.1 Total Loop Error (TLE)

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$TLE\ (SRSS) = [A + D + M + SPE + R + T + H + P + PCR]^{\frac{1}{2}} + PCN$$

$$TLE\ (SRSS) = [0.09 + 0.40 + 0 + 0 + 0 + 0 + 0 + 0 + 0]^{\frac{1}{2}} + 0$$

$$TLE\ (SRSS) = 0.70\%$$

$$TLE\ (SRSS) = 0.70\%\ X\ 120.09 = 0.84\, VAC$$

6.3 Nominal Trip Setpoint (NTSP)

Using the equations from section 4.2 and the new calculated TLE value, the nominal trip setpoint using the new drift values is calculated below:

$$NTSP = AL + TLE = 75\% + 0.70\% = 75.70\%\ (90.91\ VAC)$$

$$Margin = ASTP - NTSP = 77.86\% - 75.70\% = 2.16\%$$

A positive margin indicates that the existing ATSP is greater than the NTSP and is conservative.

6.4 Allowable Value (AV)

The allowable value for Undervoltage Relays is calculated using the new NTSP and the Loop Drift calculated again replacing the instrument accuracy, drift, and measurement and test equipment allowance as shown below:

$$LD = \ [D]^{\frac{1}{2}}$$

$$LD = \ [0.40]^{\frac{1}{2}} = 0.63\%$$

$$AV = NTSP - LD$$

$$AV = 75.84\% - 0.63\% = 75.21\%$$

6.5 Setpoint Margin

Using the NTSP value calculated in Section 6.3 and the AFT and ATSP values the setpoint margin is evaluated below:

$$Accetpance\ Criteria: NTSP \leq ATSP - AFT$$

$$75.70\% \leq 77.86\% - 0.83\%$$

$$75.70\% \leq 77.03\%$$

6.6 Allowable Value Acceptance

The allowable value acceptance criteria for a decreasing setpoint is checked using the methodology shown in Summary Setpoint Calculation Main Body Section 3.2.

$$Acceptance\ Criteria\ (Decreasing): AV_{Tech\ Spec} \geq AV_{Calc}$$

$$AV_{Tech\ Spec} \geq AV_{Calc}$$

$$76\% \geq 75.21\%$$

7.0 Conclusions and Plant Impact

After calculating an updated total loop error, nominal trip setpoint, and allowable value using the new calculated drift values provided in drift calculations SPC-DR-031 (Reference 8.3.1), the new calculated values were found acceptable using the criteria outlined in Section 3.0 of the Summary Setpoint Calculation Main Body. Therefore, the calibration interval for Buses 11, 12, 21 and 22 Undervoltage Relays can be extended to 30 months without impact to the subject setpoint and allowable value.

8.0 References

8.1 Industry Guidance:

8.1.1 EPRI Report TR-103335, Revision 2, “Guidelines for Instrument Calibration Extension/Reduction Programs”.

8.2 Engineering Manuals:

8.2.1 EM 3.3.4.2, Revision 1, “The Analysis of Instrument Drift”.

8.2.2 EM 3.3.4.1, Revision 2, “Instrument Setpoint/Uncertainty Calculations”.

8.3 Drift Calculations:

8.3.1 SPC-DR-031, Revision 0, “Drift Analysis of As-Found/As-Left Data for ASCO Valve Undervoltage Relay 214B111”.

8.4 Setpoint Calculations:

8.4.1 SPC-EA-0008, Revision 0, “4.16KV Non-Safeguards Buses 11, 12, 21, and 22 Undervoltage Relay Setpoint”.

8.5 Technical Specifications:

8.5.1 Unit 1, “NORTHERN STATES POWER COMPANY DOCKET NO. 50-282 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 1 RENEWED FACITLITY OPERATING LICENSE (No. DPR-42), Amendment 230”

8.5.2 Unit 2, “NORTHERN STATES POWER COMPANY DOCKET NO. 50-306 PRAIRIE ISLAND NUCLEAR GENERATING PLANT, UNIT 2 RENEWED FACITLITY OPERATING LICENSE (No. DPR-60, Amendment 218”

8.6 Surveillance Procedures:

8.6.1 SP 1014, Revision 23, “Unit 1 4KV Voltage and Frequency Relay Calibration”

8.6.2 SP 2014, Revision 27, “Unit 2 4KV Voltage and Frequency Relay Calibration”

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1.0 PURPOSE

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact plant operation for the Units 1 and 2 Low Temperature Overpressure Protection (LTOP) Reactor Coolant System Cold Leg Temperature (RCSCLT) control room uncertainty indication used in the Pressure Temperature Limits Report (PTLR) (Reference 8.7.1), for the (i) RCS Pressure and Temperature (P/T) Limits; (ii) Over Pressure Protection System (OPPS) Enable Temperature; (iii) Safety Injection (SI) Pump Disable Temperature; and (iv) RCS Minimum Temperature When Not Vented. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in Table 1.1 below (Reference 8.6.1).

Table 1.1: Instruments

Instrument Tag No.	Manufacturer	Model No.
1TT-450B	Foxboro	2AI-P2V
1TM-450BA	Foxboro	2AO-VAI
1TR-450	Yokogawa	DX364
2TT-450B	Foxboro	2AI-P2V
2TM-450BA	Foxboro	2AO-VAI
2TR-450	Yokogawa	DX364

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology.

3.0 Acceptance Criteria

The acceptance criteria is that the TLE calculated in this Attachment does not exceed the uncertainty allowance provided in the Operating Limits listed in the Pressure and Temperature Limits Report (PTLR) (Reference 8.7.1, Section 4.4). This is evaluated by comparing the Reactor Coolant System Cold Leg Temperature (RCSCLT) indication uncertainty of 18 °F provided in the PTLR with the calculated Total Loop Error (TLE) using drift calculation data. If the calculated TLE using drift calculation data is less than 18 °F, then sufficient margin exists and the PTLR Operating Limits will not be exceeded.

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-002 Rev. 0, “Drift Analysis of As-Found /As -Left Data for Foxboro R/E Converter 2AI-P2V” (Reference 8.3.1) and SPC-DR-003 Rev. 0, “Drift Analysis of As-Found /As -Left Data for Foxboro E/I Isolator 2AO-VAI” (Reference 8.3.2). These calculations evaluate the drift of the instruments used in the setpoint calculations. The data taken from each is summarized in Sections 4.1.1 and 4.1.2 below.

4.1.1 SPC-DR-002

The Foxboro Transmitter Model No. 2AI-P2V was evaluated and the following drift values were calculated:

$$DA\_Ext\_Rand_{trans} = \pm 0.5212\%\ Calibrated\ Span\ \ (95\%/95\%\ Factor)$$

$$DA\_Ext\_Bias_{trans} = 0\%\ Calibrated\ Span\ (95\%/95\%\ Factor)$$

4.1.2 SPC-DR-003

The Foxboro E/I Isolator Model No. 2AO-VAI was evaluated and the following drift values were calculated:

$$DA\_Ext\_Rand_{E/I} = \pm 0.1370\%\ Calibrated\ Span\ (95\%/95\%\ Factor)$$

$$DA\_Ext\_Bias_{E/I} = 0\%\ Calibrated\ Span\ (95\%/95\%\ Factor)$$

4.2 Setpoint/Uncertainty Calculations

The instruments listed in Table 1.1 are evaluated in SPC-RC-003 (Reference 8.4.1). Form 1 of SPC-RP-003 lists:

$$Process\ Span = 50.00\ to\ 700.00\ °F$$

Section 3.0, *Operating Limits*, of the Prairie Island PTLR (Reference 8.7.1), states:

> ***All limits are valid*** *until 54 EFPY, which is projected to be beyond the expiration of the operating license* ***for each of Prairie Island Units 1 and 2 [****emphasis added].*

Noting that SPC-RC-003 Rev. 0A is listed as Reference 5.11 in the PTLR, Unit 1 data from SPC-RC-003 will represent both units.

Per the Yokogawa drift specification for DXA models including DX364 (Appendix A), a deviation (drift) of 0.0399% of range (calibrated span) was recorded for a 2 year period, or 24 months. For a 30 month period, using a conservative linear approach to extrapolate per Section 6.11 of EM 3.3.4.2 (Reference 8.2.1), and assuming a plus/minus drift, this equates to:

(30 mo./24 mo.) (±0.0399%CS) = ±0.04988%CS

For a 50-750 $°F$ calibrated span, the Yokogawa drift over 30 months equates to:

(±0.04988%CS) ((700-50)°F)/(100%CS)) =±0.3242 °F

Section 6.3.1 of EM 3.3.4.1 (Reference 8.2.2) states:

> *For SRSS combinations any values which are less than 0.1 times the largest numerical value under the radical can be ignored with no significant effect on the calculation results.*

The largest numerical value under the radical is PMA_{NR} = 14°F, and

0.1 (14°F) = 1.4 °F

Since ±0.3242 °F < 1.4 °F, the Yokogawa drift is considered insignificant and can be ignored, therefore, the drift is 0°F.

Yokogawa Drift = 0°F

Per SPC-RC-003 (Reference 8.4.1), TLE_{pos} for normal conditions is calculated as follows:

$$TLE_{pos} = TLE\ (SRSSN) + Bias_{pos}$$

where,

$$TLE(SRSSN) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NR} + R_{NR} + H_{NR} + READ + {PEA_{NR}}^2 + {PMA_{NR}}^2 + {PC_{NR}}^2\right]^{\frac{1}{2}}$$

$$Bias_{pos} = D_{Bp} + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NBp} + R_{NBp} + H_{NBp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp} + IR_{Bp}$$

Substituting SPC-RC-003 (Reference 8.4.1) Unit 1 data,

$$SRSSN = [46.125\ (°F^2) + 0\ (°F^2) + 3.328\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 23.766\ (°F^2) + 30.128\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 0.04\ (°F^2) + 196\ (°F^2) + 0\ (°F^2)\ ]^{\frac{1}{2}} = \pm 17.303\ °F$$

$$Bias_{pos} = 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F = 0\ °F$$

$$TLE_{pos} = +17.303\ °F + 0\ °F = +17.303\ °F$$

4.3 Technical Specifications

SR 3.4.12.4 (References 8.5.1, 8.5.2) states *Perform a COT on OPPS* while noting:

> *Not required to be performed until 12 hours after decreasing RCS cold leg temperature to ≥ the OPPS enable temperature specified in the PTLR [Ref.8.7.1].*

SR 3.4.13.5 (References 8.5.1, 8.5.2) states *Perform a COT on OPPS* while noting:

> *Not required to be performed until 12 hours after decreasing RCS cold leg temperature to ≤ the OPPS enable temperature specified in the PTLR.*

There are no Allowable Values in the Technical Specifications for OPPS.

4.4 Pressure Temperature Limits Report (PTLR)

Operating Limits for (i) RCS Pressure and Temperature (P/T) Limits; (ii) Over Pressure Protection System (OPPS) Enable Temperature; (iii) Safety Injection (SI) Pump Disable Temperature; and (iv) RCS Minimum Temperature When Not Vented are listed/shown in Figures 6.1 and 6.2, Sections 3.4.1, Section 3.4.2, and Section 3.4.4 respectively of the PTLR (Reference 8.7.1) and are as follows:

(i) RCS P/T Limits [P/T curves do not include **18 °F** instrument uncertainty]:

(ii) OPPS Enable Temp: AL + TLE + Margin = 310 °F

225 °F + **18°F** + 67 °F = 310 °F (Operating Limit)

(iii) SI Pump Disable Temp: AL + TLE = 218 °F

200 °F + **18°F** = 218 °F (Operating Limit)

(iv) RCS Min Temp – not vented: AL + TLE = 86 °F

68 °F + **18°F** = 86 °F (Operating Limit)

There are no Allowable Values in the PTLR for OPPS. However, for the purposes of this calculation, the Operating Limits (OL) will be substituted for the Allowable Values (AV) wherever AV appears in the methodology described in the Base Calculation.

4.5 Calibration Procedures

SPC-RC-003 (Reference 8.4.1) calculates the instrument uncertainty for RCSCLT control room indication only. No setpoints are calculated. Per SP 1224 (Reference 8.6.1) and SPC-RC-003 Forms 2 and 3, 1(2)TT-450B setting tolerance and accuracy are equivalent (3.25 °F), 1(2)TM-450BA setting tolerance and accuracy are equivalent (3.25 °F), and the recorder uses the setting tolerance of 5 °F for the accuracy.

4.6 Operating Procedures

1TR-450 is referenced in Operating Procedures 1C1.2-M3 (Ref. 8.8.1), 1C1.2-M4 (Ref. 8.8.2) and 1C1.2-M5 (Ref. 8.8.3) as the control room indication to be used for PTLR (Reference 8.7.1) Operating Limits.

5.0 Assumptions

5.1 Engineering Judgement for Unit 2 Data

In Section 4.2 an engineering judgement was used regarding Unit 1 data being representative of Unit 2 data.

5.2 Engineering Judgement for Yokogawa Recorder

In Section 4.2 an engineering judgement was used regarding the Yokogawa recorder drift value being a plus/minus uncertainty.

6.0 Analysis

6.1 Unit Conversion

The total drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 in terms of percent calibrated span (%CS). To interface with the equations and values taken from the uncertainty calculation, the drift data is converted into process units (°F) using the process span stated in in Sections 4.2 as follows:

Foxboro Transmitter 2AI-P2V:

$$DA\_Ext\_Rand_{trans} = (\pm 0.5212\%CS)\frac{(700-50)°F}{100\%CS} = \pm 3.3878\ °F$$

Foxboro Transmitter 2AO-VAI:

$$DA\_Ext\_Rand_{E/I} = (\pm 0.1370\%CS)\frac{(700-50)°F}{100\%CS} = \pm 0.8905\ °F$$

6.2 Total Loop Error (TLE) using Drift Calculation Data

Instrument drift from the referenced drift calculations is used to replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the loop setpoint using the methodology shown below:

$$DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{E/I}{}^2 = A + D_R + M$$

For the Yokogawa Recorder:

$$Accuracy = A_{Rec};\ Drift = D_{R.Rec};\ MTE = M_{Rec}$$

Substituting terms,

$$TLE(SRSSN) = \left[(DA\_Ext\_Rand_{trans}{}^2 + DA\_Ext\_Rand_{E/I}{}^2) + A_{Rec} + D_{R.Rec} + M_{Rec} + OPE_R + SPEZ_R + SPES_R + P_R + T_{NR} + R_{NR} + H_{NR} + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{\frac{1}{2}}$$

$$Bias_{pos} = DA\_Ext\_Bias_{trans}{}^2 + DA\_Ext\_Bias_{E/I}{}^2 + OPE_{Bp} + SPEZ_{Bp} + SPES_{Bp} + P_{Bp} + T_{NBp} + R_{NBp} + PEA_{NBp} + PMA_{NBp} + PC_{NBp} + IR_{Bp}$$

Substituting SPC-RC-003 (Reference 8.4.1) Unit 1 data and drift calculation data,

$$TLE(SRSSN) = [((3.3878\ °F)^2 + (0.8905\ °F)^2) + 25.000\ (°F^2) + 0\ (°F^2) + 0.6496\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 23.766\ (°F^2) + 30.128\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 0\ (°F^2) + 0.04\ (°F^2) + 196\ (°F^2) + 0\ (°F^2)]^{\frac{1}{2}} = \pm 16.966\ °F$$

$$Bias_{pos} = 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F + 0\ °F = 0\ °F$$

$$TLE_{pos} = +SRSSN + Bias_{pos}$$
$$TLE_{pos} = +16.966\ °F + 0°F = +16.966\ °F$$

6.3 Nominal Trip Setpoint (NTSP)

SPC-RC-003 (Reference 8.4.1) calculates the instrument uncertainty for RCSCLT control room indication only. No setpoints are calculated.

6.4 Allowable Value (AV)

No Allowable Value is calculated in SPC-RC-003 (Reference 8.4.1), and no Allowable Values are listed in the Technical Specifications or PTLR (Reference 8.7.1) for the RCSCLT control room indication.

6.5 PTLR Operating Limits

The PTLR (Reference 8.7.1) lists an RCSCLT uncertainty indication of 18 °F, and the calculated TLE using drift calculation data from Section 6.2 of this Attachment is +16.966 °F. Therefore, the Acceptance Criteria defined in Section 3.0 of this summary attachment is satisfied, ensuring that the PTLR Operating Limits will not be exceeded.

7.0 Conclusions and Plant Impact

An updated total loop error (TLE) was calculated using the calculated drift values provided in drift calculations SPC-DR-002 (Reference 8.3.1) and SPC-DR-03 (Reference 8.3.2). The calculated TLE is less than the 18 °F uncertainty stated in the PTLR (Reference 8.7.1), thereby meeting the Section 3.0 Acceptance Criteria of this summary attachment. Therefore, the calibration interval for the RCSCLT control room indication loops 1(2)T-450B can be extended to 30 months without any impact to the Operating Limits specified in the PTLR.

8.0 References

8.1 Industry Guidance

8.1.1 EPRI Report TR-103335, Rev. 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals

8.2.1 EM 3.3.4.2, Rev. 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Rev. 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations

8.3.1 SPC-DR-002, Revision 0, "Drift Analysis of As-Found /As -Left Data for Foxboro R/E Converter 2AI-P2V".

8.3.2 SPC-DR-003, Revision 0, "Drift Analysis of As-Found /As -Left Data for Foxboro E/I Isolator 2AO-VAI".

8.4 Setpoint Calculations

8.4.1 SPC-RC-003, Revision 0, "Unit 1 Wide Range RCS Cold Leg Temperature Control Room Indication Loop 1T-4508 Uncertainty with Streaming Effects".

8.5 Technical Specifications

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42 Addendum 230)

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60 Addendum 218)

8.6 Surveillance Procedures

8.6.1 SP 1224, Rev. 35, “Event Monitoring Instrument Calibration”

8.7 Reports

8.7.1 Prairie Island Nuclear Generating Plant Units One and Two, “Pressure and Temperature Limits Report Revision 8 (Effective until 54 EFPY)”.

8.8 Operating Procedures

8.8.1 1C1.2-M3 Rev. 9, “Unit 1 Startup to Mode 3”

8.8.2 1C1.2-M4 Rev. 8, “Unit 1 Startup to Mode 4”

8.8.3 1C1.2-M5 Rev. 17, “Unit 1 Startup to Mode 5”

9.0 Appendices

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August 18, 2016

Subject: Drift specifications for DXAdvanced DX1000/DX1000N/DX2000/DX3000 models

There is no published drift specification for the DXAdvanced models because it is almost insignificant and it is not a practical specification for the measurement circuitry used in them.

We do have factory test data that provides the following information for the DX1000N:

On the 20mV DC measurement range, a 20.000 mV reference voltage was applied to the inputs and recorded for a 2 year period. The range of the measured values produced by the DX1000N varied between 19.998 mV (minimum value) to 20.006 mV (maximum value), a deviation of 8 µV. This deviation represents 0.0399% of the 20.0 mV range. See the table on the following page containing the raw data for DX1000N and DX2000 models.

This is the most sensitive measurement range on the DX1000N and it will have the highest amount of drift. The higher DCV ranges will have an even lower percentage of drift. In practical terms this means the DX1000N DCV measurement will stay within specification for many years.

This information applies to all DXA models; DX1000N/DX2000/DX3000 and DX364.

DXAdvanced Long Term Drift Data

Document Number: YCA-070917-AN01
Confidential

DX1000N(20mV)

Date		Elapsed time	Zero Input		Full Input	
Year	Date-Month	[y/mm/dd]	Max [mV]	Min [mV]	Max [mV]	Min [mV]
2005	13 Sep		0.000	-0.001	19.998	19.998
	13 Oct	00/01/00	0.000	0.000	20.003	20.002
	20-Dec	00/03/17	0.000	0.000	20.003	20.002
2006	13-Jan	00/04/00	0.000	0.000	20.003	20.002
	13 Feb	00/05/00	0.000	0.000	20.003	20.002
	13-Mar	00/06/00	0.000	0.000	20.003	20.002
	13 Apr	00/07/00	0.000	0.000	20.004	20.003
	12-May	00/08/00	0.000	0.000	20.003	20.002
	13-Jun	00/09/00	0.000	0.000	20.004	20.003
	13-Jul	00/10/00	0.000	0.000	20.005	20.004
	14-Aug	00/11/00	0.000	0.000	20.006	20.005
	13-Sep	01/00/00	0.000	0.000	20.004	20.003
	13-Oct	01/01/00	0.000	0.000	20.004	20.003
	13 Nov	01/02/00	0.000	0.000	20.002	20.001
	13 Dec	01/03/00	0.000	0.000	20.002	20.001
2007	15-Jan	01/04/00	0.001	0.000	20.002	20.001
	13-Feb	01/05/00	0.000	0.000	20.003	20.002
	13-Mar	01/06/00	0.000	0.000	20.004	20.003
	17 Apr	01/07/00	0.000	0.000	20.004	20.003
	25-May	01/08/00	0.000	0.000	20.006	20.005
	12 Jun	01/09/00	0.000	0.000	20.005	20.004
	17 Jul	01/10/00	0.000	0.000	20.006	20.005
	13 Aug	01/11/00	0.000	0.000	20.006	20.005
	13 Sep	02/00/00	0.000	0.000	20.006	20.005

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1.0 PURPOSE

The purpose of this setpoint calculation summary attachment is to provide justification that the change in the surveillance interval from 24 to 30 months does not adversely impact plant operation for the Units 1 and 2 Over Pressure Protection System (OPPS) bistable setpoints, which open both pressurizer Power Operated Relief Valves (PORV's) A and B when OPPS temperature is enabled. This justification will provide input into the LAR being submitted to extend surveillance intervals. This setpoint attachment considers the instruments listed in Table 1.1 below (References 8.6.1, 8.6.2, 8.6.3, 8.6.4, and 8.11.1).

Table 1.1: Instruments

Instrument Tag No.	Manufacturer	Model No.
1PT-419	Rosemount	1154GP9RC
1PT-420	Rosemount	1154GP9RC
1PC-419C/D	Foxboro	63U-BC-OHEA-F
1PC-420C/D	Foxboro	63U-BC-OHEA-F
2PT-419	Rosemount	1154GP9RC
2PT-420	Rosemount	1154GP9RC
2PT-419C/D	Foxboro	63U-BC-OHEA-F
2PT-420C/D	Foxboro	63U-BC-OHEA-F

2.0 Methodology

See Summary Setpoint Calculation Main Body Section 2.0 for the general setpoint evaluation methodology. Per Section 1.1 of SPC-RC-013 (Reference 8.4.1), instrument loop 1P-420 was selected as the representative loop and is applicable to 1P-419 and 1P420 (Unit 1), and 2P-419 and 2P-420 (Unit 2).

3.0 Acceptance Criteria

Maintain sufficient operating margin for the pressurizer PORV A and B lift setpoints required for compliance with Unit 1 and Unit 2 Technical Specification LCO 3.4.12 and 3.4.13 (References 8.5.1 and 8.5.2)

4.0 Design Inputs

4.1 Drift Calculations

This attachment uses data from drift calculations SPC-DR-021 Rev. 0, "Drift Analysis of As-Found /As-Left for Rosemount Transmitters 1154GP9RC" (Reference 8.3.1) and SPC-DR-005 Rev. 0, "Drift Analysis of As-Found /As -Left Data for Foxboro Alarm Unit 63U-BC" (Reference 8.3.2). These calculations evaluate the drift of the instruments used in the setpoint calculations. The data taken from each is summarized in Sections 4.1.1 and 4.1.2 below.

4.1.1 SPC-DR-021

The Rosemount Transmitter Model No. 1154GP9RC was evaluated and the following drift values were calculated:

$$DA\_Ext\_Rand_{trans} = \pm 1.264\ \%\ Calibrated\ Span\ \ (95\%/95\%\ Factor)$$

$$DA\_Ext\_Bias_{trans} = 0\ \%\ Calibrated\ Span\ (95\%/95\%\ Factor)$$

4.1.2 SPC-DR-005

The Foxboro Bistable Model No. 63U-BC-OHEA-F was evaluated and the following drift values were calculated:

$$DA\_Ext\_Rand_{bistable} = \pm 0.385\ \%\ Calibrated\ Span\ \ (95\%/95\%\ Factor)$$

$$DA\_Ext\_Bias_{bistable} = 0\ \%\ Calibrated\ Span\ (95\%/95\%\ Factor)$$

4.2 Setpoint/Uncertainty Calculations

Table 1.1 of this attachment lists the instruments that are evaluated in SPC-RP-013 (Reference 8.4.1). Form 1 of SPC-RP-013 lists the following process span:

$$Process\ Span = 0\ to\ 3000\ PSIG$$

Per SPC-RP-013, the Total Loop Error (TLE) for a seismic and potential subsequent loss of non-seismic HVAC conditions is calculated as follows:

$$TLE_{neg} = -TLE\ (SRSSN) - Bias_{neg}$$

where,

$$TLE(SRSSS) = \left[A + D_R + M + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^2 + PMA_{NR}{}^2 + PC_{NR}{}^2\right]^{1/2}$$

$$Bias_{neg} = D_{Bn} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBn} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

Substituting Unit 1 data from SPC-RC-013:

$$TLE(SRSSS) = [225\ (PSIG^2) + 752.04\ (PSIG^2) + 491.3759\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ PSIG^2\ + 0\ (PSIG^2)\ + 506.25\ (PSIG^2) + 900\ (PSIG^2) + 0\ (PSIG^2)\ + 225\ (PSIG^2)\ +\ 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2)]^{\frac{1}{2}} = \pm 55.674\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG\ + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -55.674\ PSIG - 0\ PSIG = -55.674\ PSIG$$

NOTE: In Section 5.2.3, m_1 = ±22.167 PSIG, hence, M = (±22.167 PSIG)^2 or ±491.3759 (PSIG^2). This will be corrected when the minor revision of SPC-RC-013 is developed.

4.3 Technical Specifications

There are no Allowable Values in the Technical Specifications for OPPS. Applicable LCO sections of the Technical Specifications related to the OPPS bistable pressure setpoints for PORV's A and B are shown below.

LCO 3.4.12(c) LTOP shall be provided with:

c. An OPERABLE Over Pressure Protection System (OPPS) with lift setting within the limits specified in the PTLR.

LCO 3.4.13(a) LTOP shall be provided with: 1) no SI Pumps capable of injecting into the RCS; 2) the emergency core cooling system (ECCS) accumulators isolated; and 3) one of the following pressure relief capabilities:

a. An Over Pressure Protection System (OPPS) shall be OPERABLE with two pressurizer power operated relief valves (PORVs) with lift settings within the limits specified in the PTLR.

4.4 Pressure Temperature Limits Report (PTLR)

Section 3.4.3 of the PTLR (Reference 8.7.1) states:

Over Pressure Protection System (OPPS) PORV Setpoint (LCO 3.4.12 and 3.4.13)
500 psig*

**This setpoint accounts for instrument channel uncertainty (Reference 5.8).*

Reference 5.8 of the PTLR is ENG-ME-599, Revision 1A, "OWNER RVW OF WEST PRZR PORV LTOP STROKING REQ" (Reference 8.4.2 of this attachment), states the following regarding instrument channel uncertainty:

*Reference 10 provided the WR pressure uncertainties as +1.9788 / -1.8558 percent of process span (3000 psi). For LTOPS actuation, indicated lower than actual uncertainties are conservative, and therefore, a WR pressure uncertainty of 55.674 psi (0.018558 fraction of span * 3000 psi span = 55.674 psi), rounded to 55.7 psi will be used in the analysis.*

4.5 Calibration Procedures

The Actual Plant Setpoint (APS) and As-Found Tolerance (AFT) are taken from SP 1199A and SP 2199A (References 8.6.1 and 8.6.2). The current plant setting for the bistables is 0.1666 VDC with a tolerance of ±0.0020 VDC. Per SP 1199B and SP 2199B (References 8.6.3 and 8.6.4), the transmitter span is 0 - 3000 PSIG with an output of 0.1 to 0.5 VDC to the bistables. Therefore, the current plant setting in terms of PSIG is:

$$APS\ (PSIG) = \left[\frac{0.1666 - 0.1000\ VDC}{0.5000\ -\ 0.1000\ VDC}\right] 3000\ PSIG = 499.500\ PSIG, or\ 500\ PSIG$$

$$AFT+(PSIG)=\left[\frac{0.1686\ -\ 0.1000\,VDC}{0.5000\ -0.1000\,VDC}\right]3000\ PSIG$$

$$=+514.500\ PSIG, or +515\ PSIG$$

$$AFT-\ (PSIG)=\left[\frac{0.1646\ -0.1000\,VDC}{0.5000\ -0.1000\,VDC}\right]3000\ PSIG$$

$$=-484.500\ PSIG, or -485\ PSIG$$

$$APS=500\ PSIG$$

$$AFT=\pm15\ PSIG$$

5.0 Assumptions

In Section 7.0 an engineering judgement was made regarding the reduction of operating margin and the acceptability of the PORV A and B 500 $PSIG$ actual plant setting (APS) setpoint.

6.0 Analysis

6.1 Unit Conversion

The total calculated drift tolerance interval for each instrument was calculated in References 8.3.1 and 8.3.2 using percent calibrated span (%CS). To interface with the equations and values taken from the setpoint calculation, the drift data is converted into process units using the process span (See Sections 4.2) below:

Rosemount Transmitter 1154GP9RC

$$DA\_Ext\_Rand_{trans}=\pm1.264\%CS=\pm1.264\%CS\times\frac{3000\ PSIG}{100\%CS}=\pm37.92\ PSIG$$

Foxboro Bistable 63U-BC-OHEA-F

$$DA\_Ext\_Rand_{bistable}=\pm0.385\%CS=\pm0.385\%CS\times\frac{3000\ PSIG}{100\%CS}=\pm11.55\ PSIG$$

6.2 Total Loop Error (TLE)

Instrument drift from the Section 4.1 drift calculations for the Rosemount 1154GP9RC transmitters and Foxboro 63U-BC-OHEA-F bistables are used to calculate and replace the instrument accuracy, drift, and measurement and test equipment allowance for an updated evaluation of the TLE. The methodology is shown below.

$$\left(DA\_Ext\_Rand_{trans}{}^{2}+DA\_Ext\_Rand_{bistable}{}^{2}\right)=A+D_R+M$$

The updated Total Loop Error (TLE) for a seismic and potential subsequent loss of non-seismic HVAC conditions is calculated as follows:

$$TLE_{neg}=-TLE\ (SRSSS)-Bias_{neg}$$

where,

$$TLE\ (SRSSS) = \left[\left(DA\_Ext\_Rand_{trans}{}^{2} + DA\_Ext\_Rand_{bistable}{}^{2}\right) + OPE_R + SPEZ_R + SPES_R + P_R + T_{NSR} + R_{NR} + H_{NSR} + S_R + READ + PEA_{NR}{}^{2} + PMA_{NR}{}^{2} + PC_{NR}{}^{2}\right]^{1/2}$$

$$Bias_{neg} = DA\_Ext\_Bias_{trans} + DA\_Ext\_Bias_{bistable} + OPE_{Bn} + SPEZ_{Bn} + SPES_{Bn} + P_{Bn} + T_{NSBn} + R_{NBn} + H_{NSBp} + S_{Bn} + PEA_{NBn} + PMA_{NBn} + PC_{NBn}$$

Substituting the data for Rosemount 1154GP9RC transmitter and Foxboro 63U-BC-OHEA-F bistables, the new TLE under a seismic event and potential subsequent loss of non-seismic HVAC condition for Unit 1 and Unit 2 is calculated below.

$$TLE(SRSSS) = [((37.92\ PSIG)^2 + (11.55\ PSIG)^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ PSIG^2 + 0\ (PSIG^2) + 506.25\ (PSIG^2) + 900\ (PSIG^2) + 0\ (PSIG^2) + 225\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2) + 0\ (PSIG^2)]^{\frac{1}{2}} = \pm 56.591\ PSIG$$

$$Bias_{neg} = 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG + 0\ PSIG = 0\ PSIG$$

$$TLE_{neg} = -56.591\ PSIG - 0\ PSIG = -56.591\ PSIG$$

6.3 Nominal Trip Setpoint (NTSP)

Although the calculation title for SPC-RC-013 states a bistable setpoint is calculated, only an instrument uncertainty calculation for OPPS PORV A and B loops is performed. No analytical limit is stated and no setpoints are calculated.

6.4 Allowable Value (AV)

No Allowable Value is calculated in SPC-RC-013, and no Allowable Values are listed in the Technical Specifications or PTLR for OPPS PORV A and B.

6.5 OPPS Operating Margin (OM)

This summary attachment is an input into evaluating the acceptability of the PORV A and B actuation setpoints of 500 $PSIG$ for OPPS in the PTLR, the basis of which is given in ENG-ME-599 (Reference 8.4.2). ENG-ME-599 ensures that the peak RCS pressure resulting from the design basis Mass Injection and Heat Injection events as described in USAR Section 4.4.3.3 (Reference 8.8.1) remains less than 10 CFR Part 50 Appendix G (Reference 8.9.1) and ASME Code Case N-514 limitations (Reference 8.10.1) for the reactor vessel and less than pressure limitations for the pressurizer PORV inlet piping.

From these pressure limitations, the TLE associated RCS hot leg pressure loops 1(2)P-419 and 1(2)P-420 and the differential pressure across the reactor vessel due to reactor coolant pump operation are subtracted. This pressure value is then compared to the RCS peak pressure, including overshoot, when the pressurizer PORV is actuated by OPPS. The current operating margin between these values is 5.9 psig based on SPC-RC-013 (Reference 8.4.1) which calculates TLE = – 55.7 $PSIG$ for the limiting event type and RCS temperatures considered in the analysis.

The new TLE = – $56.591\ PSIG$ is greater than existing TLE = – 55.7 $PSIG$, and the OPPS margin is decreased by:

–56.591 PSIG – (–55.7 PSIG) = –0.891 PSIG decreased margin

Therefore, the new OPPS operating margin (OM) is:

OM = 5.9 PSIG – |(–56.591 PSIG) – (–55.7 PSIG)| = 5.01 PSIG

7.0 Conclusions and Plant Impact

A new TLE was calculated using the drift values provided in drift calculations SPC-DR-021 (Reference 8.3.1) and SPC-DR-005 (Reference 8.3.2). Although the operating margin is reduced by 0.891 PSIG, the OPPS PORV actual plant setting (APS) setpoint of 500 $PSIG$ specified in the Unit 1 and Unit 2 PTLR remains acceptable. There is no impact on the Pressurizer PORV lift setpoints required for demonstrating compliance with Technical Specification LCO 3.4.12 and 3.4.13 for Low Temperature Overpressure Protection.

Therefore, the calibration interval for OPPS RCS hot leg pressure loops 1(2)P-419 and 1(2)P-420 can be extended to 30 months without impact to the APS.

8.0 References

8.1 Industry Guidance

8.1.1 EPRI Report TR-103335, Rev. 2, "Guidelines for Instrument Calibration Extension/Reduction Programs".

8.2 Engineering Manuals

8.2.1 EM 3.3.4.2, Rev. 1, "The Analysis of Instrument Drift".

8.2.2 EM 3.3.4.1, Rev. 2, "Instrument Setpoint/Uncertainty Calculations".

8.3 Drift Calculations

8.3.1 SPC-DR-021, Revision 0, "Drift Analysis of As-Found /As-Left for Rosemount Transmitters 1154GP9RC".

8.3.2 SPC-DR-005, Revision 0, "Drift Analysis of As-Found /As -Left Data for Foxboro Alarm Unit 63U-BC".

8.4 Setpoint / Mechanical Calculations

8.4.1 SPC-RP-013, Revision 0, "U1/U2 Over Pressure Protection System PC-419/420 D Bistable Setpoint".

8.4.2 ENG-ME-599, Revision 1A, "OWNER RVW OF WEST PRZR PORV LTOP STROKING REQ".

8.5 Technical Specifications

8.5.1 Northern States Power Company, Docket No. 50-282, Prairie Island Nuclear Generating Plant, Unit 1, Renewed Facility Operating License (No. DPR-42 Addendum 230)

8.5.2 Northern States Power Company, Docket No. 50-306, Prairie Island Nuclear Generating Plant, Unit 2, Renewed Facility Operating License (No. DPR-60 Addendum 218)

8.6 Surveillance Procedures

8.6.1 SP 1199A, Rev. 8, "Overpressure Protection System Loop Calibration"

8.6.2 SP 2199A, Rev. 9, "Overpressure Protection System Loop Calibration"

8.6.3 SP 1199B, Rev. 8, "Overpressure Protection System Transmitter Calibration"

8.6.4 SP 2199B, Rev. 9, "Overpressure Protection System Transmitter Calibration"

8.7 Reports

8.7.1 Prairie Island Nuclear Generating Plant Units One and Two, "Pressure and Temperature Limits Report Revision 8 (Effective until 54 EFPY)"

8.8 Updated Safety Analysis Report (USAR)

8.8.1 Prairie Island Updated Safety Analysis Report, Rev. 34, Section 4.4.3.3, "Low Temperature Overpressurization Mitigation"

8.9 Code of Federal Regulations (CFR)

8.9.1 10 CFR 50 Appendix G, "Fracture Toughness Requirements"

8.10 American Society of Mechanical Engineers (ASME)

8.10.1 Cases of ASME Boiler And Pressure Vessel Code Case N-514, "Low Temperature Overpressure Protection Section XI, Division 1", Approval Date: February 12, 1992

8.11 Interlock Logic Diagrams

8.11.1 NF-40780-1, "Interlock Logic Diagram Pressurizer System Unit 1", Rev. 77