NEXTera ENERGY
POINT BEACH

April 30, 2010

NRC 2010-0060
10 CFR 50.90

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

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

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

References:

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

(2) NRC electronic mail to NextEra Energy Point Beach, LLC, dated March 25, 2010, DRAFT – Request for Additional Information from Instrument and Control Branch Re: EPU (ML100840783)

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

Via Reference (2), the NRC staff determined that additional information was required to enable the staff's continued review of the request. Enclosure 1 provides the NextEra response to the NRC staff's request for additional information. Enclosures 2 and 3 contain calculations that support the answer to question 2. Attachment E of Enclosure 2 contains reference information supporting the calculation. This information has not been included in this submittal because it is classified as proprietary by the manufacturer of the equipment, Westinghouse Electric Company and NextEra does not consider the reference information necessary to enable the review of the calculation. If the NRC determines that the reference information is required to complete its review, please contact Steve Hale at 561/691-2592 so the appropriate affidavits can be acquired by NextEra for release of the information.

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

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

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

I declare under penalty of perjury that the foregoing is true and correct.
Executed on April 30, 2010.

Very truly yours,

NextEra Energy Point Beach, LLC

Larry Meyer
Site Vice President

Enclosure

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

ENCLOSURE 1

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

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

The NRC staff determined that additional information was required (Reference 1) to enable the Instrumentation and Control Branch to complete the review of License Amendment Request (LAR) 261, Extended Power Uprate (EPU) (Reference 2). The following information is provided by NextEra Energy Point Beach, LLC (NextEra) in response to the NRC staff's request.

EICB RAI-1

By letter date June 17, 2009 (Agencywide Documents Access and Management System Accession Number ML091690090) FPL Energy Point Beach, LLC, provided a response to Question 7. The response states "The changes to the time delay relays for 4.16 kV and 480 V loss of voltage relays and the EDG [emergency diesel generator] breaker close delay relay are documented in a PBNP [Point Beach Nuclear Plant] calculation" and is followed by a summary description of the calculation results. Please provide the relevant PBNP calculation including the analytical limit(s) and calculation of allowable value, nominal trip set point, total loop uncertainty, as-found tolerance and as-left tolerance for the technical specification changes to the time delay relays.

NextEra Response

The requested calculation was provided in Enclosure 6 of Reference (3). Accordingly, this question was retracted by the NRC based on discussions with NextEra personnel on April 8, 2010.

EICB RAI-2

Provide a representative sample of the calculations for the setpoint changes being done under the review of the Extended Power Uprate. Include the analytical limit(s) and calculation of allowable value, nominal trip set point, total loop uncertainty, as-found tolerance and as-left tolerances.

NextEra Response

Four Instrumentation and Control (I&C) calculations were provided to the NRC in response to Question 3 of Reference (4). The previously provided I&C calculations include:

- Pressurizer Pressure Instrument Loop Uncertainty and Setpoint
- Turbine Impulse Pressure Low Power Permissive P-7 Instrument Scaling and Uncertainty
- Containment Pressure Low Range
- Auxiliary Feedwater Pump Low Suction Pressure Service Water Switchover and Pump Trip Instrument Loop Uncertainty and Setpoint

In response to this request for additional information, two additional I&C calculations are provided as a representative sample of EPU setpoint changes in the following Enclosures:

- Enclosure 2 – Power Range Nuclear Instrumentation Uncertainty / Setpoint Calculation
- Enclosure 3 – Steam Line Pressure Instrument Loop Uncertainty / Setpoint Calculation

References

(1) NRC electronic mail to NextEra Energy Point Beach, LLC, dated March 25, 2010, DRAFT – Request for Additional Information from Instrument and Control Branch Re: EPU (ML100840783)

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

(3) NextEra Energy Point Beach, LLC, letter to NRC, dated September 25, 2009, License Amendment Request 261, Extended Power Uprate, Response to Request for Additional Information (ML092750395)

(4) NextEra Energy Point Beach, LLC, letter to NRC, dated November 30, 2009, License Amendment Request 261, Extended Power Uprate, Response to Request for Additional Information (ML093360143)

ENCLOSURE 2

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

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

POWER RANGE NUCLEAR INSTRUMENTATION
UNCERTAINTY / SETPOINT CALCULATION

123 pages follow

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1.0 BACKGROUND, PURPOSE, AND SCOPE OF CALCULATION

1.1 Background

The Power Range Neutron Flux instrumentation is part of the Nuclear Instrumentation System (NIS) which monitors reactor neutron flux at power. Four independent power range channels provide redundant monitoring of reactor power over a range of 0 – 120% Rated Thermal Power (RTP). Each channel consists of two uncompensated ion chamber detectors, located above and below the core midplane, which allows for measurement of the total reactor power and the relative power distribution between the upper and lower halves of the core. The detector signals are processed by a series of modules located in control room racks (or drawers) to provide protection, control, alarm, and indication functions (Ref. V.1).

Each power range channel provides an input to two bistable relay divers, which feed the two-out-of-four logic matrices for the power range high neutron flux – low range and the power range high neutron flux – high range reactor trips. Separate bistable relay drivers also provide signals to the four permissive interlocks (P-7, P-8, P-9, and P-10), which also feed two-out-of-four logic matrices for actuation (Reference D.47).

1.2 Purpose

The purpose of this calculation is to determine the power range instrument loop uncertainties and to evaluate the power range reactor trip setpoints, the power range permissive setpoints, interlocks, alarms, and indication/recording loops.

1.3 Purpose of This Revision

This revision adds setpoint calculations for Extended Power Uprate (EPU) and adds Operability Limits for routine calibration. The revision also corrects an accuracy term for the NI drawer meter that affects total loop errors.

1.4 Scope

The scope of this calculation is listed below:

- Evaluate the existing Field Trip Setpoint (FTSP) for Power Range reactor trips, permissives, rod stop, loss of detector voltage alarm, and rod drop alarm.
- Determine uncertainties associated with the instrument loops for the setpoints and permissives, control board indication, recorder and PPCS loops under normal and accident environmental conditions.
- Determine Limiting Trip Setpoints for the reactor trips and permissives
- Determine Operability Limits for routine calibration.
- Determine acceptable As-Found/As-Left Calibration Tolerances for the Power Range Drawer, Control Board Indicator, Recorder and PPCS.
- Determine Channel Check Tolerance for Control Room Indicators.

1.5 Instrumentation Evaluated

This calculation evaluates the plant equipment (for Units 1 and 2) listed in the table below. See Sections 6.2 and 6.3 of this calculation for instrument specifications, parameters, and loop configurations.

Table 1.5-1 Instrumentation List

Sensor	Power Range Monitor (Drawer)	Control Board Indicator	Control Board Recorder	PPCS
N-41 DET	N-41A/B	NI-41B	NR-45	N41
N-42 DET	N-42A/B	NI-42B		N42
N-43 DET	N-43A/B	NI-43B		N43
N-44 DET	N-44A/B	NI-44B		N44

1.6 Superseded Station Calculations

Existing calculation PBNP-IC-38 should be superseded upon issuance of 2009-0002 Revision 0.

2.0 ACCEPTANCE CRITERIA

2.1 Positive margin is required between the Limiting Trip Setpoint (LTSP) and the Field Trip Setpoint (FTSP) for primary trips. The LTSP is calculated to ensure that the instrument channel trip occurs at or before the associated Analytical Limit (AL) is reached. The LTSP is then compared to the FTSP to ensure that margin exists between the LTSP and the FTSP. Margin exists if the FTSP is less than the LTSP (for increasing setpoints) or the FTSP is greater than the LTSP (for decreasing setpoints). This criterion only applies to primary trips because backup trip functions and permissives lack an analytical limit and therefore are not required to trip at a particular value to support the accident analyses.

2.2 The Operability Limits calculated for primary trips must be at or more conservative than the corresponding Limiting Trip Setpoint. This will allow the Technical Specification tables for RPS and ESFAS trip functions to be revised to insert the LTSPs as new Allowable Values for the primary trip functions but use the more restrictive Operability Limits for channel operability determination during surveillance (COT) testing.

2.3 Channel Check Tolerance (CCT) is the maximum expected deviation between channel indications when performing a qualitative assessment of channel behavior during operation. The calculated CCT will be compared to the existing CCT to ensure that the existing CCT is ≤ the calculated CCT. If the existing CCT is non-conservative, a recommendation will be made to revise the existing CCT to satisfy the calculated CCT limit.

3.0 ABBREVIATIONS

3.1	AL	Analytical Limit
3.2	AV	Allowable Value
3.3	CCT	Channel Check Tolerance
3.4	DAF	Drawer As-Found Tolerance
3.5	DAL	Drawer As-Left Tolerance
3.6	DBE	Design Basis Event
3.7	EQ	Environmental Qualification
3.8	FSAR	Final Safety Analysis Report
3.9	FTSP	Field Trip Setpoint
3.10	LTSP	Limiting Trip Setpoint
3.11	IAF	Indicator As-Found Tolerance
3.12	IAL	Indicator As-Left Tolerance
3.13	M&TE	Measurement and Test Equipment
3.14	NIS	Nuclear Instrumentation System
3.15	OL	Operability Limit
3.16	PBNP	Point Beach Nuclear Plant
3.17	PPCSAF	PPCS As-Found Tolerance
3.18	PPCSAL	PPCS As-Left Tolerance
3.19	PE	Process Error
3.20	PL	Process Limit
3.21	PPCS	Plant Process Computer System
3.22	PR	Power Range
3.23	PS	Process Span (engineering unit)
3.24	RAD	Radiation Absorbed Dose
3.25	RAF	Recorder As-Found Tolerance
3.26	RAL	Recorder As-Left Tolerance
3.27	RCCA	Rod Cluster Control Assembly
3.28	RE	Rack Error
3.29	RTO	Reactor Thermal Output
3.30	RTP	Rated Thermal Power
3.31	RWAP	Rod Withdrawal At Power
3.32	RWFS	Rod Withdrawal From Subcritical
3.33	SLB(OC)	Steam Line Break (Outside Containment)
3.34	SRSS	Square Root of the Sum of the Squares
3.35	Tech Spec	Technical Specifications
3.36	TLE	Total Loop Error

4.0 REFERENCES

The revisions and/or dates of the References listed in this section are current as of 08/03/2007.

4.1 General

G.1 Point Beach Nuclear Plant Design Guideline DG-I01, Instrument Setpoint Methodology, Rev. 4.

G.2 Point Beach Nuclear Plant Technical Specifications Section 3.3.1 and Bases B3.3.1, Amendment 201 (Unit 1), 206 (Unit 2)

G.3 Point Beach Nuclear Plant FSAR Section 9.8.1 dated 06/07, Section 11.6 dated 06/03, Section 7.6 dated 06/07, Section 7.2 dated 08/05, Section 14.0 dated 06/03, Section 14.1.2 dated 06/01, Section 14.2.6 dated 06/07, Section 14.1.1 dated 06/07

G.4 Not used

G.5 Not used

G.6 Not used

G.7 Not used

G.8 Not used

G.9 ISA-RP67.04-02.2000 Methodologies for the Determination of Setpoints for nuclear Safety-related Instrumentation, Instrument Society of America

G.10 Not used.

G.11 WCAP 13514, Rev. 1, Design Bases Document for the Wisconsin Electric Point Beach Nuclear Plant Reactor Protection System

G.12 Not used

G.13 Not used

G.14 Not used

G.15 Not used

G.16 Not used

G.17 Not used

G.18 Westinghouse Letter WEP-06-23, "Input for Current Analysis of Record (RPS/ESFAS)", dated March 28, 2006.

G.19 Not used

G.20 WCAP-8587, Rev. 6-A, Methodology for Qualifying Westinghouse WRD Supplied NSSS Safety Related Electrical Equipment, dated March 1983.

G.21 Bechtel Specification No. 6118-M-40, "Specification for Heating, Ventilating and Air Conditioning Controls", Rev.1.

G.22 PB 634, Rev. 3, "Specification for Safety Assessment System and Plant Process Computer System for the Point Beach Nuclear Plant PPCS 2000".

G.23 WCAP-7669, "Topical Report, Nuclear Instrumentation System", dated April 1971.

G.24 Not Used

G.25 WCAP-7116, "Precautions, Limitations, and Set Points for Nuclear Steam Supply Systems," dated October 1969

G.26 Westinghouse Report WEPB-PCS-NAP-FL-001-FS-02, "WEPB Plant Computer Replacement Project Functional Design Specification Document-Flow and Level Corrections", dated October 10, 2001.

G.27 Westinghouse Report WEPB-PCS-NAP-IT-001-FS-02, "WEPB Plant Computer Replacement Project Functional Design Specification Document-Incore Thermocouples", dated October 08, 2001.

G.28 Passport Preventive Maintenance frequency check for Computer Analog to Digital Converters (located on D080 panel under PMID 17263).

G.29 Walkdown for PBNP-IC-38, dated 1/30/07 (Attachment A)

G.30 PBF-2034, "Daily Logsheets – Unit 1" Pg. 82 – 84, Rev. 70

G.31 PBF-2035, "Daily Logsheets – Unit 2" Pg. 82 – 84, Rev. 70

G.32 Westinghouse Letter WEP-07-19, "Identification of Relevant Nuclear Instrumentation System Process Impact Terms" dated March 14, 2007

G.33 PBNP Modification Request MR 98-002-C, "PPCS Changeover from Old to New PPCS", dated April 20, 2005

G.34 DIT CRR-I&C-012 "Treatment of Backup Trips and Permissives" Issued 6/4/07 (Attachment D)

G.35 NCP-26781, "Request for Technical Specification Change No. 7 Facility Operating Licenses DPR-24 and DPR-27 Point Beach Nuclear Plant" dated May 5, 1973

G.36 NPC-27238, "Modification to Technical Specification Change Request No. 7 Point Beach Nuclear Plant Unit Nos. 1 and 2 " dated April 11, 1975

G.37 NPC-35807, "Amendments Nos. 8 and 10 to Facility Operating Licenses Nos. DPR-24 and DPR-27 for the Point Beach Nuclear Units 1/2" dated August 7, 1975

G.38 NUREG-1431 Volume 1, Rev. 3.0, "Standard Technical Specifications Westinghouse Plants" June 2004

G.39 NPC 1999-05675-V3, "Point Beach Nuclear Plants Units 1 and 2 Technical Specifications Improvement Project" November 15, 1999 Volume 3

G.40 Westinghouse Letter WEP-09-2, "RPS/ESFAS Safety Analysis Limit Setpoint Changes for the Point Beach Uprate Program", dated January 8, 2009

G.41 Design Information Transmittal (DIT) CRR-I&C-014 dated 8/23/07, Supplement to Section 3.3.8 of PBNP Design Guide DG-I01 Rev 4, Methodology to determine the Operability Limit

4.2 Drawings

D.1 Not used

D.2 1045F074 Sh. 1-5, "NIS Remote Wiring Connections" Unit 2 Rev. 1
1045F074 Sh. 6, 8, "NIS Remote Wiring Connections" Unit 2 Rev. 2
1045F074 Sh. 7, "NIS Remote Wiring Connections" Unit 2 Rev. 5

D.3 1045F078 Sh. 1, 3, 5, 8, "NIS Remote Wiring Connections" Unit 1 Rev. 2
1045F078 Sh. 2, 4, 6, "NIS Remote Wiring Connections" Unit 1 Rev. 1

1045F078 Sh. 7, "NIS Remote Wiring Connections" Unit 1 Rev. 4

D.4 Not used

D.5 5651D045, Westinghouse "Nuclear Instrumentation System Detector Connections", Rev. 1

D.6 206C061 Sh. 1, "MCB C04 Annunciation Cab. 1A & 2B" Rev. 17

206C061 Sh. 2, "MCB C04 Annunciation Cab. 1A & 2B" Rev. 13

D.7 6051D060 Sh. 1, Westinghouse "NIS Console Compactor & Rate Drawer Assembly" Rev. 21
6051D060 Sh. 2, Westinghouse "NIS Console Compactor & Rate Drawer Assembly" Rev.13
6051D060 Sh. 3, Westinghouse "NIS Console Compactor & Rate Drawer Assembly" Rev.18
6051D060 Sh. 4, Westinghouse "NIS Console Compactor & Rate Drawer Assembly" Rev.12

D.8 6051D076 Sh. 1, 3, "NIS Console Misc. Control & Indication Panel", Rev. 3
6051D076 Sh. 2, "NIS Console Misc. Control & Indication Panel", Rev. 4

D.9 6054D015 Sh. 1 – 4, "NIS Console out Line" Rev. 3

D.10 Not used

D.11 Not used

D.12 Not used

D.13 Not used

D.14 883D195 Sh. 12, "NIS Permissive and Blocks" Rev. 10

D.15 E-1223E-A, "Wiring Diagram Main Control Board Section 1C04 – Front – CPR04 – Vertical Section" Unit 1, Rev. 11

D.16 E-1227E-B, "Wiring Diagram Main Control Board Section 1C04 – Rear – CPR03" Unit 1, Rev. 7

D.17 E-1226E-B, "Wiring Diagram Main Control Board Section 1C04 – Rear – CPR01" Unit 1, Rev. 5

D.18 E-94 Sh. 48, "Connection Diagram – Local Control Boards & Racks – Nuclear Rack #1C130" Unit 1, Rev. 17

D.19 E-94 Sh. 49, "Connection Diagram – Local Control Boards & Racks – Nuclear Rack #1C131" Unit 1, Rev. 15

D.20 E-94 Sh. 50, "Connection Diagram – Local Control Boards & Racks – Nuclear Rack #1C132" Unit 1, Rev. 16

D.21 E-94 Sh. 51, "Connection Diagram – Local Control Boards & Racks – Nuclear Rack #1C133" Unit 1, Rev. 16

D.22 E-99 Sh. 5, "Connection Diagram Penetration 1Q18, 1Q23, 1Q51, 1Q53, 1Q54" Unit 1, Rev. 10

D.23 E-1579E-A, "Wiring Diagram Main Control Board Section 2C04 – Front – CPR62 – Vertical Section" Unit 2, Rev. 8

D.24 E-1583E-A, "Wiring Diagram Main Control Board Section 2C04 – Rear – CPR59" Unit 2, Rev. 8

D.25 E-1582E-A, "Wiring Diagram Main Control Board Section 2C04 – Rear – CPR01" Unit 2, Rev. 7

D.26 E-2094 Sh. 48, "Connection Diagram – Local Control Boards & Racks – Nuclear Rack #2C133" Unit 2, Rev. 20

D.27 E-2094 Sh. 49, "Connection Diagram – Local Control Boards & Racks – Nuclear Rack #2C132" Unit 2, Rev. 14

D.28 E-2094 Sh. 50, "Connection Diagram – Local Control Boards & Racks – Nuclear Rack #2C131" Unit 2, Rev. 16

D.29 E-2094 Sh. 51, "Connection Diagram – Local Control Boards & Racks – Nuclear Rack #2C130" Unit 2, Rev. 16

D.30 E-2099 Sh. 5, "Connection Diagram Penetration 2Q18, 2Q23, 2Q51, 2Q53, 2Q54" Unit 2, Rev. 8

D.31 Not Used

D.32 0082, Sh. 10, "Cable Spreader Room Air Conditioning System Rack C58," Rev. 9

D.33 617F354 Sh. 4A1, "Schematic Diagram – Inputs Reactor Protection System Train "A" Unit 1" Rev. 3

D.34 617F354-2 Sh. 4A1, "Schematic Diagram – Inputs Reactor Protection System Train "A" Unit 2" Rev. 4

D.35 617F354 Sh. 4A2, "Schematic Diagram – Inputs Reactor Protection System Train "A" Unit 1" Rev. 3

D.36 617F354-2 Sh. 4A2, "Schematic Diagram – Inputs Reactor Protection System Train "A" Unit 2" Rev. 2

D.37 617F354 Sh. 4B1, "Schematic Diagram – Inputs Reactor Protection System Train "B" Unit 1" Rev. 3

D.38 617F354-2 Sh. 4B1, "Schematic Diagram – Inputs Reactor Protection System Train "B" Unit 2" Rev. 6

D.39 617F354 Sh. 4B2, "Schematic Diagram – Inputs Reactor Protection System Train "B" Unit 1" Rev. 3

D.40 617F354-2 Sh. 4B2, "Schematic Diagram – Inputs Reactor Protection System Train "B" Unit 2" Rev. 2

D.41 499B466 Sh. 1012, "Elementary Wiring Diagram Block Auto. Rod Withdraw – Unit 1" Rev. 3

D.42 499B466 Sh. 1013, "Elementary Wiring Diagram Block Man. Rod Withdraw – Unit 1" Rev. 3

D.43 499B466 Sh. 1212, "Elementary Wiring Diagram Block Auto. Rod Withdraw – Unit 2" Rev. 1

D.44 499B466 Sh. 1213, "Elementary Wiring Diagram Block Man. Rod Withdraw – Unit 2" Rev. 1

D.45 195A778 Sh. 20, "Miscellaneous Relay Elementary Diagram 1C 138 – Unit 1" Rev. 3

D.46 195A778 Sh. 30, "Miscellaneous Relay Elementary Diagram 2C 158 – Unit 2" Rev. 3

D.47 883D195 Sh. 11, "NIS Trip Signal Logic" Rev. 7

4.3 Procedures

P.1 Not used

P.2 Not used

P.3 1ICP 02.007 "Nuclear Instrumentation Power Range Channels 92 Day Channel Operational Test" Rev. 10

P.4 Not used

P.5 2ICP 02.007 "Nuclear Instrumentation Power Range Channels 92 Day Channel Operational Test" Rev. 12

P.6 Not used

P.7 Not used

P.8 Not used

P.9 Not used

P.10 Not used

P.11 Not used

P.12 Not used

P.13 Not used

P.14 Not used

P.15 Not used

P.16 O-TS-RE-001 "Power Level Determination" Rev. 13

P.17 O-TS-RE-002 "Power Range Detector Power Level Adjustment" Rev. 5

P.18 1ICP 02.022 "Nuclear Instrumentation System Power Range Channels Shutdown Operational Test" Rev. 8

P.19 2ICP 02.022 "Nuclear Instrumentation System Power Range Channels Shutdown Operational Test" Rev. 7

P.20 1ICP 04.026RD "Nuclear Instrumentation Power Range Red Channel N41 Outage Calibration and ECAD Testing" Rev. 2

P.21 1ICP 04.026WH "Nuclear Instrumentation Power Range White Channel N42 Outage Calibration and ECAD Testing" Rev. 2

P.22 1ICP 04.026BL "Nuclear Instrumentation Power Range Blue Channel N43 Outage Calibration and ECAD Testing" Rev. 2

P.23 1ICP 04.026YL "Nuclear Instrumentation Power Range Yellow Channel N44 Outage Calibration and ECAD Testing" Rev. 2

P.24 2ICP 04.026RD "Nuclear Instrumentation Power Range Red Channel N41 Outage Calibration and ECAD Testing" Rev. 3

P.25 2ICP 04.026WH "Nuclear Instrumentation Power Range White Channel N42 Outage Calibration and ECAD Testing" Rev. 3

P.26 2ICP 04.026BL "Nuclear Instrumentation Power Range Blue Channel N43 Outage Calibration and ECAD Testing" Rev. 3

P.27 2ICP 04.026YL "Nuclear Instrumentation Power Range Yellow Channel N44 Outage Calibration and ECAD Testing" Rev. 4

P.28 ICI 12, "Selection of M&TE for Field Calibrations" Rev. 8

P.29 ICP 5.51, "Secondary Vacuum Instruments" Rev. 12

P.30 REI 40.0, "Pre-Startup Calibration of the Nuclear Instrument Detectors" Rev. 7

4.4 Vendor

V.1 Westinghouse Nuclear Instrumentation System – Book 1, VTM #00193-1, Rev. 37, Sections 1.0 and 2.0

V.2 Westinghouse Main Control Board – Part 1, PBNP VTM #00132A, Rev. 25 – Westinghouse I.L. 43-252C, "252 Line Switchboard Edgewise Instruments, Five Inch Classification".

V.3 Westronics Strip Chart Recorder, PBNP VTM #00596, Rev. 4 – Westronics User Manual MO100086-01.4, "Series 4200 Continuous Writing Recorder"

V.4 Combustion Engineering, Inc. 1485-ICE 1234, Rev. 2, "Functional Design Description for Seismic Safety Parameter Display System (SSPDS)", PBNP VTM #01209, Book 4, Rev. 21.

V.5 Westinghouse letter RRS-VICO-02-689 dated 12/4/2002, "NIS Analog Meters" (Attachment E to this calculation)

V.6 Combustion Engineering, Inc. 1485-ICE 1239, Rev. 2, "Functional Design Description for Safety Assessment System and Plant Process Computer System", PBNP VTM # 01209, Book 5 - Rev. 21.

V.7 Combustion Engineering, Inc., "SAS/PPCS Computer System – Volume 21 – Manual Reinstated 5/30/03 Equipment in Plant", PBNP VTM #01055U, Revision 11, Tab F, "RTP7436/10 Digital and Analog Loopback and Calibration Card."

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

V.9 User Guide HP 34401A Multimeter, VTM #01692, Rev. 0

V.10 Imaging and Sensing Technology Corporation Technical Manual NY-WL-24154, Power Range Uncompensated Ionization Chamber VTM# 00193-3 Rev. 0

4.5 Calculations

C.1 PBNP-IC-07, Rev. 0, "Westinghouse 252 Indicator Drift Calculation"

C.2 Engineering Evaluation No. 2005-0006, Rev. 0, "Drift Calculations Evaluation"

C.3 CN-CRA-02-42, Rev. 0, "Point Beach Steamline Break Mass & Energy Release Outside Containment Analysis for Power Uprate"

C.4 CN-CPS-08-20, Rev. 0, "Plant Operability Margin to Trip and EOC Coastdown Analysis for Point Beach Units 1 and 2 Extended Power Uprate Program"

C.5 CN-TA-08-52, Rev. 0, "Partial Loss of Flow Permissive P-8 Setpoint Analysis for Point Beach Extended Power Uprate (EPU)"

C.6 CN-TA-08-55, Rev. 0, "Point Beach Units 1 and 2 Rod Withdrawal at Power Analysis (RWAP) for the Extended Power Uprate Program"

5.0 ASSUMPTIONS

5.1 Validated Assumptions

5.1.1 It is assumed that the accuracy of the PPCS display loop is ± 0.51 % of full scale. This accuracy value applies to the loop from the PPCS analog input field terminations to the PPCS printed and/or display output devices. The accuracy value includes the temperature effect, power supply effect, humidity effect, radiation effect, seismic (vibration) effect, and drift over the entire PPCS normal operating range.

Basis: Per Reference G.22, the PPCS replacement modification shall process inputs and outputs from existing I/O devices. As such, the existing signal processing I/O isolation and signal conversion cards were not replaced as a result of Modification Request 98-002 (Ref. G.33). References V.4 and V.6 document that the maximum total system error for the old PPCS computer system, during normal operating environments, from field terminations to the printed and/or display output, shall be within ± 0.5 % of the full scale (excluding errors before input of the analog input).

A review of all Westinghouse Plant Computer Replacement Reports revealed that the output values for all newly installed PPCS equipment (not including the existing I/O devices discussed in the above paragraph) shall be within 0.1 % of hand calculated results, with the following two exceptions:

1) For results based on polynomial curves, the output values shall be within 1.0 % of hand calculated results (Reference G.26).

2) For results based on steam tables, the output values shall be within 0.5 % of hand calculated results (References G.26 and G.27).

The PPCS points considered in this calculation display Reactor Thermal Power Level as a percentage based on a 0 – 5 Vdc input signal from the loop rack components. Since the Power Range loop is not a component of References G.26 or G.27, accuracy values associated with polynomial curves and steam tables are not applicable, and the accuracy of the newly installed PPCS equipment (not including the existing I/O devices) is considered to be 0.1 %.

Therefore, to determine the overall PPCS system accuracy, the specified values of 0.1 % (for newly installed PPCS equipment) and 0.5 % (for existing PPCS equipment) are combined using the SRSS methodology as follows:

$$\text{PPCSa} = \pm\sqrt{0.5^2 + 0.1^2} = \pm 0.51\%$$

In accordance with Section 3.3.3.3 of Reference G.1, if the manufacturer does not specify environmental errors associated with the subject normal environmental accuracy ratings, these effects are considered to be included in the specified accuracy ratings or are considered to be negligible.

Per Reference V.7, the PPCS analog-to-digital (A/D) converters have a drift value of ± 0.01 % for a period of 1 year. This value is not significant when compared to the much larger accuracy value of ± 0.51 %. Per Reference G.28, the A/D converters are calibrated approximately every 36 weeks to eliminate any potential drift. In addition, these components historically never need to be calibrated because they do not drift. Therefore, the vendor specified drift value is considered negligible.

Per Section 3.3.3.15 of Reference G.1, in the absence of a vendor specified drift value; it is typical for the device accuracy to be substituted in place of drift. However, in the case of PPCS, considering an additional ± 0.51 % for calculating the As-Found Tolerance would create a value large enough to allow PPCS degradation to go undetected. Conversely, by assuming that the drift value is included in the accuracy value, the As-Found Tolerance would remain tight enough to detect PPCS degradation prior to system failure. Therefore, the PPCS drift is conservatively encompassed by the ± 0.51 % accuracy value.

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

Basis: Table 6-1 of WCAP-8587 (Ref. G.20) states that when the HVAC is non-safety related, the normal temperature of 120 °F should be used. Since the Control Room and Computer Room HVAC System chiller is not powered from an essential power bus, the Control Room and Computer Room HVAC System is considered as a non-safety related system.

5.1.3 It is assumed that the As-Left setting tolerances for instruments evaluated in this calculation are as follows:

Sensor:	N/A (not calibrated)
Power Range Drawer:	± 0.5% RTP (Indication)
	± 1.0% RTP (Trips)
	+0, -1% RTP (Permissives)
	± 0.025 Vdc (Calibration)
Recorder:	± 1.00 mVdc
Control Board Indicator:	± 1.0% RTP
PPCS:	± 0.6% RTP

Basis: These As-Left setting tolerance values have historically provided acceptable instrument performance and consistency in the calibration program. These As-Left setting tolerances are routinely achievable for the installed instruments, consistent with safety limits and test equipment capability. They are currently used in practice at the station, and implemented by calibration procedures listed in References P.3, P.5, and P.20 – P.27. As-Found setting tolerances are to be determined in this calculation.

5.1.4 It is assumed that the Power Range detector uncertainties of accuracy, drift, power supply, temperature, humidity, and radiation are negligible.

Basis: Per Section 1.2 of Appendix C, the daily calibration of the power range channels (References G.30 and G.31) accounts for the sensor accuracy, drift, power supply, temperature, humidity, and radiation. Any uncertainties associated with the calibration are considered as process errors to this calculation (Ref. G.32).

5.1.5 It is assumed that the maximum environmental operating temperature for the existing installed PPCS system is 95 °F.

Basis: Reference G.33 (Attachments 1 and 5) identifies that the most temperature sensitive component of the new PPCS system is the non-ruggedized Sparc computer, which has an operating temperature limit of 95 °F. Note: the maximum temperature used for evaluating PPCS uncertainties is 85 °F, which is bounded by the PPCS operating temperature limit.

5.2 Unvalidated Assumptions

None

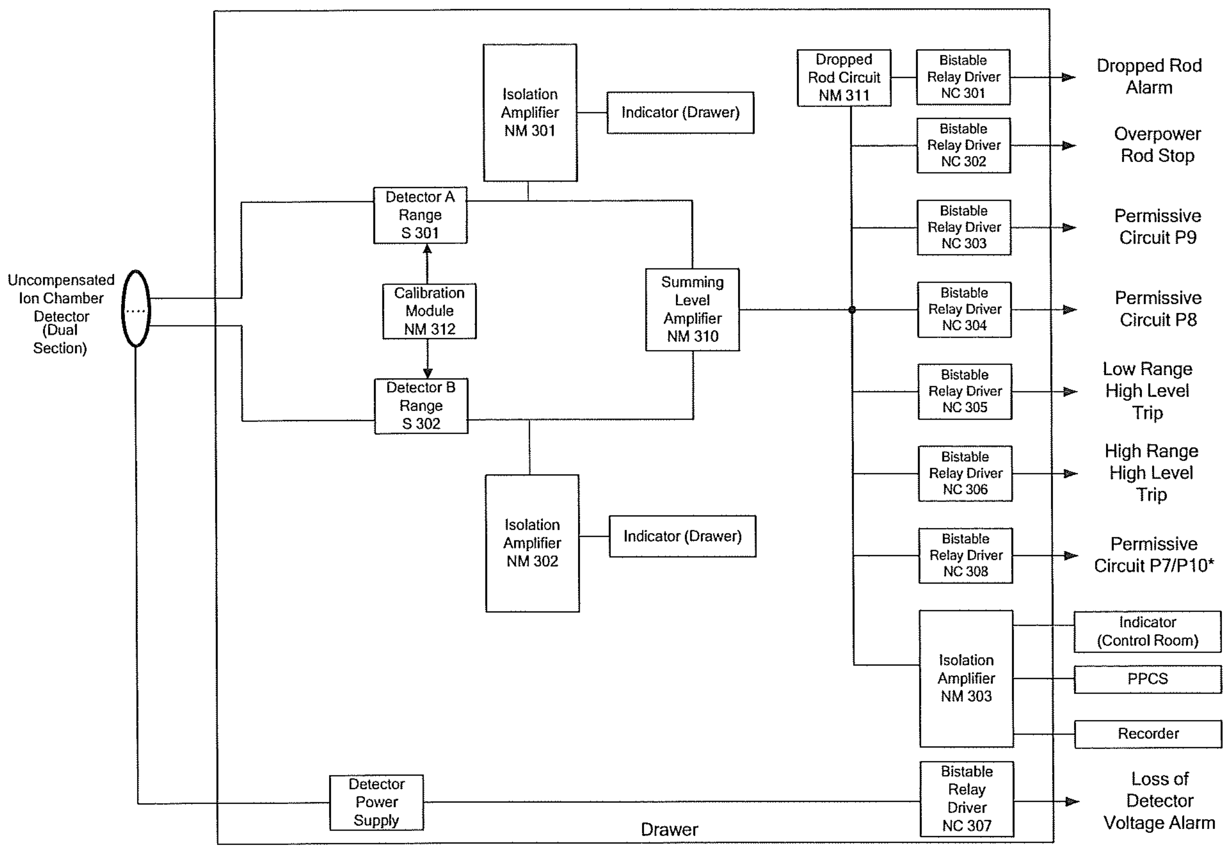
6.0 DESIGN INPUTS

6.1 Loop Definitions

The Power Range Monitoring Loops (channels) analyzed in this calculation are shown in block diagram format in Figure 6.2-1 and explained in more detail in Sections 6.2 and 6.3.

6.2 Loop Block Diagram

The block diagram below (Figure. 6.2-1) shows the component configuration for the Power Range instrument loops that are addressed in this calculation. The diagram is generic and applies to loops N-41 through N-44 (Ref. D.5-D.30, and V.1).



* Permissives P7 and P10 share a common bistable relay driver with the same setpoint, but different functions (Reference V.1 and Attachment C).

Figure 6.2-1 Block Diagram of Power Range Circuit

6.3 Component Models and Tag Numbers

The following table identifies components shown in Figures 6.2-1 for each of the Power Range instrument loops and provides the associated plant information for use throughout this calculation.

Table 6.3-1, Power Range Instruments

Component	Model	Tag Number	Input	Output	Reference(s)
Uncompensated Ion Detector	Westinghouse GEN MODEL #1384	N-41 DET N-42 DET N-43 DET N-44 DET	Leakage Neutron Flux	$10^{-4} - 3.6 \times 10^{-3}$ amps	V.1
Summing Level Amplifier*	Westinghouse NM310	N-41A/B N-42A/B N-43A/B N-44A/B	$10^{-4} - 3.6 \times 10^{-3}$ amps	0 – 10 Vdc	P.20 – P.27
Isolation Amplifier*	Westinghouse NM303		0-10 Vdc	(2) 0 – 5 Vdc (1) 0 – 1 mAdc (1) 0 – 50 mVdc (1) 0 – 10 Vdc	P.20 – P.27
Bistable Relay Driver*	Westinghouse NC301 – NC308		0-10 Vdc	Digital Contacts	V.1
Control Board Indicator	Westinghouse 252	NI-41B, NI-42B NI-43B, NI-44B	0-10 Vdc	0 – 120%	P.20 – P.27
Control Board Recorder	Westronics 4200 Series	NR-45	0-50 mVdc	0 – 120%	P.20 – P.27
PPCS	N/A	N41, N42 N43, N44	0-5 Vdc	0 – 120%	P.20 – P.27

* - Grouped as Power Range Drawer

6.4 Environmental Considerations

As stated in Section 1.1, above, the power range instrumentation performs protection, control, alarm, and indication functions. Attachment C explains that only normal environmental conditions need to be considered for the power range protection functions. Although neutron flux is classified by PBNP as a Regulatory Guide 1.97 variable, the combination of source and intermediate ranges covers 10^{-11} amps to 100% rated power with one decade of overlap. Therefore, the power range is not considered in RG 1.97. In addition, a separate Wide Range Flux Monitoring System (N-40), not in the scope of this calculation, is environmentally qualified for post accident conditions and would also be available for post-accident monitoring. The power range control, alarm, and indication functions are required only during normal plant operation – therefore, only normal environmental conditions need to be considered for these functions also.

The devices used in the power range instrument loops are located in the Containment, Computer Room, or Control Room. Therefore, the environmental conditions in each of these areas are discussed.

6.4.1 Containment

Per Reference D.29, the Power Range Sensors are located in containment. These detectors are located in the primary shield wall, external to the reactor (Ref. G.3)

Per Ref. G.20, the Containment Building maximum normal temperature inside the secondary shield wall is 135°F. Reference G.20 also states that the minimum is 65°F and the Containment Building maximum normal humidity is 70%. Per Attachment C, the detector location is exposed to 5 x 10^4 R/hr.

Table 6.4-1, Containment Environmental Conditions

Normal Conditions	Calibration Temp.(°F)	Max. Temp. (°F)	Humidity (%)	Radiation
	65	135	70	5x10^4 R/hr

Per Attachment C and Assumption 5.1.4, the detectors are calibrated daily, thus negating any uncertainty due to normal containment environmental conditions.

6.4.2 Control Room and Computer Room

The PR drawers, indicators, PPCS, and the recorder are located in the control room or computer room (Ref. D.15 – D.21 and D.23 – D.29).

The Control Room HVAC System controls the temperature of the Control Room and the Computer Room at 75 °F per Reference G.21. Per FSAR Section 9.8.1 (Ref. G.3), the temperature can vary ± 10 °F. This temperature variation is supported by the fact that the Johnson Controls T-4002-202 thermostat (Ref. D.32) in the Control Room is capable of controlling the room temperature within these bounds (Ref.V.8). Therefore, per Section 3.3.4.7 of Ref. G.1, the minimum temperature of 65 °F is used as the calibration temperature for the components in the Control Room and Computer Room.

Since the indicator, PPCS, and recorder are only required during normal plant operating conditions, 85°F is used as the maximum temperature (Per Assumption 5.1.5, the maximum operating temperature of the PPCS is 95°F). Per Assumption 5.1.2, the maximum normal temperature is 120 °F. This maximum temperature is used and justified by the intended functions of the High Flux Reactor Trip loop (primary trip). This function necessitates the instrumentation to operate under compromised environmental conditions caused by a loss of the HVAC cooling unit.

The Control Room humidity of 50 % is documented in Ref. G.20. FSAR Section 11.6.2, fifth paragraph (Ref. G.3) states that the control room is in Zone I and Table 11.6-1 (Ref. G.3) states the maximum dose rate in Zone I is 1.0 mrem/hr.

Table 6.4-2. Control Room and Computer Room Environmental Conditions

Conditions	Calibration Temp. (°F)	Max. Temp. (°F)	Humidity (%)	Radiation Dose Rate
Normal (Trip)	65	120	50	1 mrem/hr
Normal (Indication, PPCS and Recorder)	65	85	50	1 mrem/hr

Table 6.4-3, Summary of Environmental Conditions

TLE	Device	Location	Environ. (Temp °F)	Temp. Effect	Comments (Basis for Environment)
High Flux Trip Loop (normal) TLE_{TRIP}	Sensor	Containment	135	St	Both High Flux trip loops (High range and Low range) are Safety related. CR max. temp of 120°F can be expected with loss of HVAC.
	PR Drawer	Control Room	120	Dt	
Indicator Loop (normal) TLE_{IND}	Sensor	Containment	135	St	Indication loop is non-Safety Related. When HVAC is lost, this loop is not operable. No need to evaluate above 85°F.
	PR Drawer	Control Room	85	Dt	
	Indicator	Control Room	85	It	
PPCS Loop (normal) TLE_{PPCS}	Sensor	Containment	135	St	PPCS loop is non-Safety Related. When HVAC is lost, this loop is not operable. No need to evaluate above 85°F.
	PR Drawer	Control Room	85	Dt	
	PPCS	Control Room	85	PPCSt	
Recorder Loop (normal) TLE_{REC}	Sensor	Containment	135	St	Recorder loop is non-Safety Related. When HVAC is lost, this loop is not operable. No need to evaluate above 85°F.
	PR Drawer	Control Room	85	Dt	
	Recorder	Control Room	85	Rt	

6.5 Analytical Limits (AL), Process Limits, and Field Trip Setpoints (FTSP)

The Analytical Limits and Field Trip Setpoints for the High Neutron flux reactor trips at current power and for EPU are given in Table 6.5-1 below:

Table 6.5-1, Reactor Trip Limits and Setpoints

Trip	Analytical Limit	Field Trip Setpoint	Reference
Low Range – High Flux (RWFS)	35%	↑20%	G.18, P.3, P.5, P.18 and P.19
High Range – High Flux (RWAP, RCCA Ejection and SLB(OC))	118%	↑107%	G.18, P.3, P.5, P.18 and P.19
High Range – High Flux (RWAP for EPU)	116% (AL_{EPU})	↑107%	G.40 and C.6

The Process Limits and Field Trip Setpoints for permissives are given in Table 6.5-2 below:

Table 6.5-2, Permissive Setpoints

Permissive	Process Limit	Field Trip Setpoint (FTSP)	Reference
P-7	None	9.5%↑ RTP	P.18 and P.19
P-8 (current)	None	49%↑ RTP	P.18 and P.19
P-8 (for EPU)	45%	35%↑ RTP (proposed)	G.40 and C.5
P-9 (current)	None	49%↑ RTP	P.18 and P.19
P-9 (for EPU)	35% for T_{avg} <572°F 50% for T_{avg} ≥572°F	35%↑ for T_{avg} <572°F (proposed) 50%↑ for T_{avg} ≥572°F (proposed)	G.40 and C.4
P-10	None	8.5%↓ RTP 9.5%↑ RTP	P.18 and P.19

7.0 METHODOLOGY

7.1 Uncertainty Determination

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

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

To convert 95/95 uncertainty values to 75/75 uncertainty values (when applicable); this calculation uses the conversion factor specified in Section 3.3.3.13 of Reference G.1. All individual instrument uncertainties are evaluated and shown as 95/95 values, and are combined under the Total Loop Error radical as such. Conversion to a 75/75 value is performed after the 95/95 TLE radical is computed.

B) Treatment of Significant Digits and Rounding

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

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

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

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

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

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

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

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

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

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

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

C) Determination of Channel Check Tolerance (CCT)

Per Section 3.3.8.7 of Reference G.1, the CCT value is considered a 75/75 value. However, converting the CCT from 95/95 into a 75/75 value restricts the tolerance allowed for the indication loop devices and essentially makes it more difficult for the plant to meet their requirements. This approach is considered to be overly conservative. Therefore, this calculation will determine CCT as a 95/95 value.

Although Reference G.1 does not discuss the rounding techniques for CCT values, it is typical for tolerance values to be rounded down. This approach tightens the tolerance band, thus creating a conservative tolerance value. However, in the case of CCT, when a channel is determined non-operational, it is most likely to be found grossly out of tolerance, i.e., the difference between the channel readings far surpasses the allowable CCT value. Therefore, in an effort to reduce the occurrence of false out of tolerance CCT readings, this calculation will round the CCT value up to the precision that is readable on the indication device.

7.1.1 Sources of Uncertainty

Per Ref. G.1, the device uncertainties to be considered for normal environmental conditions include the following:

Sensor Accuracy	(Sa)
Sensor Drift	(Sd)
Sensor M&TE	(Sm)
Sensor Setting Tolerance	(Sv)
Sensor Power Supply Effect	(Sp)
Sensor Temperature Effect	(St)
Sensor Humidity Effect	(Sh)
Sensor Radiation Effect	(Sr)
Sensor Seismic Effect	(Ss)

Power Range Drawer Accuracy	(Da)
Power Range Drawer Drift	(Dd)
Power Range Drawer M&TE	(Dm_1. Dm_2)
Power Range Drawer Setting Tolerance	(Dv_1, Dv_2, Dv_3)
Power Range Drawer Power Supply Effect	(Dp)
Power Range Drawer Temperature Effect	(Dt)
Power Range Drawer Humidity Effect	(Dh)
Power Range Drawer Radiation Effect	(Dr)
Power Range Drawer Seismic Effect	(Ds)

Indicator Accuracy	(Ia)
Indicator Drift	(Id)
Indicator M&TE	(Im)
Indicator Setting Tolerance	(Iv)
Indicator Power Supply Effect	(Ip)
Indicator Temperature Effect	(It)
Indicator Humidity Effect	(Ih)
Indicator Radiation Effect	(Ir)
Indicator Seismic Effect	(Is)
Indicator Readability Effect	(Irea)
Recorder Accuracy	(Ra)
Recorder Drift	(Rd)
Recorder M&TE	(Rm)
Recorder Setting Tolerance	(Rv)
Recorder Power Supply Effect	(Rp)
Recorder Temperature Effect	(Rt)
Recorder Humidity Effect	(Rh)
Recorder Radiation Effect	(Rr)
Recorder Seismic Effect	(Rs)
Recorder Readability Effect	(Rrea)
PPCS Accuracy	(PPCSa)
PPCS Drift	(PPCSd)
PPCS M&TE	(PPCSm)
PPCS Setting Tolerance	(PPCSv)
PPCS Power Supply Effect	(PPCSp)
PPCS Temperature Effect	(PPCSt)
PPCS Humidity Effect	(PPCSh)
PPCS Radiation Effect	(PPCSr)
PPCS Seismic Effect	(PPCSs)
PPCS Readability Effect	(PPCSrea)
Process Error	(PE)
Bias Terms	(Bias)

The uncertainties will be generally calculated in percent of span and converted to the process units as required.

Per Sections 3.1 and 3.2 of Reference G.1, the functions of the Power Range Neutron Flux monitors are classified into the following categories:

- The Power Range High Flux Reactor Trip Setpoints, which provide inputs to RPS, are classified as Category A function. The total loop error should be expressed as 95/95 (95% probability at a 95% confidence level) value.
- The Control Room indication total loop error, which is non-safety related, is classified as Category E function. The total loop error should be expressed as a 75/75 value.

- The recorder and PPCS display, which only provides data monitoring function and is non-safety related, is classified as Category E function. The total loop error should be expressed as a 75/75 value.

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

7.1.2 Total Loop Error Equation Summary

The general equation for total instrument loop error found in Ref. G.1, Section 3.3.7 is modified in order to calculate each function individually.

7.1.2.1 Total Trip Loop Error (TLE_{TRIP}) Equation Summary

Per Section 6.4, only normal operating environmental conditions are considered. Per Figure 6.2-1, the total loop error for the Power Range High Flux trips (High and Low Range) consist of the following uncertainties:

$$TLE_{TRIP} = \pm\sqrt{\begin{array}{l} Sa^2 + Da^2 + Sd^2 + Dd^2 + Sm^2 + Dm_1^2 \\ + Sv^2 + Dv_2^2 + Sp^2 + Dp^2 + St^2 + Dt^2 + \\ Sh^2 + Dh^2 + Sr^2 + Dr^2 + Ss^2 + Ds^2 + PE^2 \end{array}} \pm Biases \quad \text{(Eq. 7.1.2.1)}$$

7.1.2.2 Total Indication Loop Error (TLE_{IND}) Equation Summary

Per Section 6.4, only normal operating environmental conditions are considered. Per Figure 6.2-1, the total loop error for the Power Range Neutron Flux Indicator consists of the following uncertainties:

$$TLE_{IND} = \pm\sqrt{\begin{array}{l} Sa^2 + Da^2 + Ia^2 + Sd^2 + Dd^2 + Id^2 \\ + Sm^2 + Dm_1^2 + Im^2 + Sv^2 + Dv_1^2 + \\ Iv^2 + Sp^2 + Dp^2 + Ip^2 + St^2 + Dt^2 + \\ It^2 + Sh^2 + Dh^2 + Ih^2 + Sr^2 + Dr^2 + \\ Ir^2 + Ss^2 + Ds^2 + Is^2 + Iread^2 + PE^2 \end{array}} \pm Biases \quad \text{(Eq. 7.1.2.2)}$$

7.1.2.3 Total PPCS Loop Error (TLE_{PPCS}) Equation Summary

Per Section 6.4, only normal operating environmental conditions are considered. Per Figure 6.2-1, the total loop error for the Power Range Neutron Flux PPCS display consists of the following uncertainties:

$$TLE_{PPCS} = \pm \sqrt{\begin{aligned}&Sa^2 + Da^2 + PPCSa^2 + Sd^2 + Dd^2 + PPCSd^2 \\ &+ Sm^2 + Dm_1^{\ 2} + PPCSm^2 + Sv^2 + Dv_1^{\ 2} + PPCSv^2 \\ &+ Sp^2 + Dp^2 + PPCSp^2 + St^2 + Dt^2 + PPCSt^2 + \\ &Sh^2 + Dh^2 + PPCSh^2 + Sr^2 + Dr^2 + PPCSr^2 + \\ &Ss^2 + Ds^2 + PPCSs^2 + PPCSrea^2 + PE^2\end{aligned}} \pm Biases \quad \text{(Eq. 7.1.2.3)}$$

7.1.2.4 Total Recorder Loop Error (TLE_{REC}) Equation Summary

Per Section 6.4, only normal operating environmental conditions are considered. Per Figure 6.2-1, the total loop error for the Power Range Neutron Flux Recorder consists of the following uncertainties:

$$TLE_{REC} = \pm \sqrt{\begin{aligned}&Sa^2 + Da^2 + Ra^2 + Sd^2 + Dd^2 + Rd^2 \\ &+ Sm^2 + Dm_1^{\ 2} + Rm^2 + Sv^2 + Dv_1^{\ 2} + \\ &Rv^2 + Sp^2 + Dp^2 + Rp^2 + St^2 + Dt^2 + \\ &Rt^2 + Sh^2 + Dh^2 + Rh^2 + Sr^2 + Dr^2 + \\ &Rr^2 + Ss^2 + Ds^2 + Rs^2 + Rread^2 + PE^2\end{aligned}} \pm Biases \quad \text{(Eq. 7.1.2.4)}$$

7.1.3 As-Found Tolerance Equation Summary

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

7.1.3.1 Power Range Drawer As-Found Tolerance (DAF)

The acceptable As-Found Tolerance for the Power Range Drawer is calculated by the following equation:

$$DAF = \pm \sqrt{Dv^2 + Dd^2 + Dm^2} \quad \text{(Eq. 7.1.3.1)}$$

Where:

Dv = Power Range Drawer Setting Tolerance
Dd = Power Range Drawer Drift
Dm = Power Range Drawer M&TE Error (DM_1 or DM_2)

7.1.3.2 Indicator As-Found Tolerance (IAF)

The acceptable As-Found Tolerance for the Indicator is calculated by the following equation:

$$IAF = \pm \sqrt{Iv^2 + Id^2 + Im^2} \quad \text{(Eq. 7.1.3.2)}$$

Where:

Iv = Indicator Setting Tolerance
Id = Indicator Drift
Im = Indicator M&TE Error

7.1.3.3 PPCS As-Found Tolerance (PPCSAF)

The acceptable As-Found Tolerance for the PPCS is calculated by the following equation:

$$PPCSAF = \pm \sqrt{PPCSv^2 + PPCSd^2 + PPCSm^2} \quad \text{(Eq. 7.1.3.3)}$$

Where:

PPCSv = PPCS Setting Tolerance
PPCSd = PPCS Drift
PPCSm = PPCS M&TE Error

7.1.3.4 Recorder As-Found Tolerance (RAF)

The acceptable As-Found Tolerance for the Recorder is calculated by the following equation:

$$RAF = \pm \sqrt{Rv^2 + Rd^2 + Rm^2} \quad \text{(Eq. 7.1.3.4)}$$

Where:

Rv = Recorder Setting Tolerance
Rd = Recorder Drift
Rm = Recorder M&TE Error

7.1.4 As-Left Tolerance Equation Summary

Per Section 3.3.8.6 of Reference G.1, the As-Left Tolerances are calculated independently for the components in the loop.

7.1.4.1 Power Range Drawer As-Left Tolerance (DAL)

The As-Left Tolerance for the Power Range Drawer is equal to the setting tolerance:

$$DAL = \pm Dv \quad \text{(Eq. 7.1.4.1)}$$

Where:

Dv = Power Range Drawer Setting Tolerance

7.1.4.2 Indicator As-Left Tolerance (IAL)

The As-Left Tolerance for the Indicator is equal to its setting tolerance:

$$IAL = \pm Iv \quad \text{(Eq. 7.1.4.2)}$$

Where:

Iv = Indicator Setting Tolerance

7.1.4.3 PPCS As-Left Tolerance (PPCSAL)

The As-Left Tolerance for the PPCS is equal to its setting tolerance:

$$PPCSAL = \pm PPCSv \quad \text{(Eq. 7.1.4.3)}$$

Where:

PPCSv = PPCS Setting Tolerance

7.1.4.4 Recorder As-Left Tolerance (RAL)

The As-Left Tolerance for the Recorder is equal to its setting tolerance:

$$RAL = \pm Rv \quad \text{(Eq. 7.1.4.4)}$$

Where:

Rv = Recorder Setting Tolerance

7.1.5 Operability Limit (OL) Equation Summary

Per Section 3.3.8.2 of Reference G.41, the Operability Limit (OL) is defined as a calculated limiting value that the As-Found bistable setpoint is allowed to have during a Technical Specification surveillance Channel Operational Test (COT), beyond which the instrument channel is considered inoperable and corrective action must be taken. Two OLs are calculated, one on each side of the FTSP as-left tolerance band, incorporating a calculated 3-sigma (3σ) drift value. A channel found drifting beyond its 3σ drift value is considered to be operating abnormally (i.e., is inoperable).

Per Section 3.3.8.4 of Reference G.41, the OL on each side of the FTSP is calculated as follows:

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

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

Where:

the FTSP is expressed in percent of span
OL^+ is the Operability Limit above the FTSP
OL^- is the Operability Limit below the FTSP
RAL is the rack as-left tolerance (typically the bistable tolerance)
$Rd_{3\sigma}$ is the 3σ rack drift value determined as follows:

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

The rack drift value ($Rd_{2\sigma}$) is the 2-sigma drift value for components checked during the COT, typically the bistable drift.

7.1.6 Channel Check Tolerance (CCT)

Per Reference G.1, the channel check tolerance (CCT) represents the maximum expected deviation between channel indications that monitor the same plant process parameter. The CCT is determined for the instrument loops that require a qualitative assessment of channel behavior during operation. This assessment involves an observed comparison of the channel indication/status.

As stated in Section 3.3.8.7 of Reference G.1, the CCT is determined by combining the reference accuracy (a), setting tolerance (v), drift (d), and readability (rea) of each device, including the sensor, in the indication loop. A channel check involves a comparison of the two indications independent of the number of redundant loops. The channel check tolerance is the combination of these uncertainties (in % span) using the SRSS method shown below:

$$CCT = \pm\sqrt{\begin{aligned}&(Sa^2 + Da^2 + Ia^2 + Sd^2 + Dd^2 + Id^2 + Sv^2 + Dv^2\\ &+ Iv^2 + Irea^2)_{ind\,a} + (Sa^2 + Da^2 + Ia^2 + Sd^2 + Dd^2 + Id^2\\ &+ Sv^2 + Dv^2 + Iv^2 + Irea^2)_{ind\,b}\end{aligned}} \qquad \text{(Eq. 7.1.6)}$$

7.2 Limiting Trip Setpoint (LTSP) Equation Summary

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

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

$$LTSP\uparrow = AL + [(0.839)^*\ TLE_{rdm}^- + TLE_{bias}^-]PS \qquad \text{(Eq. 7.2-1)}$$

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

$$LTSP\downarrow = AL + [(0.839)^* \; TLE_{rdm}^{+} + TLE_{bias}^{+}]PS \qquad \text{(Eq. 7.2-2)}$$

7.3 Drift Considerations

The drift values established in Reference C.1 will be utilized for the indicators.

Use of the aforementioned drift value (as design input to this calculation) is based on justification provided by Engineering Evaluation 2005-0006 (Ref. C.2). This evaluation reviews the station's M&TE and M&TE control programs, based on requirements imposed by the methodology used to prepare instrument setpoint and uncertainty calculations for the station (Ref. G.1). The evaluation concludes that the station's M&TE and M&TE control programs have remained equivalent or improved since the drift calculations were initially prepared, and therefore, renders the drift calculations acceptable for use in current (present-day) calculation revisions performed for the station.

8.0 BODY OF CALCULATION

8.1 Device Uncertainty Analysis

This section will introduce all applicable uncertainties for the devices that comprise the Power Range Neutron Flux monitoring loop shown in Figure 6.2-1.

From Ref. G.1 (Section 3.3.4.3), the drift values calculated from As-Found/As-Left instrument calibration data normally include the error effects under normal conditions of drift, accuracy, power supply, plant vibration, calibration temperature, normal radiation, normal humidity, M&TE used for calibration, and instrument readability. If it is determined that the calibration conditions are indicative of the normal operating conditions, the environmental effects need not be included separately. All device uncertainty terms are considered random and independent unless otherwise noted.

8.1.1 Sensor Accuracy (Sa)

Per Assumption 5.1.4, the accuracy of the sensor is negligible. Therefore,

Sa = ± 0.000% span

8.1.2 Sensor Drift (Sd)

Per Assumption 5.1.4, the drift of the sensor is negligible. Therefore,

Sd = ± 0.000% span

8.1.3 Sensor M&TE (Sm)

Per References P.20 – P.27, the Sensors are uncalibrated devices. Therefore, there is no error due to calibration equipment.

Sm = ± 0.000% span

8.1.4 Sensor Setting Tolerance Effect (Sv)

Per References P.20 – P.27, the Sensors are uncalibrated devices. Per References P.16 and P.17 the sensor output is compared against the Daily Power Calorimetric. Any error associated with the sensor power level adjustment is accounted for in the Power Calorimetric portion of the process error (Section 8.1.49). Therefore,

Sv = ± 0.000% span

8.1.5 Sensor Power Supply Effect (Sp)

Per Assumption 5.1.4, the power supply effect of the sensor is negligible. Therefore,

Sp = ± 0.000% span

8.1.6 Sensor Temperature Effect (St)

Per Assumption 5.1.4, the temperature effect of the sensor is negligible. Therefore,

St = ± 0.000% span

8.1.7 Sensor Humidity Effect (Sh)

Per Assumption 5.1.4, the humidity effect of the sensor is negligible. Therefore,

Sh = ± 0.000% span

8.1.8 Sensor Radiation Effect (Sr)

Per Assumption 5.1.4, the radiation effect of the sensor is negligible. Therefore,

Sr = ± 0.000% span

8.1.9 Sensor Seismic Effect (Ss)

There is no seismic effect provided by the vendor for the Power Range Drawer (Ref. V.1). Per Section 3.3.4.10 of Reference G.1, the effects of seismic or vibration events for non-mechanical instrumentation are considered zero unless vendor or industry experience indicates otherwise. Therefore,

Ss = ± 0.000% span

8.1.10 Power Range Drawer Accuracy (Da)

The Power Range (PR) Drawer accuracy is ± 2.0 % full scale (Ref. V.1). This accuracy is interpreted to include all modules inside the drawer (see Table 6.3-1) through which the neutron flux signals from the sensor are processed. Therefore,

Da = ± 2.000 % Span

8.1.11 Power Range Drawer Drift (Dd)

The vendor does not provide a drift specification for the PR Drawer (Ref. V.1). Per Section 3.3.3.15 of Reference G.1, when drift is not specified by the vendor, the accuracy of the component is used as the drift for the entire calibration period. Therefore,

Dd = ± 2.000 % Span

8.1.12 Power Range Drawer M&TE (Dm_1, Dm_2)

The PR Drawer is calibrated using the drawer Test Calibration Module (NM312), which has an accuracy of ± 0.5% as read on an ion current meter for each channel (Ref. V.5). This module supplies the input to the summing amplifier for high and low range. Per Reference V.1, the summing amplifier averages the two signals and the output is read on the percent power indicator located on the drawer. Because of this, the errors for each signal (high and low) prior to the summing amplifier could be propagated through an averaging function per Reference G.9. However, it can be shown that it is more conservative to calculate these errors for one signal (high or low) following the standard methodology as opposed to propagating the errors for both signals to determine a combined error. As a result, the errors are calculated without propagation for use in this calculation. Therefore, the M&TE Error is the accuracy of the test module combined with the readability errors due to reading the input current and output percent power.

$$Ma = \pm 0.5\% \text{ span}$$

Completed procedures of REI 40.0 (Ref P.30) can be used to show that the current range for power neutron flux is within 0 – 500 μA. For this range, the calibration module is set to input 0.5 milliamps as read on the indicator. Per Section 3.3.4.4 of Reference G.1, the readability of an analog device for M&TE is ¼ its minor division. Per Reference G.29, at the 0.5 mA scale, the input current meter has minor divisions every 0.005 milliamp. Therefore,

$$Mrea_1 = \pm (1/4) * 0.005 \text{ mA} * (100\% \text{ span}/[0.5 \text{ mA}])$$

$$Mrea_1 = \pm 0.250\% \text{ span}$$

Per Section 3.3.4.4 of Reference G.1, the readability of an analog device for M&TE is ¼ its minor division. Per Reference G.29, the output percent level meter has minor divisions every 1% RTP with a span of 120% RTP. Therefore,

$$Mrea_2 = \pm 1/4 * 1\% \text{ RTP} * (100\% \text{ span}/120\% \text{ RTP})$$

$$Mrea_2 = \pm 0.208\% \text{ span}$$

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

$$M = \pm\sqrt{m_1^2 + m_2^2 + \ldots . m_n^2}$$

$$Dm_1 = \pm\sqrt{Ma^2 + Mrea_1^2 + Mrea_2^2}$$

$$Dm_1 = \pm\sqrt{0.50^2 + 0.250^2 + 0.208^2}$$

$$\mathbf{Dm_1 = \pm 0.596\% \text{ span}}$$

While calibrating the power range drawer, the output of the summing amplifier is also read. The M&TE error of the multiplier should also be considered (Note, this is applicable only for the calculation of the As-Found Tolerances with Vdc output).

Per References P.20 – P.27, the power range drawer summing amplifier output is measured with a multimeter capable of measuring 0 – 10 Vdc output. According to calibration procedure ICI-12 (Ref. P.28), the following M&TE are capable of performing this measurement.

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

RA_{mte} = ± 0.025% reading
RA_{mte} = ± 0.025% reading * 10 Vdc
RA_{mte} = ± 0.0025 Vdc
RA_{std} = 0
RD_{mte} = ± 6 DG * 0.001 Vdc
RD_{mte} = ± 0.006 Vdc

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

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

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

<u>HP 34401A multimeter (6.5 digit display, 10 Vdc range) (Ref. V.9):</u>

RA_{mte} = ± (0.0035 % reading + 0.0005 % range)
RA_{mte} = ± [0.0035 % (10 Vdc) + 0.0005 % (10 Vdc)]
RA_{mte} = ± 0.0004 Vdc
RA_{std} = 0
RD_{mte} = ± 0.00001 Vdc

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

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

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

For conservatism, the uncertainty of the Fluke 45 is used for the output M&TE error for reading the Power Range Drawer level amplifier output.

Converting the uncertainty to % span,

m_{45} = (uncertainty/calibrated span) * 100%
m_{45} = (± 0.0065 Vdc/10 Vdc) * 100%
m_{45} = ± 0.065 % span

The total M&TE uncertainty is from the calibration module, the readability of the input current indicator on the drawer, and the multimeter used to measure the output of the summing amplifier. Therefore, using the multiple M&TE equation given in Section 3.3.4.4 of Reference G.1:

$$M = \pm\sqrt{m_1^2 + m_2^2 + \dots m_n^2}$$

$$Dm_2 = \pm\sqrt{Ma^2 + Mrea_1^2 + m_{45}^2}$$

$$Dm_2 = \pm\sqrt{0.50^2 + 0.250^2 + 0.065^2}$$

Dm_2 = ±0.563% span

8.1.13 Power Range Drawer Setting Tolerance (Dv_1, Dv_2, Dv_3)

Per References P.20 – P.27 and Assumption 5.1.3, the PR Drawer setting tolerance is ± 0.50% RTP as read on 1(2)N-41A – 1(2)N-44A. This is the setting tolerance associated with calibrating the drawer for output to the indicator, recorder, and PPCS. However, at the output to the bistable relays for trips and permissives, the drawer has a setting tolerance of ± 1.0% RTP. Therefore, this setting tolerance is used in determining the tolerances for these purposes. Since the scale of RTP is 0 – 120% RTP (Ref. G.29), these values must be converted to process span.

Indication

Dv_1 = ±0.50% RTP

Dv_1 = ±0.50% RTP * (100% span/120% RTP)

Dv_1 = ± 0.417% span

Trips

Dv_2 = ±1.0% RTP

Dv_2 = ±1.0% RTP * (100% span/120% RTP)

Dv_2 = ± 0.833% span

Calibration

Dv_3 = ± 0.025 Vdc

Dv_3 = ± 0.025 Vdc * (100% span/10.000 Vdc)

Dv_3 = ± 0.250% span

8.1.14 Power Range Drawer Power Supply Effect (Dp)

The vendor does not specify a power supply effect for the power range drawer (Ref. V.1). Section 3.3.3.16 of Reference G.1 states that industry experience with similar devices should be considered in the absence of vendor data. Review of similar devices from the same vendor does not provide power supply effect information. Therefore, the power range drawer power supply effect is considered negligible.

Dp = ± 0.000% span

8.1.15 Power Range Drawer Temperature Effect (Dt)

Per Reference V.1, the power range drawer has an ambient temperature range of 40°F – 120°F. Per Section 6.4, the maximum temperature range the power range drawer is expected to operate is 65°F – 120°F. Per Section 3.3.3.3 of Reference G.1, in the absence of vendor specified temperature effects, the temperature error is negligible as long as environmental conditions meet the vendor specified requirements. Therefore,

Dt = ± 0.000% span

8.1.16 Power Range Drawer Humidity Effect (Dh)

Per Section 3.3.3.20 of Reference G.1, changes in ambient humidity have a negligible effect on the uncertainty of the instruments used in this calculation. Therefore,

Dh = ± 0.000% span

8.1.17 Power Range Drawer Radiation Effect (Dr)

The power range drawer is located in the Control Room, which has a mild radiological environment under all plant conditions. Per Section 3.3.3.21 of Reference G.1, radiation errors are considered to be included in the drift error. Therefore,

Dr = ± 0.000% span

8.1.18 Power Range Drawer Seismic Effect (Ds)

There is no seismic effect provided by the vendor for the power range drawer (Ref. V.1). Per Section 3.3.4.10 of Reference G.1, the effects of seismic vibration events for non-mechanical instrumentation are considered zero unless vendor or industry experience indicates otherwise. Therefore,

Ds = ± 0.000% span

8.1.19 Indicator Accuracy (Ia)

Reference C.1 has determined the historical drift values for the indicator. Per Reference G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the Accuracy of the indicator is included in the drift value. Therefore,

Ia = ± 0.000 % span

8.1.20 Indicator Drift (Id)

Per References P.20 – P.27, the power range indicators are Westinghouse 252 and they are calibrated individually. Reference C.1 is the As-Found/As-Left drift analysis for Westinghouse HX-252 indicators that are either string calibrated with Foxboro 66BC-O isolators or individually calibrated. Although the drift analysis performed in Reference C.1 does not specifically include the As-Found/As-Left data of the power range indicator, the 95/95 drift value calculated for individually calibrated Westinghouse HX-252 indicator therein is considered representative of the indicators experienced at PBNP. Since the power range indicators are tested and calibrated every 18 months (Ref. P.20 and P.27), the 100%, 2-year 95/95 drift value (Table 8.2 of Ref. C.1) is conservatively used. Therefore,

Id = ± 1.028 % span
Bias = ± 0.000 % span

8.1.21 Indicator M&TE Effect (Im)

Reference C.1 has determined the historical drift values for the indicator. Per Reference G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the M&TE Effect of the indicator is included in the drift value. Therefore,

Im = ± 0.000 % span

8.1.22 Indicator Setting Tolerance (Iv)

Per References P.20 – P.27 and Assumption 5.1.3, the setting tolerance of the power range indicators is ± 1.0% RTP. Therefore,

Iv = ±1.0% RTP * (100% span/120% RTP)

Iv = ± 0.833 % span

8.1.23 Indicator Power Supply Effect (Ip)

Reference C.1 has determined the historical drift values for the indicator. Per Reference G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the Power Supply Effect of the indicator is included in the drift value. Therefore,

Ip = ± 0.000 % span

8.1.24 Indicator Temperature Effect (It)

Per Section 6.4.3, the indicators are located in the Control Room, which is environmentally controlled between 65 °F and 120 °F. The vendor information (Ref. V.2) does not provide temperature effects for the indicators. Per Reference G.27, the temperature effect is included in the drift value. Therefore,

It = ± 0.000 % span

8.1.25 Indicator Humidity Effect (Ih)

Per Section 3.3.3.20 of Reference G.1, changes in ambient humidity have a negligible effect on the uncertainty of the instruments used in this calculation. Therefore,

Ih = ± 0.000 % span

8.1.26 Indicator Radiation Effect (Ir)

Per Section 6.4.3, the indicators are located in the Control Room, which has a mild radiological environment under all plant conditions. Reference C.1 has determined the historical drift values for the indicator. Per Reference G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the Radiation Effect of the indicator is included in the drift value. Therefore,

Ir = ± 0.000 % span

8.1.27 Indicator Seismic Effect (Is)

There is no seismic effect provided by the vendor for the indicators (Ref. V.2). From Section 6.4, only normal plant operating conditions are evaluated. Therefore,

Is = ± 0.000 % span

8.1.28 Indicator Readability Effect (Irea)

Reference C.1 has determined the historical drift values for the indicator. Per Reference G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the Readability Effect of the indicator is included in the drift value. Therefore,

Irea = ± 0.000 % span

8.1.29 PPCS Accuracy (PPCSa)

Per Assumption 5.1.1, the PPCS accuracy is ± 0.510% span. Therefore,

PPCSa = ± 0.510% span

8.1.30 PPCS Drift (PPCSd)

Per Assumption 5.1.1, the drift for the PPCS is included in the accuracy term. Therefore,

PPCSd = ± 0.000% span

8.1.31 PPCS M&TE Effect (PPCSm)

Per References P.20 – P.27, the PPCS is calibrated by measuring an input voltage (0 – 5 Vdc) from the power range drawer and observing the output on the PPCS. The readability of the PPCS is accounted for in Section 8.1.38. Therefore, the M&TE effect of the PPCS is due to the multimeter measuring the input voltage. Per Reference P.28, the following M&TE are capable of this measurement.

HP 34401A multimeter (6.5 digit display, 10.0 Vdc range) (Ref. V.9)

RA_{mte} = ± (0.0035 % reading + 0.0005 % range)
RA_{mte} = ± [0.0035 % (5 Vdc) + 0.0005 % (10 Vdc)]
RA_{mte} = ± 0.000225 Vdc
RA_{std} = 0
RD_{mte} = ± 0.00001 Vdc

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

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

$$m_{HP} = \pm\sqrt{0.000225^2 + 0^2 + 0.00001^2} = \pm 0.000225 \text{ Vdc}$$

Fluke 45 multimeter (5 digit display, 30 Vdc range)

RA_{mte} = uncertainty * max reading
RA_{mte} = ± 0.025% reading * 5Vdc
RA_{mte} = ± 0.00125 Vdc
RA_{std} = 0
RD_{mte} = ± 2 DGTS * 0.001 Vdc
RD_{mte} = ± 0.002 Vdc

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

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

$$m_{45} = \pm\sqrt{0.00125^2 + 0^2 + 0.002^2} = \pm 0.00236 \text{ Vdc}$$

Fluke 8842A multimeter (6.5 digit display, 20 Vdc range)

RA_{mte} = uncertainty * max reading
RA_{mte} = ± 0.0035% reading * 5 Vdc
RA_{mte} = ± 0.000175 Vdc
RA_{std} = 0
RD_{mte} = ± 2 DGTS * 0.0001 Vdc
RD_{mte} = ± 0.0002 Vdc

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

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

$$m_{8842} = \pm\sqrt{0.000175^2 + 0^2 + 0.0002^2} = \pm 0.000266\text{Vdc}$$

The uncertainty of the Fluke 45 (m_{45} = ± 0.00236 Vdc) is used as the bounding M&TE because it is the less accurate.

Converting to % span,

PPCSm = ± 0.00236 Vdc * (100% span/5 Vdc)

PPCSm = ± 0.047% span

8.1.32 PPCS Setting Tolerance (PPCSv)

Per References P.20 – P.27 and Assumption 5.1.3, the setting tolerance for the PPCS is ± 0.6% RTP. Therefore,

PPCSv = ± 0.6% RTP * (100% span/120% RTP)

PPCSv = ± 0.500 % span

8.1.33 PPCS Power Supply Effect (PPCSp)

Per Assumption 5.1.1, the power supply effect for the PPCS is included in the accuracy term. Therefore,

PPCSp = ± 0.000 % span

8.1.34 PPCS Temperature Effect (PPCSt)

Per Assumption 5.1.1, the temperature effect for the PPCS is included in the accuracy term. Therefore,

PPCSt = ± 0.000 % span

8.1.35 PPCS Humidity Effect (PPCSh)

Per Assumption 5.1.1, the humidity effect for the PPCS is included in the accuracy term. Therefore,

PPCSh = ± 0.000 % span

8.1.36 PPCS Radiation Effect (PPCSr)

Per Assumption 5.1.1, the radiation effect for the PPCS is included in the accuracy term. Therefore,

PPCSr = ± 0.000 % span

8.1.37 PPCS Seismic Effect (PPCSs)

Per Assumption 5.1.1, the seismic effect for the PPCS is included in the accuracy term. Therefore,

PPCSs = ± 0.000 % span

8.1.38 PPCS Readability Effect (PPCSrea)

Section 3.3.5.3 of Reference G.1 states that the readability error for digital indication is the least significant digit. Per References P.20 – P.27, the power range PPCS display is readable to at least 0.1% RTP. Therefore,

PPCSrea = ± 0.1% RTP * (100% span/120% RTP)

PPCSrea = ± 0.083% span

8.1.39 Recorder Accuracy (Ra)

Per Reference V.3, the accuracy of analog recording for an input range of 50 mVdc is ± 0.25 % of full scale. The vendor also specifies a repeatability of ± 0.1 % of full scale for voltage input signals. Section 3.3.4.1 of Reference G.1 states that the accuracy term includes the combined effects of the repeatability. Therefore,

Ra = ± 0.250 % span

8.1.40 Recorder Drift (Rd)

The vendor specifications (Ref V.3) do not provide a drift allowance. Per Section 3.3.3.15 of Reference G.1, when drift is not specified by the vendor, the accuracy of the component is used as the drift for the entire calibration period. Therefore,

Rd = ± 0.250 % span

8.1.41 Recorder M&TE Effect (Rm)

Per References P.20 – P.27, the Recorder is calibrated by measuring the output from the power range drawer on the recorder. Therefore, the M&TE effect of the recorder is due to the multimeter measuring the input voltage. Per Reference P.28, the following M&TE are capable of this measurement.

<u>Fluke 45 multimeter (medium resolution, 5-digit display, 300 mVdc range):</u>

RA_{mte} = ± 0.025% reading
RA_{mte} = ± 0.025% reading * 50 mVdc
RA_{mte} = ± 0.0125 Vdc
RA_{std} = 0
RD_{mte} = ± 2 DG * 0.01 Vdc
RD_{mte} = ± 0.02 Vdc

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

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

$$m_{45} = \pm\sqrt{0.0125^2 + 0^2 + 0.02^2} = \pm 0.0236 \text{ mVdc}$$

<u>HP 34401A multimeter (6.5 digit display, 100 mVdc range) (Ref. V.9):</u>

RA_{mte} = ± (0.0050 % reading + 0.0035 % range)
RA_{mte} = ± [0.0050 % (50 mVdc) + 0.0035 % (100 mVdc)]
RA_{mte} = ± 0.006 mVdc
RA_{std} = 0
RD_{mte} = ± 0.0001 mVdc

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

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

$$m_{HP} = \pm\sqrt{0.006^2 + 0^2 + 0.0001^2} = \pm 0.006 \text{ mVdc}$$

For conservatism, the uncertainty of the Fluke 45 is used for the input M&TE for the recorder

Rm = ± (0.0236 mVdc / 50 mVdc) * 100 % span

Rm = ± 0.047 % span

8.1.42 Recorder Setting Tolerance (Rv)

Per References P.20 – P.27, and Assumption 5.1.3, the setting tolerance of the recorder is ± 1.00 mVdc with a range of 0 – 50 mVdc. Therefore,

Rv = ± 1.00 mVdc * (100% span/50 mVdc)

Rv = ± 2.000% span

8.1.43 Recorder Power Supply Effect (Rp)

The vendor does not provide power supply effect specifications for the recorder (Ref. V.3). Section 3.3.3.16 of Ref. G.1 states that industry experience with similar devices should be considered in the absence of vendor data. Review of similar devices from the same vendor does not provide power supply effect information. Therefore, the Recorder Power Supply Effect is considered negligible.

Rp = ± 0.000 % span

8.1.44 Recorder Temperature Effect (Rt)

Per Section 6.4, the Recorder is located in the Control Room, which has an ambient temperature between 65 °F and 85 °F. From vendor information (Ref. V.3), the Recorder has an operating range of +32 °F to +122 °F with no associated temperature effect. Therefore, the temperature effect is considered negligible.

Rt = ± 0.000 % span

8.1.45 Recorder Humidity Effect (Rh)

Per Section 3.3.3.20 of Reference G.1, changes in ambient humidity have a negligible effect on the uncertainty of the instruments used in this calculation. Therefore,

Rh = ± 0.000 % span

8.1.46 Recorder Radiation Effect (Rr)

The recorder is located in the Control Room, which has a mild radiological environment under all plant conditions. Per Section 3.3.3.21 of Reference G.1, radiation errors are considered to be included in the drift error. Therefore,

Rr = ± 0.000 % span

8.1.47 Recorder Seismic Effect (Rs)

There is no seismic effect provided by the vendor for the recorders (Ref. V.3). Per Section 6.4, only normal plant operating conditions are evaluated. Therefore,

Rs = ± 0.000 % span

8.1.48 Recorder Readability Effect (Rrea)

Section 3.3.5.3 of Reference G.1 states that the readability error for an analog device is ½ the minor division. Per Reference G.29, the minor division on the recorder is 1% RTP. Therefore,

Rrea = ± [½ * 1% RTP] * (100% span/120% RTP)

Rrea = ± 0.417% span

8.1.49 Process Error (PE)

Per Reference G.32, the process error for the power range is a factor of the Power Calorimetric uncertainty, uncertainty due to Downcomer Temperature, and the Radial Power Distribution uncertainty. These are all treated as random errors and are combined using the SRSS method. Therefore,

$$PE = \pm\sqrt{PE_P{}^2 + PE_D{}^2 + PE_R{}^2}$$

where,

PE_P = Power Calorimetric Error
PE_D = Downcomer Temperature Error
PE_R = Radial Power Distribution Error

From Reference G.32,

PE_P = ± 2.0% RTP
PE_D = ± 0.45% RTP, ± 4.99% RTP
PE_R = ± 4.0% RTP

For conservatism, the worst case Downcomer Temperature Error is used.

$$PE = \pm\sqrt{2.00^2 + 4.99^2 + 4.00^2}$$

PE = ± 6.70 % RTP

Converting to % span,

PE = ± 6.70% RTP * (100% span/120% RTP)

PE = ± 5.583% span

8.2 Device Uncertainty Summary

8.2.1 Sensor Uncertainties

Table 8.2.1, Sensor Uncertainties

Parameter	Uncertainty (% span) (95/95)	Reference Section
Sensor Accuracy (Sa)	± 0.000	8.1.1
Sensor Drift (Sd)	± 0.000	8.1.2
Sensor M&TE (Sm)	± 0.000	8.1.3
Sensor Setting Tolerance (Sv)	± 0.000	8.1.4
Sensor Power Supply Effect (Sp)	± 0.000	8.1.5
Sensor Temperature Effect (St)	± 0.000	8.1.6
Sensor Humidity Effect (Sh)	± 0.000	8.1.7
Sensor Radiation Effect (Sr)	± 0.000	8.1.8
Sensor Seismic Effect (Ss)	± 0.000	8.1.9

8.2.2 Power Range Drawer Uncertainties

Table 8.2.2, Power Range Drawer Uncertainties

Parameter	Uncertainty (% span) (95/95)	Reference Section
Power Range Drawer Accuracy (Da)	± 2.000	8.1.10
Power Range Drawer Drift (Dd)	± 2.000	8.1.11
Power Range Drawer M&TE (Dm)	$Dm_1 = \pm 0.596$ $Dm_2 = \pm 0.563$	8.1.12
Power Range Drawer Setting Tolerance (Dv)	$Dv_1 = \pm 0.417$ $Dv_2 = \pm 0.833$ $Dv_3 = \pm 0.250$	8.1.13
Power Range Drawer Power Supply Effect (Dp)	± 0.000	8.1.14
Power Range Drawer Temperature Effect (Dt)	± 0.000	8.1.15
Power Range Drawer Humidity Effect (Dh)	± 0.000	8.1.16

Parameter	Uncertainty (% span) (95/95)	Reference Section
Power Range Drawer Radiation Effect (Dr)	± 0.000	8.1.17
Power Range Drawer Seismic Effect (Ds)	± 0.000	8.1.18

8.2.3 Indicator Uncertainties

Table 8.2.3, Indicator Uncertainties

Parameter	Uncertainty (% span) (95/95)	Reference Section
Indicator Accuracy (Ia)	± 0.000	8.1.19
Indicator Drift (Id)	± 1.028	8.1.20
Indicator M&TE (Im)	± 0.000	8.1.21
Indicator Setting Tolerance (Iv)	± 0.833	8.1.22
Indicator Power Supply Effect (Ip)	± 0.000	8.1.23
Indicator Temperature Effect (It)	± 0.000	8.1.24
Indicator Humidity Effect (Ih)	± 0.000	8.1.25
Indicator Radiation Effect (Ir)	± 0.000	8.1.26
Indicator Seismic Effect (Is)	± 0.000	8.1.27
Indicator Readability Effect (Irea)	± 0.000	8.1.28

8.2.4 PPCS Uncertainties

Table 8.2.4, PPCS Uncertainties

Parameter	Uncertainty (% span) (95/95)	Reference Section
PPCS Accuracy (PPCSa)	± 0.510	8.1.29
PPCS Drift (PPCSd)	± 0.000	8.1.30
PPCS M&TE (PPCSm)	± 0.047	8.1.31
PPCS Setting Tolerance (PPCSv)	± 0.500	8.1.32
PPCS Power Supply Effect (PPCSp)	± 0.000	8.1.33
PPCS Temperature Effect (PPCSt)	± 0.000	8.1.34

Parameter	Uncertainty (% span) (95/95)	Reference Section
PPCS Humidity Effect (PPCSh)	± 0.000	8.1.35
PPCS Radiation Effect (PPCSr)	± 0.000	8.1.36
PPCS Seismic Effect (PPCSs)	± 0.000	8.1.37
PPCS Readability Effect (PPCSrea)	± 0.083	8.1.38

8.2.5 Recorder Uncertainties

Table 8.2.5, Recorder Uncertainties

Parameter	Uncertainty (% span) (95/95)	Reference Section
Recorder Accuracy (Ra)	± 0.250	8.1.39
Recorder Drift (Rd)	± 0.250	8.1.40
Recorder M&TE (Rm)	± 0.047	8.1.41
Recorder table Setting Tolerance (Rv)	± 2.000	8.1.42
Recorder Power Supply Effect (Rp)	± 0.000	8.1.43
Recorder Temperature Effect (Rt)	± 0.000	8.1.44
Recorder Humidity Effect (Rh)	± 0.000	8.1.45
Recorder Radiation Effect (Rr)	± 0.000	8.1.46
Recorder Seismic Effect (Rs)	± 0.000	8.1.47
Recorder Readability Effect (Rrea)	± 0.417	8.1.48

8.2.6 Process Considerations

Table 8.2.6, Process Considerations

Parameter	Uncertainty (% span) (95/95)	Reference Section
Process Error (PE)	± 5.583	8.1.49

8.3 Total Loop Errors

8.3.1 Total Trip Loop Error (TLE_{TRIP})

Per Section 6.5, the total trip loop error is used to evaluate two different power range setpoint values. Both of these setpoints are increasing toward the process AL. Per Section 7.2, only the negative TLE is needed with separate random and bias terms. Using Eq. 7.1.2.1,

$$TLE_{TRIP\text{-}rdm}^{-} = -\sqrt{\begin{array}{l} Sa^2 + Da^2 + Sd^2 + Dd^2 + Sm^2 + Dm_1^2 \\ + Sv^2 + Dv_2^2 + Sp^2 + Dp^2 + St^2 + Dt^2 + \\ Sh^2 + Dh^2 + Sr^2 + Dr^2 + Ss^2 + Ds^2 + PE^2 \end{array}}$$

Substituting from Section 8.2,

$$TLE_{TRIP\text{-}rdm}^{-} = -\sqrt{\begin{array}{l} 0.000^2 + 2.000^2 + 0.000^2 + 2.000^2 + 0.000^2 \\ + 0.596^2 + 0.000^2 + 0.833^2 + 0.000^2 + 0.000^2 \\ + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 \\ + 0.000^2 + 0.000^2 + 0.000^2 + 5.583^2 \end{array}}$$

$$TLE_{TRIP\text{-}rdm}^{-} = -\ 6.342\%\ \text{span} \qquad (95/95)$$

Per Section 8.2, there are no bias uncertainties. Therefore,

$$TLE_{TRIP\text{-}bias}^{-} = 0.000\%\ \text{span}$$

8.3.2 Total Indication Loop Error (TLE_{IND})

Per Section 7.1.1, the indicator loop is calculated as a 75/75 value. Therefore, the random and bias parts are determined separately for conversion from 95/95.

$$TLE_{IND} = \pm\sqrt{\begin{array}{l} Sa^2 + Da^2 + Ia^2 + Sd^2 + Dd^2 + Id^2 \\ + Sm^2 + Dm_1^2 + Im^2 + Sv^2 + Dv_1^2 + \\ Iv^2 + Sp^2 + Dp^2 + Ip^2 + St^2 + Dt^2 + \\ It^2 + Sh^2 + Dh^2 + Ih^2 + Sr^2 + Dr^2 + \\ Ir^2 + Ss^2 + Ds^2 + Is^2 + Iread^2 + PE^2 \end{array}}$$

Substituting from Section 8.2,

$$TLE_{IND\text{-}rdm} = \pm\sqrt{\begin{array}{l}0.000^2 + 2.000^2 + 0.000^2 + 0.000^2 + 2.000^2 + \\ 1.028^2 + 0.000^2 + 0.596^2 + 0.000^2 + 0.000^2 + \\ 0.417^2 + 0.833^2 + 0.000^2 + 0.000^2 + 0.000^2 + \\ 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + \\ 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + \\ 0.000^2 + 0.000^2 + 0.000^2 + 5.583^2\end{array}}$$

$TLE_{IND\text{-}rdm} = \pm 6.438\%$ span (95/95)

Per Section 8.2, there are no bias uncertainties. Therefore,

$TLE_{IND\text{-}bias} = 0.000\%$ span

Convert to 75/75 error:
$error_{75/75} = (1.15/1.96) * error_{95/95}$ (Section 3.3.3.13 of Ref. G.1)
$TLE_{IND} = (1.15/1.96) * \pm 6.438\ \%\ span = \pm 3.777\ \%\ span$

$TLE_{IND} = \pm 3.777\ \%$ span **(75/75)**

Converting to process units,

$TLE_{IND} = (\pm 3.777\%\ span) * (120\%\ RTP)/100\%\ span$

$TLE_{IND} = \pm 4.532\%$ RTP **(75/75)**

8.3.3 Total PPCS Loop Error (TLE_{PPCS})

Per Section 7.1.1, the PPCS total loop error is calculated as a 75/75 value. Therefore, the random and bias parts are determined separately for conversion from 95/95.

$$TLE_{PPCS\text{-}rdm} = \pm\sqrt{\begin{array}{l}Sa^2 + Da^2 + PPCSa^2 + Sd^2 + Dd^2 + PPCSd^2 \\ + Sm^2 + Dm_1{}^2 + PPCSm^2 + Sv^2 + Dv_1{}^2 + PPCSv^2 \\ + Sp^2 + Dp^2 + PPCSp^2 + St^2 + Dt^2 + PPCSt^2 + \\ Sh^2 + Dh^2 + PPCSh^2 + Sr^2 + Dr^2 + PPCSr^2 + \\ Ss^2 + Ds^2 + PPCSs^2 + PPCSrea^2 + PE^2\end{array}}$$

Substituting from Section 8.2,

$$TLE_{PPCS\text{-}rdm} = \pm\sqrt{\begin{array}{l}0.000^2 + 2.000^2 + 0.510^2 + 0.000^2 + 2.000^2 + 0.000^2 \\ + 0.000^2 + 0.596^2 + 0.047^2 + 0.000^2 + 0.417^2 + 0.500^2 \\ + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + \\ 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + \\ 0.000^2 + 0.000^2 + 0.000^2 + 0.083^2 + 5.583^2\end{array}}$$

$TLE_{PPCS\text{-}rdm}$ = ± 6.342% span (95/95)

Per Section 8.2, there are no bias uncertainties. Therefore,

$TLE_{PPCS\text{-}bias}$ = 0.000% span

Convert to 75/75 error:
$error_{75/75} = (1.15/1.96) * error_{95/95}$ (Section 3.3.3.13 of Ref. G.1)
$TLE_{PPCS} = (1.15/1.96) * \pm 6.342$ % span = ±3.721 % span

TLE_{PPCS} = ± 3.721 % span (75/75)

Converting to process units,

TLE_{PPCS} = (±3.721% span) * (120% RTP)/100% span

TLE_{PPCS} = ± 4.465% RTP (75/75)

8.3.4 Total Recorder Loop Error (TLE_{REC})

Per Section 7.1.1, the recorder total loop error is calculated as a 75/75 value. Therefore, the random and bias parts are determined separately for conversion from 95/95.

$$TLE_{REC\text{-}rdm} = \pm\sqrt{\begin{array}{l}Sa^2 + Da^2 + Ra^2 + Sd^2 + Dd^2 + Rd^2 \\ + Sm^2 + Dm_1^2 + Rm^2 + Sv^2 + Dv_1^2 + \\ Rv^2 + Sp^2 + Dp^2 + Rp^2 + St^2 + Dt^2 + \\ Rt^2 + Sh^2 + Dh^2 + Rh^2 + Sr^2 + Dr^2 + \\ Rr^2 + Ss^2 + Ds^2 + Rs^2 + Rread^2 + PE^2\end{array}}$$

Substituting from Section 8.2,

$$TLE_{REC\text{-}rdm} = \pm\sqrt{\begin{array}{l}0.000^2 + 2.000^2 + 0.250^2 + 0.000^2 + 2.000^2 + 0.250^2 \\ + 0.000^2 + 0.596^2 + 0.047^2 + 0.000^2 + 0.417^2 + \\ 2.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + \\ 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + \\ 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.417^2 + 5.583^2\end{array}}$$

$TLE_{REC\text{-}rdm}$ = ± 6.633% span (95/95)

Per Section 8.2, there are no bias uncertainties. Therefore,

$TLE_{REC\text{-}bias}$ = 0.000% span

Convert to 75/75 error:
$error_{75/75}$ = (1.15/1.96) * $error_{95/95}$ (Section 3.3.3.13 of Ref. G.1)
TLE_{REC} = (1.15/1.96) * ±6.633 % span = ±3.892 % span

TLE_{REC} = ± 3.892 % span (75/75)

Converting to process units,

TLE_{REC} = (±3.892% span) * (120% RTP)/100% span

TLE_{REC} = ± 4.670% RTP (75/75)

8.4 Setpoint Evaluations

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

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

$$LTSP_{HR} = AL + [(0.839)^* \, TLE_{TRIP\text{-}rdm}^{-} + TLE_{TRIP\text{-}bias}^{-}]PS$$

Where,

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

Substituting,

$$LTSP_{HR} = 118\%\ RTP + [(0.839)^* \ -6.342\%\ span + 0.000\%\ span]^* 120\%\ RTP$$

$LTSP_{HR}$ = 111.61% RTP (95/95)

The margin between LTSP and FTSP is calculated in accordance with Section 3.3.8.5 of Reference G.1:

Margin = LTSP – FTSP

where,

LTSP	= 111.61% RTP	
FTSP	= 107% RTP	Section 6.5

Substituting,

Margin = 111.61% RTP – 107% RTP

Margin = 4.61% RTP

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

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

$$LTSP_{HR} = AL_{EPU} + [(0.839)^* \, TLE_{TRIP\text{-}rdm}^{-} + TLE_{TRIP\text{-}bias}^{-}]PS$$

Where,

AL_{EPU}	= 116% RTP	Section 6.5
$TLE_{TRIP\text{-}rdm}^{-}$	= -6.342% span	Section 8.3.1
$TLE_{TRIP\text{-}bias}^{-}$	= 0.000% span	Section 8.3.1
PS	= 120% RTP	

Substituting,

$LTSP_{HR}$ = 116% RTP + [(0.839)* -6.342% span + 0.000% span]*120% RTP

$LTSP_{HR}$ = 109.61% RTP **(95/95)**

The margin between LTSP and FTSP is calculated in accordance with Section 3.3.8.5 of Reference G.1:

Margin = LTSP – FTSP

where,

LTSP	= 109.61% RTP		
FTSP	= 107% RTP		Section 6.5

Substituting,

Margin = 109.61% RTP – 107% RTP

Margin = 2.61% RTP

8.4.3 Power Range Low Range High Flux Reactor Trip Setpoint Evaluation

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

$LTSP_{LR}$ = AL + [(0.839)* $TLE_{TRIP\text{-}rdm}^{-}$ + $TLE_{TRIP\text{-}bias}^{-}$]PS

Where,

AL	= 35% RTP	Section 6.5
$TLE_{TRIP\text{-}rdm}^{-}$	= -6.342% span	Section 8.3.1
$TLE_{TRIP\text{-}bias}^{-}$	= 0.000% span	Section 8.3.1
PS	= 120% RTP	

Substituting,

$LTSP_{LR}$ = 35% RTP + [(0.839)* -6.342% span + 0.000% span]*120% RTP

$LTSP_{LR}$ = 28.61% RTP **(95/95)**

The margin between LTSP and FTSP is calculated in accordance with Section 3.3.8.5 of Reference G.1:

Margin = LTSP – FTSP

where,

LTSP	=	28.61% RTP	
FTSP	=	20% RTP	Section 6.5

Substituting,

Margin = 28. 61% RTP – 20% RTP

Margin = 8.61% RTP

8.4.4 Permissive Setpoint Evaluation

Current Power Level

Per Attachment C, the permissive setpoints do not require uncertainties to be applied because permissive setpoints are nominal values. Only the unblock function of each permissive performs the safety function of removing an operational bypass (block) automatically at a predetermined power level. Attachment C recommends that permissive field setpoints for the permissive unblock and block functions should be changed as follows:

Permissive	Recommended Block (reset) FTSP	Recommended Unblock FTSP	Recommended Allowable Value
P-7	9% ↓ RTP	10%↑ RTP	≤ 13%
P-8	49% ↓ RTP	50%↑ RTP	≤ 53%
P-9	49% ↓ RTP	50%↑ RTP	≤ 53%
P-10	10%↑ RTP	9% ↓ RTP	≥ 6%

Per Attachment C, for each permissive there should be a 1% RTP deadband established between the permissive unblock setpoint and the block (reset) value. Therefore, the reset for P-7, P-8, and P-9 should be 1% below the setpoint while the reset (block) for the P-10 permissive should be 1% above the setpoint.

It should be noted that the P-10 unblock setpoint allows for margin between the lower range limit of the span (0% RTP) as the error with uncertainties is less than 9% (Section 8.3.1). In other words, no operability issues will result because $FTSP_{P\text{-}10} - TLE_{L/LA} > 0\%$ RTP.

Recommended Technical Specification Allowable Values for the above permissive FTSPs are established 3% from the FTSP in the direction of the unblock function (because unblocking is the safety-related protection function of the permissive). Establishing 3% margin between the FTSP and the Allowable Value is based on conservatively rounding down (to a whole number) the Operability Limit uncertainty (3.11% span x 120% RTP = 3.73% RTP) determined in Section 8.5 for the power range reactor trip functions.

Changes required for Extended Power Uprate (EPU)

Per Attachment C, the P-8 and P-9 setpoints need to be revised for EPU based on Westinghouse calculations CN-TA-08-52 Rev 0 [Reference C.5] and CN-CPS-08-20 Rev 0 [Reference C.4], respectively. The changes are summarized below:

- P-8 Permissive

  For EPU, the P-8 setpoint needs to be lowered from the current ~50% to protect the reactor during a partial loss of flow event. Reference C.5 requires that the P-8 setpoint limit reactor power to 45% when the P-8 permissive block is in effect. Based on a 10% instrument uncertainty assumed in Reference C.5, Westinghouse recommended the P-8 field setpoint be lowered to **35% RTP**. To show that 10% uncertainty is a conservative assumption for P-8, Section 8.4 determines the uncertainty for reactor trip functions to be less than 7%. This uncertainty is also applicable to power range permissive functions that are approached from a single direction. Because the P-8 uncertainty is less than the 10% uncertainty assumed in Reference C.5, a P-8 field setpoint of 35% will be conservative.

  Changing the P-8 Permissive FTSP to 35% RTP will also require changing the Technical Specification 3.3.1 Allowable Value from its present ≤ 50% value. A new P-8 Allowable Value can be determined by adding the 3.5% Operability Limit uncertainty determined in Section 8.5 below for the reactor trip functions to the 35% FTSP. For conservatism, the resulting 38.5% RTP is then rounded down to an even **38%** to establish a P-8 Allowable Value for EPU conditions.

- P-9 Permissive

  For EPU, the P-9 setpoint needs to change from a single value to a multiple setpoint tied to operation at different ranges of T_{avg}. Specifically, for T_{avg} operation between 558°F and 572°F, page 9 of Reference C.4 requires that the P-9 permissive setpoint be 35%. For T_{avg} operation between 572°F to 577°F, a P-8 setpoint of 50% is acceptable. Finally, for an End-of-Cycle (EOC) T_{avg}/power coastdown maneuver, a P-8 setpoint of 50% is acceptable over the full T_{avg} range of 558°F to 577°F.

  The revised P-9 permissive setpoints are nominal values that do not require applying instrument uncertainty. The reason for this is that P-9 is a permissive for a backup trip function (reactor trip on turbine trip) that is not credited in any accident analysis [Reference G.40]. As such, there is no "analytical limit" in an analysis that is being protected by use of the P-9 block, and a failure of the permissive will not impact any analysis. Without an analytical limit, there is no value against which to apply instrument uncertainty. For this reason, the following nominal field trip setpoints will be used for P-9 for EPU:

35% RTP	for 558°F ≤ Full Load T_{avg} < 572°F
50% RTP	for 572°F ≤ Full Load T_{avg} ≤ 577°F

  Changing the P-9 Permissive FTSP to these values will also require changing the Technical Specification 3.3.1 Allowable Value from its present ≤ 50% value. A new P-9 Allowable Values can be determined by adding the 3.5% Operability Limit uncertainty determined in Section 8.5 below for the reactor trip functions to the two new FTSPs. For conservatism, the resulting values of 38.5% RTP and 53.5% RTP are rounded down to an even **38%** and **53%** to establish P-9 Allowable Values for both T_{avg} bands under EPU conditions.

8.4.5 Rod Withdrawal Stop

Attachment C discussed the Rod Withdrawal Stop setpoint. Per Attachment C, the existing setpoint is acceptable and is stated below.

$\mathbf{FTSP_{RWS}}$ **= 105% RTP**

8.4.6 Dropped Rod Alarm Setpoint Evaluation

Attachment C discussed the Rod Drop Alarm setpoint. Per Attachment C, the existing setpoint is acceptable and is stated below.

$\mathbf{FTSP_{DRA}}$ **= Decreasing 2.5% RTP / 5 sec.**

8.4.7 Loss of Detector Voltage Alarm

Attachment C discussed the Loss of Detector Voltage Alarm setpoint. Per Attachment C, the existing setpoint is acceptable and is stated below.

$\mathbf{FTSP_{EVA}}$ **= 50 Vdc below Operating Voltage**

8.5 Operability Limit Determination

This section determines Operability Limits for both high neutron flux reactor trip functions. Operability Limits are established for the as-found value of the trip bistable during the Tech Spec Channel Operational Test (COT) surveillance, to determine if the channel portion measured during the COT is operating within its 3-sigma drift limits. Two Operability Limits are determined for each trip function, one on each side of the FTSP.

Per Section 7.1.5, the OL on each side of the FTSP is calculated by applying the square-root-sum-of-the-squares combination of As-Left tolerance and 3σ rack drift to the FTSP.

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

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

$Rd_{3\sigma} = (1.5)\ Rd_{2\sigma}$ (Eq. 7.1.5-3)
$Rd_{3\sigma} = (1.5)\ 2.0\ \%\ span$ ($Dd_{2\sigma}$ from Section 8.1.11)
$Rd_{3\sigma} = \pm 3.0\ \%\ span$

The FTSP for the high range - high flux trip of 107% (Section 6.5), expressed as percent span, is:

FTSP = 107 ÷ 120% = 89.16 % span

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

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

$OL^+ = 89.16\% + (0.833^2 + 3.0^2)^{1/2}$ (RAL is Dv_2 from Section 8.1.13)

$OL^+ = 89.16\% + 3.11$

$OL^+ = 92.27\%$ span

Expressed in % RTP, $OL^+ = (0.9227 * 120\%) = 110.72\%$

For readability in the calibration procedures, the OL^+ is conservatively rounded down to the nearest whole percent. Therefore, OL^+ = **110%**.

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

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

$OL^- = 89.16\% - (0.833^2 + 3.0^2)^{1/2}$

$OL^- = 89.16\% - 3.11$

$OL^- = 86.05\%$ span

Expressed in % RTP, $OL^- = (0.8605 * 120\%) = 103.26\%$

For readability in the calibration procedures, the OL^- is conservatively rounded up to the nearest whole percent. Therefore, OL^- = **104%**.

Because the High Range – High Flux Reactor Trip is an increasing trip, the OL^+ value of 110% should be the limit compared to the COT as-found value to determine Technical Specification operability of the channel. However, an as-found value outside either the OL^+ or OL^- indicates that the channel is operating abnormally.

From Section 8.4.1, the Limiting Trip Setpoint for the High Range – High Flux Reactor Trip is **111.63% RTP**. For this increasing trip, the OL^+ value of 110% is more conservative (i.e., restrictive) than the LTSP. Per Section 2.2, with margin between the OL^+ value and the LTSP, the OL^+ value is acceptable to use for channel operability determination during COT.

8.5.2 Low Range – High Flux Reactor Trip Operability Limit

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

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

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

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

The FTSP for the low range - high flux trip of 20% (Section 6.5), expressed as percent span, is:

FTSP = 20 ÷ 120% = 16.67 % span

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

$OL^+ = FTSP + [RAL^2 + Rd_{3\sigma}{}^2]^{½}$ (Eq. 7.1.5-1)

$OL^+ = 16.67\ \% + (0.833^2 + 3.0^2)^{½}$ (RAL is Dv_2 from Section 8.1.13)

$OL^+ = 16.67\ \% + 3.11$

$OL^+ = 19.78$ % span

Expressed in % RTP, $OL^+ = (0.1978 * 120\%) = 23.74\%$

For readability in the calibration procedures, the OL^+ is conservatively rounded down to the nearest whole percent. Therefore, OL^+ = **23%**.

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

$OL^- = FTSP - [RAL^2 + Rd_{3\sigma}{}^2]^{½}$ (Eq. 7.1.5-2)

$OL^- = 16.67\ \% - (0.833^2 + 3.0^2)^{½}$

$OL^- = 16.67\ \% - 3.11$

$OL^- = 13.56$ % span

Expressed in % RTP, $OL^- = (0.1356 * 120\%) = 16.27\%$

For readability in the calibration procedures, the OL^- is conservatively rounded up to the nearest whole percent. Therefore, OL^- = **17%**.

Because the Low Range – High Flux Reactor Trip is an increasing trip, the OL^+ value of 23% should be the limit compared to the COT as-found value to determine Technical Specification operability of the channel. However, an as-found value outside either the OL^+ or OL^- indicates that the channel is operating abnormally.

From Section 8.4.3, the Limiting Trip Setpoint for the Low Range – High Flux Reactor Trip is **28.63% RTP**. For this increasing trip, the OL^+ value of 23% is more conservative (i.e., restrictive) than the LTSP. Per Section 2.2, with margin between the OL^+ value and the LTSP, the OL^+ value is acceptable to use for channel operability determination during COT.

8.5.3 Permissive Operability Limits

Separate calculations are not performed for the Operability Limits for the four permissive FTSPs discussed in Section 8.4.4 above. The ±3% RTP margin on each side of the FTSP established above for the high range and low range high flux reactor trip OLs is also applicable to the permissives. For each permissive, the OL^+ will be set 3% RTP above the FTSP, and the OL^- will be set 3% RTP below the FTSP, as shown in the following table and in Attachment B:

Permissive	FTSP	Recommended OL^+ and OL^-
Current Power Level:		
Permissive P-7 Unblock	10%↑ RTP	OL^+ 13% RTP OL^- 7% RTP
Permissive P-8 Unblock	50%↑ RTP	OL^+ 53% RTP OL^- 47% RTP
Permissive P-9 Unblock	50%↑ RTP	OL^+ 53% RTP OL^- 47% RTP
Permissive P-10 Unblock	9%↓ RTP	OL^+ 12% RTP OL^- 6% RTP
EPU Changes:		
Permissive P-8 Unblock	35%↑ RTP	OL^+ 38% RTP OL^- 32% RTP
Permissive P-9 Unblock – for Tavg < 572°F	35%↑ RTP	OL^+ 38% RTP OL^- 32% RTP
Permissive P-9 Unblock – for Tavg ≥ 572°F	50%↑ RTP	OL^+ 53% RTP OL^- 47% RTP

8.6 Acceptable As-Left and As-Found Calibration Tolerances

8.6.1 Acceptable As-Found Calibration Tolerances

8.6.1.1 Power Range Drawer As-Found Tolerance (DAF_1, DAF_2, DAF_3)

Using Eq. 7.1.3.1 to determine the As-Found tolerance for indication,

$$DAF_1 = \pm\sqrt{Dv_1^2 + Dd^2 + Dm_1^2}$$

where:

Dv_1	$= \pm 0.417$ % Span	Section 8.1.13
Dd	$= \pm 2.000$ % Span	Section 8.1.11
Dm_1	$= \pm 0.596$ % Span	Section 8.1.12

$$DAF_1 = \pm\sqrt{0.417^2 + 2.000^2 + 0.596^2}$$

$$DAF_1 = \pm 2.128 \text{ \% Span}$$

Converting to calibration units and rounding to procedure precision,

DAF_1 = ±2.128 % span * (120% RTP/100% span)

DAF_1 = ±2.554% RTP

Per References P.20 – P.27, the power range drawers are calibrated using the calibration module input and reading the output on the local analog indicator. Per Section 3.3.5.3 of Reference G.1, the readability of an analog instrument is ½ the smallest division. Reference G.29 shows that each division represents 1% RTP. Conservatively rounding for procedure precision,

DAF_1 = ± 2.0% RTP

Using Eq. 7.1.3.1 to determine the As-Found tolerance for trips,

$$DAF_2 = \pm\sqrt{Dv_2^{\,2} + Dd^2 + Dm_1^{\,2}}$$

where:

Dv_2	= ±0.833 % Span	Section 8.1.13
Dd	= ±2.000 % Span	Section 8.1.11
Dm_1	= ±0.596 % Span	Section 8.1.12

$$DAF_2 = \pm\sqrt{0.833^2 + 2.000^2 + 0.596^2}$$

DAF_2 = ±2.247 % Span

Converting to calibration units and rounding to procedure precision,

DAF_2 = ±2.247% span * (120% RTP/100% span)

DAF_2 = ±2.696% RTP

Conservatively rounding to procedure precision,

DAF_2 = ± 2.0% RTP

Using Eq. 7.1.3.1 to determine the As-Found tolerance for calibration,

$$DAF_3 = \pm\sqrt{Dv_3^{\,2} + Dd^2 + Dm_2^{\,2}}$$

where:

Dv_3	= ±0.250 % Span	Section 8.1.13
Dd	= ±2.000 % Span	Section 8.1.11
Dm_2	= ±0.563 % Span	Section 8.1.12

$DAF_3 \quad = \pm\sqrt{0.250^2 + 2.000^2 + 0.563^2}$

$DAF_3 \quad = \pm 2.093$ % Span

Converting to calibration units and rounding to procedure precision,

$DAF_3 \quad = \pm 2.093\%$ span * (10.000 Vdc/100% span)

$DAF_3 \quad = \pm 0.209$ Vdc

Therefore,

$DAF_3 \quad = \pm$ 0.209 Vdc

8.6.1.2 Indicator As-Found Tolerance (IAF)

Using Eq. 7.1.3.2,

$$IAF = \pm\sqrt{Iv^2 + Id^2 + Im^2}$$

Where:

Iv	= ± 0.833% span	Section 8.1.22
Id	= ± 1.028% span	Section 8.1.20
Im	= ± 0.000% span	Section 8.1.21

$$IAF = \pm\sqrt{0.833^2 + 1.028^2 + 0.000^2}$$

IAF = ± 1.323% span

Converting to calibration units and rounding to procedure precision,

IAF = ± 1.323% span * (120% RTP/100% span)

IAF = ± 1.588% RTP

Per Section 3.3.5.3 of Reference G.1, the readability of an analog instrument is ½ the smallest division. Reference G.29 shows that each division represents 2% RTP. Therefore, the As-Found Tolerance must be conservatively rounded to 1.0% RTP. As a result,

IAF = ± 1.0% RTP

8.6.1.3 PPCS As-Found Tolerance (PPCSAF)

Using Eq. 7.1.3.3,

$$PPCSAF = \pm \sqrt{PPCSv^2 + PPCSd^2 + PPCSm^2}$$

Where:

PPCSv	= ± 0.500% span	Section 8.1.32
PPCSd	= ± 0.000% span	Section 8.1.30
PPCSm	= ± 0.047% span	Section 8.1.31

$$PPCSAF = \pm \sqrt{0.500^2 + 0.000^2 + 0.047^2}$$

PPCSAF = ± 0.502% span

Converting to calibration units and rounding to procedure precision,

PPCSAF = ± 0.502% span * (120% RTP/100% span)

PPCSAF = ± 0.6% RTP

8.6.1.4 Recorder As-Found Tolerance (RAF)

Using Eq. 7.1.3.4,

$$RAF = \pm \sqrt{Rv^2 + Rd^2 + Rm^2}$$

Where:

Rv	= ± 2.000% span	Section 8.1.42
Rd	= ± 0.250% span	Section 8.1.40
Rm	= ± 0.047% span	Section 8.1.41

$$RAF = \pm \sqrt{2.000^2 + 0.250^2 + 0.047^2}$$

RAF = ± 2.016% span

Converting to calibration units and rounding to procedure precision,

RAF = ± 2.016% span * (50 mVdc/100% span)

RAF = ± 1.01 mVdc

8.6.2 Acceptable As-Left Calibration Tolerances

8.6.2.1 Power Range Drawer As-Left Tolerances (DAL_1, DAL_2)

Using Eq. 7.1.4.1, the Acceptable As-Left Tolerance for the Power Range Drawer for indication is,

$DAL_1 = \pm Dv_1$
$DAL_1 = \pm 0.417\%$ span — Section 8.1.13

Converting to calibration units and rounding to procedure precision,

$DAL_1 = \pm 0.417\%$ span * (120% RTP/100% span)

$DAL_1 = \pm 0.5\%$ RTP

Using Eq. 7.1.4.1, the Acceptable As-Left Tolerance for the Power Range Drawer for trips is,

$DAL_2 = \pm Dv_2$
$DAL_2 = \pm 0.833\%$ span — Section 8.1.13

Converting to calibration units and rounding to procedure precision,

$DAL_2 = \pm 0.833\%$ span * (120% RTP/100% span)

$DAL_2 = \pm 1.0\%$ RTP

Permissive setpoints are an exception to this ± 1.0% as-left tolerance for trip setpoints. A 1% deadband is established in the calibration procedure between permissive [unblock] setpoints and their associated reset [block] setpoints. For the three permissive setpoints that restore protective functions on increasing signal (P-7, P-8, and P-9), the unblock setting that clears the permissive is established 1% above the setting that blocks the trips. The as-left tolerance for the unblock setting is the 1% margin between the two setpoints; i.e., the unblock setting +0, -1 percent RTP. The corresponding as-left tolerance for the block setting is established by the 1% band below the block setting; i.e., the block setting +0, -1 percent RTP.

The P-10 permissive shares the same trip bistable with the P-7 permissive, such that the P-10 unblock is the P-7 block function, and the P-10 block is the P-7 unblock function. The as-left tolerances for the P-10 block and unblock are therefore the same as the P-7 unblock and block as-left tolerances, respectively.

Using Eq. 7.1.4.1, the Acceptable As-Left Tolerance for the Power Range Drawer for calibration is,

$DAL_3 = \pm Dv_3$

DAL_3 = ± 0.250% span   Section 8.1.13

Converting to calibration units and rounding to procedure precision,

DAL_3 = ± 0.250% span * (10.000 Vdc/100% span)

DAL_3 = ± 0.025 Vdc

8.6.2.2 Indicator As-Left Tolerances (IAL)

Using Eq. 7.1.4.2, the Acceptable As-Left Tolerance for the Indicator is,

IAL = ± Iv
IAL = ± 0.833% span   Section 8.1.22

Converting to calibration units and rounding to procedure precision,

IAL = ± 0.833% span * (120% RTP/100% span)

IAL = ± 1.0% RTP

8.6.2.3 PPCS As-Left Tolerances (PPCSAL)

Using Eq. 7.1.4.3, the Acceptable As-Left Tolerance for the PPCS is,

PPCSAL = ± PPCSv
PPCSAL = ± 0.500% span   Section 8.1.32

Converting to calibration units and rounding to procedure precision,

PPCSAL = ± 0.500% span * (120% RTP/100% span)

PPCSAL = ± 0.6% RTP

8.6.2.4 Recorder As-Left Tolerances (RAL)

Using Eq. 7.1.4.4, the Acceptable As-Left Tolerance for the Recorder is,

RAL = ± RALv
RAL = ± 2.000% span   Section 8.1.42

Converting to calibration units and rounding to procedure precision,
RAL = ± 2.000% span * (50 mVdc/100% span)

RAL = ± 1.00 mVdc

8.7 Channel Check Tolerance (CCT)

Using Eq. 7.1.6, the Channel Check Tolerance is determined as follows (at a 95/95 value):

$$CCT = \pm\sqrt{\begin{aligned}&(Sa^2 + Da^2 + Ia^2 + Sd^2 + Dd^2 + Id^2 + Sv^2 + Dv_1^2 \\ &+ Iv^2 + Irea^2)_{ind\,a} + (Sa^2 + Da^2 + Ia^2 + Sd^2 + Dd^2 + Id^2 \\ &+ Sv^2 + Dv_1^2 + Iv^2 + Irea^2)_{ind\,b}\end{aligned}}$$

Substituting from Section 8.2,

$$CCT = \pm\sqrt{\begin{aligned}&(0.000^2 + 2.000^2 + 0.000^2 + 0.000^2 + 2.000^2 + 1.028^2 \\ &+ 0.000^2 + 0.417^2 + 0.833^2 + 0.000^2)_{ind\,a} + (0.000^2 + \\ &2.000^2 + 0.000^2 + 0.000^2 + 2.000^2 + 1.028^2 + 0.000^2 \\ &+ 0.417^2 + 0.833^2 + 0.000^2)_{ind\,b}\end{aligned}}$$

$$CCT = \pm 4.455\% \text{ span}$$

Converting to process units,

$$CCT = \pm 4.455\% \text{ span} * (120\% \text{ RTP}/100\% \text{ span})$$

$$CCT = \pm 5.346\% \text{ RTP} \qquad (95/95)$$

Per Reference G.29, the control room indication for Power Range has a minor division of 2.0% RTP. Per Section 7.1.C, the CCT value should be rounded to the precision that is readable on the associated loop indicator. Per Section 3.3.5.3 of Reference G.1, the readability of these indicators is ± ½ the smallest division (or 1.0% RTP). Therefore, the CCT value is rounded up to the nearest 1.0% RTP interval.

CCT = ± 5.0% RTP (95/95)

Per References G.30 and G.31, the existing CCT for Power Range is ± 3.0% RTP. The existing CCT is less than the calculated CCT. Therefore per Section 2.0, the existing CCT is acceptable and may be retained.

9.0 RESULTS AND CONCLUSIONS, WITH LIMITATIONS

9.1 Total Loop Error

The Total Loop Errors calculated in Section 8.3 are shown below:

Table 9.1, Total Loop Errors

	TLE (95/95)	TLE (75/75)	Reference
$TLE_{TRIP - rdm}$	- 6.342% span	N/A	8.3.1
TLE_{IND}	N/A	± 4.532% RTP	8.3.2
TLE_{PPCS}	N/A	± 4.465% RTP	8.3.3
TLE_{REC}	N/A	± 4.670% RTP	8.3.4

9.2 Analytical Limits

The Analytical Limits are determined by Westinghouse (Ref. G.18 and G.40) and are summarized below:

Table 9.2, Analytical Limits

Primary Trip Function	Analytical Limit (AL)	Reference
High Range – High Flux Current Power Level	118% RTP	Section 6.5
High Range – High Flux EPU	116% RTP	Section 6.5
Low Range – High Flux (both current and EPU)	35% RTP	Section 6.5

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

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

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

Operability Limits have been determined for the reactor trip functions and permissive unblock functions. The OLs provide new limits to be applied in the I&C calibration procedures for establishing Technical Specification operability of the channels during Channel Operational Testing (COT).

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

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

Table 9.3-1 Operability Limits

Function	FTSP	Recommended OL^+ and OL^-	Reference
High Range – High Flux Reactor Trip	107%↑ RTP	OL^+ 110% RTP OL^- 104% RTP	**Section 8.5.1**
Low Range – High Flux Reactor Trip	20%↑ RTP	OL^+ 23% RTP OL^- 17% RTP	**Section 8.5.2**
Permissive P-7 Unblock	10%↑ RTP	OL^+ 13% RTP OL^- 7% RTP	**Section 8.5.3**
Permissive P-8 Unblock – for existing power level	50%↑ RTP	OL^+ 53% RTP OL^- 47% RTP	**Section 8.5.3**
Permissive P-9 Unblock – for existing power level	50%↑ RTP	OL^+ 53% RTP OL^- 47% RTP	**Section 8.5.3**
Permissive P-10 Unblock	9%↓ RTP	OL^+ 12% RTP OL^- 6% RTP	**Section 8.5.3**
EPU Changes:			
Permissive P-8 Unblock	35%↑ RTP	OL^+ 38% RTP OL^- 32% RTP	**Section 8.5.3**
Permissive P-9 Unblock – for Tavg < 572°F	35%↑ RTP	OL^+ 38% RTP OL^- 32% RTP	**Section 8.5.3**
Permissive P-9 Unblock – for Tavg ≥ 572°F	50%↑ RTP	OL^+ 53% RTP OL^- 47% RTP	**Section 8.5.3**

9.4 Setpoint Evaluation

This calculation has determined Limiting Trip Setpoints for the primary reactor trip setpoints for High Range and Low Range High Flux for the current power level and also for the Extended Power Uprate (EPU) condition. These new LTSPs are based on the Analytical Limits summarized in 9.2 above.

As discussed in Section 9.3 above, it is recommended that the LTSPs listed in Table 9.4-1 below for the current power level be included as new Allowable Values in TS Table 3.3.1-1 by submittal of a license amendment request (LAR). It is also recommended that the separate EPU license amendment request revise the Allowable Value to the value shown below for the High Range - High Flux trip, due to the change in Analytical Limit from 118% to 116% for EPU.

Table 9.4.1, Trip Setpoints

Function	Limiting Trip Setpoint	Recommended TS Allowable Value	Existing Field Trip Setpoint	Margin	Reference
High-Range – High Flux Trip @ Current Power Level	111.61% RTP	≤ 111% RTP	107%↑ RTP	4.61% RTP	Section 8.4.1
High-Range – High Flux Trip @ EPU level	109.61% RTP	≤ 109% RTP	107%↑ RTP	2.61% RTP	Section 8.4.2
Low Range – High Flux Trip	28.61% RTP	≤ 28% RTP	20%↑ RTP	8.61% RTP	Section 8.4.3
Rod Withdrawal Stop	N/A	N/A	105%↑ RTP	N/A	Section 8.4.5

Per Section 8.4.3, it is recommended that the permissive setpoints be changed as follows:

Table 9.4.2, Permissive Setpoints

Permissive	Existing FTSP	Recommended FTSP	Recommended TS Allowable Value	Reference
At Current Power Level:				
P-7 (unblock)	9.5%↑ RTP	10%↑ RTP	≤ 13% RTP	Section 8.4.4
P-8 (unblock)	49%↑ RTP	50%↑ RTP	≤ 53% RTP	Section 8.4.4
P-9 (unblock)	49%↑ RTP	50%↑ RTP	≤ 53% RTP	Section 8.4.4
P-10 (unblock)	8.5%↓ RTP	9%↓ RTP	≥ 6% RTP	Section 8.4.4

Permissive	Existing FTSP	Recommended FTSP	Recommended TS Allowable Value	Reference
Revise for Extended Power Uprate:				
P-8 (unblock)	N/A	35%↑ RTP	≤ 38% RTP	Section 8.4.4
P-9 (unblock)	N/A	35%↑ RTP 50%↑ RTP	≤ 38% RTP for 558°F ≤ Tavg < 572°F ≤ 53% RTP for 572°F ≤ Tavg ≤ 577°F	Section 8.4.4

Per Section 8.4, the alarm setpoints are acceptable and are summarized below.

Table 9.4.3, Alarm Setpoints

Alarm	Setpoint	Reference
Rod Drop	Decreasing 2.5% RTP / 5 sec	Section 8.4.6
Loss of Detector Voltage	50 Vdc below operating voltage	Section 8.4.7

9.5 Acceptable As-Left and As-Found Tolerances

This calculation has determined the Acceptable As-Found and As-Left Tolerances for the calibrated instruments listed in Table 1.5-1 (sensors are not calibrated). The calibration procedures listed in Section 10 should be revised as appropriate.

Table 9.5, As-Left and As-Found Tolerances

Instrument	As-Left Tolerance	As-Found Tolerance	Reference
Drawer 1(2)N-41, 1(2)N-42 1(2)N-43, 1(2)N-44	DAL_1 = ± 0.5% RTP DAL_2 = ± 1.0% RTP DAL_3 = ± 0.025 Vdc	DAF_1 = ± 2.0% RTP DAF_2 = ± 2.0% RTP DAF_3 = ± 0.205 Vdc	8.6.1.1 8.6.2.1
Control Board Indicators 1(2)NI-41B, 1(2)NI-42B 1(2)NI-43B, 1(2)NI-44B	± 1.0% RTP	±1.0% RTP	8.6.1.2 8.6.2.2
PPCS 1(2)N-41, 1(2)N-42 1(2)N-43, 1(2)N-44	± 0.6% RTP	± 0.6% RTP	8.6.1.3 8.6.2.3
Recorder 1(2)NR-45	± 1.00 mVdc	± 1.01 mVdc	8.6.1.4 8.6.2.4

9.6 Channel Check Tolerance

The Channel Check Tolerance for the control board indicators is summarized below. The existing CCT value is more restrictive than the calculated CCT. Therefore, the existing CCT is acceptable and may be retained.

Table 9.6-1, Channel Check Tolerance

	Calculated	Existing	Reference
CCT	± 5.0% RTP	± 3.0% RTP	Section 8.7

9.7 Limitations

9.7.1 Temperature Limitations

The results of this calculation are valid only if the temperature inside the Control/Computer Room instrumentation panels does not exceed 120°F. GAR 01031654 has been generated to track this limitation.

9.7.2 Implementation Limitation

Changes recommended by this calculation are NOT to be implemented without approval of the PBNP Design Authority or the appointed designee.

9.8 Graphical Representation of Setpoints

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

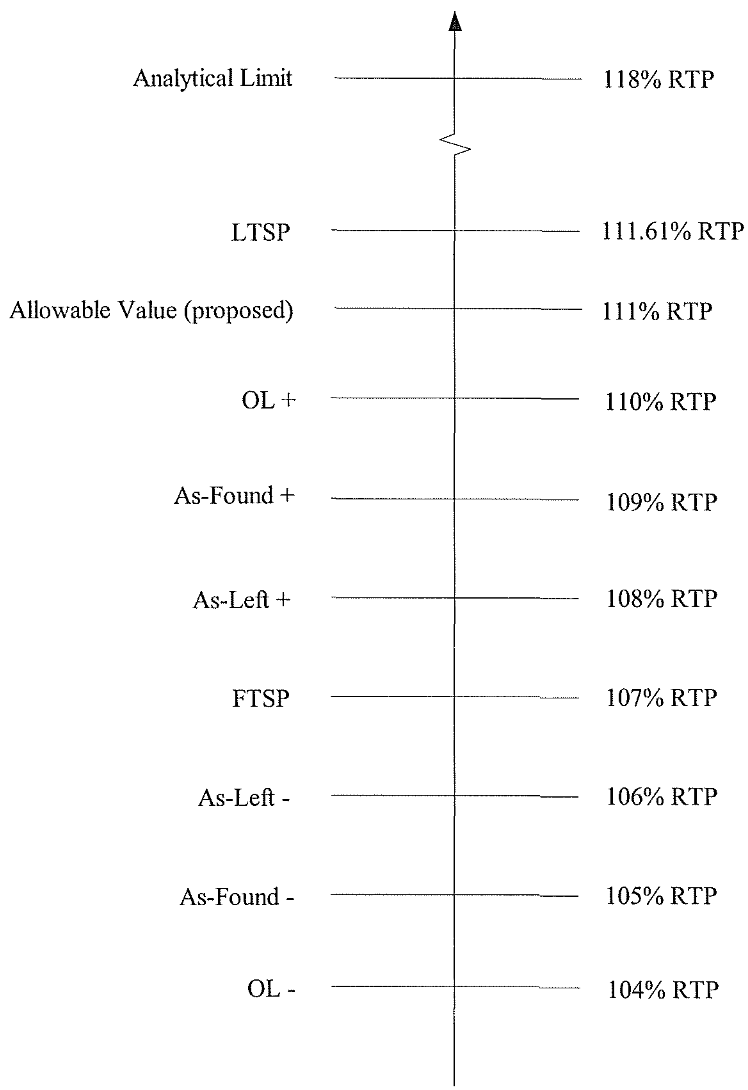


Figure 9.8.2, High Range - High Flux Reactor Trip Setpoint for Extended Power Uprate

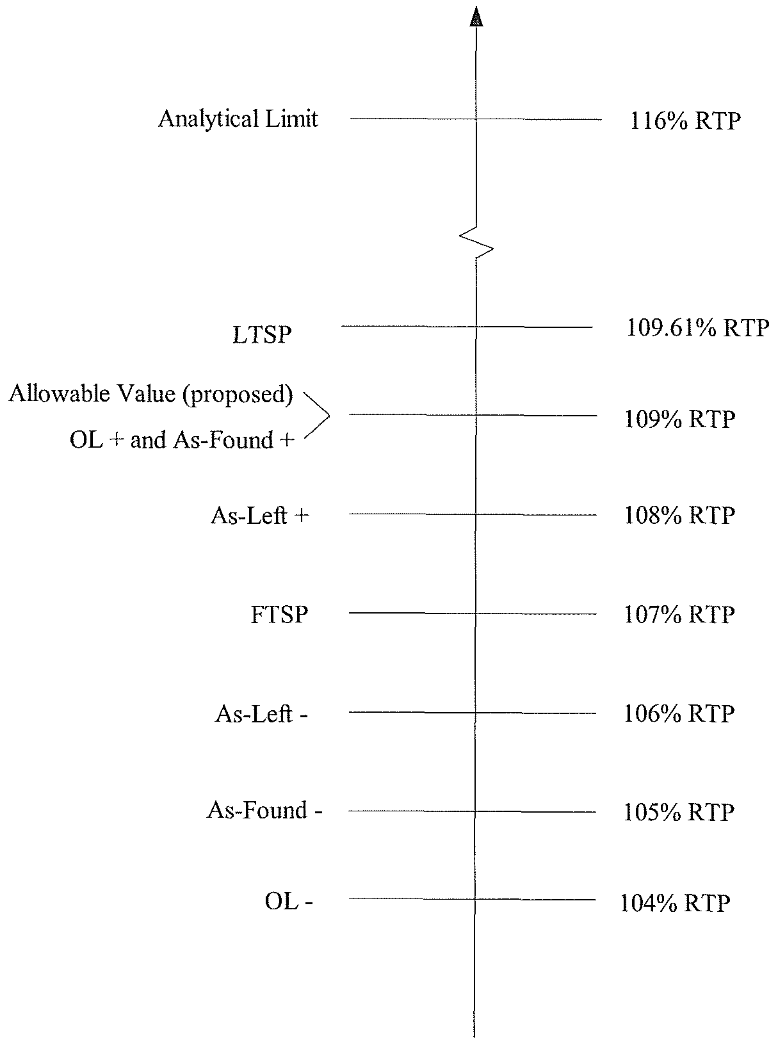


Figure 9.8.3, Low Range - High Flux Reactor Trip Setpoint

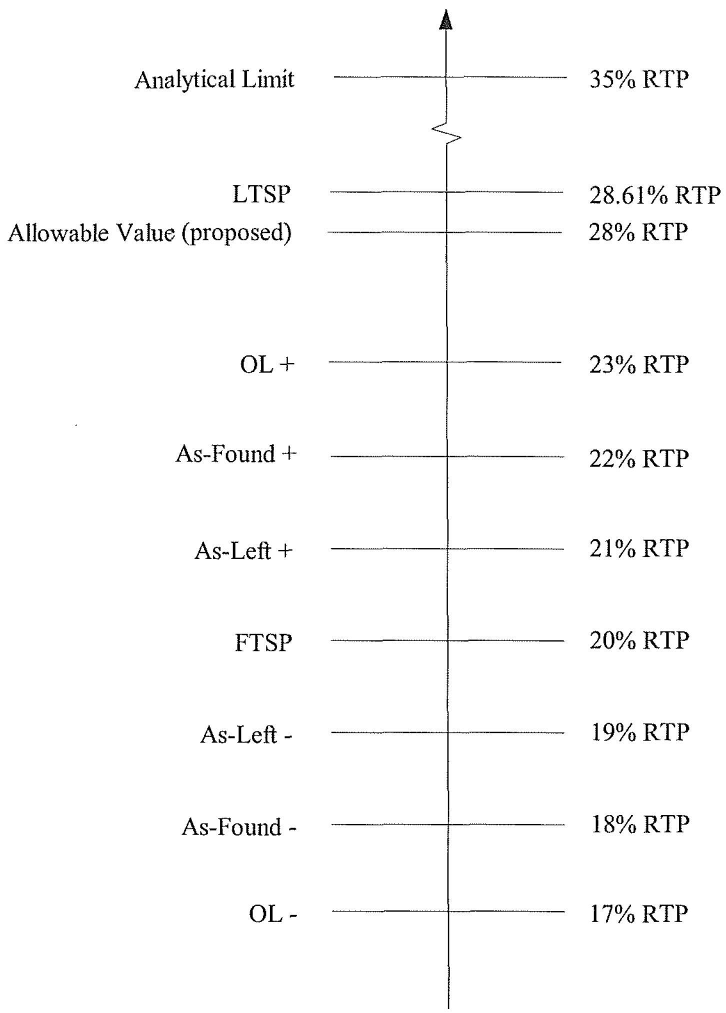


Figure 9.8.4, Proposed Settings for P-7 and P-10 Permissives

Proposed P-7 Unblock Allowable Value and OL +	13% RTP
As-Found +	12% RTP
FTSP and As-Left +	10% RTP
As-Left -	9% RTP
As-Found -	8% RTP
OL -	7% RTP

OL +	12% RTP
As-Found +	11% RTP
FTSP and As-Left +	9% RTP
As-Left -	8% RTP
As-Found -	7% RTP
Proposed P-10 Unblock Allowable Value and OL -	6% RTP

Figure 9.8.5, Proposed Settings for P-8 Permissive

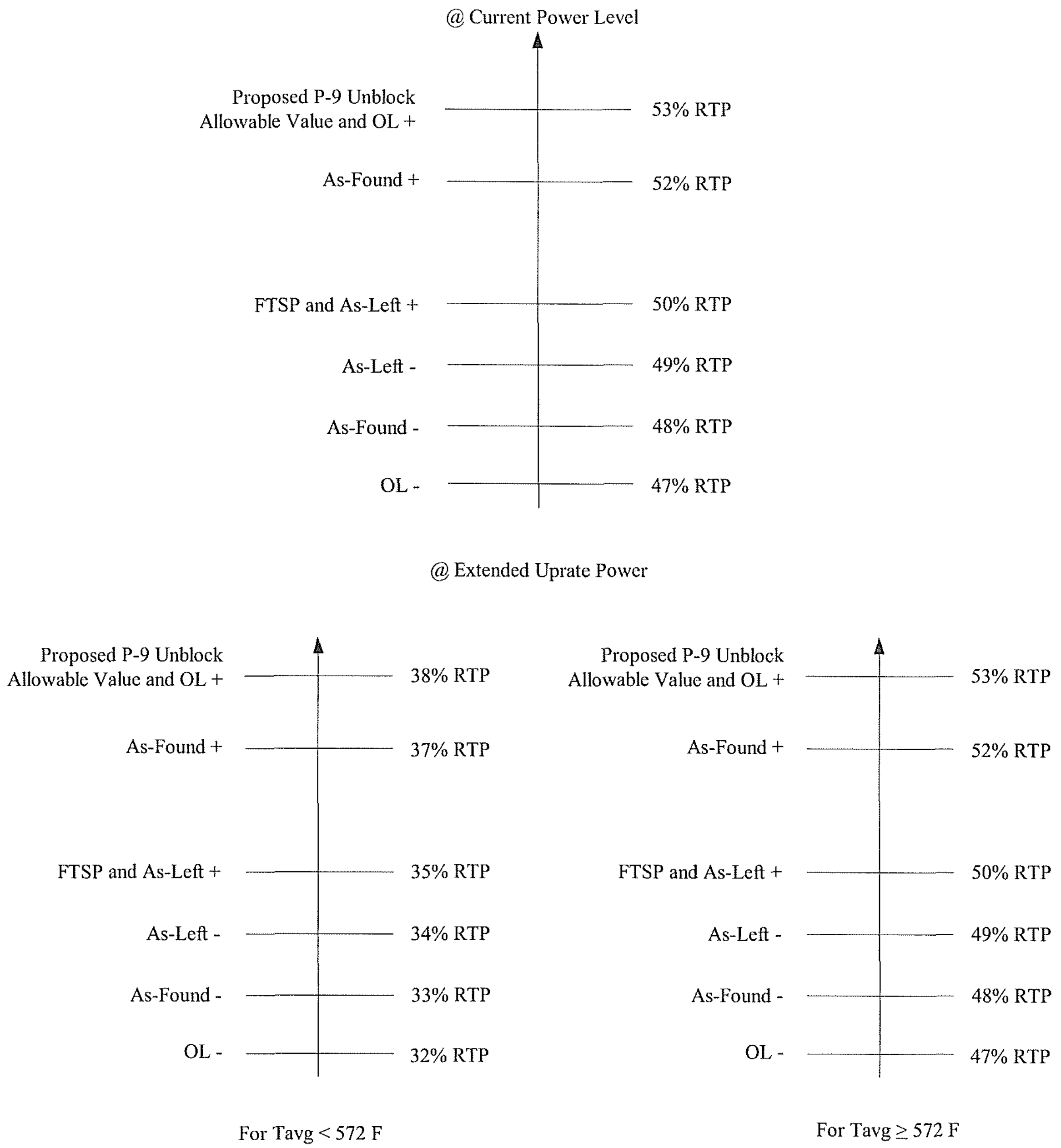
@ Current Power Level

Proposed P-8 Unblock Allowable Value and OL +	53% RTP
As-Found +	52% RTP
FTSP and As-Left +	50% RTP
As-Left -	49% RTP
As-Found -	48% RTP
OL -	47% RTP

@ Extended Uprate Power

Proposed P-8 Unblock Allowable Value and OL +	38% RTP
As-Found +	37% RTP
FTSP and As-Left +	35% RTP
As-Left -	34% RTP
As-Found -	33% RTP
OL -	32% RTP

Figure 9.8.6, Proposed Settings for P-9 Permissive



10.0 IMPACT ON PLANT DOCUMENTS

[NOTE: Passport Engineering Change (EC) Number for Calculation 2009-0002 is 13195.]

- Setpoint Document, STPT 1.1, Rev. 3, "Reactor Trip NIS, Unit 1"

  Low Range – High Flux and High Range – High Flux setpoints should be changed per Section 9.4.

- Setpoint Document, STPT 1.1, Rev. 4, "Reactor Trip NIS, Unit 2"

  Low Range – High Flux and High Range – High Flux setpoints should be changed per Section 9.4.

- Setpoint Document, STPT 3.1, Rev. 11, "P6, P7, P8, P9, and P10"

  Permissive Allowable Values and setpoints for P7 – P10 should be changed per Sections 9.3 and 9.4.

- Setpoint Document, STPT 4.1, Rev. 8, "Rod Stop and Turbine Runback Setpoints: Rod Stops"

  Per Section 6.5, no changes are required for the Rod Withdrawal Stop setpoint.

- 1ICP 02.007, "Nuclear Instrumentation Power Range Channels 92 Day Channel Operational Test" Rev. 10

  New As-Found Tolerances for the Low Range – High Flux, High Range – High Flux, and Rod Stop bistables for loops N-41 through N-44 need to be incorporated. Also, new allowable values and setpoints need to be incorporated for the Low Range – High Flux and High Range – High Flux bistables.

- 2ICP 02.007, "Nuclear Instrumentation Power Range Channels 92 Day Channel Operational Test" Rev. 12

  New As-Found Tolerances for the Low Range – High Flux, High Range – High Flux, and Rod Stop bistables for loops N-41 through N-44 need to be incorporated. Also, new allowable values and setpoints need to be incorporated for the Low Range – High Flux and High Range – High Flux bistables.

- 1ICP 02.022, "Nuclear Instrumentation System Power Range Channels Shutdown operational Test" Rev. 8

  New setpoints and allowable values for permissives P7 – P10 need to be incorporated. In addition, As-Found/As-Left Tolerances for permissive P7 – P10, Low Range – High Flux, High Range – High Flux, and Rod Stop bistables for loops N-41 – N-44 need to be incorporated.

- 2ICP 02.022, "Nuclear Instrumentation System Power Range Channels Shutdown operational Test" Rev. 7

  New setpoints and allowable values for permissives P7 – P10 need to be incorporated. In addition, As-Found/As-Left Tolerances for permissive P7 – P10, Low Range – High Flux, High Range – High Flux, and Rod Stop bistables for loops N-41 – N-44 need to be incorporated.

- 1ICP 04.026RD, "Nuclear Instrumentation Power Range Red Channel N41 Outage Calibration and ECAD Testing.

  New As-Found Tolerances for the Power Range Drawer (NM310), Recorder, Control Room Indicator, and PPCS for loop N-41 need to be incorporated.

- 1ICP 04.026WH, "Nuclear Instrumentation Power Range White Channel N42 Outage Calibration and ECAD Testing.

  New As-Found Tolerances for the Power Range Drawer (NM310), Recorder, Control Room Indicator, and PPCS for loop N-42 need to be incorporated.

- 1ICP 04.026BL, "Nuclear Instrumentation Power Range Blue Channel N43 Outage Calibration and ECAD Testing.

  New As-Found Tolerances for the Power Range Drawer (NM310), Recorder, Control Room Indicator, and PPCS for loop N-43 need to be incorporated.

- 1ICP 04.026YL, "Nuclear Instrumentation Power Range Yellow Channel N44 Outage Calibration and ECAD Testing.

  New As-Found Tolerances for the Power Range Drawer (NM310), Recorder, Control Room Indicator, and PPCS for loop N-44 need to be incorporated.

- 2ICP 04.026RD, "Nuclear Instrumentation Power Range Red Channel N41 Outage Calibration and ECAD Testing.

  New As-Found Tolerances for the Power Range Drawer (NM310), Recorder, Control Room Indicator, and PPCS for loop N-41 need to be incorporated.

- 2ICP 04.026WH, "Nuclear Instrumentation Power Range White Channel N42 Outage Calibration and ECAD Testing.

  New As-Found Tolerances for the Power Range Drawer (NM310), Recorder, Control Room Indicator, and PPCS for loop N-42 need to be incorporated.

- 2ICP 04.026BL, "Nuclear Instrumentation Power Range Blue Channel N43 Outage Calibration and ECAD Testing.

  New As-Found Tolerances for the Power Range Drawer (NM310), Recorder, Control Room Indicator, and PPCS for loop N-43 need to be incorporated.

- 2ICP 04.026YL, "Nuclear Instrumentation Power Range Yellow Channel N44 Outage Calibration and ECAD Testing.

  New As-Found Tolerances for the Power Range Drawer (NM310), Recorder, Control Room Indicator, and PPCS for loop N-44 need to be incorporated.

- Technical Specification 3.3.1 "Reactor Protection System (RPS) Instrumentation" Amendment 201 (Unit 1) and 206 (Unit 2)

  New Allowable Values for Low Range – High Flux, High Range – High Flux, and permissives P-7, P-8, P-9, and P-10 have been determined in this calculation and should be incorporated accordingly.

11.0 ATTACHMENT LIST

Attachment A	Walkdown for PBNP-IC-38 (12 pages)
Attachment B	Instrument Scaling Changes for Calibration Procedures 1(2)ICP 02.007, 1(2)ICP 02.022, 1(2)ICP 04.026RD, 1(2) 04.026WH, 1(2)ICP 04.026BL, and 1(2)ICP 04.026YL (18 pages)
Attachment C	Process and Environmental Considerations (9 pages)
Attachment D	DIT CRR-I&C-012 "Treatment of Backup Trips and Permissives" Issued 6/4/07 (5 pages)
Attachment E	Westinghouse letter RRS-VICO-02-689, "NIS Analog Meters", dated 12/4/02 (5 pages)

12.0 10 CFR 50.59 REVIEW

10 CFR 50.59 screening SCR 2007-0078-00 was prepared to support implementing the limits determined by this calculation into the associated calibration procedures. The screening concluded that a 50.59 evaluation and UFSAR change are not required as a result of the addition of calibration limits listed in Section 9.7 above.

NRC prior approval of a licensing amendment is required in order to implement the revised values in the Technical Specifications for the RPS Allowable values associated with the reactor trip and permissive functions determined in this calculation. The purpose of a 50.59 review is to determine if prior NRC approval is necessary to implement changes to the plant. No 50.59 review is necessary for revising the Technical Specification values because prior NRC approval through a license amendment is already acknowledged to be necessary. The present intent is to include the TS changes identified as EPU changes in this calculation for RPS and ESFAS setpoints in the Extended Power Uprate License Amendment Request.

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

Attachment A

PART 1 - WALKDOWN REQUEST FORM

Calculation No PBNP-IC-38

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

El. 44', CB, CR, 1(2)C-130 to 1(2)C-133, and 1(2)C04

Scope

Determine the minor divisions associated with Power Range Detector (A and B) Current on Power Range B drawers:

1(2)N-41B – 1(2)N-44B

Determine the minor divisions associated with Percent Full Power on Power Range A drawers:

1(2)N-41A – 1(2)N-44A

Determine the minor divisions associated with the Power Range indicators

1(2)NI-41B
1(2)NI-42B
1(2)NI-43B
1(2)NI-44B

Determine the minor division of the Power Range Recorder 1(2)NR-00045

References.

S&L Lead W. Barass Signature [illegible] Date [illegible]

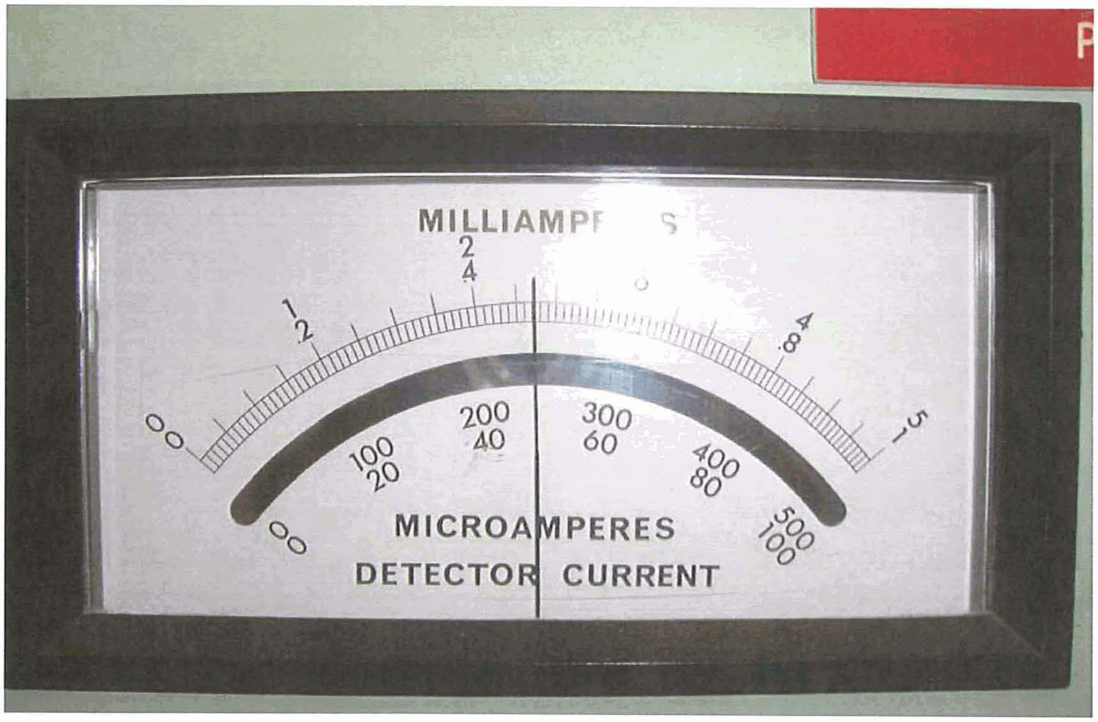
[illegible]	[illegible]	[illegible]
Data Taker Name	Signature	Date
[illegible]	[illegible]	[illegible]
Independent Verifier Name	Signature	Date

Attachment A

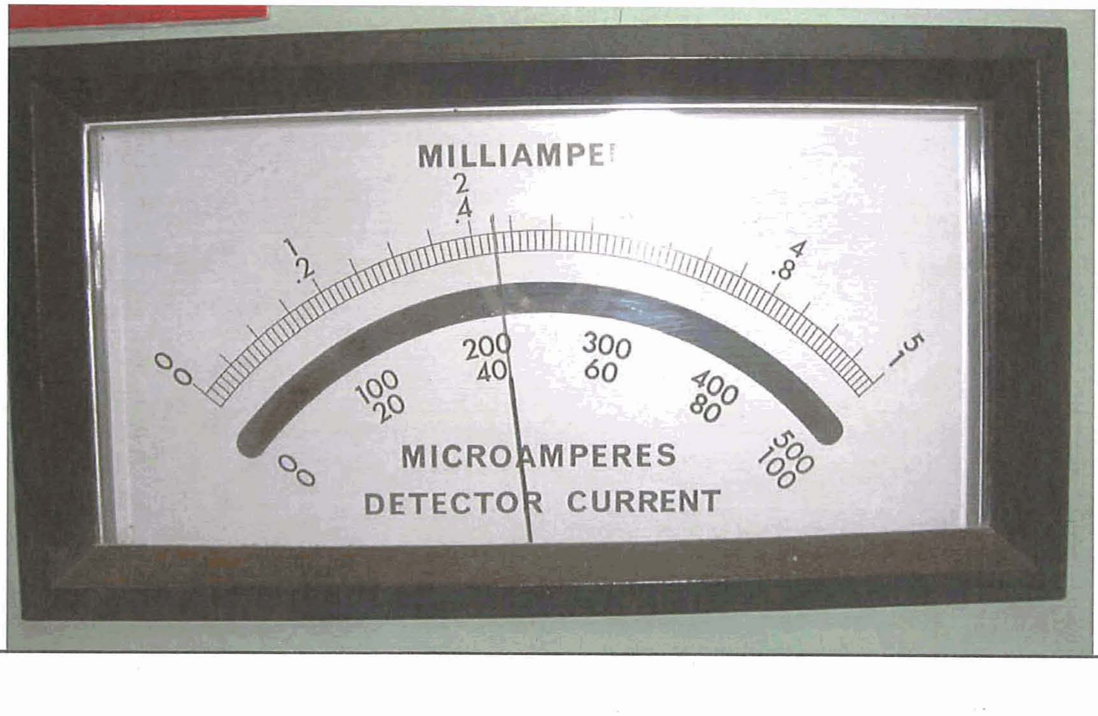
PART 2 - WALKDOWN DATA COLLECTION FORM
Results: See attached photographs. Note that units 1 and 2 indication are identical

Attachment A

1(2)N-41B – Detector A

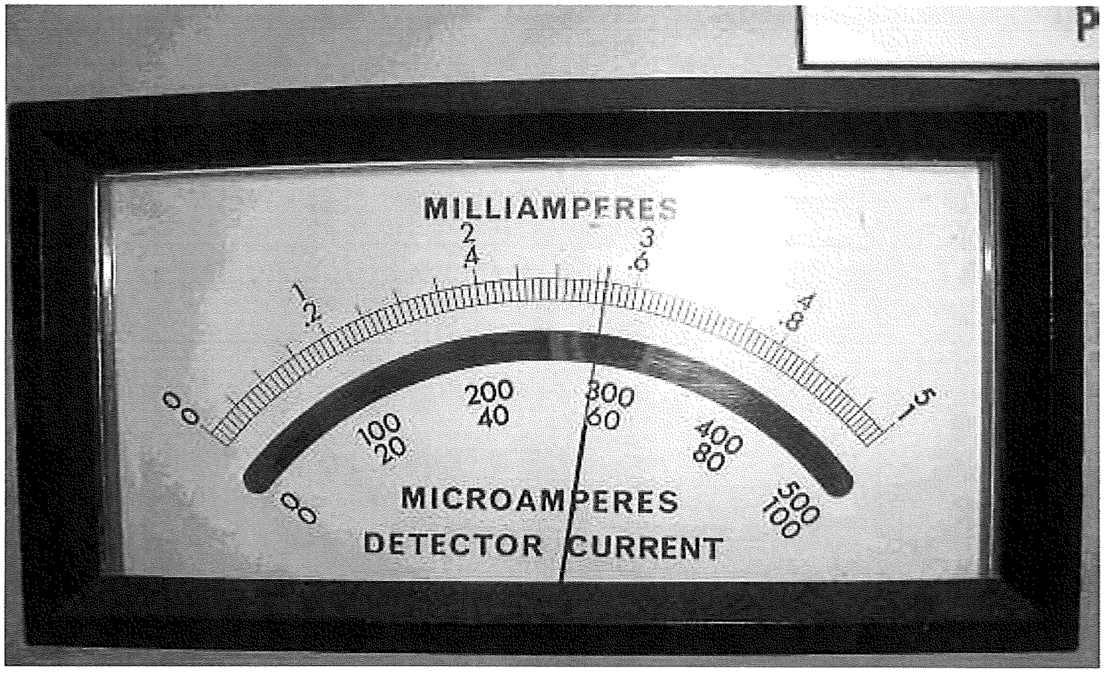


1(2)N-41B – Detector B

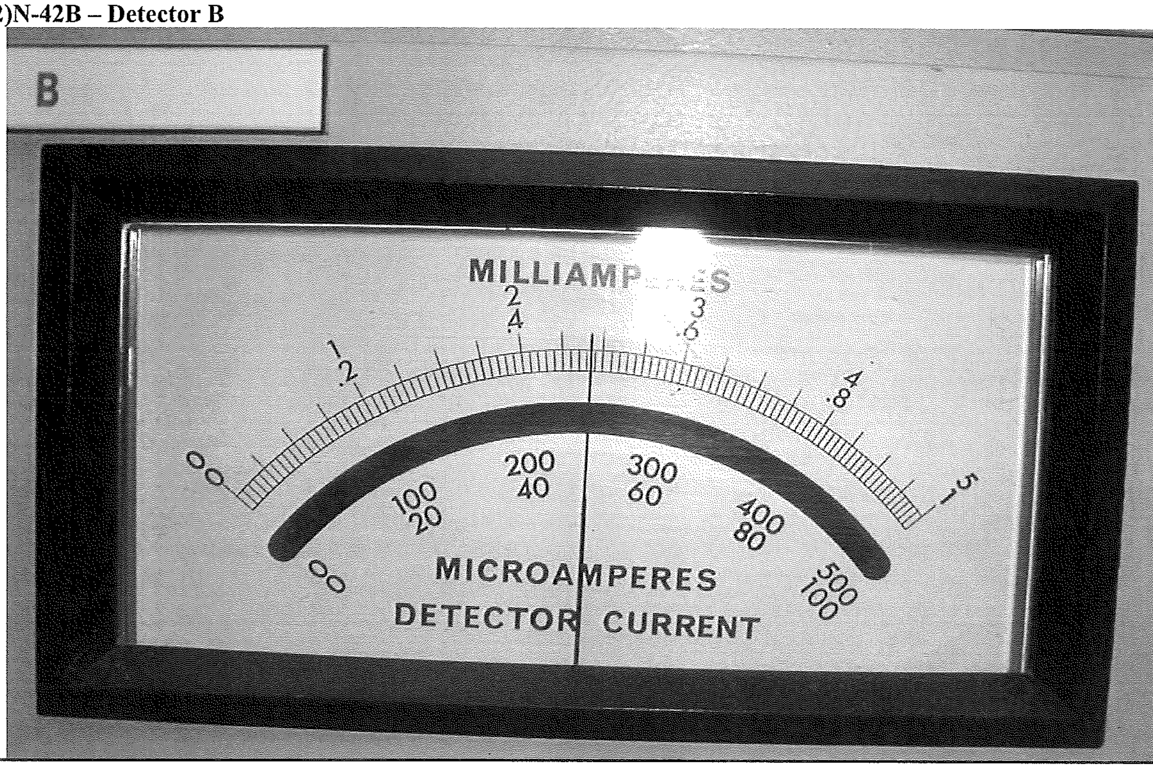


Attachment A

1(2)N-42B – Detector A

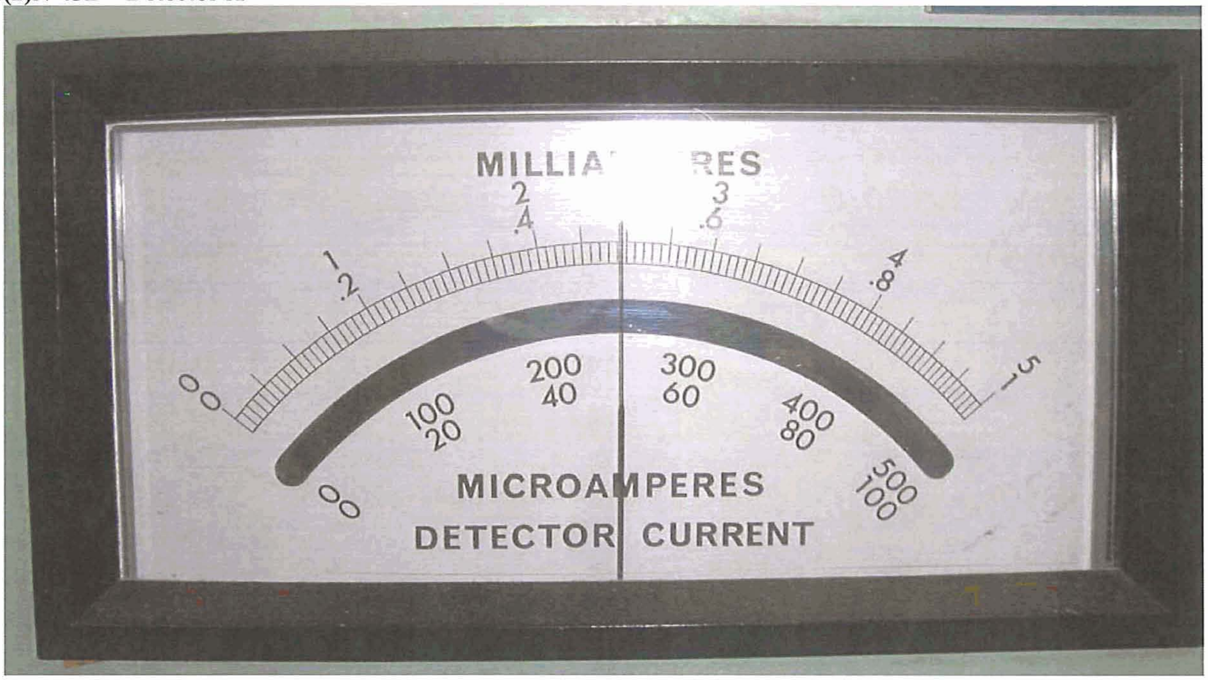


1(2)N-42B – Detector B



Attachment A

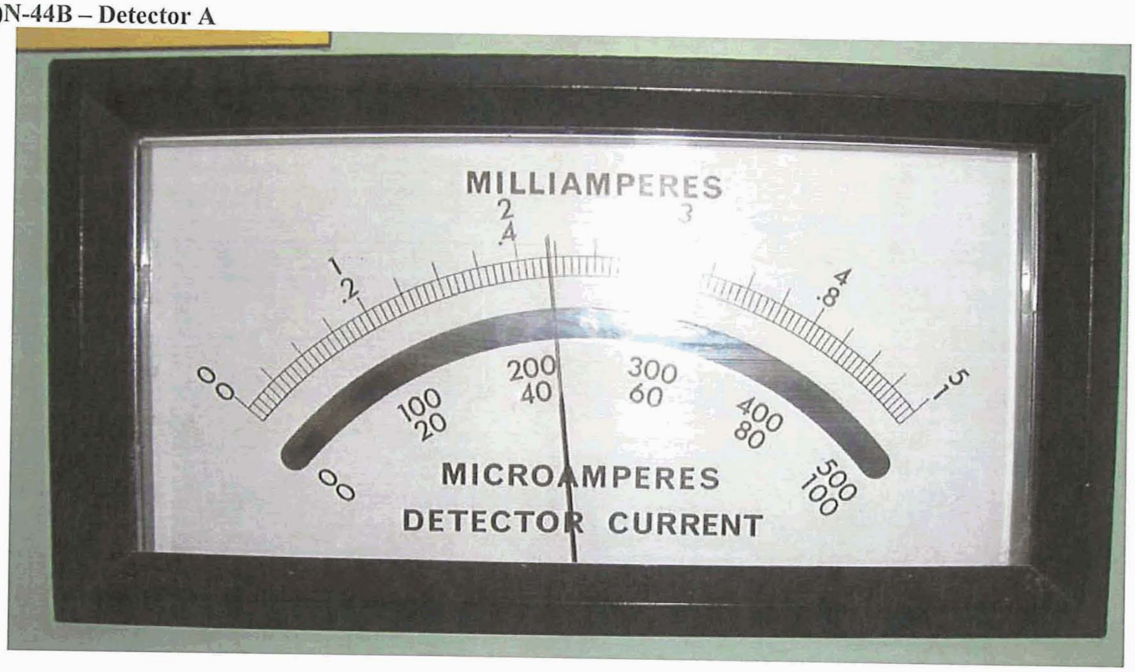
1(2)N-43B – Detector A



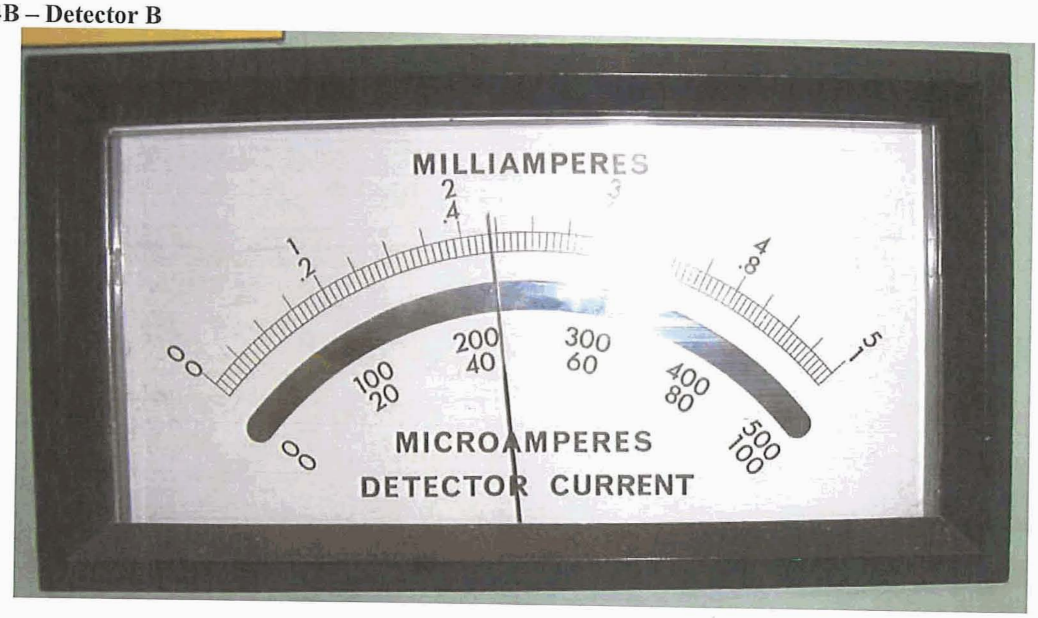
1(2)N-43B – Detector B

Attachment A

1(2)N-44B – Detector A

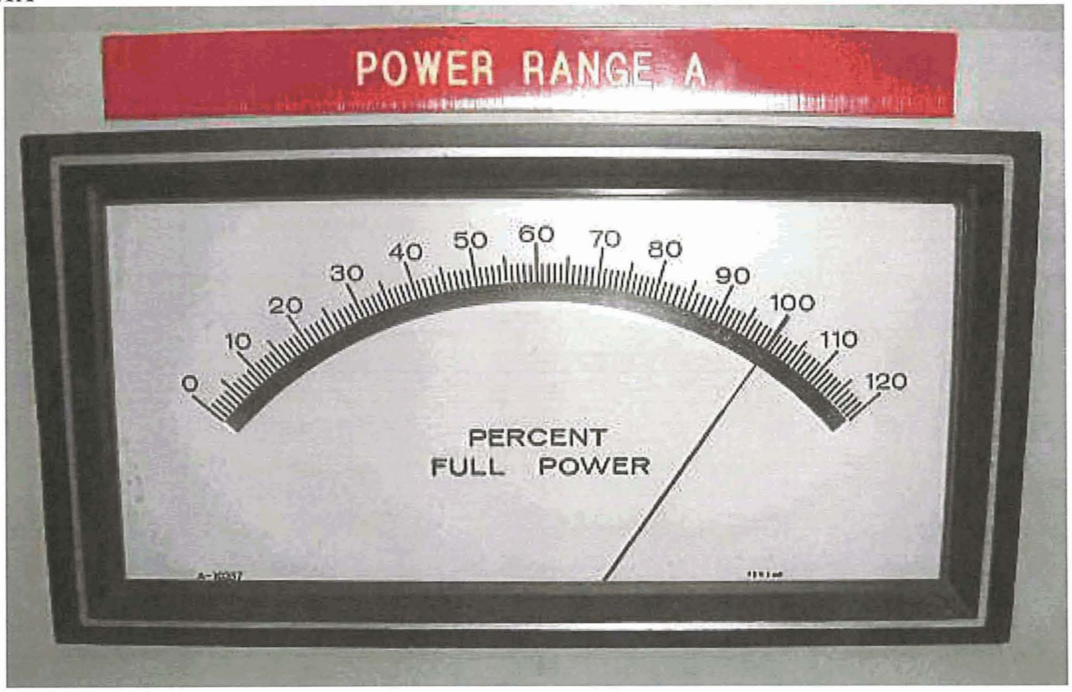


1(2)N-44B – Detector B

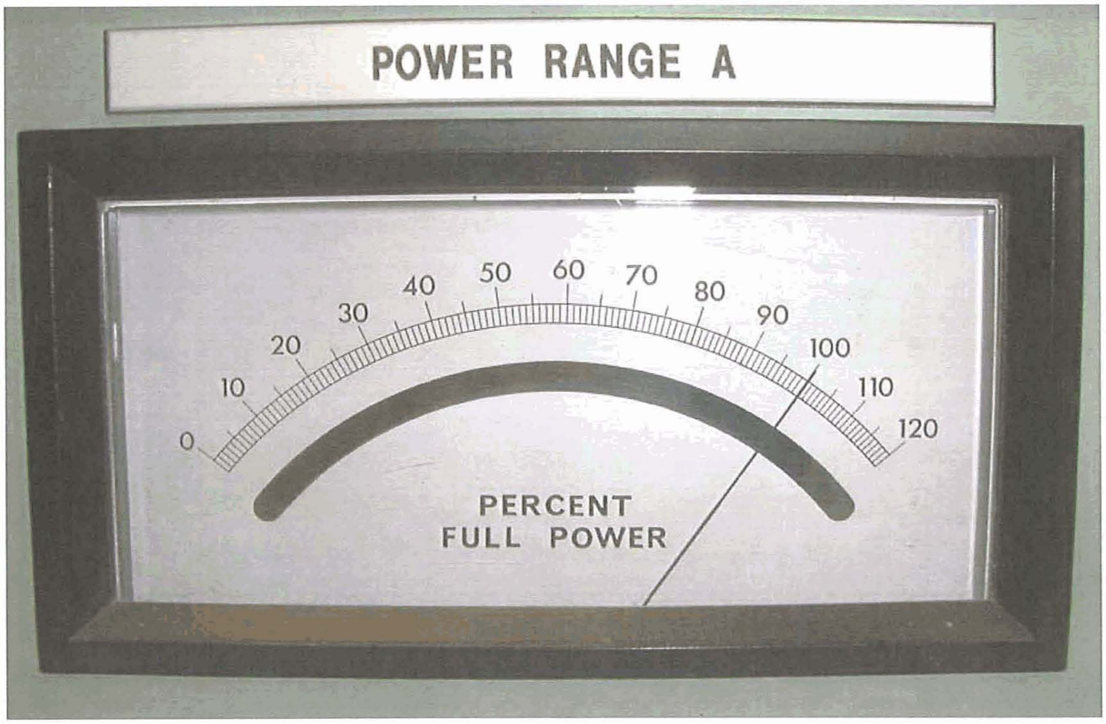


Attachment A

1(2)N-41A

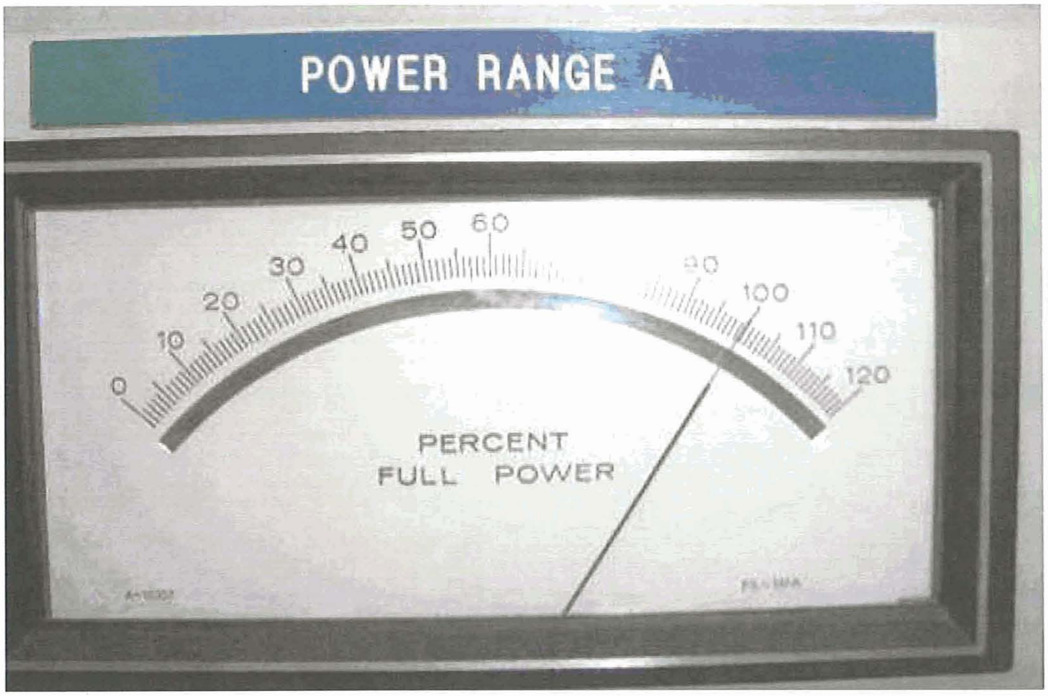


1(2)N-42A

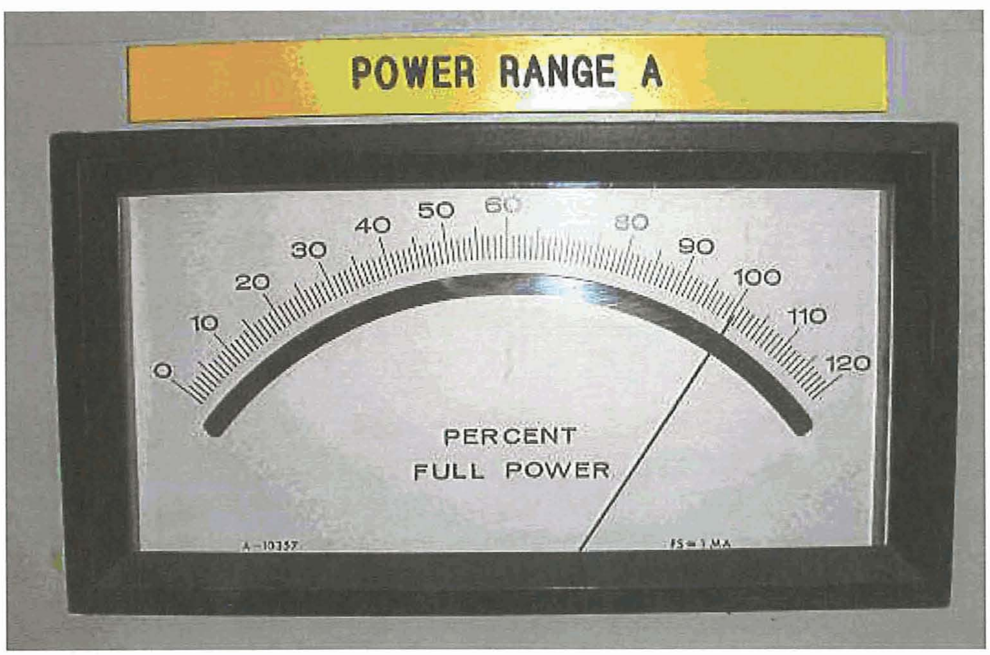


Attachment A

1(2)N-43A

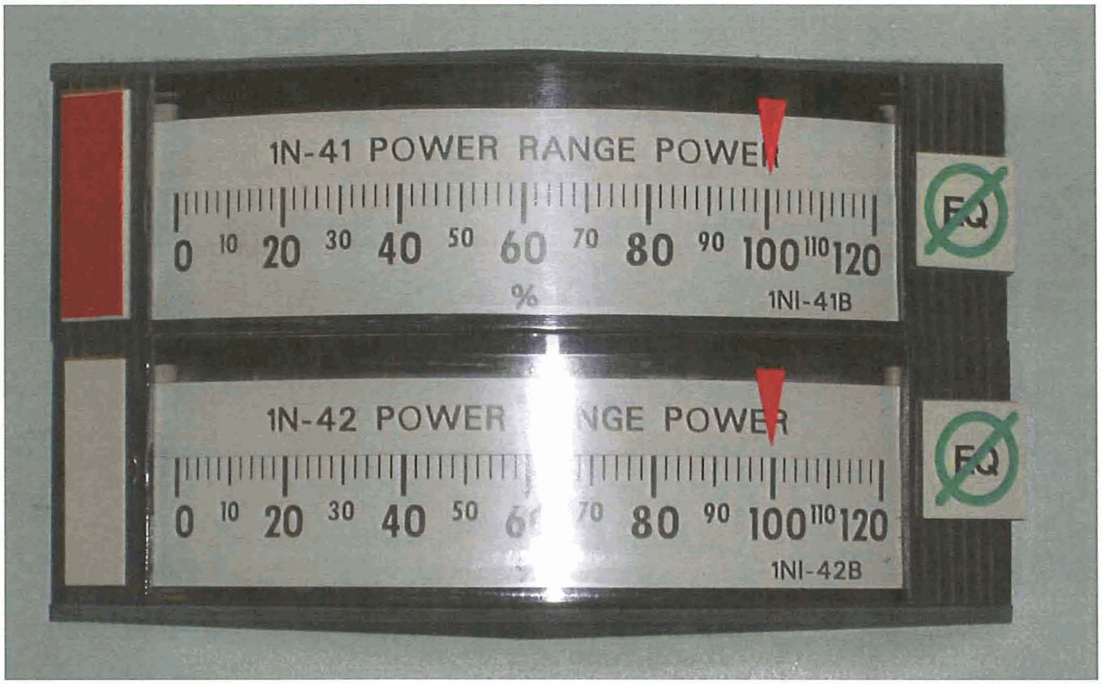


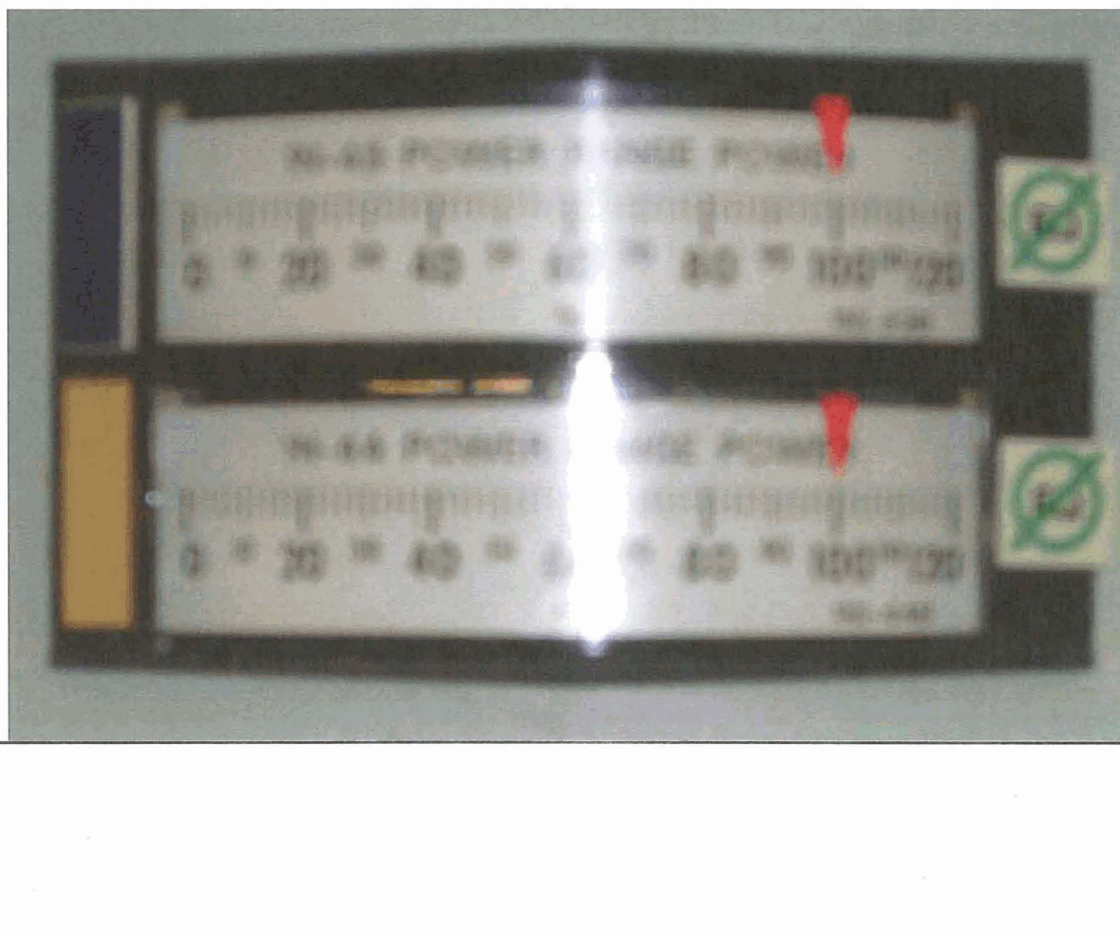
1(2)N-44A



Attachment A

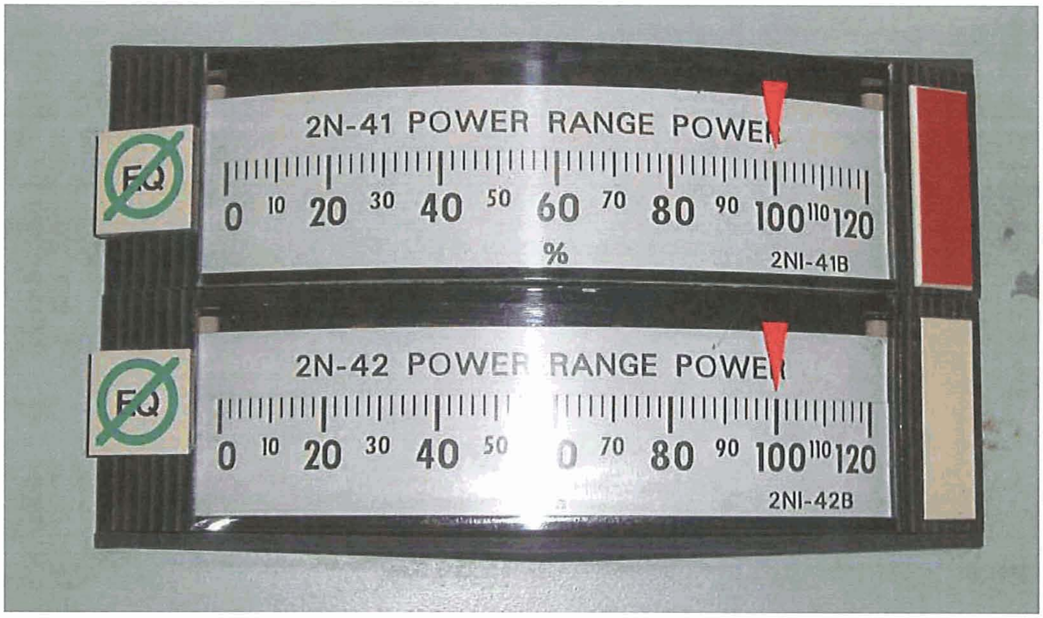
1NI-41B – 44B

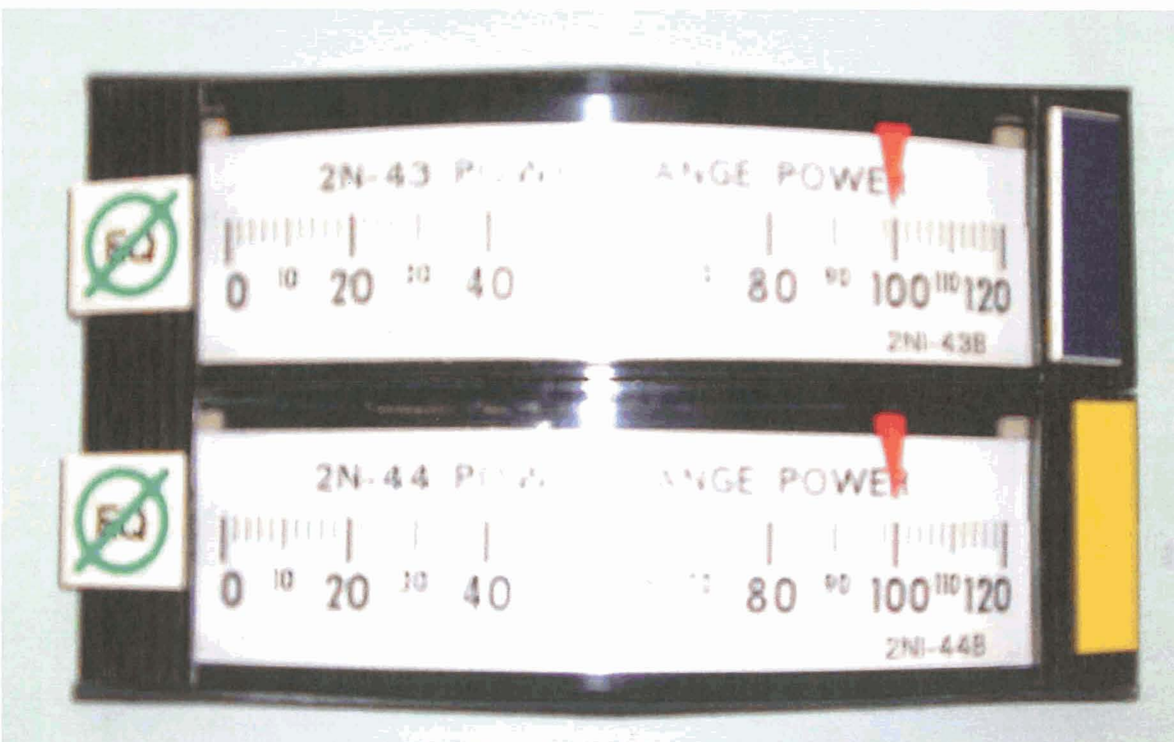




Attachment A

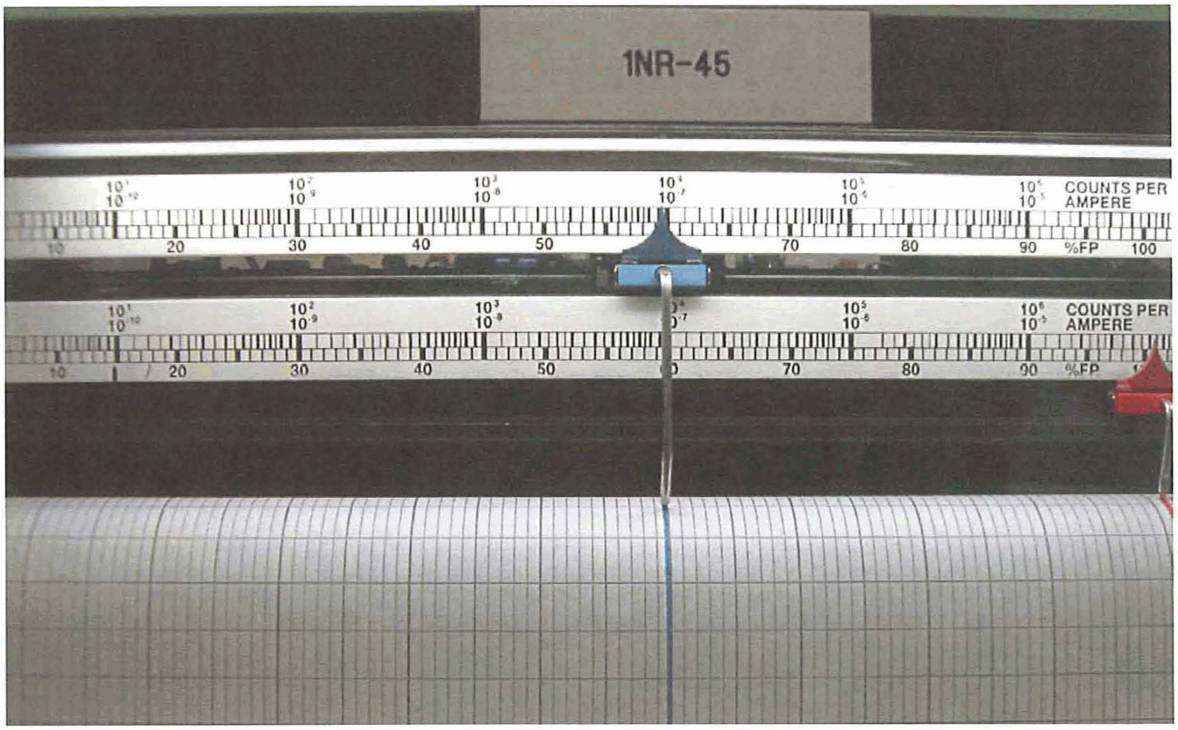
2NI-41B – 44B



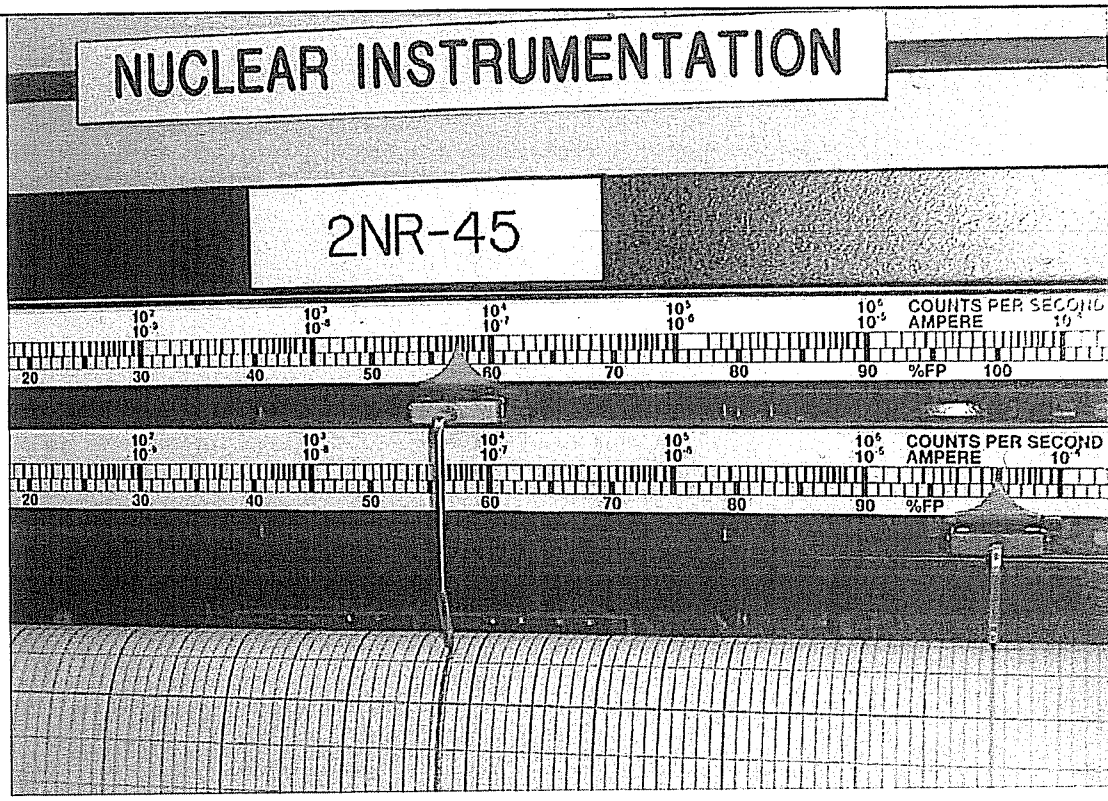


Attachment A

1(2)NR-00045



Attachment A



Attachment B

This calculation has determined Acceptable As-Found Tolerance values for all instruments identified in Section 1.5. In addition, new Operability Limits have been determined for the reactor trips during the Channel Operational Test (COT). The following tables provide changes to calibration procedures P.3, P.5, and P.20 – P.27. The shaded boxes represent the changes; other fields are shown for convenience.

1(2) ICP 02.007 Series – Current Power Level

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

Bistable NC305	OUTPUT			LIMITS					
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %		Operability Limits %	
Overpower Low Setpoint Trip	20.0 ↑			18.0	22.0	19.0	21.0	17.0	23.0
• TECHNICAL SPECIFICATION LIMIT ≤ 28%									

Bistable NC305	OUTPUT			LIMITS			
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %	
Reset	18.0 ↓			16.0	20.0	17.0	19.0

Bistable NC302	OUTPUT			LIMITS			
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %	
Overpower Rod Stop	105.0 ↑			103.0	107.0	104.0	106.0

Bistable NC302	OUTPUT			LIMITS			
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %	
Reset	103.0 ↓			101.0	105.0	102.0	104.0

Bistable NC306	OUTPUT			LIMITS					
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %		Operability Limits %	
Overpower High Setpoint Trip	107.0 ↑			105.0	109.0	106.0	108.0	104.0	110.0
• TECHNICAL SPECIFICATION LIMIT ≤ 111%									

Bistable NC306	OUTPUT			LIMITS			
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %	
Reset	105.0 ↓			103.0	107.0	104.0	106.0

Attachment B

1(2) ICP 02.007 Series – Extended Power Uprate Level

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

Bistable NC305	OUTPUT			LIMITS					
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %		Operability Limits %	
Overpower Low Setpoint Trip	20.0 ↑			18.0	22.0	19.0	21.0	17.0	23.0
• TECHNICAL SPECIFICATION LIMIT ≤ 28%									

Bistable NC305	OUTPUT			LIMITS			
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %	
Reset	18.0 ↓			16.0	20.0	17.0	19.0

Bistable NC302	OUTPUT			LIMITS			
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %	
Overpower Rod Stop	105.0 ↑			103.0	107.0	104.0	106.0

Bistable NC302	OUTPUT			LIMITS			
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %	
Reset	103.0 ↓			101.0	105.0	102.0	104.0

Bistable NC306	OUTPUT			LIMITS					
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %		Operability Limits %	
Overpower High Setpoint Trip	107.0 ↑			105.0	109.0	106.0	108.0	104.0	109.0
• TECHNICAL SPECIFICATION LIMIT ≤ 109%									

Bistable NC306	OUTPUT			LIMITS			
	SETPOINT %	AS-FOUND %	AS-LEFT %	As-Found Tolerance %		As-Left Tolerance %	
Reset	105.0 ↓			103.0	107.0	104.0	106.0

Attachment B

1(2) ICP 02.022 Series – Current Power Level

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

Bistable NC308	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
P-7 Unblock and P-10 Block	10.0% ↑			8.0%	12.0%	9.0%	10.0%	7.0%	13.0%
• P-7 TECHNICAL SPECIFICATION LIMIT ≤ 13%									

Bistable NC308	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
P-7 Block and P-10 Unblock	9.0% ↓			7.0%	11.0%	8.0%	9.0%	6.0%	12.0%
• P-10 TECHNICAL SPECIFICATION LIMIT ≥ 6%									

Bistable NC305	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
Overpower Low Setpoint Trip	20.0% ↑			18.0%	22.0%	19.0%	21.0%	17.0%	23.0%
• TECHNICAL SPECIFICATION LIMIT ≤ 28%									

Bistable NC305	OUTPUT			LIMITS			
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance	
Reset	18.0% ↓			16.0%	20.0%	17.0%	19.0%

Bistable NC303	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
P-9 Unblock	50.0%↑			48.0%	52.0%	49.0%	50.0%	47.0%	53.0%
• P-9 TECHNICAL SPECIFICATION LIMIT ≤ 53%									

Bistable NC303	OUTPUT			LIMITS			
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance	
P-9 Block (reset)	49.0% ↓			47.0%	51.0%	48.0%	49.0%

Attachment B

Bistable NC304	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
P-8 Unblock	50.0%↑			48.0%	52.0%	49.0%	50.0%	47.0%	53.0%
• P-8 TECHNICAL SPECIFICATION LIMIT ≤ 53%									

Bistable NC304	OUTPUT			LIMITS			
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance	
P-8 Block (reset)	49.0% ↓			47.0%	51.0%	48.0%	49.0%

Bistable NC302	OUTPUT			LIMITS			
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance	
Overpower Rod Stop	105.0% ↑			103.0%	107.0%	104.0%	106.0%

Bistable NC302	OUTPUT			LIMITS			
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance	
Reset	103.0% ↓			101.0%	105.0%	102.0%	104.0%

Bistable NC306	OUTPUT		LIMITS	
	SETPOINT	AS-FOUND	LOW	HIGH
*Overpower High Setpoint Trip	107.0% ↑		105.0%	109.0%
• TECHNICAL SPECIFICATION LIMIT ≤ 111%				

Bistable NC306	OUTPUT		LIMITS	
	SETPOINT	AS-LEFT	LOW	HIGH
*Overpower High Setpoint Trip	85.0% ↑		84.0%	86.0%
Reset	83.0% ↓		82.0%	83.0%
• TECHNICAL SPECIFICATION LIMIT ≤ 111%				

Attachment B

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

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

Bistable NC308	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
P-7 Unblock and P-10 Block	10.0% ↑			8.0%	12.0%	9.0%	10.0%	7.0%	13.0%
• P-7 TECHNICAL SPECIFICATION LIMIT ≤ 13%									

Bistable NC308	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
P-7 Block and P-10 Unblock	9.0% ↓			7.0%	11.0%	8.0%	9.0%	6.0%	12.0%
• P-10 TECHNICAL SPECIFICATION LIMIT ≥ 6%									

Bistable NC305	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
Overpower Low Setpoint Trip	20.0% ↑			18.0%	22.0%	19.0%	21.0%	17.0%	23.0%
• TECHNICAL SPECIFICATION LIMIT ≤ 28%									

Bistable NC305	OUTPUT			LIMITS			
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance	
Reset	18.0% ↓			16.0%	20.0%	17.0%	19.0%

Bistable NC303	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
P-9 Unblock for Tavg < 572°F	35.0%↑			33.0%	37.0%	34.0%	35.0%	32.0%	38.0%
P-9 Unblock for Tavg ≥ 572°F	50.0%↑			48.0%	52.0%	49.0%	50.0%	47.0%	53.0%
• P-9 TECHNICAL SPECIFICATION LIMIT for Tavg < 572°F : ≤ 38% • P-9 TECHNICAL SPECIFICATION LIMIT for Tavg ≥ 572°F : ≤ 53%									

Bistable NC303	OUTPUT			LIMITS			
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance	
P-9 Block (Tavg < 572°F)	34.0% ↓			32.0%	36.0%	33.0%	34.0%
P-9 Block (Tavg ≥ 572°F)	49.0% ↓			47.0%	51.0%	48.0%	49.0%

Attachment B

Bistable NC304	OUTPUT			LIMITS					
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance		Operability Limits	
P-8 Unblock	35.0% ↑			33.0%	37.0%	34.0%	35.0%	32.0%	38.0%
• P-8 TECHNICAL SPECIFICATION LIMIT ≤ 38%									

Bistable NC304	OUTPUT			LIMITS			
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance	
P-8 Block (reset)	34.0% ↓			32.0%	36.0%	33.0%	34.0%

Bistable NC302	OUTPUT			LIMITS			
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance	
Overpower Rod Stop	105.0% ↑			103.0%	107.0%	104.0%	106.0%

Bistable NC302	OUTPUT			LIMITS			
	SETPOINT	AS-FOUND	AS-LEFT	As-Found Tolerance		As-Left Tolerance	
Reset	103.0% ↓			101.0%	105.0%	102.0%	104.0%

Bistable NC306	OUTPUT		LIMITS	
	SETPOINT	AS-FOUND	LOW	HIGH
*Overpower High Setpoint Trip	107.0% ↑		105.0%	109.0%
• TECHNICAL SPECIFICATION LIMIT ≤ 109%				

Bistable NC306	OUTPUT		LIMITS	
	SETPOINT	AS-LEFT	LOW	HIGH
*Overpower High Setpoint Trip	85.0% ↑		84.0%	86.0%
Reset	83.0% ↓		82.0%	83.0%
• TECHNICAL SPECIFICATION LIMIT ≤ 109%				

Attachment B

1(2)ICP 04.026RD

It is recommended that the calibration table for the drawer is broken into two separate tables as follows for the percent level indicator and the output from the summing amplifier.

1N-41 PERCENT FULL POWER								
INPUT		IDEAL	AS-FOUND	AS-LEFT	As-Found Limits		As-Left Limits	
Detector A Current	Detector B Current	Percent Full Power Meter %	Percent Full Power Meter %	Percent Full Power Meter %	Low %	High %	Low %	High %
0	0	0.0			0.0	2.0	0.0	0.5
		10.0			8.0	12.0	9.5	10.5
		30.0			28.0	32.0	29.5	30.5
		50.0			48.0	52.0	49.5	50.5
		80.0			78.0	82.0	79.5	80.5
		100.0			98.0	102.0	99.5	100.5
		110.0			108.0	112.0	109.5	110.5
		120.0			NA	NA	NA	NA
		110.0			108.0	112.0	109.5	110.5
		100.0			98.0	102.0	99.5	100.5
		80.0			78.0	82.0	79.5	80.5
		50.0			48.0	52.0	49.5	50.5
		30.0			28.0	32.0	29.5	30.5
		10.0			8.0	12.0	9.5	10.5
0	0	0.0			0.0	2.0	0.0	0.5

Attachment B

1N-41 NM-310 SUMMING AMPLIFIER OUTPUT								
INPUT		IDEAL	AS-FOUND	AS-LEFT	As-Found Limits		As-Left Limits	
Detector A Current	Detector B Current	NM-310 Output Vdc	NM-310 Output Vdc	NM-310 Output Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
0	0	0.000			-0.205	0.205	-0.025	0.025
		0.833			0.628	1.038	0.808	0.858
		2.500			2.295	2.705	2.475	2.525
		4.166			3.961	4.371	4.141	4.191
		6.666			6.461	6.871	6.641	6.691
		8.333			8.128	8.538	8.308	8.358
		9.167			8.962	9.372	9.142	9.192
		10.000			9.795	10.205	9.975	10.025
		9.167			8.962	9.372	9.142	9.192
		8.333			8.128	8.538	8.308	8.358
		6.666			6.461	6.871	6.641	6.691
		4.166			3.961	4.371	4.141	4.191
		2.500			2.295	2.705	2.475	2.525
		0.833			0.628	1.038	0.808	0.858
0	0	0.000			-0.205	0.205	-0.025	0.025

Data Sheet 4

1(2)NR-45 1(2)N-41 Power Range Power							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL mVdc	AS-FOUND mVdc	AS-LEFT mVdc	As-Found mVdc		As-Left mVdc	
0.00	0.0			-1.01	1.01	-1.00	1.00
5.000	25.00			23.99	26.01	24.00	26.00
10.000	50.00			48.99	51.01	49.00	51.00

Attachment B

1(2)NI-41B 1(2)N-41 Power Range Power							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL %	AS-FOUND %	AS-LEFT %	As-Found %		As-Left %	
0.00	0.0			-1.0	1.0	-1.0	1.0
5.000	60.0			59.0	61.0	59.0	61.0
8.333	100.0			99.0	101.0	99.0	101.0
10.000	120.0			119.0	121.0	119.0	121.0
8.333	100.0			99.0	101.0	99.0	101.0
5.000	60.0			59.0	61.0	59.0	61.0
0.00	0.0			-1.0	1.0	-1.0	1.0

1(2)N41 PPCS Point							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL %	AS-FOUND %	AS-LEFT %	As-Found %		As-Left %	
0.00	0.0			-0.6	0.6	-0.6	0.6
1.250	30.0			29.4	30.6	29.4	30.6
2.500	60.0			59.4	60.6	59.4	60.6
4.167	100.0			99.4	100.6	99.4	100.6
5.000	120.0			119.4	120.6	119.4	120.6

Attachment B

1(2)ICP 04.026WH

It is recommended that the calibration table for the drawer is broken into two separate tables as follows for the percent level indicator and the output from the summing amplifier.

1N-42 PERCENT FULL POWER								
INPUT		IDEAL	AS-FOUND	AS-LEFT	As-Found Limits		As-Left Limits	
Detector A Current	Detector B Current	Percent Full Power Meter %	Percent Full Power Meter %	Percent Full Power Meter %	Low %	High %	Low %	High %
0	0	0.0			0.0	2.0	0.0	0.5
		10.0			8.0	12.0	9.5	10.5
		30.0			28.0	32.0	29.5	30.5
		50.0			48.0	52.0	49.5	50.5
		80.0			78.0	82.0	79.5	80.5
		100.0			98.0	102.0	99.5	100.5
		110.0			108.0	112.0	109.5	110.5
		120.0			NA	NA	NA	NA
		110.0			108.0	112.0	109.5	110.5
		100.0			98.0	102.0	99.5	100.5
		80.0			78.0	82.0	79.5	80.5
		50.0			48.0	52.0	49.5	50.5
		30.0			28.0	32.0	29.5	30.5
		10.0			8.0	12.0	9.5	10.5
0	0	0.0			0.0	2.0	0.0	0.5

Attachment B

1N-42 NM-310 SUMMING AMPLIFIER OUTPUT								
INPUT		IDEAL	AS-FOUND	AS-LEFT	As-Found Limits		As-Left Limits	
Detector A Current	Detector B Current	NM-310 Output Vdc	NM-310 Output Vdc	NM-310 Output Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
0	0	0.000			-0.205	0.205	-0.025	0.025
		0.833			0.628	1.038	0.808	0.858
		2.500			2.295	2.705	2.475	2.525
		4.166			3.961	4.371	4.141	4.191
		6.666			6.461	6.871	6.641	6.691
		8.333			8.128	8.538	8.308	8.358
		9.167			8.962	9.372	9.142	9.192
		10.000			9.795	10.205	9.975	10.025
		9.167			8.962	9.372	9.142	9.192
		8.333			8.128	8.538	8.308	8.358
		6.666			6.461	6.871	6.641	6.691
		4.166			3.961	4.371	4.141	4.191
		2.500			2.295	2.705	2.475	2.525
		0.833			0.628	1.038	0.808	0.858
0	0	0.000			-0.205	0.205	-0.025	0.025

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1(2)NR-45 1(2)N-42 Power Range Power							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL mVdc	AS-FOUND mVdc	AS-LEFT mVdc	As-Found mVdc		As-Left mVdc	
0.00	0.0			-1.01	1.01	-1.00	1.00
5.000	25.00			23.99	26.01	24.00	26.00
10.000	50.00			48.99	51.01	49.00	51.00

Attachment B

1(2)NI-42B 1(2)N-42 Power Range Power							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL %	AS-FOUND %	AS-LEFT %	As-Found %		As-Left %	
0.00	0.0			-1.0	1.0	-1.0	1.0
5.000	60.0			59.0	61.0	59.0	61.0
8.333	100.0			99.0	101.0	99.0	101.0
10.000	120.0			119.0	121.0	119.0	121.0
8.333	100.0			99.0	101.0	99.0	101.0
5.000	60.0			59.0	61.0	59.0	61.0
0.00	0.0			-1.0	1.0	-1.0	1.0

1(2)N42 PPCS Point							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL %	AS-FOUND %	AS-LEFT %	As-Found %		As-Left %	
0.00	0.0			-0.6	0.6	-0.6	0.6
1.250	30.0			29.4	30.6	29.4	30.6
2.500	60.0			59.4	60.6	59.4	60.6
4.167	100.0			99.4	100.6	99.4	100.6
5.000	120.0			119.4	120.6	119.4	120.6

Attachment B

1(2)ICP 04.026BL

It is recommended that the calibration table for the drawer is broken into two separate tables as follows for the percent level indicator and the output from the summing amplifier.

1N-43 PERCENT FULL POWER								
INPUT		IDEAL	AS-FOUND	AS-LEFT	As-Found Limits		As-Left Limits	
Detector A Current	Detector B Current	Percent Full Power Meter %	Percent Full Power Meter %	Percent Full Power Meter %	Low %	High %	Low %	High %
0	0	0.0			0.0	2.0	0.0	0.5
		10.0			8.0	12.0	9.5	10.5
		30.0			28.0	32.0	29.5	30.5
		50.0			48.0	52.0	49.5	50.5
		80.0			78.0	82.0	79.5	80.5
		100.0			98.0	102.0	99.5	100.5
		110.0			108.0	112.0	109.5	110.5
		120.0			NA	NA	NA	NA
		110.0			108.0	112.0	109.5	110.5
		100.0			98.0	102.0	99.5	100.5
		80.0			78.0	82.0	79.5	80.5
		50.0			48.0	52.0	49.5	50.5
		30.0			28.0	32.0	29.5	30.5
		10.0			8.0	12.0	9.5	10.5
0	0	0.0			0.0	2.0	0.0	0.5

Attachment B

1N-43 NM-310 SUMMING AMPLIFIER OUTPUT								
INPUT		IDEAL	AS-FOUND	AS-LEFT	As-Found Limits		As-Left Limits	
Detector A Current	Detector B Current	NM-310 Output Vdc	NM-310 Output Vdc	NM-310 Output Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
0	0	0.000			-0.205	0.205	-0.025	0.025
		0.833			0.628	1.038	0.808	0.858
		2.500			2.295	2.705	2.475	2.525
		4.166			3.961	4.371	4.141	4.191
		6.666			6.461	6.871	6.641	6.691
		8.333			8.128	8.538	8.308	8.358
		9.167			8.962	9.372	9.142	9.192
		10.000			9.795	10.205	9.975	10.025
		9.167			8.962	9.372	9.142	9.192
		8.333			8.128	8.538	8.308	8.358
		6.666			6.461	6.871	6.641	6.691
		4.166			3.961	4.371	4.141	4.191
		2.500			2.295	2.705	2.475	2.525
		0.833			0.628	1.038	0.808	0.858
0	0	0.000			-0.205	0.205	-0.025	0.025

Attachment B

Data Sheet 4

1(2)NR-45 1(2)N-43 Power Range Power							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL mVdc	AS-FOUND mVdc	AS-LEFT mVdc	As-Found mVdc		As-Left mVdc	
0.00	0.0			-1.01	1.01	-1.00	1.00
5.000	25.00			23.99	26.01	24.00	26.00
10.000	50.00			48.99	51.01	49.00	51.00

1(2)NI-43B 1(2)N-43 Power Range Power							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL %	AS-FOUND %	AS-LEFT %	As-Found %		As-Left %	
0.00	0.0			-1.0	1.0	-1.0	1.0
5.000	60.0			59.0	61.0	59.0	61.0
8.333	100.0			99.0	101.0	99.0	101.0
10.000	120.0			119.0	121.0	119.0	121.0
8.333	100.0			99.0	101.0	99.0	101.0
5.000	60.0			59.0	61.0	59.0	61.0
0.00	0.0			-1.0	1.0	-1.0	1.0

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1(2)N43 PPCS Point							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL %	AS-FOUND %	AS-LEFT %	As-Found %		As-Left %	
0.00	0.0			-0.6	0.6	-0.6	0.6
1.250	30.0			29.4	30.6	29.4	30.6
2.500	60.0			59.4	60.6	59.4	60.6
4.167	100.0			99.4	100.6	99.4	100.6
5.000	120.0			119.4	120.6	119.4	120.6

1(2)ICP 04.026YL

It is recommended that the calibration table for the drawer is broken into two separate tables as follows for the percent level indicator and the output from the summing amplifier.

1N-44 PERCENT FULL POWER								
INPUT		IDEAL	AS-FOUND	AS-LEFT	As-Found Limits		As-Left Limits	
Detector A Current	Detector B Current	Percent Full Power Meter %	Percent Full Power Meter %	Percent Full Power Meter %	Low %	High %	Low %	High %
0	0	0.0			0.0	2.0	0.0	0.5
		10.0			8.0	12.0	9.5	10.5
		30.0			28.0	32.0	29.5	30.5
		50.0			48.0	52.0	49.5	50.5
		80.0			78.0	82.0	79.5	80.5
		100.0			98.0	102.0	99.5	100.5
		110.0			108.0	112.0	109.5	110.5
		120.0			NA	NA	NA	NA
		110.0			108.0	112.0	109.5	110.5
		100.0			98.0	102.0	99.5	100.5
		80.0			78.0	82.0	79.5	80.5
		50.0			48.0	52.0	49.5	50.5
		30.0			28.0	32.0	29.5	30.5
		10.0			8.0	12.0	9.5	10.5
0	0	0.0			0.0	2.0	0.0	0.5

Attachment B

1N-44 NM-310 SUMMING AMPLIFIER OUTPUT								
INPUT		IDEAL	AS-FOUND	AS-LEFT	As-Found Limits		As-Left Limits	
Detector A Current	Detector B Current	NM-310 Output Vdc	NM-310 Output Vdc	NM-310 Output Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
0	0	0.000			-0.205	0.205	-0.025	0.025
		0.833			0.628	1.038	0.808	0.858
		2.500			2.295	2.705	2.475	2.525
		4.166			3.961	4.371	4.141	4.191
		6.666			6.461	6.871	6.641	6.691
		8.333			8.128	8.538	8.308	8.358
		9.167			8.962	9.372	9.142	9.192
		10.000			9.795	10.205	9.975	10.025
		9.167			8.962	9.372	9.142	9.192
		8.333			8.128	8.538	8.308	8.358
		6.666			6.461	6.871	6.641	6.691
		4.166			3.961	4.371	4.141	4.191
		2.500			2.295	2.705	2.475	2.525
		0.833			0.628	1.038	0.808	0.858
0	0	0.000			-0.205	0.205	-0.025	0.025

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1(2)NR-45 1(2)N-44 Power Range Power							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL mVdc	AS-FOUND mVdc	AS-LEFT mVdc	As-Found mVdc		As-Left mVdc	
0.00	0.0			-1.01	1.01	-1.00	1.00
5.000	25.00			23.99	26.01	24.00	26.00
10.000	50.00			48.99	51.01	49.00	51.00

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1(2)NI-44B 1(2)N-44 Power Range Power							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL %	AS-FOUND %	AS-LEFT %	As-Found %		As-Left %	
0.00	0.0			-1.0	1.0	-1.0	1.0
5.000	60.0			59.0	61.0	59.0	61.0
8.333	100.0			99.0	101.0	99.0	101.0
10.000	120.0			119.0	121.0	119.0	121.0
8.333	100.0			99.0	101.0	99.0	101.0
5.000	60.0			59.0	61.0	59.0	61.0
0.00	0.0			-1.0	1.0	-1.0	1.0

1(2)N44 PPCS Point							
INPUT Vdc	OUTPUT			LIMITS			
	IDEAL %	AS-FOUND %	AS-LEFT %	As-Found %		As-Left %	
0.00	0.0			-0.6	0.6	-0.6	0.6
1.250	30.0			29.4	30.6	29.4	30.6
2.500	60.0			59.4	60.6	59.4	60.6
4.167	100.0			99.4	100.6	99.4	100.6
5.000	120.0			119.4	120.6	119.4	120.6

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Process and Environmental Considerations

1.0 Reactor Protection Trip Setpoints

1.1. Analyzed Events

The power range channels feed two reactor trip functions, the high range – high flux setting and the low range – high flux setting.

The high range – high flux setting reactor trip is credited as the primary trip in three analyses (Reference G.18):

1. Rod withdrawal at power (RWAP)
2. Rod Control Cluster Assembly (RCCA) ejection (HFP cases)
3. Steam line break outside containment (SLB(OC))

This reactor trip is also a backup/anticipatory trip for the following events:

1. Rod withdrawal from subcritical (RWFS)
2. Loss of load
3. Reduction in feedwater enthalpy
4. Excessive load increase
5. CVCS malfunction (boron dilution) at power
6. Steam line break inside containment (SLB(IC))

None of these backup/anticipatory trips has a process limit associated with its respective analysis. Therefore, they will not be considered in the setpoint evaluation.

The low range – high flux setting reactor trip is credited as the primary trip in two analyses (Reference G.18):

1. Rod withdrawal from subcritical (RWFS)
2. RCCA ejection (HZP cases)

This reactor trip is a backup/anticipatory trip for the startup of an inactive reactor coolant loop. No process limit is provided for this event; therefore, it will not be considered in the setpoint evaluation.

The analyses with analytical limits will be discussed separately.

1.1.1 Rod Withdrawal at Power

An uncontrolled Rod Control Cluster Assembly (RCCA) withdrawal at power is a positive reactivity insertion that produces an increase in core heat flux. Since the heat removed from the reactor coolant system (RCS) by the steam generators is unchanged, T_{avg} increases. A continued temperature increase would eventually result in Departure from Nucleate Boiling (DNB). A continued T_{avg} increase also has the potential, if unchecked, to challenge the integrity of both the RCS boundary and the main steam pressure boundary. An uncontrolled withdrawal of a RCCA at

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power could be the result of operator action or a malfunction of the rod control system. A spectrum of reactivity insertion rates, with the maximum reactivity insertion rate based on a rate greater than that for a simultaneous withdrawal of the two banks of greatest combined worth at maximum speed, were analyzed for a range of power levels (Reference G.3 Section 14.1.2). For rapid RCCA withdrawal, analysis shows the reactor trips on power range high neutron flux – high setting shortly after the initiation of the event, with only small changes in T_{avg} and RCS pressure, and a large margin to DNB is maintained. Slower RCCA withdrawal is of less interest here, as analysis shows the reactor trips on OTΔT after a longer transient, however these cases result in larger RCS temperature and pressure increases than the rapid withdrawal (for very low reactivity insertion rates, steam generator safety valves relieve a significant amount of steam prior to the reactor trip). DNB margin is again maintained. The power range high neutron flux – high reactor trip is a primary trip for this accident. The analytical limit is 118% and the process sensor functional time is 100.219 seconds (Reference G.18). There is no loss of inventory to the containment in any rod withdrawal event; therefore normal containment environmental parameters should be used in calculating uncertainties.

1.1.2 RCCA ejection (Hot Full Power cases)

The Hot Full Power (HFP) RCCA ejection cases assume control bank D is inserted to its insertion limit at the initiation of the event and there is a stuck rod adjacent to the ejected control rod. The RCCA ejection is a loss of coolant accident, with the break located in the reactor pressure vessel head, and some fuel melting is anticipated in the HFP cases, although there is no danger of sudden fuel dispersal into the reactor coolant (Reference G.3 Section 14.2.6). The high range – high flux reactor trip is the primary trip for this accident. The analytical limit is 118% (Reference G.18). There is no process sensor functional time since the reactor trip occurs very early in the transient; therefore normal containment environmental parameters should be used in calculating uncertainties.

1.1.3 Steam Line Break Outside Containment

The high range – high flux reactor trip is the primary reactor trip signal for only the largest break cases at nominal full power for the SLB(OC) analysis (Reference C.3). The analytical limit is 118% and the process sensor functional time for the largest breaks is 8 seconds (Reference G.18). Since the steam line beaks in this analysis all occur outside containment, normal containment environmental parameters should be used in calculating uncertainties.

1.1.4 Rod Withdrawal From Subcritical (RWFS)

This accident is a primary system heatup event, producing an increase in neutron flux and core power, which could result in fuel damage, clad damage, or departure from nucleate boiling (DNB). The increased heat flux also expands the reactor coolant, potentially increasing primary system pressure sufficiently to challenge the integrity of the reactor coolant system (RCS) pressure boundary. The uncontrolled rod withdrawal from subcritical (10^{-9} % of nominal power) assumes the simultaneous withdrawal of the two control banks with the maximum combined worth at maximum speed (Reference G.3 Section 14.1.1). This continuous reactivity insertion results in a very fast power rise, reaching the low range – high flux setting setpoint at 10 seconds (References G.3 Section 14.1.1 and Table 14.1.1-1). The low range – high flux reactor trip is a primary trip for this accident. The analytical limit is 35% and the process sensor functional time

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is 10 seconds (Reference G.18). The analysis shows the transient is terminated before any fuel damage or clad damage occurs, and the thermal flux remains low enough that DNB is not reached. There is no breach of the primary coolant system; therefore normal containment environmental parameters should be used in calculating uncertainties.

1.1.5 HZP RCCA Ejection

The HZP RCCA ejection cases assume control bank D fully inserted and control banks B and C at their insertion limits (Reference G.3 Section 14.2.6); this configuration is the reason a reactor trip signal is required to mitigate the accident. The low range – high flux setting reactor trip is a primary trip for this accident. The analytical limit is 35% for this case. The RCCA ejection is a loss of coolant accident with attendant fuel damage; because the reactor trip occurs very early in the transient (Reference G.3 Section 14.2.6), normal environmental parameters should be used in calculating uncertainties.

1.2 Process Considerations

Reference G.32 provides values for the process errors to be used with the power range reactor trips. The daily calibration of the power range channels, which is based on the results of the power calorimetric, accounts for the sensor (detector) effects of accuracy, drift, power supply, temperature, humidity, and radiation. Therefore, these effects can be neglected in calculating a loop error.

1.3 Environmental Considerations

The summary of the analyzed events for which the power range reactor trips are credited demonstrates that only normal containment environmental conditions would be in effect. However, as discussed in the previous paragraph, even the normal environmental effects on the sensor (detector) can be ignored because of the daily calibration of the power range channels.

The power range detectors are energized during power operations. The detectors are rated for a maximum thermal neutron flux of $1X10^{11}$ nv (Reference V.10). This is somewhat greater than the maximum expected thermal neutron flux during full power operation (Reference G.3 Figure 7.6-2). The detectors are rated for a maximum gamma flux of 5×10^5 R/hr (Reference V.10). Per Table 6-2 of WCAP-8587 (Reference G.20), the expected normal gamma dose at the detector location, 5×10^4 R/hr, is somewhat less. Therefore, the radiation dose experienced by the detector assembly is within the design specifications and no additional error due to radiation need be considered.

1.4 Reactor Trip Setpoint Values

<u>High Range – High Flux Trip</u>

The originally specified value for the high range reactor trip was 108 % of full power (Reference G.25). At around the same time, this value was placed in the PBNP Tech Specs as a limiting value for the setpoint—that is, the "field setting" or "field trip setpoint" could be any value below this limiting value. However, because there was no difference between the setpoint value specified in the PLS and the limiting value in the Tech Specs, any slight change in the setpoint

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value over the operational cycle—for example, due to instrument drift—would, if the setpoint were found outside the Tech Spec limit when the channel was tested, cause a Tech Spec violation. As a result, the field trip setpoint for the trip was moved away from the Tech Spec limiting value and established at 107 % full power, a setting that was considered adequate to prevent this problem.

During the conversion of the PBNP custom Technical Specifications (CTS) to the "improved" Technical Specifications (ITS), which were based on the Westinghouse Owners Group (WOG) Standard Technical Specifications (STS), the values that had appeared in the CTS were declared to be "Allowable Values" (Reference G.11). Since, in the case of the high range trip, the field setpoint had been established by backing off from the Tech Spec value to account for changes (e.g., drift) over the course of the operating cycle, the CTS values could be considered, in some sense, equivalent to Allowable Values.

However, there was no calculation that established the relationship of the CTS Tech Spec value to the value of the field setpoint—rather, for the reasons described above, this relationship was somewhat arbitrary. As a result, the Allowable Values in the ITS were taken directly from the values which had been in the CTS and which, in turn, had originally been considered to be limiting values for the field trip setpoint. In the case of the high range setpoint, the limiting value of 108% that had appeared in the CTS became the ITS Allowable Value. The field trip setpoint remained at 107%.

As described above, the originally specified field setpoint for this function was 108 % full power. This is a typical trip setpoint value established by Westinghouse for this function. However, at PBNP, over time, this value was converted into an Allowable Value and the field setpoint was lowered to 107 %. For comparison, the WOG STS (References G.38 and G.39), on which the PBNP ITS are based, lists a setpoint value of $\leq$ 109% RTP for this function and a higher value (111.2 % RTP) for the Allowable Value.

For Extended Power Uprate, the Analytical Limit for the high range – high flux trip setpoint was changed from 118% to 116% for the RWAP transient [References G-40 and Westinghouse calc CN-TA-08-55 Rev 0]. Therefore, a separate Limiting Trip Setpoint calculation for the EPU condition is necessary for the high range – high flux trip setpoint.

<u>Low Range – High Flux Trip</u>

The originally specified value for the low range trip was 25% of full power (Reference G.25). However, as in the case of the high range trip, this same value became the Tech Spec limiting value for the setpoint, and the field setpoint was lowered to 20 % to prevent Tech Spec violations.

The current field setpoint of 20% provides significant margin to the Analytical Limit of 35%, even when instrument uncertainties are considered. Although the field setting could be restored to the original 25% value and still have sufficient margin, no recommendation is made to increase the field setting at this time.

For Extended Power Uprate, the low range – high flux trip setpoint Analytical Limit of 35% was retained for the Rod Withdrawal from Subcritical analysis. Therefore, a separate EPU calculation

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for this setpoint is not necessary, and the current power level calculation will continue to be valid for EPU.

2.0 Reactor Protection Interlocks

The power range channels also feed several reactor protection system interlocks: P-7 permissive, P-8 permissive, P-9 permissive, and P-10 permissive. These permissive interlocks are described below:

2.1 P-7 Permissive

The P-7 permissive (low power reactor trips block) automatically blocks six reactor trips when either power range power or turbine power (as reflected by first stage turbine impulse pressure) decrease to approximately 10% RTP. The reactor protection function of this permissive is to automatically re-instate the reactor trips when power is increased above the P-7 setpoint. Two-out-of-four power range channels or either first stage turbine impulse pressure signal above approximately 10% de-energize the P-7 relays on increasing power (References D.33, D.34, D.37, and D.38). The following reactor trip functions are blocked by the P-7 permissive:

- 2/2 loop loss of reactor coolant flow
- 2/2 reactor coolant pumps breaker trip
- RCP 4 kV bus undervoltage
- Pressurizer low pressure
- Pressurizer high level
- Turbine trip

The original power range input to P-7 was 10 % of full power. For reasons described in Section 1.4.1 above, the same 10 % value also became the Tech Spec limiting value for the P-7 setpoint, and the field setpoint was lowered to prevent Tech Spec violations. At present, the field trip setpoint for the unblock function is 9.5% RTP and the reset (or block) function is 8.5% RTP (Reference P.18 and P.19). These values are the same as the P-10 permissive, although the reactor protection functions for these permissives, automatic unblocking of the reactor trips, occur at the opposite settings. This characteristic is due to a single bistable relay driver in each channel feeding both the P-10 permissive input and the nuclear instrumentation input to the P-7 permissive. The consequences of this situation are discussed in the configuration consideration section.

2.2 P-8 Permissive

The P-8 permissive blocks a reactor trip when a single reactor coolant loop loses flow with power range power below the P-8 setpoint. The reactor protection function of this permissive is to re-instate the reactor trips when power is increased above the P-8 setpoint. The power range channels feed a 2/4 logic matrix that de-energizes the P-8 relays at the setpoint, currently at 49% (References P.18, P.19, D.33, and D.34). The reactor trips blocked by the P-8 permissive are:

- ½ loop loss of reactor coolant flow
- ½ reactor coolant pumps breaker trip

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The original power range input to P-8 was 50 % of full power (Reference G.25). For reasons described in Section 1.4.1 above, the same 50 % value also became the Tech Spec limiting value for the P-8 setpoint, and the field setpoint was lowered to prevent Tech Spec violations. At present, the field trip setpoint for the unblock function is 49% RTP (References P.18 and P.19).

For EPU, the P-8 setpoint was re-analyzed by Westinghouse calculation CN-TA-08-52 Revision 0 [References G.40 and C.5] for an Analytical Limit of 45% rather than a nominal value of 50%. Further, the Westinghouse calculation stipulated that, with instrument uncertainty, the TS Allowable Value should be set at 35%. Although permissives do not typically have a specific Analytical Limit, establishing this limit forces that actual field setting for P-8 to be less than the AL by at least the amount of uncertainty. Therefore, the P-8 permissive field setting should be established in this calculation based on the 45% Analytical Limit and consideration given to setting the TS Allowable Value to 35% as recommended by Westinghouse, provided the uncertainty of the channel is an value less than 10% (the difference between the AL and the AV). This would make the required field setting for the P-8 setpoint some value below 35%.

2.3 P-9 Permissive

The P-9 permissive blocks the reactor trip on turbine trip signal below approximately 50% power when the condenser is operating normally. With a condenser steam dump capability of 40% and rod motion, Point Beach can sustain a turbine trip below 50% without requiring a reactor trip. Above 50%, steam dump capability is not sufficient to absorb the RCS energy due to a loss of load, and a reactor trip on turbine trip is required. The reactor protection function of the P-9 permissive is to unblock (remove) the turbine trip reactor trip when any of the following conditions occur:

- Loss of both circulating water pumps
- condenser vacuum is 22 inches Hg decreasing on either transmitter
- power range power is greater than 49% RTP (two-out-of-four coincidence)

The power range channels feed a 2/4 logic matrix that de-energizes the P-9 relays on increasing power at 49% (References P.18, P.19, P.29, D.33, D.34, D.37, and D.38).

The original power range input to P-9 was 50 % of full power for plant startup tests (Reference G.25). For reasons described in Section 1.4.1 above, the same 50% value also became the Tech Spec limiting value for the P-9 setpoint, and the field setpoint was lowered to prevent Tech Spec violations. At present, the field trip setpoint for the unblock function is 49% RTP (References P.18 and P.19).

For EPU, the P-9 setpoint has been re-analyzed by Westinghouse calculation CN-CPS-08-20 Revision 0 [References G.40 and C.4] to determine if the existing P-9 setpoint is adequate to provide loss of load protection for the reactor when power is below the existing ~50% setpoint. The analysis determined that multiple P-9 setpoint values were needed for higher power levels under EPU conditions based on the operating full load T_{avg}. P-9 must be reduced to 35% if full load Tavg is between 558°F and 572°F. For full load T_{avg} between 572°F and 577°F, the existing setpoint is adequate to block the reactor trip below 50%. Therefore, for EPU, a dual setpoint will be specified for this permissive. The specifics of the P-9 setpoint change are addressed in Section 8.4.4 of this calculation.

Attachment C

2.4 P-10 Permissive

The P-10 permissive permits manual blocking of the intermediate range high neutron flux reactor trip and the power range high neutron flux – low setting reactor trip when reactor power is greater than 9.5% RTP (Reference P.18 and P.19). It also automatically blocks the source range high neutron flux reactor trip and de-energizes the source range detectors. However, the protection function of this permissive is performed when power range power decreases to 8.5% RTP (Reference P.18 and P.19) and automatically unblocks the above trips. The unblock logic is 3/4 channels at 8.5% decreasing. This actuation energizes the P-10 relays, which then de-energize the intermediate range block relays and the power range block relays. This function also removes the P-10 source range block signal, allowing automatic source range channel restoration when power is reduced to the P-6 permissive reset point (References P.18, P.19, D.35, and D.36).

The original P-10 setpoint was 10 % full power. For reasons described in Section 1.4.1 above, this same 10 % value also became the Tech Spec limiting value for the P-10 setpoint, and the field setpoint was lowered to prevent Tech Spec violations. At present, the field trip setpoint for the unblock function is 8.5% RTP. The Tech Spec also contains a low limit value of >8% RTP as is discussed in the next section.

2.5 Configuration Considerations

As noted in Figure 6.2-1, permissives P-7 and P-10 share a common bistable relay driver, but they perform different functions. As neutron flux increases, the P-7 relay is de-energized when the setpoint is reached. As neutron flux decreases, the P-10 relay is energized when the setpoint is reached. However, because of the bistable deadband (or "lockup"), the setpoint values for the two functions cannot be the same, and the two functions cannot be considered independently, as the setpoint of one function is the reset point of the other and vise versa. The setpoint evaluations of P-7 and P-10 must take this equipment configuration into account when establishing the setpoints for these permissives. This situation was recognized early in plant operation; the Atomic Energy Commission (Reference G.35) was requested to change the required automatic unblock of the intermediate range high neutron flux reactor trip and the power range high neutron flux – low setting reactor trip to ≤ 5% of rated power to allow for a 2% deadband in the P-10 bistable. Point Beach later modified this request (Reference G.36) to allow settings of ≥ 10% (± 2%) for P-7 and ≤ 10% (± 2%) for P-10. In August of 1975, the NRC (Reference G.37) changed the interlock specification to ≥ 9% (± 1%) for P-7 and ≤ 9% (± 1%) for P-10 to account for the 2% deadband. The current configuration (Reference P.18 and P.19) uses a 1% power deadband (or lockup); the calculation should also use a 1% deadband setting in establishing the permissive setpoint / reset settings.

An additional consequence is that no calibration procedure specifically addresses the power range inputs to the P-7 permissive. However, calibration of the P-10 permissive performs the calibration of the P-7 permissive as well. Therefore, ICP 02.022 (References P.18 and P.19) should be used as the reference calibration for the nuclear instrumentation inputs to P-7.

Attachment C

2.6 Permissive Setpoints

As described above, the existing field trip setpoints for these functions were moved away from the originally recommended values to prevent Tech Spec violations and the originally recommended setpoint values were converted into Tech Spec Allowable Values. It is recommended that the nominal setpoints (field trip setpoints) be reset to the originally specified values from Section 1.3 of WCAP-7116 (Reference G.25) and that the Tech Spec Allowable Values for these functions be re-established based on these nominal setpoints, in accordance with the practice of the Standardized Tech Specs (STS). These nominal setpoints are:

- P-7: 10% RTP
- P-8: 50% RTP
- P-9: 50% RTP
- P-10: 9% RTP

Refer to Section 8.4.4 of this calculation for discussion of the setpoint changes required for Extended Power Uprate conditions.

The nominal setpoint values should be the unblock functions, since removing the permissive block (unblocking) performs the protection function defined in IEEE-279 (1968 version) and FSAR Section 7.2.1.1.o (Reference G.3). This means the allowable values for P-7, P-8, and P-9 would be set higher than the nominal setpoints and the allowable value for P-10 would be set lower than the nominal setpoint. The block (reset) should be set lower than the nominal trip setpoint by 1% for P-7, P-8, and P-9; the block should be set higher than the nominal trip setpoint by 1% for P-10. For the P-10 and P-7 permissives, this means the reactor trips blocked by P-7 will be automatically unblocked at 10% power and the P-10 permissive will allow manual blocking of the intermediate range and power range low range trips at the same 10% power level. At 9% power, the high flux reactor trips will be automatically unblocked and the P-7 trips automatically blocked.

None of these interlocks are credited as primary or backup/anticipatory trips in any accident analysis (Reference G.18). The block permissives and block permissive resets are considered nominal setpoints and no formal setpoint evaluation or calculation of the instrument uncertainty for these interlocks is required (Reference G.32). However, refer to Section 8.4.4 of this calculation for a discussion of changes in the P-8 and P-9 permissives required for EPU that involve uncertainty considerations.

3.0 Rod Withdrawal Stop

The power range high neutron flux rod withdrawal stop inhibits outward control rod motion (in automatic or manual) when 1 of 4 power range channels reaches 105% RTP (References P.18, P.19, and D.41 – D.46). The rod stop is considered a supervisory, not a protective function (Reference G.11 Section 5.3) and is not credited in any accident analysis. Therefore, no limiting trip setpoint needs to be established and no formal uncertainty calculation is required. There is no Tech Spec Allowable Value associated with this function, and the 105% RTP nominal setpoint is the originally supplied value (Reference: G.25, Section 3.1.1).

Attachment C

4.0 Alarms

4.1 Loss of Detector Voltage Alarm

The setpoint document for alarms and operational adjustments also contains a specific setpoint for power range loss of detector voltage, 700 Vdc (References P.20 – P.27). The loss of detector voltage alarm serves to alert operators in the event of a loss of voltage. The loss of voltage alarm is not a process variable and a nominal setting, based on engineering judgment and past practice, is appropriate to determine this setpoint. Therefore, it is unnecessary to determine instrument uncertainty or to perform a formal setpoint calculation. The original guidance set this alarm at 100 Vdc below the operating point (Reference G.25), and that guidance is still in place. If no operational problems have arisen using this value, there is no reason to make any change. The 700 Vdc setpoint is acceptable as it stands and no additional evaluation is necessary.

4.2 Rod Drop Alarm

The rod drop indication responds to dynamic power range channel signal changes associated with a dropped rod condition, but does not respond to slower signal changes consistent with normal plant operation. The rod drop alarm circuit compares each channels nuclear power signal with the same signal after it is conditioned by an adjustable rate lag circuit (Reference G.3 Section 7.6.1.3.b). The alarm logic is one-out-of-four channels (References D.35 and D.36). While this alarm could alert operators to a dropped control rod condition, the accident analysis does not take credit for the annunciator (Reference G.3 Section 14.1.3). The alarm signal conditioning produces an output that actuates the alarm when the input power decreases by 2.5% in 5 seconds (References P.20 – P.27). Because the rod drop alarm is not credited in any accident analysis, no formal setpoint evaluation or uncertainty calculation is required (Reference G.18). The original setpoint for this alarm was a 5% power drop in 5 seconds (Reference G.25); at some point, the power decrease was changed to 2.5%. This change is in the conservative direction, and, since the change has not resulted in spurious alarms, no additional evaluation is needed.

Attachment D

QF-0545 (FP-E-MOD-11) Rev. 0

NMC Committed to Nuclear Excellence Fleet Modification Process	**Design Information Transmittal (DIT)**

From:	Jim Nagell / Kim Strickland - Point Beach Nuclear Plant				
To :	Dean Crumpacker - Sargent & Lundy				
Mod or Tracking Number:	CRR Project	Date:	6/4/07	DIT No:	CRR-I&C-012
Mod Title:	*Treatment of Backup Trips and Permissives*				
Plant:	PBNP	Unit 1 ☐ Unit 2 ☐ Common ☒		Quality Classification:	QA

SUBJECT: Backup trips and permissive setpoints lack an analytical limit for establishing a limiting trip setting. Allowable values for backup trips and permissives should be determined by applying a "3-sigma" drift value. DG-I01 does not currently address this issue. It will be revised to do so and until then the information provided by this DIT and Figure 3.3.8-2 gives sufficient information for use within CRR calculation revisions.

Check if applicable:

- ☐ **This DIT confirms information previously transmitted orally on _______ by ________________.**
- ☐ **This information is preliminary. See explanation below.**

SOURCE OF INFORMATION (Source documents should be uniquely identified)

Graded Approach ISA-TR67.04.09-2005

DESCRIPTION OF INFORMATION (Write the information being transmitted or list each document being transmitted)

"Insert to DG-IO1 Section 3.3.8," position statement "Treatment of Backup Trips and Permissives."

Attachment D

QF-0545 (FP-E-MOD-11) Rev. 0

NMC Committed to Nuclear Excellence Fleet Modification Process	Design Information Transmittal (DIT)

DISTRIBUTION (Recipients should receive all attachments unless otherwise indicated. All attachments are uncontrolled unless otherwise indicated)

PREPARED BY (The Preparer and Approver may be the same person.)

Jim Nagell	Sr. Engineer	Jim Nagell	6/4/07
Preparer Name	Position	Signature	Date

APPROVED BY (The cognizant Engineering Supervisor has release authority. Consult the Design Interface Agreement or local procedures to determine who else has release authority.)

Kelly Holt	Supv. Engineering	[signature]	6-6-07
Approver Name	Position	Signature	Date

A copy of the DIT (along with any attachments not on file) should be sent to the modification fille

Attachment D

Insert to DG-101 Section 3.3.8

Treatment of Backup Trips and Permissives

Backup/anticipatory trips and permissives are protection system features that are not credited in accident analyses for performing primary protective functions. Therefore, setpoints for these features lack an analytical limit for establishing a limiting trip setting. Although they are not credited in analyses, backup/anticipatory trips enhance overall reliability and diversity of the protection systems (i.e., provide defense-in-depth). Permissives (also called "operating bypasses" in IEEE-279) automatically enable protective functions at predetermined settings. For these reasons, backup trips and permissives are regarded as safety functions of the protection system, but perform no active role as trip functions assumed in accident analyses. By using a "graded approach" (ISA-TR67.04.09-2005) philosophy toward setpoints that lack analytical limits, backup trips and permissives can be calculated with less rigor than primary protection functions.

Based on discussion and correspondence[1] with Westinghouse regarding how setpoints are determined for backup trips and permissives, instrument uncertainties are neither required nor necessary to establish these setpoints. Setpoint uncertainties are not required because, unlike primary protective trips that have analytical limits, backup trips and permissives have no limit against which the uncertainties are applied. Instead, the setpoints for these protection system features are nominal values. These nominal values were typically provided for original plant operation (e.g., in WCAP-7116, Precautions, Limitations, and Settings) or have proven to be acceptable for safe and reliable operation over the years since plant startup. Therefore, historical precedent is an acceptable technical basis for establishing the nominal setpoint value for backup trips and permissives.

Some accident analyses may contain a "process limit" value for a backup trip as an input to the analysis. This analysis input may have been used to determine which of several trip functions occurred first in the accident, to determine which parameter performed the primary trip function. When the analysis demonstrates that a backup trip occurring at the process limit does not perform the primary trip function, the process limit should not be regarded as an analytical limit.

Although uncertainties are not needed to determine a nominal setpoint for backup trips and permissives, an evaluation should be made to verify that the nominal setpoint does not interfere with other operational limits/settings for the same parameter. Loop uncertainties may also be needed for other non-protection reasons such as determining setting tolerances.

Technical Specification Values for Backup Trips and Permissives

NRC regulation 10CFR50.36 requires that Limiting Safety System Settings (LSSS) be specified for protection system trips that protect Safety Limits. As discussed above, backup trips and permissives are not based on safety analysis limits. As a result, these functions do not meet the strict definition of a LSSS. However, backup/permissive functions are currently assigned a Tech Spec Allowable Value, even though the AV term is only appropriate for primary trips.

[1] Page 6 of Westinghouse letter WEP-94-525 dated 2/1/94.

Attachment D

As defined in the Technical Specifications, Allowable Values are as-found limits that apply to the portion of an instrument loop that is tested periodically during the Channel Operational Test (COT). Any uncertainties used to determine the Allowable Value are limited to the portion of the loop tested during the COT. The COT typically applies to the bistable portion, excluding the field sensor.

Allowable Values for backup trips and permissives should be determined by applying a "3-sigma" drift value for the COT-tested instruments to the as-left setting tolerance for the COT-tested instruments (i.e., the rack as-left tolerance), rather than a 2-sigma drift value used to determine the as-found limit. A 3σ drift value is an appropriate outlier criterion for an Allowable Value for backup trips and permissives that lack an analytical limit. Applying the 3σ drift to the rack as-left tolerance ensures that drift occurring beyond the AV limit is significant to 99.7% probability and that a channel exhibiting 3σ drift is declared inoperable rather than just evaluated for operability (which is the purpose of a Technical Specification Allowable Value, as compared to an as-found limit).

The rack as-left tolerance (RAL) applied during the COT should either be derived in the calculation or justified as a calculation assumption. See Section 3.3.8.6 [of DG-I01] for how to determine the rack as-left setting tolerance.

The rack 3σ drift value ($Rd_{3\sigma}$) can be derived from the 2σ rack drift value (Rd) by multiplying Rd by 1.5.

$$Rd_{3\sigma} = (1.5)\,Rd$$

As discussed in Section 3.3.8.6, the 2σ rack drift value should be obtained either from as-left/as-found drift analysis of the COT instrument string, or from the SRSS of the individual COT instrument drift values.

For an increasing trip, the Allowable Value for backup trips and permissives is then determined using the SRSS of RAL and $Rd_{3\sigma}$, as follows:

$$AV = FTSP + [RAL^2 + Rd_{3\sigma}^2]^{1/2}$$

A diagram of the relationship between the FTSP, RAL, RAF, and Allowable Value for backup trips and permissives is shown in Figure 3.3.8-2.

Attachment D

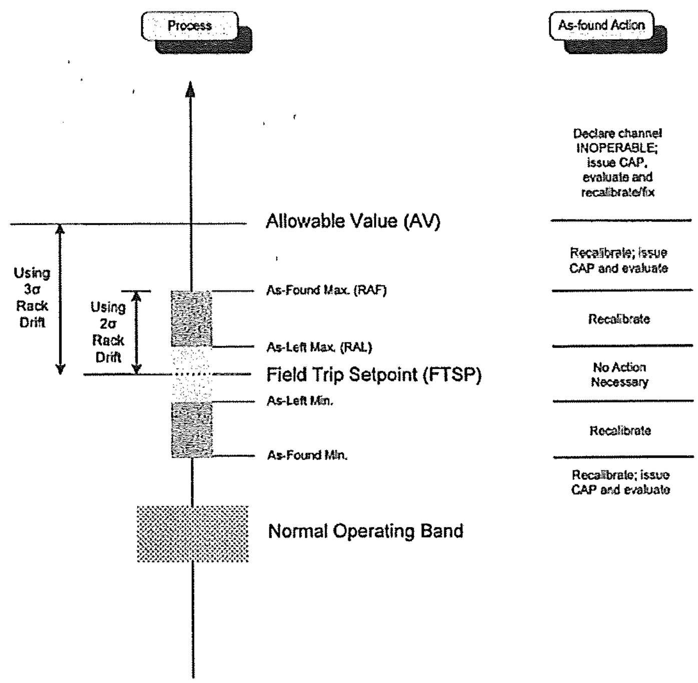

Figure 3.3.8-2

Backup Trip/Permissive Allowable Value
(for increasing trip)

ENCLOSURE 3

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

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

STEAM LINE PRESSURE INSTRUMENT
LOOP UNCERTAINTY / SETPOINT CALCULATION

127 pages follow

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1.0 BACKGROUND, PURPOSE, AND SCOPE OF CALCULATION

1.1 Background

The Steam Line Pressure is monitored by the associated instrumentation shown in References D.9 and D.10. Two steam generators transfer energy from the reactor coolant system (RCS) to the main steam system. One main steam line is connected to each of the generators and there are three steam line pressure instrumentation channels for each main steam line. The main steam line pressure channels—1(2)P-468, 1(2)P-469, 1(2)P-482, 1(2)P-478, 1(2)P-479, and 1(2)P-483—perform protection, control, alarm, and indication functions.

It is important to note that steam line pressure refers to the pressure in the steam flow piping downstream from the steam generator while steam generator pressure refers to the pressure inside the steam generator itself. The transmitters analyzed in this calculation measure steam line pressure, as they are tapped on the steam flow piping (Ref. D.9 and D.10). Therefore, Steam Line Pressure is used to describe the measurement throughout this calculation. However, since no transmitters exist at the steam generator, the steam line pressure transmitters are also used to provide an indirect measurement of steam generator pressure when needed.

1.2 Purpose

The purpose of this calculation is to determine the instrument uncertainties associated with the low steam line pressure safety injection setpoint, evaluate the low steam line pressure safety injection setpoint, and determine the instrument uncertainties associated with the control room indication of steam line pressure.

1.3 Purpose of This Revision

This revision determines Operability Limits (OL) associated with the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint for the purpose of determining channel operability during Technical Specification surveillance testing. This revision also updates the Limiting Trip Setpoints to include EPU setpoints based on revised Analytical Limits.

1.4 Scope

This calculation determines the calibration values associated with the Steam Line Pressure instruments. The scope of this calculation is listed below:

- Determine Operability Limits (OL) for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

- Determine loop components needed to evaluate Low Steam Line Pressure Safety Injection setpoint and indication functions.
- Determine the total loop error (TLE) for the indication loop under normal and accident operating conditions for use in WEP-SPT-20 for EOP setpoints.
- Determine the TLE for the bistable loop under accident operating conditions.
- Determine the TLE for the indicator and PPCS to determine compliance with the station's values used in the Tech Specs.
- Determine acceptable As-Found and As-Left calibration tolerances for applicable components.
- Calculate channel check tolerance (CCT).
- Evaluate the existing field trip setpoint (FTSP) and the Allowable Value (AV) for the Low Steam Line Pressure Safety Injection setpoint.
- Determine the parametric values used for Tech Spec surveillance.
- Determine transmitter uncertainties for use in PBNP-IC-40 "Steam Flow/Feedwater Flow Mismatch Instrument Loop Uncertainty/Setpoint Calculation" under normal conditions.

1.5 Instrumentation Evaluated

This calculation evaluates the plant equipment listed in the table below. The instrument loops are the same for Unit 1 and Unit 2. See Sections 6.2, 6.3, and 6.4 of this calculation for instrument specifications, parameters, and loop configurations.

Table 1.5-1: Instrumentation List

Pressure Transmitter	Power Supply	Lead/Lag Unit	Current Repeater	Bistable	PPCS	Pressure Indicator
PT-468	PQ-468	PM-468A	PM-468B	PC-468A/B	N/A	PI-468
PT-469	PQ-469	PM-469A	PM-469B	PC-469A/B	P-469	PI-469
PT-482	PQ-482	PM-482A	PM-482B	PC-482A/B	P-482	PI-482A
PT-478	PQ-478	PM-478A	PM-478B	PC-478A/B	N/A	PI-478
PT-479	PQ-479	PM-479A	PM-479B	PC-479A/B	P-479	PI-479
PT-483	PQ-483	PM-483A	PM-483B	PC-483A/B	P-483	PI-483A

1.6 Superseded Station Calculations

The following existing calculation(s) will be superseded upon issuance of Revision 4 of Calc. PBNP-IC-39:

- Calculation PBNP-IC-39, "Low Steam Line (Steam Generator) Pressure Safety Injection Instrument Loop Uncertainty / Setpoint Calculation", Rev. 3

2.0 ACCEPTANCE CRITERIA

This calculation evaluates the adequacy of the existing Low Steam Line Pressure Safety Injection Field Trip Setpoint (FTSP). The FTSP is acceptable if the following criteria are met:

2.1 Positive margin is required between the Limiting Trip Setpoint (LTSP) and the Field Trip Setpoint (FTSP) for primary trips. The LTSP is calculated to ensure that the instrument channel trip occurs at or before the associated AL is reached. The LTSP is then compared to the FTSP to ensure that margin exists between the LTSP and the FTSP. Margin exists if the FTSP is less than the LTSP (for increasing setpoints) or the FTSP is greater than the LTSP (for decreasing setpoints). This criterion only applies to primary trips because backup trip functions and permissives lack an analytical limit and therefore are not required to trip at a particular value to support the accident analyses.

2.2 The Margin-to-Trip values determined from the Low Steam Pressure Safety Injection Trip Setpoint (FTSP) must be above the Limiting Trip Setpoint to protect the minimum process pressure analytical limit (AL).

2.3 The FTSP for the Low Steam Pressure Safety Injection Trip must be no lower than the Limiting Trip Setpoint as detailed in Figure 9.8.1.

2.4 The Operability Limits calculated for primary trips must be at or more conservative than the corresponding Limiting Trip Setpoint. This will allow the Technical Specification tables for RPS and ESFAS trip functions to be revised to insert the LTSPs as new Allowable Values for the primary trip functions but use the more restrictive Operability Limits for channel operability determination during surveillance (COT) testing.

2.5 Channel Check Tolerance (CCT) is the maximum expected deviation between channel indications when performing a qualitative assessment of channel behavior during operation. The calculated CCT will be compared to the existing CCT to ensure that the existing CCT is ≤ the calculated CCT. If the existing CCT is non-conservative, a recommendation will be made to revise the existing CCT to satisfy the calculated CCT limit.

This calculation also evaluates the steam generator pressure parameteric value.

Parametric values are limits placed on specific plant parameters to ensure Tech Spec compliance. The calculated parametric values are compared to the existing parametric values, which appear in an operator log, to ensure that the existing parametric is ≤ to the calculated parametric for an increasing process or the existing parametric is ≥ to the calculated parametric for a decreasing process.

3.0 ABBREVIATIONS

3.1	AL	Analytical Limit
3.2	AV	Allowable Value
3.3	BAF	Bistable Acceptable As-Found
3.4	BAL	Bistable Acceptable As-Left
3.5	CCT	Channel Check Tolerance
3.6	COT	Channel Operational Test
3.7	CRI	Control Room Indication
3.8	EOP	Emergency Operating Procedure
3.9	ESF	Engineering Safety Features
3.10	FSAR	Final Safety Analysis Report
3.11	FTSP	Field Trip Setpoint
3.12	HELB	High Energy Line Break
3.13	IAF	Indicator Acceptable As-Found
3.14	IAL	Indicator Acceptable As-Left
3.15	I/IAF	Current-to-Current Repeater Acceptable As-Found
3.16	I/IAL	Current-to-Current Repeater Acceptable As-Left
3.17	LOCA	Loss of Coolant Accident
3.18	LTSP	Limiting Trip Setpoint
3.19	M&TE	Measurement and Test Equipment
3.20	MSLB	Main Steam Line Break
3.21	OL	Operability Limit
3.22	PE	Process Error
3.23	PBNP	Point Beach Nuclear Plant
3.24	PL	Process Limit
3.25	PPCS	Plant Process Computer System
3.26	PPCSAF	PPCS Acceptable As-Found
3.27	PPCSAL	PPCS Acceptable As-Left
3.28	PS	Process Span (engineering unit)
3.29	RAD	Radiation Absorbed Dose
3.30	RAF	Rack Acceptable As-Found
3.31	RAL	Rack Acceptable As-Left
3.32	RE	Rack Error
3.33	SAF	Sensor Acceptable As-Found
3.34	SAL	Sensor Acceptable As-Left
3.35	SLB	Steam Line Break
3.36	SRSS	Square Root of the Sum of the Squares
3.37	TLE	Total Loop Error
3.38	TRM	Technical Requirements Manual
3.39	TSR	TRM Surveillance Requirement
3.40	Tech Spec	PBNP Technical Specifications
3.41	Xmtr	Transmitter

4.0 REFERENCES

The revisions and/or dates of the references in this section are current as of 1/07/2009.

4.1 General

G.1 Point Beach Nuclear Plant Design Guideline DG-I01, Instrument Setpoint Methodology, Rev. 4

G.2 Point Beach Final Safety Analysis Report, Section 9.5 (dated June 1999), Section 9.8.1 (dated August 2008), Section 11.6.2 (dated June 2002), and Table 7.6-1 (dated August 2008)

G.3 Not Used.

G.4 Deleted per Rev. 2 of this Calculation.

G.5 ASME Steam Tables for Industrial Use, based on IAPWS-IF97.

G.6 Deleted per Rev. 2 of this Calculation.

G.7 PBNP Condition Report A/R No. 141685 (CR 95-109) Evaluation, dated February 22, 1995

G.8 Not Used.

G.9 Not Used.

G.10 Not Used.

G.11 Not Used.

G.12 Not Used.

G.13 Not Used.

G.14 Not Used.

G.15 Not Used.

G.16 PBNP CARDS System for the following cables:

Unit 1	Unit 2
ZK1I468A	ZP2I468A
ZL1I469A	ZQ2I469A
ZM1I482A	ZR2I482A
ZM1I478A	ZR2I478A
ZN1I479A	ZS2I479A
ZK1I483F	ZP2I483F

G.17 Not Used.

G.18 Not Used.

G.19 Not Used.

G.20 Not Used.

G.21 Bechtel Corporation Specification No. 6118-M-40, "Specification for Heating, Ventilating, and Air Conditioning Controls", Rev. 1

G.22 WCAP-8587, "Methodology for Qualifying Westinghouse WRD Supplied NSSS Safety Related Electrical Equipment", dated March 1983, Rev. 6-A

G.23 The Rockbestos Company Report QR-7804, "Report on Tests to Establish Insulation Resistance vs. Temperature Characteristic for Firewall III Irradiation Cross-Linked Polyethylene Constructions for Class 1E Service in Nuclear Generating Stations", dated January 1988

G.24 Point Beach Nuclear Plant Technical Specifications, Section 3.3.2, B3.3.2, Amendment 201(U1) and Amendment 206 (U2)

G.25 PB 634, "Specification for Safety Assessment System and Plant Process Computer System for the Point Beach Nuclear Plant PPCS 2000", Rev. 3

G.26 Walkdown Calculation No. PBNP-IC-39, dated 6/12/06 (Attachment B)

G.27 Modification Package MR 99-003, "HELB Walls Doors and Blow-Off Panel in the CCW HX Room to Resolve HELB Issue", completed 12/09/2003

G.28 Report 1-PM-468A, "Instrument Traveller Sheet – Refurbishment Project", dated 4/17/89

G.29 Report 1-PM-469A, "Instrument Traveller Sheet – Refurbishment Project", dated 4/8/90

G.30 Report 1-PM-482A, "Instrument Traveller Sheet – Refurbishment Project", dated 4/17/89

G.31 Report 2-PM-468A, "Instrument Traveller Sheet – Refurbishment Project", dated 10/2/89

G.32 Report 2-PM-469A, "Instrument Traveller Sheet – Refurbishment Project", dated 10/7/89

G.33 Report 2-PM-482A, "Instrument Traveller Sheet – Refurbishment Project", dated 10/16/89

G.34 Report 1-PM-478A, "Instrument Traveller Sheet – Refurbishment Project", dated 4/24/89

G.35 Report 1-PM-479A, "Instrument Traveller Sheet – Refurbishment Project", dated 4/19/90

G.36 Report 1-PM-483A, "Instrument Traveller Sheet – Refurbishment Project", dated 4/20/89

G.37 Report 2-PM-478A, "Instrument Traveller Sheet – Refurbishment Project", dated 10/7/89

G.38 Report 2-PM-479A, "Instrument Traveller Sheet – Refurbishment Project", dated 10/7/89

G.39 Report 2-PM-483A, "Instrument Traveller Sheet – Refurbishment Project", dated 10/19/89

G.40 Tyco Electronics (Raychem) Report EDR-5336, "Nuclear Product Requalification Testing", Rev. 5, dated 9/6/05

G.41 Franklin Technical Report F-C5120-1, "Qualification Tests of Electrical Cables in a Simulated Steam Line Break (SLB) and Loss-of-Coolant Accident (LOCA) Environment", dated August 1980

G.42 WCAP 7116, "Point Beach Nuclear Power Plant Precautions, Limitations, and Set Points for Nuclear Steam Supply Systems", Page 8, dated 10/1/69

G.43 Westinghouse Correspondence WEP-06-23, "Input for Current Analysis of Record (RPS/ESFAS)", dated March 28, 2006

G.44 EQCK-BOST-001, "Checklist for Environmental Qualification Assessment of Boston Insulated Wire & Cable Company Bostrad 7 Insulated Single Shielded Twisted Pair, and Double Shielded Twisted Pair Cables", Rev. 1

G.45 DIT No. CRR-I&C-006, dated 2/17/2006, Regarding Elevated Temperature Impacts on Control Room Indicators

G.46 Report F-C3694, "Type Test Cable Qualification Program and Data for Nuclear Plant Designed Life Simulation through Simultaneous Exposure", prepared for the Okonite Co., dated 1/74

G.47 PBNP Modification Request MR 98-002-C, "PPCS Changeover from Old to New PPCS", dated April 20, 2005

G.48 NPC-28427, dated September 1, 1983, "Implementation of Regulatory Guide 1.97 for Emergency Response Capability, Point Beach Nuclear Plant, Units 1 and 2"

G.49 Passport Q-Basis Information for 1(2)PT-468, 1(2)PT-469, 1(2)PT-482, 1(2)PT-478, 1(2)PT-479, and 1(2)PT-483 (in "Attributes" tab)

G.50 ASME Section VIII – 1967

G.51 Westinghouse Report WEPB-PCS-NAP-FL-001-FS-02, "WEPB Plant Computer Replacement Project Functional Design Specification Document-Flow and Level Corrections", dated October 10, 2001

G.52 Westinghouse Report WEPB-PCS-NAP-IT-001-FS-02, "WEPB Plant Computer Replacement Project Functional Design Specification Document-Incore Thermocouples", dated October 08, 2001

G.53 Passport Preventive Maintenance frequency check for Computer Analog to Digital Converters (located on D080 panel under PMID 17263)

G.54 Walkdown Calculation No. PBNP-IC-39, dated 7/17/06 (Attachment C)

G.55 NPC-36703, Seismic Evaluation Report, USNRC Generic Letter 87-02, USI A-46 Resolution, Rev. 1, dated January 1996

G.56 PBF-2034, Rev. 74 – Control Room Log – Unit 1

G.57 PBF-2035, Rev. 74 – Control Room Log – Unit 2

G.58 TRM 3.7.3, "Steam Generator Pressure and Temperature (P/T) Limits" Rev. 1

G.59 BIW Bostrad and Bostrad, "Flame Resistant Cables for Nuclear Power Plants", Report No. B901, September 1969.

G.60 PBNP AR # 1057854, dated October 10, 2006

G.61 NPC 2005-00414, EQ Field Verification Data, PAB and Turbine, dated June 28, 2005

G.62 Westinghouse Correspondence WEP-94-525, "Point Beach units 1 and 2 Reactor Protection & ESF Activation Analytical Limit Verification information Revision" dated February 1, 1994

G.63 Design Information Transmittal (DIT) CRR-I&C-014 dated 8/23/07, Supplement to Section 3.3.8 of PBNP Design Guide DG-I01 Rev 4, Methodology to determine the Operability Limit

G.64 Not Used

G.65 WEP-09-2 RPS/ESFAS Safety Analysis Limit Setpoint Changes for the Point Beach Uprate Program, 8 January 2009.

G.66 Wisconsin Electric Nuclear Power Business Unit Design and Installation Guidelines, DG-I02, Rev. 0, "Instrument Scaling Methodology"

4.2 Drawings

D.1 BD-6 Sh. 1, Block Diagram-Instrument Reactor Protection System Comp, Steam Flow & Feedwater Flow-Loop A, Rev. 6

D.2 BD-7 Sh. 1 , Block Diagram-Instrument Reactor Protection System Comp, Steam Flow & Feedwater Flow-Loop B, Rev. 7

D.3 BD-18 JOB 10668, Block Diagram-Instrument Reactor Control System Steam Generator Level -Loop A, Rev. 13

D.4 BD-19 JOB 10668, Block Diagram-Instrument Reactor Control System Steam Generator Level -Loop B, Rev. 11

D.5 BD-6, Block Diagram-Instrument Reactor Protection System Comp, Steam Flow & Feedwater Flow-Loop A, Rev. 5

D.6 BD-7, Block Diagram-Instrument Reactor Protection System Comp, Steam Flow & Feedwater Flow-Loop B, Rev. 5

D.7 BD-18 JOB 10665, Block Diagram-Instrument Reactor Control System Steam Generator Level -Loop A, Rev. 10

D.8 BD-19 JOB 10665, Block Diagram-Instrument Reactor Control System Steam Generator Level -Loop B, Rev. 10

D.9 M-201, Sh. 1, "P&ID Main & Reheat Steam System Unit 1", Rev. 54

D.10 M-2201, Sh. 1, "P&ID Main & Reheat Steam System Unit 2", Rev. 49

D.11 0082 Sh. 10, "Cable Spreading Room Air Conditioning System Rack C58", Rev. 9

D.12 P-107, Unit 1, "Main Steam Outside CTMT to HP Turb Control Valves and to Condenser 30.24 EB-1, 24.18.16 EB-2 & 10HB-12", Rev. 12

D.13 P-108, Unit 1, "Main Steam Loop A&B From Steam Generator to Containment Penetrations 130" EB-1 Inside CTMT1", Rev. 5

D.14 P-207, Unit 2, Sh.1, "Main Steam Outside CTMT to HP Turb Control Valves 30", 24"EB-1 24", 18", 16"EB-2, 10"HB-12", Rev. 1

D.15 P-208, Unit 2, "Main Steam Loop A&B From Steam Generator to Containment Penetrations (30EB-1)", Rev. 4

4.3 Procedures

P.1 1ICP 04.001E, "Reactor Protection and Safeguards Analog Racks Steam Pressure Refueling Calibration", Rev. 7

P.2 2ICP 04.001E, "Reactor Protection and Safeguards Analog Racks Steam Pressure Refueling Calibration", Rev. 7

P.3 1ICP 04.004-2, "Steam Generator Pressure Transmitter Outage Calibration", Rev. 7

P.4 Deleted per Rev. 2 of this Calculation.

P.5 1ICP 02.001RD, "Reactor Protection and Engineered Safety Features Red Channel Analog 92 Day Surveillance Test", Rev. 11

P.6 1ICP 02.001BL, "Reactor Protection and Engineered Safety Features Blue Channel Analog 92 Day Surveillance Test", Rev. 12

P.7 1ICP 02.001WH, "Reactor Protection and Engineered Safety Features White Channel Analog 92 Day Surveillance Test", Rev. 11

P.8 1ICP 02.001YL, "Reactor Protection and Engineered Safety Features Yellow Channel Analog 92 Day Surveillance Test", Rev. 10

P.9 2ICP 04.004-2, "Steam Generator Pressure Transmitter Outage Calibration", Rev. 8

P.10 Deleted per Rev. 2 of this Calculation.

P.11 2ICP 02.001RD, "Reactor Protection and Engineered Safety Features Red Channel Analog 92 Day Surveillance Test", Rev. 11

P.12 2ICP 02.001BL, "Reactor Protection and Engineered Safety Features Blue Channel Analog 92 Day Surveillance Test", Rev. 14

P.13 2ICP 02.001WH, "Reactor Protection and Engineered Safety Features White Channel Analog 92 Day Surveillance Test", Rev. 11

P.14 2ICP 02.001YL, "Reactor Protection and Engineered Safety Features Yellow Channel Analog 92 Day Surveillance Test", Rev. 12

P.15 ICP 11.95, "Installation of Seismic/Environmental Qualified Transmitter 2PT-483 (MR IC-260)", Rev. 0 (available on microfilm)

P.16 ICI 12, "Selection of M&TE for Field Calibrations", Rev. 8

P.17 ICP 11.39, "Installation of Seismic/Environmental Qualified Transmitter 1PT-468 (MR IC-259)", Rev. 0 (available on microfilm)

P.18 ICP 11.40, "Installation of Seismic/Environmental Qualified Transmitter 1PT-469 (MR IC-259)", Rev. 0 (available on microfilm)

P.19 ICP 11.48, "Installation of Seismic/Environmental Qualified Transmitter 1PT-478 (MR IC-259)", Rev. 0 (available on microfilm)

P.20 ICP 11.49, "Installation of Seismic/Environmental Qualified Transmitter 1PT-479 (MR IC-259)", Rev. 0 (available on microfilm)

P.21 ICP 11.50, "Installation of Seismic/Environmental Qualified Transmitter 1PT-482 (MR IC-259)", Rev. 0 (available on microfilm)

P.22 ICP 11.51, "Installation of Seismic/Environmental Qualified Transmitter 1PT-483 (MR IC-259)", Rev. 0 (available on microfilm)

P.23 ICP 11.90, "Installation of Seismic/Environmental Qualified Transmitter 2PT-468 (MR IC-260)", Rev. 0 (available on microfilm)

P.24 ICP 11.91, "Installation of Seismic/Environmental Qualified Transmitter 2PT-469 (MR IC-260)", Rev. 0 (available on microfilm)

P.25 ICP 11.93, "Installation of Seismic/Environmental Qualified Transmitter 2PT-478 (MR IC-260)", Rev. 0 (available on microfilm)

P.26 ICP 11.94, "Installation of Seismic/Environmental Qualified Transmitter 2PT-479 (MR IC-260)", Rev. 0 (available on microfilm)

P.27 ICP 11.92, "Installation of Seismic/Environmental Qualified Transmitter 2PT-482 (MR IC-260)", Rev. 0 (available on microfilm)

P.28 Fleet Procedure FP-E-RTC-02, "Equipment Classification – Q-List", Rev. 1

P.29 1ICP 02.020BL, Rev. 10, "Post-Refueling Pre-Startup RPS and ESF Blue Channel Analog Surveillance Test"

P.30 1ICP 02.020RD, Rev. 11, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test"

P.31 1ICP 02.020WH, Rev. 10, "Post-Refueling Pre-Startup RPS and ESF White Channel Analog Surveillance Test"

P.32 1ICP 02.020YL, Rev. 10, "Post-Refueling Pre-Startup RPS and ESF Yellow Channel Analog Surveillance Test"

P.33 2ICP 02.020BL, Rev. 10, "Post-Refueling Pre-Startup RPS and ESF Blue Channel Analog Surveillance Test"

P.34 2ICP 02.020RD, Rev. 10, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test"

P.35 2ICP 02.020WH, Rev. 10, "Post-Refueling Pre-Startup RPS and ESF White Channel Analog Surveillance Test"

P.36 2ICP 02.020YL, Rev. 10, "Post-Refueling Pre-Startup RPS and ESF Yellow Channel Analog Surveillance Test"

4.4 Vendor

V.1 Not Used.

V.2 Not Used.

V.3 Not Used.

V.4 Not Used.

V.5 Not Used.

V.6 Not Used.

V.7 Foxboro 66B series Electronic Consotrol Current Repeater, Data sheet GS 2A-2D 1 A, PBNP VTM #00623A4, Rev. 11

V.8 Foxboro 63U-B Duplex Alarm, PBNP VTM #00623A4, Rev. 11

V.9 Foxboro Specifications "Lead-Lag Module", PBNP VTM #00623A4, Rev. 11

V.10 Foxboro 610A Power Supply Specifications, PBNP VTM #00623A4, Rev. 11

V.11 Foxboro PSS-9-1B1A, "Model N-E11 and N-E13 series Nuclear Electronic Pressure Transmitters", VTM #00432, Rev. 21

V.12 Westinghouse Component Instruction Manual, Main Control Board – Part 1, VTM #00132A, Rev. 25

V.13 Foxboro Corporate Product Specification CPS-0804, Rev. G, "Nuclear Electronic Gauge Pressure Transmitters N-E11GM Series, Style A&B", VTM #00432, Rev. 21

V.14 Johnson Controls Temperature Composite Book 2, VTM #00309B, Rev. 05, dated 8/15/94 – T-4000 Series Pneumatic Room Thermostats (Tab – Thermostats & Thermometers)

V.15 Combustion Engineering, Inc. 1485-ICE 1234, Rev. 2, "Functional Design Description for Seismic Safety Parameter Display System (SSPDS)", PBNP VTM #01209, Book 4 - Rev. 21

V.16 Westinghouse Model 44 Steam Generator (Unit 1), VTM #00104, Rev. 19

V.17 Westinghouse Model 47F Steam Generator (Unit 2), VTM #00109, Rev. 17

V.18 Combustion Engineering, Inc. 1485-ICE 1239, Rev. 2, "Functional Design Description for Safety Assessment System and Plant Process Computer System", PBNP VTM #01209, Book 5, Rev. 21

V.19 Combustion Engineering, Inc., "SAS/PPCS Computer System – Volume 21 – Manual Reinstated 5/30/03 Equipment in Plant", PBNP VTM #01055U, Revision 11, Tab F, "RTP7436/10 Digital and Analog Loopback and Calibration Card."

4.5 Calculations

C.1 VECTRA Calculation No. PBNP-IC-13, "Foxboro N-E11GM Transmitter Drift Calculation", Rev. 0

C.2 Not Used.

C.3 VECTRA Calculation No. PBNP-IC-07, "Westinghouse 252 Indicator Drift Calculation", Rev. 0

C.4 VECTRA Calculation No. PBNP-IC-10, "Foxboro 66RC-OLA Lead/Lag Drift Calculation", Rev. 0

C.5 Not Used.

C.6 EE 2005-0006, "Drift Calculations Evaluations", Rev. 0

C.7 Sargent & Lundy Calculation M-09334-357-HE.1, "Environmental Effects of High Energy Line Breaks Outside Containment", Table 7-1, Rev. 3

C.8 Not Used.

C.9 Duke Calculation PBNP-IC-06, "Foxboro 63U-BC Bistable Drift Calculation", Rev. 0

C.10 Not Used.

C.11 Calculation No. 97-0140, "Revised Radiation Dose to Equipment Outside of Containment Following a Design Basis LOCA", Rev. 2

C.12 CN-CRA-01-70, "Point Beach SLB and Containment Response at 102% of 1524.5 MWt with FRV Failure", Rev. 0

C.13 CN-TA-08-64, "Point Beach Units 1 and 2 (WEP/WIS) Hot Full Power Steamline Break - Core Response for the Extended Power Uprate (EPU)", Rev. 0

5.0 ASSUMPTIONS

5.1 Validated Assumptions

5.1.1 Not Used.

5.1.2 Not Used.

5.1.3 Not Used.

5.1.4 Not Used.

5.1.5 It is assumed that the maximum power supply effect for the I/I converters (isolators) is 1.0 % span and this effect is considered a random error.

Basis: PBNP evaluation of A/R No. 141685 (CR 95-109) (Ref. G.7) indicates that the I/I Converter output fluctuates between 0.5 to 1.0 % due to the effect on the non-regulated portion of the internal 50 volt power supply in which the I/I converter is connected. Furthermore, this error should be treated as random not a bias. Therefore, the maximum fluctuation of ± 1 % is used in this calculation as the power supply effect for the I/I Converter.

5.1.6 Not Used.

5.1.7 Not Used.

5.1.8 Not Used.

5.1.9 It is assumed that the accuracy of the PPCS display loop is ±0.51% of full scale. This accuracy value applies to the loop from the PPCS analog input field terminations to the PPCS printed and/or display output devices. The accuracy value includes the temperature effect, power supply effect, humidity effect, radiation effect, seismic (vibration) effect, and drift over the entire PPCS normal operating range.

Basis: Per Reference G.25, the PPCS replacement modification shall process inputs and outputs from existing I/O devices. As such, the existing signal processing I/O isolation and signal conversion cards were not replaced as a result of Modification Request 98-002. References V.15 and V.18 document that the maximum total system error for the old PPCS computer system, during normal operating environments, from field terminations to the printed and/or display output shall be within ±0.5% of the full scale (excluding errors before input of the analog input).

A review of all Westinghouse Plant Computer Replacement Reports revealed that the output values for all newly installed PPCS equipment (not including the existing I/O devices discussed in the above paragraph) shall be within 0.1% of hand calculated results, with the following two exceptions:

1) For results based on polynomial curves, the output values shall be within 1.0% of hand calculated results (Reference G.51)

2) For results based on steam tables, the output values shall be within 0.5% of hand calculated results (References G.51 and G.52).

The PPCS points considered in this calculation display the Low Steam Line Pressure (in units of psig) based on a 10-50 mAdc input signal from the loop rack components. Since the Low Steam Line Pressure loop is not a component of References G.51 or G.52, accuracy values associated with polynomial curves and steam tables are not applicable, and the accuracy of the newly installed PPCS equipment (not including the existing I/O devices) is considered to be 0.1%.

Therefore, to determine the overall PPCS system accuracy, the specified values of 0.1% (for newly installed PPCS equipment) and 0.5% (for existing PPCS equipment) are combined using the SRSS methodology as follows:

$$\text{PPCS a} = \pm\sqrt{0.5^2 + 0.1^2} = \pm 0.51\%$$

In accordance with Section 3.3.3.3 of Reference G.1, if the manufacturer does not specify environmental errors associated with the subject normal environmental accuracy ratings these effects are considered to be included in the specified accuracy ratings or are considered to be negligible.

Per Reference V.19, the PPCS analog-to-digital (A/D) converters have a drift value of ±0.01% for a period of 1-year. This value is not significant when compared to the much larger accuracy value of ±0.51%. Per Reference G.53, the A/D converters are calibrated approximately every 36 weeks to eliminate any potential drift. In addition these components historically never need to be calibrated because they do not drift. Therefore, the vendor specified drift value is considered negligible.

Per Section 3.3.3.15 of Reference G.1, in the absence of a vendor specified drift value, it is typical for the device accuracy to be substituted in place of drift. However, in the case of PPCS, considering an additional ±0.51% for calculating the As-Found Tolerance would create a value large enough to allow PPCS degradation to go undetected. Conversely, by assuming that the drift value is included in the accuracy value, the As-Found Tolerance would remain tight enough to detect PPCS degradation prior to system failure. Therefore, the PPCS drift is conservatively encompassed by the ±0.51% accuracy value.

5.1.10 It is assumed that the accuracy of the Lead/lag Modules 1(2)PM-468A, 469A, 482A, 478A, 479A, and 483A is ± 0.2 mA.

<u>Basis:</u> References G.28 through G.39 are Instrument Traveler Sheets – Refurbishment Project for Lead/Lag Modules 1PM-468A, 469A, 482A, 478A, 479A, and 483A, 2PM-468A, 469A, 482A, 478A, 479A, and 483A, and indicate that these modules were refurbished in 1989 and 1990. Also in each of these

reports is attached a calibration report by Westinghouse Instrument Service Company, which indicates that the modules were calibrated to within the acceptance tolerance or allowable error of ± 0.2 mA. The acceptance tolerance or allowable error of ± 0.2 mA is, therefore, considered as the accuracy of the Lead/Lag modules.

5.1.11 It is assumed that the As-Left setting tolerances for the instruments evaluated in this calculation are as follows:

± 0.20 mAdc for Sensor
± 0.20 mAdc for I/I Converter
± 0.002 Vdc for Lead/Lag Unit
± 0.002 Vdc for Bistable
± 0.80 mAdc for Control Room Indicator
± 7.0 psi for PPCS Indicator

Basis: These As-Left Setting Tolerance values have historically provided acceptable instrument performance and consistency in the calibration program. These As-Left setting tolerances are routinely achievable for the installed instruments, consistent with safety limits and test equipment capability. They are currently used in practice at the station, and implemented by calibration procedures P.1 - P.3, P.5 - P.9, P.11 - P.14. As-Found setting tolerances are to be determined in this calculation.

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

Basis: Table 6-1 of WCAP-8587 (Ref. G.22) states that when the HVAC is non-safety related, the maximum expected temperature of 120 °F should be used. Since the Control Room and Computer Room HVAC System chiller is not powered from an essential power bus, the Control Room and Computer Room HVAC System is considered as a non-safety related system.

5.1.13 It is assumed that the maximum environmental operating temperature for the existing installed PPCS system is 95 °F.

Basis: Reference G.47 (Attachments 1 and 5) identifies that the most temperature sensitive component of the new PPCS system is the non-ruggedized Sparc computer, which has an operating temperature limit of 95 °F. Note: the maximum temperature used for evaluating PPCS uncertainties is 85 °F, which is bounded by the PPCS operating temperature limit.

5.2 Unvalidated Assumptions

None

6.0 DESIGN INPUTS

6.1 Loop Definitions

The loop components addressed in this calculation were identified in Refs. D.1 through D.8. The loops associated with steam line pressure are shown below in Figure 6.2-1. Section 6.3 lists the instruments addressed in this calculation. The relationship between the input and the output is provided for each component in Section 6.4. The instrument loops are the same for Unit 1 and Unit 2. Therefore, the setpoint and uncertainty calculations are applicable for both units.

6.2 Loop Block Diagram

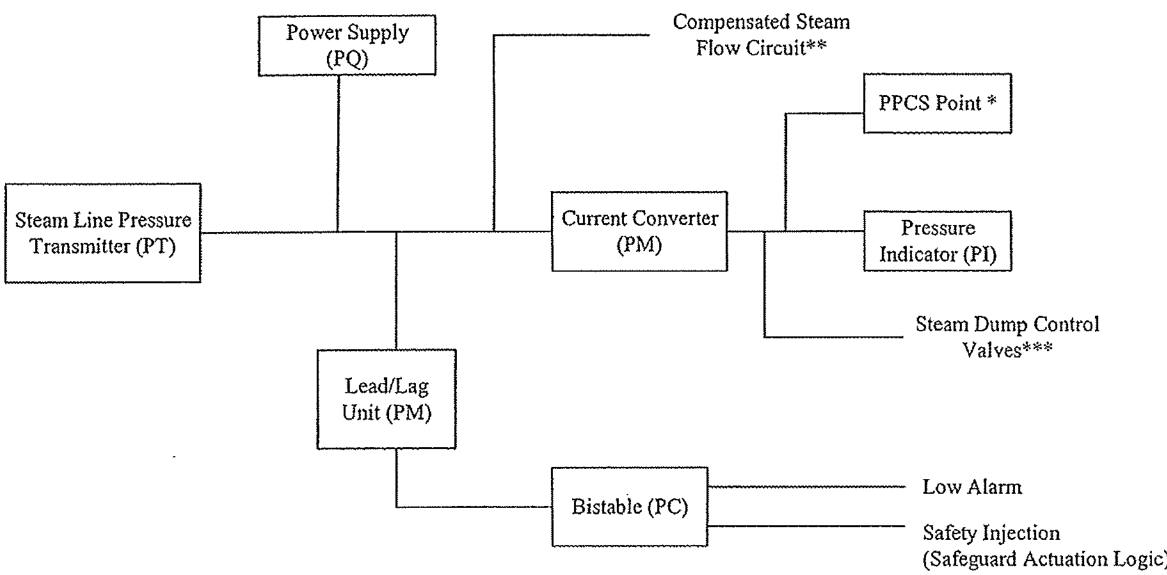


Figure 6.2-1, Steam Line Pressure Instrument Loops P-468, P-469, P-478, P-479, P-482, & P-483
*** PPCS points are not applicable to loops P-468 and P-478.**
**** To Reactor Protection System (Uncertainty calculated in PBNP-IC-40 for Steam Flow/Feedwater Flow Mismatch)**
***** Only by loops P-468 and P-478 input to Steam Dump Control valves.**

6.3 Component Models and Tag Numbers

The following table identifies each component shown in Figure 6.2-1 for the Steam Line Pressure instrument loops, and it provides the associated equipment information for use throughout this calculation.

Table 6.3-1: *Steam Line Instruments*

Component	Model	Equipment Tag Number	Reference
Steam Line Pressure Transmitter	Foxboro N-E11GM	Loop A : 1(2)PT-468, 469 & 482 Loop B : 1(2)PT-478, 479 & 483	P.3 and P.9
Power Supply	Foxboro 610AC-O	Loop A : 1(2)PQ-468, 469 & 482 Loop B : 1(2)PQ-478, 479 & 483	D.1, D.2, D.5, D.6
Lead/Lag Unit	Foxboro 66RC-OLA	Loop A : 1(2)PM-468A, 469A & 482A Loop B : 1(2)PM-478A, 479A & 483A	D.1, D.2, D.5, D.6
Current Converter	Foxboro 66BC-O	Loop A : 1(2)PM-468B, 469B & 482B Loop B : 1(2)PM-478B, 479B & 483B	D.1, D.2, D.5, D.6
Bistable	Foxboro 63U-BC-OHCA	Loop A : 1(2)PC-468A/B, 469A/B & 482A/B Loop B : 1(2)PC-478A/B,479A/B & 483A/B	D.3, D.4, D.7, D.8
PPCS Computer Point	N/A	Loop A : 1(2)P-469 & 482 Loop B : 1(2)P-479 & 483	D.3, D.4, D.7, D.8
Control Board Indicator	Westinghouse HX-252	Loop A : 1(2)PI-468, 469 & 482A Loop B : 1(2)PI-478, 479 & 483A	D.3, D.4, D.7, D.8

6.4 Range List

The following table lists each component of the Steam Line Pressure Instrument loops and the respective input and output of each device (Ref. P.1 through P.3, P.5 through P.9, and P.11 through P.14).

Table 6.4-1, Range List

Component (Instrument Number)	Input Signal/Range (units)		Output Signal/Range (units)		References
	Signal	Range	Signal	Range	
1(2)PT-468 1(2)PT-469 1(2)PT-482	Loop A Steam Line Pressure	0.00-1400.00 (psig)	Steam Line Pressure	9.50-49.50[1] (mAdc)	P.3 and P.9
1(2)PT-478 1(2)PT-479 1(2)PT-483	Loop B Steam Line Pressure	0.00-1400.00 (psig)	Steam Line Pressure	9.74-49.74[1] (mAdc)	P.3 and P.9
1(2)PC-468A/B 1(2)PC-469A/B 1(2)PC-482A/B 1(2)PC-478A/B 1(2)PC-479A/B 1(2)PC-483A/B	Steam Line Pressure	0.1000-0.5000[2] (Vdc)	Steam Line Pressure	Contact Closure	P.5 – P.8, P.11 – P.14
1(2)PM-468A 1(2)PM-469A 1(2)PM-482A 1(2)PM-478A 1(2)PM-479A 1(2)PM-483A	Steam Line Pressure	0.1000-0.5000[2] (Vdc)	Steam Line Pressure	0.1000-0.5000[2] (Vdc)	P.1 and P.2
1(2)PM-468B 1(2)PM-469B 1(2)PM-482B 1(2)PM-478B 1(2)PM-479B 1(2)PM-483B	Steam Line Pressure	0.1000-0.5000[2] (Vdc)	Steam Line Pressure	10.00-50.00 (mAdc)	P.1 and P.2
1(2)PI-468 1(2)PI-469 1(2)PI-482A 1(2)PI-478 1(2)PI-479 1(2)PI-483A	Steam Line Pressure	10.00-50.00 (mAdc)	Control Board Indication	0-1400.0 (psig)	P.1 and P.2
1(2)P-469 1(2)P-482 1(2)P-479 1(2)P-483	Steam Line Pressure	10.00-50.00 (mAdc)	PPCS Point ID	0-1400.0 (psig)	P.1 and P.2

[1] Range is 10 – 50 mAdc with static head correction
[2] 10 – 50 mAdc signal across a 10 Ω resistor

6.5 Cables

The Following table lists the Steam Line Pressure instrument cables and the relevant information required to calculate the Insulation Resistance (IR) effects:

Table 6.5-1, Steam Line Pressure Cables

Transmitter	Cable	Length (ft)	Manufacturer	Reference
1PT-468	ZK1I468A	265	Okonite	G.16
1PT-469	ZL1I469A	260	Okonite	G.16
1PT-482	ZM1I482A	277	Okonite	G.16
1PT-478	ZM1I478A	302	Okonite	G.16
1PT-479	ZN1I479A	325	Okonite	G.16
1PT-483	ZK1I483F	320	Brand Rex	G.16
2PT-468	ZP2I468A	230	Okonite	G.16
2PT-469	ZQ2I469A	290	Okonite	G.16
2PT-482	ZR2I482A	290	Okonite	G.16
2PT-478	ZR2I478A	215	BIW	G.16
2PT-479	ZS2I479A	260	BIW	G.16
2PT-483	ZP2I483F	375	Rockbestos	G.16

6.6 Environmental Considerations

The Steam Line Pressure channels P-468, P-469, P-482, P-478, P-479, and P-483, shown in the block diagram form in Figure 6.2-1, provide input to the Engineered Safety Features Actuation System (ESFAS) as well as alarm and indication in the Control Room. These channels also provide indication at the PPCS. Four of the six channels also provide input to the Reactor Protection System (RPS), while two of the six channels are used for control of atmospheric steam dump valves.

The Point Beach commitment letter to the NRC (Ref. G.48) and Passport (Ref. G.49) identify steam generator pressure as a Reg. Guide 1.97 Type A and D variable. FSAR Table 7.6-1 (Ref. G.2) and the Q Basis codes 7, 8, and 21 in Passport (Ref. G.49) identify steam generator pressure as a Category 1 variable (Note: PBNP is in the process of adding Reg. Guide 1.97 Category values into Passport). Q Basis codes 7, 8, and 21 are defined in Fleet Procedure FP-E-RTC-02 (Ref. P.28).

Steam Line Pressure has an associated Parametric Value which is monitored via the control room indication and recorded in operator logs to ensure that the TRM requirement is not violated (Ref. G.56 and G.57). Routine surveillance of instrumentation (in the Control Room) to determine Tech Spec compliance for a specific process is performed during normal plant operating conditions.

The PPCS indication is used for data monitoring and trending purposes. This function is non-safety related. This instrument loop is only required to operate during normal plant operating conditions.

6.6.1 Auxiliary Building

The Steam Line Pressure transmitters are located in the Auxiliary Building (Ref. P.3 and P.9)

The design temperatures for the Auxiliary Building HVAC system per Ref. G.21 are 65°F during winter and 85°F during summer. The HVAC unit keeps the minimum normal temperature above 65°F during the outage. Therefore, 65°F is to be used as the calibration temperature in this calculation.

FSAR Section 9.5 (Ref. G.2) states that the Auxiliary Building HVAC is non-safety related. From Table 6-1 of Reference G.22, the Auxiliary Building maximum temperature for normal conditions is 104°F. For a non-safety related HVAC system, the maximum temperature is 120°F due to a loss of air conditioning (Ref. G.22, Table 6-1). Since surveillance is only performed during normal plant operating conditions, for indication loops associated with Parametric values and PPCS indication, 104°F is used as the maximum temperature. For EOP normal conditions (Regulatory Guide 1.97 Category 1 variables), 120°F is used as the maximum temperature since the instrumentation is expected to operate under compromised environmental conditions caused by a loss of the HVAC Cooling Unit. For EOP accident conditions, the maximum Aux. Building accident temperature is used.

All transmitters (1(2)PT-478, 1(2)PT-479, and 1(2)PT-483) for Loop B Steam Line Pressure are located in the Fan Room (Refs. P.3 and P.9). A steamline break (SLB) in the fan room could cause the temperature to reach 298 °F (Ref. C.7). The transmitters for Loop A Steam Line Pressure, 1(2)PT-468, 1(2)PT-469, and 1(2)PT-482, are located in the spent fuel pool room of the Auxiliary Building (Ref. P.3 and P.9). Per Reference C.7, a new HELB barrier was installed per MR 99-003 (Ref. G.27) to confine postulated HELB to the CCW HX/BAT room and thereby prevent the steam from entering other areas of the Auxiliary Building. Hence, the spent fuel pool room does not experience the environmental effects of a postulated HELB. However, the environmental conditions associated with a harsh environment in the fan room will be conservatively used for all the transmitters. Transmitter cables in the Auxiliary Building could be exposed to a harsh environment.

The Auxiliary Building normal humidity of 70% and radiation of 400 RADs (40 year dose) for normal conditions is documented in Ref. G.22. Calculation 97-0140 (Ref. C.11) revises post-LOCA radiation dose for outside containment due to changes in containment sump water volumes and changes in assumed water volumes injected from the Boric Acid Storage Tank. The Steam Line Pressure transmitters are not identified in Calculation No. 97-0140. Therefore, the post-LOCA environmental service conditions for outside containment following a LOCA are considered to be the same as the normal environment conditions as shown in Ref. G.22. Temperature conditions for accident considerations are documented in Ref. C.7.

Table 6.6-1: Auxiliary Building Ambient Environmental Conditions

Functions	Calibration Temp. (°F)	Max. Temperature (°F)	Humidity (%)	Radiation (RADs)
EOP Normal	65	120	70	400 (40 year dose)
Parametric	65	104	70	400 (40 year dose)
Trip and EOP Accident	65	298	100	400 (40 year dose)

6.6.2 Control Room and Computer Room

The rack components and control board indicators are located in the Control Room and Computer Room (Ref. P.1, P.2, P.5 through P.8, and P.11 through P.14).

The Control Room HVAC System controls the temperature of the Control Room and the Computer Room at 75°F per Ref. G.21. Per FSAR Section 9.8.1 (Ref. G.2), the temperature can vary ± 10°F. This temperature variation is supported by the fact that the Johnson Controls T-4002-202 thermostat (Ref. D.11) in the Control Room is capable of controlling the room temperature (Ref.V.14) within these bounds. Therefore, the minimum temperature of 65°F is used as the calibration temperature for the components in the Control Room and Computer Room.

Since the Tech Spec surveillance (parametric) for control room indication and display monitoring is only performed during normal plant operating conditions, 85 °F is used as the maximum temperature for these functions (Note, the maximum temperature limit for the PPCS is 95°F per Assumption 5.1.13). Per Assumption 5.1.12, the maximum expected temperature is 120°F (loss of chiller). This maximum temperature of 120 °F is used for the Trip and EOP functions (safety-related and Regulatory Guide 1.97 Category 1 variable) since these functions may require the instrumentation to operate under compromised environmental conditions caused by a loss of the HVAC Cooling Unit.

The Control Room humidity of 50% and 95% (loss of chiller) is documented in Reference G.22. Section 11.6.2 (fifth paragraph) of FSAR (Ref. G.2) states that the Control Room is in Zone I and Table 11.6-1 states the maximum dose rate in Zone I is 1.0 mrem/hr.

Table 6.6-2. Control Room and Computer Room Ambient Environmental Conditions

Function	Calibration Temp. (°F)	Max. Temperature (°F)	Humidity (%)	Radiation (RADs)
Parametric	65	85	50	1 mrem/hr
Trip and EOP	65	120	95	1 mrem/hr

Table 6.6-3, Summary of TLE Environmental Conditions

TLE	Device	Location	Environ. (Temp °F)	Temp. Effect	Comments (Basis for Environment)
Bistable Loop (accident) TLE_{1a}	Transmitter	Aux. Building	298	St_a	Bistable loop is Safety related. CR max. temp of 120°F can be expected under accident conditions with loss of HVAC.
	Lead/Lag	Comp. Room	120	LLt	
	Bistable	Comp. Room	120	Bt	
PPCS Loop (normal) TLE_{2n}	Transmitter	Aux. Building	104	St_{n1}	PPCS loop is non-Safety Related. When HVAC is lost, this loop is not operable. No need to evaluate above 85°F.
	I/I	Comp. Room	85	I/It	
	PPCS	Comp. Room	85	PPCSt	
Indicator Loop (EOP normal) TLE_{3n}	Transmitter	Aux. Building	120	St_{n2}	Indicator loop is Safety related. CR max. temp of 120°F can be expected with loss of HVAC.
	I/I	Comp. Room	120	I/It	
	Indicator	Control Room	120	It	
Indicator Loop (EOP accident) TLE_{3a}	Transmitter	Aux. Building	298	St_a	Indicator loop is Safety related. CR max. temp of 120°F can be expected under accident conditions with loss of HVAC.
	I/I	Comp. Room	120	I/It	
	Indicator	Control Room	120	It	
Indicator Loop (parametric) TLE_{3p}	Transmitter	Aux. Building	104	St_{n1}	Parametric values are not required with a loss of HVAC. Therefore, there is no need to evaluate above 85°F.
	I/I	Comp. Room	85	I/It	
	Indicator	Control Room	85	It	

6.7 Existing Analytical Limit (AL), Field Trip Setpoint (FTSP), and Existing Allowable Value (AV)

The EPU Analytical Limit for Low Steam Line Pressure Safety Injection, discussed below, is 410 psia (Ref. G.65 & C.13), which is equivalent to 395.3 psig. The Field Trip Setpoint (FTSP) is 530 psig (Ref. P.5 through P.8 and P.11 through P.14). The Existing Allowable Value is ≥ 500 psig (Ref. G.24).

Table 6.7-1, Setpoint Evaluation Values

Function	Values	References
Existing Analytical Limit	(335 psia) 320.3 psig	G.43
EPU Analytical Limit	410 psia (395.3 psig)	C.13 & G.65
Field Trip setpoint	530 psig	P.5 through P.8, and P.11 through P.14
Existing Allowable Value	≥ 500 psig	G.24

The low steam line pressure safety injection is credited as a primary trip in two accident analyses (Reference G.43):

1. Core response to rupture of a steam pipe (with 2 loops in service)
2. Steam line break outside containment

This actuation is also considered a backup trip for the following event, and a process limit is provided:

3. Steam line break inside containment

Each of these three situations will be discussed in turn.

6.7.1 Rupture of a steam pipe (with 2 loops in service)

The analytical limit provided is 335 psia (existing) & 410 psia (EPU). A process sensor functional time of 1.5 seconds is provided (Reference G.43).

The steam line pressure transmitters are located outside containment. Since the steam line break could occur inside or outside of containment, it is possible for the transmitters "to experience adverse environmental conditions during a secondary side break." (Reference G.24) Therefore, post-accident environmental conditions should be considered when evaluating the setpoint with respect to this analytical limit.
<u>Margin-to-Trip</u>

Westinghouse Calculation CN-TA-08-64 [Reference C.13] determined that normal operational transients under EPU conditions would not cause a Low Steam Pressure Safety Injection Trip, with margin. Note that CN-TA-08-64 requires PBNP Units 1 & 2 to support a Low Steamline Pressure – Safety Injection (SI) safety analysis setpoint of 410 psia (or higher) with an 18/2-second (or faster-responding) lead/lag on the steam pressure signal. Refer to the calculation for the specific margin provided for different transients.

6.7.2 Steam line break outside containment

The analytical limit provided is 335 psia (existing) & 410 psia (EPU). A process sensor functional time of 16 seconds is provided (Reference G.43).

This analysis should not be confused with the rupture of a steam pipe (with 2 loops in service) analysis, discussed immediately above, which evaluates the effect of a large steam line break on the core. Unlike the rupture of a steam pipe (with 2 loops in service) analysis—which demonstrates that a safety limit is not exceeded—the steam line break outside containment is done to determine the mass and energy release for main steam line breaks for use as input to an environmental evaluation of safety-related electrical equipment outside containment.

The steam line pressure transmitters are located outside containment. Since the steam line break could occur inside or outside of containment, it is possible for the transmitters "to experience adverse environmental conditions during a secondary side break." (Reference G.24) However, this limit 335 psia (existing) & 410 psia (EPU) is the same as the analytical limit for the rupture of a steam pipe (with 2 loops in service) case, discussed immediately above. Since (1) the limit for the steam line break outside containment is the same as the analytical limit for the rupture of a steam pipe (with 2 loops in service) and (2) the setpoint evaluation for the rupture of a steam pipe (with 2 loops in service) case will incorporate the larger instrument uncertainties resulting from post-accident environmental conditions, the steam line break outside containment case is considered equivalent to the rupture of a steam pipe (with 2 loops in service) case.

Margin-to-Trip

Westinghouse Calculation CN-TA-08-64 [Reference C.13] determined that normal operational transients under EPU conditions would not cause a Low Steam Pressure Safety Injection Trip, with margin. Note that CN-TA-08-64 requires PBNP Units 1 & 2 to support a Low Steamline Pressure – Safety Injection (SI) safety analysis setpoint of 410 psia (or higher) with an 18/2-second (or faster-responding) lead/lag on the steam pressure signal. Refer to the calculation for the specific margin provided for different transients.

6.7.3 Steam line break inside containment

A process limit of 515 psia is provided. No process sensor functional time is provided (Reference G.43).

This analysis should not be confused with the rupture of a steam pipe (with 2 loops in service) analysis, discussed above, which evaluates the effect of a large steam line break on the core. Unlike the rupture of a steam pipe (with 2 loops in service) analysis—which demonstrates that core limits are not exceeded—the steam line break inside containment analysis demonstrates that containment limits are not exceeded.

In the analysis of a steam line break inside containment (Reference C.12), all three automatic safety injection signals—high containment pressure, low pressurizer pressure, and low steam line pressure—were used as inputs. The results of the analysis show that safety injection is actuated by the high containment pressure safety injection signal. Since the low steam line pressure safety injection signal did not produce the safety injection—and, therefore, is not credited as the primary trip in this accident analysis—it functions as a backup trip. Hence, although the value of 515 psia was used as an input to the analysis, this value should not be used in determining the limiting trip setpoint (LTSP).

However, because the signal functions as a backup trip and because the low steam line pressure safety injection setpoint has, starting with the originally specified setpoint (Reference G.42), always been set at a value ≥ 500 psig (Existing); ≥520 psig (EPU), it is recommended that the field trip setpoint (FTSP) be maintained ≥ 500 psig(Existing); ≥520 psig (EPU).

Margin-to-Trip

Westinghouse Calculation CN-TA-08-64 [Reference C.13] determined that normal operational transients under EPU conditions would not cause a Low Steam Pressure Safety Injection Trip, with margin. Note that CN-TA-08-64 requires PBNP Units 1 & 2 to support a Low Steamline Pressure – Safety Injection (SI) safety analysis setpoint of 410 psia (or higher) with an 18/2-second (or faster-responding) lead/lag on the steam pressure signal. Refer to the calculation for the specific margin provided for different transients.

6.7.4 Summary

The following analytical limit should be used in establishing the LTSP for low steam line pressure safety injection. The appropriate environmental conditions must be included in the setpoint evaluation.

- Core response to rupture of a steam pipe (with 2 loops in service): 335 psia (existing) & 410 psia (EPU), post-accident environment

In addition, it is recommended that the FTSP be maintained ≥ 500 psig(Existing); ≥520 psig (EPU).

7.0 METHODOLOGY

7.1 Uncertainty Determination

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

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

To convert 95/95 random uncertainty values to 75/75 uncertainty values (when applicable); this calculation uses the conversion factor specified in Section 3.3.3.13 of Reference G.1. All individual instrument uncertainties are evaluated and shown as 95/95 values, and are combined under the Total Loop Error radical as such. Conversion to a 75/75 value is performed after the random 95/95 TLE radical is computed.

B) Treatment of Significant Digits and Rounding

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

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

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

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

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

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

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

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

4. For Total Loop Uncertainties and Channel Check Tolerances, the calculated result should be rounded to the numerical precision that is readable on the

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

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

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

C) Determination of Channel Check Tolerance (CCT)

Per Section 3.3.8.7 of Reference G.1, the CCT value is considered a 75/75 value. However, converting the CCT from 95/95 into a 75/75 value restricts the tolerance allowed for the indication loop devices and essentially makes it more difficult for the plant to meet their requirements. This approach is considered to be overly conservative. Therefore, this calculation will determine CCT as a 95/95 value.

Although Reference G.1 does not discuss the rounding techniques for CCT values, it is typical for tolerance values to be rounded down. This approach tightens the tolerance band, thus creating a conservative tolerance value. However, in the case of CCT, when a channel is determined non-operational, it is most likely to be found grossly out of tolerance, i.e., the difference between the channel readings far surpasses the allowable CCT value. Therefore, in an effort to reduce the occurrence of false out of tolerance CCT readings, this calculation will round the CCT value up to the precision that is readable on the indication device.

D) Seismic Consideration for RPS/ESFAS Trip Setpoints

Seismic uncertainty must be evaluated as a contributor to overall loop error for some (not all) RPS/ESFAS trip setpoints. The specific setpoints that require evaluation for seismic effects are those that are credited as primary trips for accidents/transients that could credibly occur as the result of a seismic event. These setpoints are found in the Seismic Evaluation Report, USNRC Generic Letter 87-02, USI A-46 Resolution (NPC-36703) (Ref. G.55) and are listed below.

Table 7.1-1, Credible Accidents/Transients During or Following a SSE

FSAR Section	ACCIDENT/TRANSIENT	Primary Reactor Trip Variable
14.1.3	Rod Cluster Control Assembly (RCCA) Drop	Low Pressurizer Pressure
14.1.6	Reduction in Feedwater Enthalpy	None Required
14.1.7	Excessive Load Increase	None Required
14.1.8	Loss of Reactor Coolant Flow	Low RCS flow
14.1.9	Loss of External Electrical Load	Over Temp – Delta T High Pressurizer Pressure Low-Low S/G Level
14.1.10	Loss of Normal Feedwater	Low-Low S/G Level
14.1.11	Loss of All AC Power to the Auxiliaries	Low-Low S/G Level
14.2.5	Stuck Open Steam Dump or S/G Safety Valve	None Required

Trip setpoints not shown in the above table do not need to include a seismic uncertainty term because their trip function is not required during or following a seismic event.

<u>Seismic versus Harsh Environment</u>

Seismic events do not create a harsh environment. Therefore, seismic uncertainties and harsh environment uncertainties need not be combined in a single calculation of total loop error. If any of the above trips credited during a seismic event are also credited as primary trips during a LOCA/MSLB that creates a harsh environment, then the uncertainty term (seismic or harsh environment) that results in the worst-case (largest) of the two TLEs should be applied for determining the limiting trip setpoint.

E) Seismic Consideration for EOP Setpoints

The PBNP EOP setpoints are developed in accordance with the recommendations of the Westinghouse Owners Group Emergency Response Guidelines (ERGs). The NRC reviews and approves the ERGs and plants with a Westinghouse NSSS are expected to follow them, documenting any plant-specific differences.

The ERG Executive Volume provides guidance on the subject of instrument uncertainty as it relates to EOP setpoints. This guidance includes a discussion of the following components that contribute to the total instrument channel accuracy:

Process measurement accuracy

Primary element accuracy
Sensor allowable deviation:
- Reference accuracy
- Temperature effect
- Pressure effect
- Drift

Rack allowable deviation:
- Rack calibration accuracy
- Rack environmental effects
- Rack drift
- Comparator setting accuracy

Environmental allowance due to the effects of being exposed to a high-energy line break:
- Temperature
- Pressure
- Humidity
- Radiation
- Chemical spray
- Acceleration
- Vibration
- Reference leg heatup

Indicator allowable deviation

Nowhere in this detailed guidance is there any mention of a seismic term. (It should be noted that, as is clear from the context, the vibration and acceleration terms mentioned in the above list refer only to the vibration or acceleration associated with a high-energy line break.) That is, the ERG recommendations do not require that seismic effects be included in the determination of instrument uncertainty for EOP setpoints.

Therefore, seismic effects will not be considered in the instrument loop uncertainties used in determining EOP setpoints.

7.1.1 Sources of Uncertainty

Per Ref. G.1, the device uncertainties to be considered for normal environmental conditions include the following:

Sensor Accuracy	(Sa)
Sensor Drift	(Sd)
Sensor M&TE	(Sm)
Sensor Setting Tolerance	(Sv)
Sensor Power Supply Effect	(Sp)
Sensor Temperature Effect	(St_a, St_{n1}, St_{n2})
Sensor Humidity Effect	(Sh_n, Sh_a)
Sensor Radiation Effect	(Sr_n, Sr_a)

Sensor Seismic Effect	(Ss)
Sensor Static Pressure Effect	($Sspe_n$, $Sspe_a$)
Sensor Overpressure Effect	($Sope_n$, $Sope_a$)
Current-to-Current Converter Accuracy	(I/Ia)
Current-to-Current Converter Drift	(I/Id)
Current-to-Current Converter M&TE	(I/Im)
Current-to-Current Converter Setting Tolerance	(I/Iv)
Current-to-Current Converter Power Supply Effect	(I/Ip)
Current-to-Current Converter Temperature Effect	(I/It)
Current-to-Current Converter Humidity Effect	(I/Ih)
Current-to-Current Converter Radiation Effect	(I/Ir)
Current-to-Current Converter Seismic Effect	(I/Is)
Lead/Lag Accuracy	(LLa)
Lead/Lag Drift	(LLd)
Lead/Lag M&TE	(LLm)
Lead/Lag Setting Tolerance	(LLv)
Lead/Lag Power Supply Effect	(LLp)
Lead/Lag Temperature Effect	(LLt)
Lead/Lag Humidity Effect	(LLh)
Lead/Lag Radiation Effect	(LLr)
Lead/Lag Seismic Effect	(LLs)
PPCS Accuracy	(PPCSa)
PPCS Drift	(PPCSd)
PPCS M&TE	(PPCSm)
PPCS Setting Tolerance	(PPCSv)
PPCS Power Supply Effect	(PPCSp)
PPCS Temperature Effect	(PPCSt)
PPCS Humidity Effect	(PPCSh)
PPCS Radiation Effect	(PPCSr)
PPCS Seismic Effect	(PPCSs)
PPCS Readability Effect	(PPCSrea)
Indicator String Accuracy	(Ia)
Indicator String Drift	(Id)
Indicator String M&TE	(Im)
Indicator String Setting Tolerance	(Iv)
Indicator Power Supply Effect	(Ip)
Indicator Temperature Effect	(It)
Indicator Humidity Effect	(Ih)
Indicator Radiation Effect	(Ir)
Indicator Seismic Effect	(Is)
Indicator Readability Effect	(Irea)
Bistable Accuracy	(Ba)
Bistable Drift	(Bd)
Bistable M&TE	(Bm)

Bistable Setting Tolerance	(Bv)
Bistable Power Supply Effect	(Bp)
Bistable Temperature Effect	(Bt)
Bistable Humidity Effect	(Bh)
Bistable Radiation Effect	(Br)
Bistable Seismic Effect	(Bs)
Rack Accuracy	(Ra)
Rack Drift	(Rd)
Rack M&TE	(Rm)
Rack Setting Tolerance	(Rv)
Rack Power Supply Effect	(Rp)
Rack Temperature Effect	(Rt)
Rack Humidity Effect	(Rh)
Rack Radiation Effect	(Rr)
Rack Seismic Effect	(Rs)
Insulation Resistance Effect	(IR)
Process Error	(PE)

The uncertainties will be calculated in percent of span and converted to the process units as required.

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

7.1.2 Total Loop Error Equation Summary (TLE)

This calculation determines the uncertainties associated with the bistable, PPCS and indicator loops. Therefore, the Total Loop Error equation stated per Reference G.1 will be modified in order to calculate each function individually.

7.1.2.1 Total Bistable Loop Error (TLE_{1a})

Per Figure 6.2-1, the total loop error for the bistable contains the uncertainties for the loop sensor, rack and bistable:

$$TLE_{1a} = \sqrt{\begin{array}{l} Sa^2 + LLa^2 + Ba^2 + Sd^2 + LLd^2 + Bd^2 + Sm^2 + LLm^2 \\ + Bm^2 + Sv^2 + LLv^2 + Bv^2 + Sp^2 + LLp^2 + Bp^2 + St_a{}^2 \\ + LLt^2 + Bt^2 + Sh_a{}^2 + LLh^2 + Bh^2 + Sr_a{}^2 + LLr^2 + Br^2 \\ + Ss^2 + LLs^2 + Bs^2 + Sspe_a{}^2 + Sope_a{}^2 \end{array}} + Biases \quad \text{(Eq. 7.1.2.1)}$$

Where: TLE1a= Total Accident Bistable Loop Error

7.1.2.2 Total PPCS Loop Error (TLE_{2n})

Per Figure 6.2-1, the total loop error for the PPCS contains the uncertainties for the loop sensor, rack and PPCS:

$$TLE_{2n} = \sqrt{\begin{aligned}&Sa^2 + I/Ia^2 + PPCSa^2 + Sd^2 + I/Id^2 + PPCSd^2 + Sm^2 \\ &+ I/Im^2 + PPCSm^2 + Sv^2 + I/Iv^2 + PPCSv^2 + Sp^2 + I/Ip^2 \\ &+ PPCSp^2 + St_{n1}^2 + I/It^2 + PPCSt^2 + Sh_n^2 + I/Ih^2 + PPCSh^2 \\ &+ Sr_n^2 + I/Ir^2 + PPCSr^2 + Ss^2 + I/Is^2 + PPCSs^2 + Sspe_n^2 \\ &+ Sope_n^2\end{aligned}} + Biases \quad \text{(Eq. 7.1.2.2)}$$

where:

TLE_{2n} = Total Normal PPCS Loop Error

7.1.2.3 Total Indicator Loop Error (TLE_{3n}, TLE_{3a}, TLE_{3p})

Per Figure 6.2-1, the total loop error for the indicator contains the uncertainties for the loop sensor, rack and indicator:

$$TLE_{3n} = \sqrt{\begin{aligned}&Sa^2 + I/Ia^2 + Ia^2 + Sd^2 + I/Id^2 + Id^2 + Sm^2 \\ &+ I/Im^2 + Im^2 + Sv^2 + I/Iv^2 + Iv^2 + Sp^2 + I/Ip^2 \\ &+ Ip^2 + St_{n2}^2 + I/It^2 + It^2 + Sh_n^2 + I/Ih^2 + Ih^2 \\ &+ Sr_n^2 + I/Ir^2 + Ir^2 + Ss^2 + I/Is^2 + Is^2 + Sspe_n^2 \\ &+ Sope_n^2\end{aligned}} + Biases \quad \text{(Eq. 7.1.2.3-1)}$$

where:

TLE_{3n} = Total Normal Indicator Loop Error

$$TLE_{3a} = \sqrt{\begin{aligned}&Sa^2 + I/Ia^2 + Ia^2 + Sd^2 + I/Id^2 + Id^2 + Sm^2 + I/Im^2 \\ &+ Im^2 + Sv^2 + I/Iv^2 + Iv^2 + Sp^2 + I/Ip^2 + Ip^2 + St_a^2 \\ &+ I/It^2 + It^2 + Sh_a^2 + I/Ih^2 + Ih^2 + Sr_a^2 + I/Ir^2 + Ir^2 \\ &+ Ss^2 + I/Is^2 + Is^2 + Sspe_a^2 + Sope_a^2\end{aligned}} + Biases \quad \text{(Eq. 7.1.2.3-2)}$$

where:

TLE_{3a} = Total Accident Indicator Loop Error

$$TLE_{3p} = \sqrt{\begin{aligned}&Sa^2 + I/Ia^2 + Ia^2 + Sd^2 + I/Id^2 + Id^2 + Sm^2 + I/Im^2 \\ &+ Im^2 + Sv^2 + I/Iv^2 + Iv^2 + Sp^2 + I/Ip^2 + Ip^2 + {St_{n1}}^2 \\ &+ I/It^2 + It^2 + {Sh_n}^2 + I/Ih^2 + Ih^2 + {Sr_n}^2 + I/Ir^2 + Ir^2 \\ &+ Ss^2 + I/Is^2 + Is^2 + {Sspe_n}^2 + {Sope_n}^2\end{aligned}} + Biases \qquad \text{(Eq. 7.1.2.3-3)}$$

where:

TLE_{3p} = Total Parametric Loop Error

7.1.3 As-Found Tolerance Equation Summary

Per Section 3.3.8.6 of Reference G.1, the As-Found Tolerances are calculated independently for each of the loop components. The following equations will be used.

7.1.3.1 Sensor As-Found Tolerance (SAF)

The Acceptable As-Found Tolerance for the sensor (SAF) is calculated with the following equation:

$$SAF = \pm\sqrt{Sv^2 + Sd^2 + Sm^2} \qquad \text{(Eq. 7.1.3.1)}$$

Where:

Sv = Sensor Setting Tolerance
Sd = Sensor Drift
Sm = Sensor M&TE error

7.1.3.2 Current-to-Current Converter As-Found Tolerance (I/IAF)

The Acceptable As-Found Tolerance for the I/I converter (I/IAF) is calculated with the following equation:

$$I/IAF = \pm\sqrt{I/Iv^2 + I/Id^2 + I/Im^2} \qquad \text{(Eq. 7.1.3.2)}$$

Where:

I/Iv = Current-to-Current Converter Setting Tolerance
I/Id = Current-to-Current Drift
I/Im = Current-to-Current M&TE error

7.1.3.3 Lead/Lag As-Found Tolerance (LLAF)

The Acceptable As-Found Tolerance for the lead/lag unit (LLAF) is calculated with the following equation:

$$LLAF = \pm \sqrt{LLv^2 + LLd^2 + LLm^2} \quad \text{(Eq. 7.1.3.3)}$$

Where:

LLv = Lead/Lag Setting Tolerance
LLd = Lead/Lag Drift
LLm = Lead/Lag M&TE error

7.1.3.4 Indicator As-Found Tolerance (IAF)

The Acceptable As-Found Tolerance for the indicator (IAF) is calculated with the following equation:

$$IAF = \pm \sqrt{Iv^2 + Id^2 + Im^2} \quad \text{(Eq. 7.1.3.4)}$$

Where:

Iv = Indicator Setting Tolerance
Id = Indicator Drift
Im = Indicator M&TE error

7.1.3.5 PPCS As-Found Tolerance (PPCSAF)

The Acceptable As-Found Tolerance for the computer (PPCSAF) is calculated with the following equation:

$$PPCSAF = \pm \sqrt{PPCSv^2 + PPCSd^2 + PPCSm^2} \quad \text{(Eq. 7.1.3.5)}$$

Where:

PPCSv = PPCS Setting Tolerance
PPCSd = PPCS Drift
PPCSm = PPCS M&TE error

7.1.3.6 Bistable As-Found Tolerance (BAF)

Per Figure 6.2-1, the bistable outputs to the SI logic and an alarm. Therefore, the As-Found Tolerance must be applied to both setpoints. The Acceptable As-Found Tolerance for the bistable (BAF) is calculated with the following equation:

$$BAF = \pm \sqrt{Bv^2 + Bd^2 + Bm^2} \quad \text{(Eq. 7.1.3.6)}$$

Where:

Bv = Bistable Setting Tolerance
Bd = Bistable Drift
Bm = Bistable M&TE error

7.1.4 As-Left Tolerance Equation Summary

Per Section 3.3.8.6 of Reference G.1, the As-Left Tolerances are calculated independently for the rack components, sensor and indicator.

7.1.4.1 Sensor As-Left Tolerance (SAL)

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

SAL = ± Sv

Where:

Sv = Sensor Setting Tolerance

7.1.4.2 Current-to-Current Converter As-Left Tolerance (I/IAL)

The Acceptable As-Left Tolerance for the I/I converter is equal to its setting tolerance:

I/IAL = ± I/Iv

Where:

I/Iv = Current-to-Current Converter Setting Tolerance

7.1.4.3 Lead/Lag Unit As-Left Tolerance (LLAL)

The Acceptable As-Left Tolerance for the lead/lag unit is equal to its setting tolerance:

LLAL = ± LLv

Where:

LLv = Lead/Lag Setting Tolerance

7.1.4.4 Indicator As-Left Tolerance (IAL)

The Acceptable As-Left Tolerance for the indicator (IAL) is equal to its setting tolerance:

IAL = ± Iv

Where:

Iv = Indicator Setting Tolerance

7.1.4.5 PPCS As-Left Tolerance (PPCSAL)

The Acceptable As-Left Tolerance for the PPCS (PPCSAL) is equal to its setting tolerance:

PPCSAL = ± PPCSv

Where:

PPCSv = PPCS Setting Tolerance

7.1.4.6 Bistable As-Left Tolerance (BAL)

Per Figure 6.2-1, the bistable outputs to the SI logic and an alarm. Therefore, the As-Left Tolerance must be applied to both setpoints. The Acceptable As-Left Tolerance for the bistable (BAL) is equal to its setting tolerance:

BAL = ± Bv

Where:

Bv = Bistable Setting Tolerance

7.1.5 Parametric Values

The parametric values are limits for process parameters to validate current limits in operator logs to ensure Tech Spec limits are not violated. The parametric values are calculated as follows:

Parametric Values = (Tech Spec Limits + TLE) (Eq. 7.1.5-1)

Where:

TLE = The 75/75 value of the Total Loop Error for the indicator loop as required in the Operator Daily Logsheet

The direction (positive or negative) of the TLE applied to the Tech Spec limit is determined by the process. For example, an increasing process requires that the negative TLE be applied to the Tech Spec limit to establish the parametric value.

7.1.6 Operability Limit (OL) Equation Summary

Per Section 3.3.8.2 of Reference G.63, the Operability Limit (OL) is defined as a calculated limiting value that the As-Found bistable setpoint is allowed to have during a Technical Specification surveillance Channel Operational Test (COT), beyond which the instrument channel is considered inoperable and corrective action must be taken. Two OLs are calculated, one on each side of the FTSP as-left tolerance band, incorporating a calculated 3-sigma (3σ) drift value. A channel found drifting beyond its 3σ drift value is considered to be operating abnormally (i.e., is inoperable).

Per Section 3.3.8.4 of Reference G.63, the OL on each side of the FTSP is calculated as follows:

$$OL^{+} = FTSP + [RAL^2 + Rd_{3\sigma}^{2}]^{1/2} \qquad \text{(Eq. 7.1.6-1)}$$

$$OL^{-} = FTSP - [RAL^2 + Rd_{3\sigma}^{2}]^{1/2} \qquad \text{(Eq. 7.1.6-2)}$$

Where:

the FTSP is expressed in percent of span
OL^+ is the Operability Limit above the FTSP
OL^- is the Operability Limit below the FTSP
RAL is the rack as-left tolerance (typically the bistable tolerance)
$Rd_{3\sigma}$ is the 3σ rack drift value determined as follows:

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

The rack drift value ($Rd_{2\sigma}$) is the 2-sigma drift value for components checked during the COT, typically the bistable drift.

7.1.7 Scaling

Per Reference G.66, for an instrument with a linear input and output relationship, the output signal can be determined as follows:

$$y - y_1 = m * (x - x_1) \qquad \text{(Eq. 7.1.7-1)}$$

$$m = (y_2 - y_1) / (x_2 - x_1) \qquad \text{(Eq. 7.1.7-2)}$$

$$y = m * (x - x_1) + y_1 \qquad \text{(Eq. 7.1.7-3)}$$

Where:

x	= Process value variable, a known input (psig)
x_1	= Process value variable, at 0 % span (psig)
x_2	= Process value variable, at 100 % span (psig)
y	= Analog value variable, an unknown output (mAdc)
y_1	= Analog value at 0 % span (mAdc)
y_2	= Analog value at 100 % span (mAdc)
m	= Slope, or gain of the function, scale factor

7.2 Drift Considerations

The drift values established in Reference C.1 are utilized for the transmitters, Reference C.3 utilized for the indicators, Reference C.4 utilized for the lead/lag unit, and Reference C.9 utilized for the bistables.

Use of the aforementioned drift value (as design input to this calculation) is based on justification provided by Engineering Evaluation 2005-0006 (Ref. C.6). This evaluation reviews the station's M&TE and M&TE control programs, based on requirements imposed by the methodology used to prepare instrument setpoint and uncertainty calculations for the station (Ref. G.1). The evaluation concludes that the station's M&TE and M&TE control programs have remained equivalent or improved since the drift calculations were initially prepared, and therefore, renders the drift calculations acceptable for use in current (present-day) calculation revisions performed for the station.

7.3 Channel Check Tolerance Equation Summary (CCT)

Per Reference G.1, the CCT represents the maximum expected deviation between channel indications that monitor the same plant process parameter. The CCT is determined for instrument loops that require a qualitative assessment of channel behavior during operation. This assessment involves an observed comparison of the channel indication/status.

When performing a channel check, it is generally assumed that the instrument loops are redundant to each other, i.e., measuring the same parameter. A channel check involves a comparison of two indications independent of the number of redundant loops using the reference accuracy (a), setting tolerance (v), drift (d), and readability (rea) of each device.

Per Section 7.1, the CCT value is rounded up to the numerical precision that is readable on the associated loop indicator and is considered a 95/95 value. The CCT is determined using the SRSS method shown below:

$$CCT = \sqrt{\begin{aligned} &Sa_1^2 + I/Ia_1^2 + Ia_1^2 + Sv_1^2 + I/Iv_1^2 + Iv_1^2 + Sd_1^2 + I/Id_1^2 \\ &+ Id_1^2 + Irea_1^2 + Sa_2^2 + I/Ia_2^2 + Ia_2^2 + Sv_2^2 + I/Iv_2^2 \\ &+ Iv_2^2 + Sd_2^2 + I/Id_2^2 + Id_2^2 + Irea_2^2 \end{aligned}} \quad \text{(Eq. 7.3-1)}$$

7.4 Setpoint Calculations

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

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

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

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

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

7.5 Process Error Calculation

The process bias uncertainty will be calculated by calculating the differential pressure corresponding to head correction at the design temperature (68°F) and comparing it to the differential pressure at the maximum temperature during accident condition (298°F).

$$dP\ Error = [(\Delta v * dP_{head\_correction}) / PS] * 100\% \qquad \text{(Equation 7.6-1)}$$

Where:

dP Error	= Differential Pressure Process Error
Δv	= Specific Gravity Difference from 68°F to 298°F
$dP_{head\_correction}$	= Differential Pressure of the Head Correction
PS	= Process Span

8.0 BODY OF CALCULATIONS

8.1 Device Uncertainty Analysis

This section will determine all applicable uncertainties for the devices that comprise the Steam Line Pressure Instrumentation Loop shown in Section 6.

From Ref. G.1 (Section 3.3.4.3), the drift values calculated from As-Found/As-Left instrument calibration data normally include the error effects under normal conditions of drift, accuracy, power supply, plant vibration, calibration temperature, normal radiation, normal humidity, M&TE used for calibration, and instrument readability. If it is determined that the calibration conditions are indicative of the normal operating conditions, the environmental effects need not be included separately. All device uncertainty terms are considered random and independent unless otherwise noted.

8.1.1 Sensor Accuracy (Sa)

Ref. C.1 has determined the historical drift values for the N-E11GM transmitter. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the Sensor Accuracy of the transmitter is included in the instrument drift value. Therefore,

Sa = ± 0.000% span

8.1.2 Sensor Drift (Sd)

Ref. C.1 has determined historical drift values for the N-E11GM transmitter. The 95%/95% sensor drift value for a two year interval is conservatively used based on 18 months channel calibration and 25% Tech Spec Allowance.

Sd = ± 0.518% span

Bias = ± 0.000% span

8.1.3 Sensor M&TE (Sm)

Ref. C.1 has determined the historical drift values for the N-E11GM transmitter. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the Sensor M&TE of the transmitter is included in the instrument drift value. Therefore,

Sm = ± 0.000% span

8.1.4 Sensor Setting Tolerance (Sv)

Per Ref. P.3, P.9 and Assumption 5.1.11, the sensor setting tolerance is ± 0.20 mAdc, and the calibrated span is 40 mAdc. Therefore,

Sv = (sensor setting tolerance/calibrated span) * 100%
Sv = (± 0.20 mAdc / 40 mAdc) * 100%

Sv = ±0.500% span

8.1.5 Sensor Power Supply Effect (Sp)

Ref. C.1 has determined the historical drift values for the N-E11GM transmitter. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the Sensor Power Supply Effect of the transmitter is included in the instrument drift value. Therefore,

Sp = ± 0.000% span

8.1.6 Sensor Temperature Effect (St)

The Steam Line Pressure transmitters are Foxboro Model N-E11GM. Per Ref. G.61, the transmitter limits are 200 and 2000 psi. Per Ref. V.13, this corresponds to capsule code E. Therefore, the upper span limit of 2000 psi is used. Per References P.3 and P.9, the calibrated span is 1400 psig, which is 70% of the upper span limit. Reference V.13 specifies a zero shift span error of ± 1.5 % per 100 °F for a calibrated span between 50% and 80% of max span (or upper span limit) and a span error of ± 1.25 % per 100 °F. These errors are combined using the SRSS method per Ref. G.1.

From Section 6.6.1, the transmitters are located in the Aux. Building where the normal ambient temperature range is 65 to 120 °F. As stated in Section 6.6.1, the transmitters are evaluated for the two different normal environmental conditions: 65°F to 104°F and 65°F to 120°F. These errors are combined using the SRSS method per Reference G.1.

Zero Shift error (St_{-ZERO}) at normal parametric conditions (65 to 104°F)

St_{-ZERO} = ± (1.5% span/100°F) * (104 – 65°F)
St_{-ZERO} = ± 0.585% span

Span Shift error (St_{-SPAN}) at normal parametric conditions (65 to 104°F)

St_{-SPAN} = ± (1.25% span/100°F) * (104 – 65°F)
St_{-SPAN} = ± 0.488% span

Sensor Temperature Effect at normal parametric conditions (65 to 104°F) (St_{n1})

$St_{n1} = \pm [(St_{-ZERO})^2 + (St_{-SPAN})^2]^{1/2}$
$St_{n1} = \pm [(0.585\%\ span)^2 + (0.488\%\ span)^2]^{1/2}$

$\mathbf{St_{n1} = \pm 0.762\%\ span}$

Zero Shift error (St_{-ZERO}) at normal EOP conditions (65 to 120°F)

$St_{-ZERO} = \pm (1.5\%\ span/100°F) * (120 - 65°F)$
$St_{-ZERO} = \pm 0.825\%\ span$

Span Shift error (St_{-SPAN}) at normal EOP conditions (65 to 120°F)

$St_{-SPAN} = \pm (1.25\%\ span/100°F) * (120 - 65°F)$
$St_{-SPAN} = \pm 0.688\%\ span$

Sensor Temperature Effect at normal EOP conditions (St_{n2})

$St_{n2} = \pm [(St_{-ZERO})^2 + (St_{-SPAN})^2]^{1/2}$
$St_{n2} = \pm [(0.825\%\ span)^2 + (0.688\%\ span)^2]^{1/2}$

$\mathbf{St_{n2} = \pm 1.074\%\ span}$

Ref. V.13 defines temperature above 250°F within the LOCA/HELB profile. Per Section 6.6.1, the sensor accident temperature is 298°F. Per Ref. V.13, the maximum output shift for a LOCA/HELB is ±8.0%. Therefore,

$\mathbf{St_a = \pm 8.000\%\ span}$

8.1.7 Sensor Humidity Effect (Sh_n, Sh_a)

Per Section 3.3.3.20 of Reference G.1, changes in ambient humidity have a negligible effect on the uncertainty of the instruments used in this calculation.

$\mathbf{Sh_n = \pm 0.000\%\ span}$

$\mathbf{Sh_a = \pm 0.000\%\ span}$

8.1.8 Sensor Radiation Effect (Sr_n, Sr_a)

Ref. C.1 has determined the historical drift values for the N-E11GM transmitter. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the Sensor Radiation Effect of the transmitter during normal conditions is included in the instrument drift value. Therefore,

$\mathbf{Sr_n = \pm 0.000\%\ span}$

Per Section 6.6, the Aux. Building does not experience an increase in radiation from normal during an accident. As a result, the Sensor Radiation Effect of the transmitter under accident conditions is the same under normal conditions. Therefore,

$\mathbf{Sr_a = \pm 0.000\%\ span}$

8.1.9 Sensor Seismic Effect (Ss)

Ref. C.1 has determined the historical drift values for the N-E11GM transmitter. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the effect of normal vibration is included in the instrument drift value. Therefore,

$$Ss_n = \pm 0.000\% \text{ span}$$

Steam Line Pressure is not a trip variable included in Table 7.1-1, and therefore, the trip function is not required during and following a seismic event. Furthermore, per Section 3.3.3.10 of Reference G.1, it is assumed that instrumentation will be recalibrated prior to any subsequent accident, thus negating any permanent shift that may have occurred due to the seismic event. Therefore,

$$Ss_a = \pm 0.000\% \text{ span}$$

It should also be noted that seismic effects will not be included in the Total Loop Error for EOP indication. Per section 7.1(E), seismic effects do not contribute to the total instrument channel accuracy when determining EOP setpoints. Therefore, this effect is equal to zero in the Total Loop Error radical for EOP Indication (TLE_{3a} in Section 8.3.4).

8.1.10 Sensor Static Pressure Effect ($Sspe_n$, $Sspe_a$)

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

$$Sspe_n = \pm 0.000\% \text{ span}$$

$$Sspe_a = \pm 0.000\% \text{ span}$$

8.1.11 Sensor Overpressure Effect ($Sope_n$, $Sope_a$)

The Steam Line Pressure transmitters are rated for a maximum over-range pressure of 3000 psig (Ref. V.13). Per References V.16 and V.17, the mechanical design condition (shell design) for the secondary side of the steam generators is 1085 psig. From ASME Section VIII (Ref. G.50), the allowable overpressure is 10% of the design (or 108.5 psig). Therefore, the maximum pressure inside the vessel is 1193.5 psig. The maximum over-range pressure is rated well above the Steam Generator design pressure (1193.5 psig) and the calibrated span of 1400 psig (Ref. P.3 and P.9). Therefore, the sensor overpressure effect is considered negligible.

$$Sope_n = \pm 0.000\% \text{ span}$$

$$Sope_a = \pm 0.000\% \text{ span}$$

8.1.12 Current-to-Current Converter Accuracy (I/Ia)

Per Ref. V.7, the I/I Converter accuracy is ±0.5% of output span.

I/Ia = ± 0.500% span

8.1.13 Current-to-Current Converter Drift (I/Id)

Drift is unspecified by the vendor (V.7). Per Section 3.3.3.15 of Reference G.1, in the absence of an appropriate drift analysis and when drift is unspecified by the vendor, the instrument's accuracy is used to represent the instrument drift over the entire calibration period.

I/Id = ± 0.500% span

8.1.14 Current-to-Current Converter M&TE (I/Im)

Per References P.1 and P.2, the I/I Converters are calibrated using a multimeter appropriate for 0.1-0.5 Vdc at the Converter input (due to a 10 Ω loop series test point resistor), and a multimeter appropriate for 10-50 mAdc at the output. The M&TE effect is due to the multimeters used at the I/I Converter input and output. According to calibration procedure ICI 12 (Ref. P.16), the following M&TE are capable of performing this measurement.

<u>HP 34401A multimeter at I/I Input (6.5 digit display, 1.0 Vdc range)</u>

RA_{mte} = ± (0.0040 % reading + 0.0007 % range)
RA_{mte} = ± [0.0040 % (0.5 Vdc) + 0.0007 % (1.0 Vdc)]
RA_{mte} = ± 0.000027 Vdc
RA_{std} = 0
RD_{mte} = ± 0.000001 Vdc

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

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

$$m_{HP} = \pm\sqrt{0.000027^2 + 0^2 + 0.000001^2} = \pm 0.000027 \text{ Vdc}$$

<u>Fluke 45 multimeter at I/I Input (5 digit display, 3.0 Vdc range)</u>

RA_{mte} = uncertainty * max reading
RA_{mte} = ± 0.025% reading * 0.5 Vdc
RA_{mte} = ± 0.000125 Vdc
RA_{std} = 0
RD_{mte} = ± 2 DGTS * 0.0001 Vdc
RD_{mte} = ± 0.0002 Vdc

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

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

$$m_{45} = \pm\sqrt{0.000125^2 + 0^2 + 0.0002^2} = \pm 0.000236\,\text{Vdc}$$

Fluke 8842A multimeter at I/I Input (6.5 digit display, 2.0 Vdc range)

RA_{mte} = uncertainty * max reading
RA_{mte} = ± 0.003% reading * 0.5 Vdc
RA_{mte} = ± 0.000015 Vdc
RA_{std} = 0
RD_{mte} = ± 2 DGTS * 0.00001 Vdc
RD_{mte} = ± 0.00002 Vdc

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

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

$$m_{8842} = \pm\sqrt{0.000015^2 + 0^2 + 0.00002^2} = \pm 0.000025\,\text{Vdc}$$

The uncertainty of Fluke 45 (m_{45} = ± 0.000236 Vdc) is used as the bounding input M&TE because it is the less accurate of the two M&TE.

Converting to % span,

m_{45} = ± (0.000236 Vdc / 0.4 Vdc) * 100 % span

m_{45} = ± 0.059 % span

Fluke 45 multimeter at I/I Output (fast resolution, 100 mAdc range):

RA_{mte} = uncertainty * max reading
RA_{mte} = ± 0.05% reading * 50 mAdc
RA_{mte} = ± 0.025 mAdc
RA_{std} = 0
RD_{mte} = ± 3 DGTS * 0.001 mAdc
RD_{mte} = ± 0.003 mAdc

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

$$m_{45} = \pm\sqrt{RA^2_{mte} + RA^2_{std} + RD^2_{mte}}$$

$m_{45} = \pm\sqrt{0.025^2 + 0^2 + 0.003^2} = \pm 0.025$ mAdc

HP 34401A multimeter at I/I Output (6.5 digit display, 100 mAdc range)

RA_{mte} = ± (0.050 % reading + 0.005 % range)
RA_{mte} = ± [0.050 % (50 mAdc) + 0.005 % (100 mAdc)]
RA_{mte} = ± 0.030 mAdc
RA_{std} = 0
RD_{mte} = ± 0.0001 mAdc

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

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

$$m_{HP} = \pm\sqrt{0.030^2 + 0^2 + 0.0001^2} = \pm 0.030 \text{ mAdc}$$

The uncertainty of HP 34401A (m_{HP} = ± 0.030 mAdc) is used as the bounding output M&TE because it is the less accurate of the two M&TE.

Converting to % span,

m_{HP} = ±(0.030 mAdc / 40 mAdc) * 100% span

m_{HP} = ±0.075 % span

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

$$M = \pm\sqrt{m_1{}^2 + m_2{}^2 + \ldots m_n{}^2}$$

$$I/Im = \pm\sqrt{m_{45}{}^2 + m_{HP}{}^2}$$

$$I/Im = \pm\sqrt{0.059^2 + 0.075^2}$$

I/Im = ± 0.095 % span

8.1.15 Current-to-Current Converter Setting Tolerance (I/Iv)

Per Ref. P.1, P.2 and Assumption 5.1.11, the I/I Converter setting tolerance is ±0.20 mAdc and the calibration span is 40 mAdc.

I/Iv = calibration tolerance * (100% span / calibrated span)
I/Iv = ± 0.20 mAdc * (100% span /40 mAdc)

I/Iv = ± 0.500% span

8.1.16 Current-to-Current Converter Power Supply Effect (I/Ip)

From Reference G.7, the I/I Converter has been shown to experience a random power supply effect caused by the non-regulated portion of the internal 50-volt power supply. This primarily affects only the I/I Converters or isolators. Therefore, per Assumption 5.1.5,

I/Ip = ± 1.000% span

8.1.17 Current-to-Current Converter Temperature Effect (I/It)

As stated in Section 6.6.2, the I/I Converter is located in the Control Room, which has a bounding ambient temperature range of 65 °F to 120 °F. From vendor information (Ref. V.7), the I/I Converter has a normal operating range of 40°F to 120 °F with no associated temperature effect. Therefore, the temperature effect is considered negligible.

I/It = ± 0.000% span

8.1.18 Current-to-Current Converter Humidity Effect (I/Ih)

Per Section 3.3.3.20 of Reference G.1, changes in ambient humidity have a negligible effect on the uncertainty of the instruments used in this calculation.

I/Ih = ± 0.000% span

8.1.19 Current-to-Current Converter Radiation Effect (I/Ir)

The I/I Converter is located in the Control Room where the radiation is minimal. Furthermore, per Section 3.3.3.21 of Reference G.1, normal radiation errors are considered small with respect to other uncertainties and can be calibrated out. Therefore, the I/I Converter radiation effect is considered negligible.

I/Ir = ± 0.000% span

8.1.20 Current-to-Current Converter Seismic Effect (I/Is)

There is no seismic effect provided by the vendor for the I/I converter (Ref. V.7). Per Section 3.3.4.10 of Ref. G.1, the effects of normal seismic or vibration events for non-mechanical instrumentation are considered zero unless vendor or industry experience indicates otherwise. Therefore,

I/Is = ± 0.000% span

8.1.21 Lead/Lag Accuracy (LLa)

Per Assumption 5.1.10, the accuracy of the Lead/Lag Modules is ± 0.2 mA and the calibration span is 40 mAdc. Therefore,

LLa = (module accuracy/calibrated span) * 100%
LLa = (± 0.2 mA/40 mA) * 100% span

LLa = ± 0.500% span

8.1.22 Lead/Lag Drift (LLd)

Reference V.9 does not provide a drift specification for the Lead/Lag Module. Per Section 3.3.3.15 of Reference G.1, when drift is not specified by the vendor, the accuracy of the component is used as the drift for the entire calibration period. Therefore,

LLd = ± 0.500% span

8.1.23 Lead/Lag M&TE (LLm)

Per Ref. P.1 and P.2, the Steam Line Pressure Lead/Lag Modules are calibrated using a multimeter appropriate for 0.1-0.5 Vdc (due to a 10 Ω loop series test point resistor) at the module input and output. The M&TE effect is due to the multimeter used at the module input and output. According to calibration procedure ICI-12 (Ref. P.16), Fluke 45 and 8842A are capable of performing this measurement.

For the Fluke 45 multimeter (5 digit display, 3 Vdc range)

RA_{mte} = uncertainty * max reading
RA_{mte} = ± 0.025% reading * 0.5 Vdc
RA_{mte} = ± 0.000125 Vdc
RA_{std} = 0
RD_{mte} = ± 2 DGTS * 0.0001 Vdc
RD_{mte} = ± 0.0002 Vdc

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

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

$$LLm_{45} = \pm\sqrt{0.000125^2 + 0^2 + 0.0002^2} = \pm 0.000236\,Vdc$$

LLm_{45} = uncertainty * (100% span / calibrated span)
LLm_{45} = ± 0.000236 Vdc * (100% span / 0.4 Vdc)
LLm_{45} = ± 0.059% span

For the Fluke 8842A multimeter (6.5 digit display, 2 Vdc range)

RA_{mte} = uncertainty * max reading
RA_{mte} = ± 0.003% reading * 0.5 Vdc
RA_{mte} = ± 0.000015 Vdc
RA_{std} = 0
RD_{mte} = ± 2 DGTS * 0.00001 Vdc
RD_{mte} = ± 0.00002 Vdc

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

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

$$LLm_{8842} = \pm\sqrt{0.000015^2 + 0^2 + 0.00002^2} = \pm 0.000025\,Vdc$$

LLm_{8842} = (uncertainty / calibrated span) * 100% span
LLm_{8842} = ± (0.000025 Vdc / 0.4 Vdc) * 100%
LLm_{8842} = ± 0.00625% span

The worst case and bounding input and output M&TE error is LLm_{45} = ±0.059% span.

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

$$M = \pm\sqrt{m_1{}^2 + m_2{}^2 + \ldots. m_n{}^2}$$

$$LLm = \pm\sqrt{0.059^2 + 0.059^2} = \pm 0.083\%\ span$$

LLm = ± 0.083% span

8.1.24 Lead/Lag Setting Tolerance (LLv)

Per Ref. P.1, P.2 and Assumption 5.1.11, the Lead/Lag Module tolerance is ± 0.002 Vdc, and the calibrated span is 0.40 Vdc. Therefore,

LLv = (module setting tolerance/calibrated span) * 100%
LLv = (± 0.002 Vdc/0.4 Vdc) * 100% span
LLv = ± 0.500% span

8.1.25 Lead/Lag Power Supply Effect (LLp)

The vendor does not provide any power supply effect for the Lead/Lag Modules (Ref. V.9). Section 3.3.3.16 of Ref. G.1 states that industry experience with similar devices should be considered in the absence of vendor data. Review of similar devices from the same vendor (Foxboro Spec 200 modules such as the 63U-BC Bistable) does not provide power supply effect information. Therefore, the Lead/Lag Modules power supply effect is considered negligible and included in the drift effect.

LLp = ± 0.000% span

8.1.26 Lead/Lag Temperature Effect (LLt)

The vendor has not provided a temperature effect specification for the Lead/Lag Modules (Ref. V.9). Per Refs P.1 and P.2, the Lead/Lag Modules are located in the Control Room, which is a temperature-controlled area and subject to a mild environment under all plant conditions. From vendor information in Reference V.9, the Lead/Lag Modules are specified to operate in an ambient temperature range of 40 to 120 °F. Therefore, the temperature effect is considered negligible and included in the drift effect.

LLt = ± 0.000% span

8.1.27 Lead/Lag Humidity Effect (LLh)

Per Section 3.3.3.20 of Reference G.1, changes in ambient humidity have a negligible effect on the uncertainty of the instruments used in this calculation. Therefore,

LLh = ± 0.000% span

8.1.28 Lead/Lag Radiation Effect (LLr)

The Lead/Lag Modules are located in the Control Room, which has a mild environment under all plant conditions. Per Section 3.3.3.21 of Reference G.1, radiation errors are considered to be included in the drift error. Therefore,

LLr = ± 0.000% span

8.1.29 Lead/Lag Seismic Effect (LLs)

There is no seismic effect provided by the vendor for the Lead/Lag Modules (Ref. V.9). Per Section 3.3.4.10 of Ref. G.1, the effects of seismic or vibration events for non-mechanical instrumentation are considered zero unless vendor or industry experience indicates otherwise. Therefore,

LLs = ± 0.000% span

8.1.30 Bistable Accuracy (Ba)

Reference C.9 has determined the historical drift values for Foxboro Model 63U-BC Bistables. Per Reference G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the accuracy of the Bistables is included in the instrument drift value. Therefore,

Ba = ± 0.000% span

8.1.31 Bistable Drift (Bd)

Reference C.9 has determined the historical drift values for Foxboro Model 63U-BC Bistables. Per References P.5 through P.8 and P.11 through P.14, the containment pressure Bistables are calibrated every 92 days or quarterly. Per Table 8.2 of Reference C.9, the quarterly 95% probability/95% confidence Bistable Drift value is:

Bd = ± 0.212% span

8.1.32 Bistable M&TE (Bm)

Reference C.9 has determined the historical drift values for Foxboro Model 63U-BC Bistables. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the M&TE Effect of the bistable is included in the instrument drift value. Therefore,

Bm = ± 0.000% span

8.1.33 Bistable Setting Tolerance (Bv)

Per References P.5 through P.8 and P.11 through P.14, the bistable setting tolerance is +0.002 Vdc / - 0.000 Vdc and the calibrated span is 0.4 Vdc. Per Assumption 5.1.11, this value is a symmetrical ± 0.002 Vdc (Note, the signal is in Vdc due to a 10 Ω resistor connected across the calibration point). Therefore,

Bv = ± 0.0020 Vdc
Bv = ± uncertainty * (100% span / calibrated span)
Bv = ± 0.0020 Vdc * (100% span / 0.40 Vdc)

Bv = ± 0.500% span

8.1.34 Bistable Power Supply Effect (Bp)

Reference C.9 has determined the historical drift values for Foxboro Model 63U-BC Bistables. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the Power Supply Effect of the bistable is included in the instrument drift value. Therefore,

Bp = ± 0.000% span

8.1.35 Bistable Temperature Effect (Bt)

The bistable is located in the Control Room where the temperature is controlled by the HVAC system. Per Reference G.21, the change in temperature for the Control Room goes from 65 °F to 120 °F. Since the vendor does not provide any temperature effect information (Ref. V.8), it is expected that the temperature inside the Control Room is well within the operating range of the bistable, and therefore there is no temperature effect.

Bt = ± 0.000% span

8.1.36 Bistable Humidity Effect (Bh)

Per Section 3.3.3.20 of Reference G.1, changes in ambient humidity have a negligible effect on the uncertainty of the instruments used in this calculation.

Bh = ± 0.000% span

8.1.37 Bistable Radiation Effect (Br)

The bistable is located in the Control Room where the radiation is minimal. Furthermore, per Section 3.3.3.21 of Reference G.1, normal radiation errors are considered small with respect to other uncertainties and can be calibrated out. Therefore, the bistable radiation effect is considered negligible.

Br = ± 0.000% span

8.1.38 Bistable Seismic Effect (Bs)

There is no seismic effect provided by the vendor for the bistable (Ref. V.8). Per Section 3.3.4.10 of Ref. G.1, the effects of normal seismic or vibration events for non-mechanical instrumentation are considered zero unless vendor or industry experience indicates otherwise. Therefore,

Bs = ± 0.000% span

8.1.39 PPCS Accuracy (PPCSa)

Per Assumption 5.1.9, the PPCS accuracy is ±0.510% span. Therefore,

PPCSa = ± 0.510% span

8.1.40 PPCS Drift (PPCSd)

Per Assumption 5.1.9, the drift for the PPCS is included in the accuracy term. Therefore,

PPCSd = ± 0.000% span

8.1.41 PPCS M&TE (PPCSm)

Per Reference P.1 and P.2, the Steam Line Pressure PPCS is calibrated with a multimeter capable of measuring 10-50 mAdc on the input and reading the PPCS display at the output (PPCS Readability Effect is accounted for in Section 8.1.48). According to calibration procedure ICI 12 (Reference P.16), the following M&TE are capable of performing this measurement.

Fluke 45 multimeter (fast resolution, 5 digit display, 100 mAdc range):

RA_{mte} = uncertainty * max reading
RA_{mte} = ±0.05% reading * 50 mAdc
RA_{mte} = ±0.025 mAdc
RA_{std} = 0
RD_{mte} = ± 3 DGTS * 0.001 mAdc
RD_{mte} = ± 0.003 mAdc

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

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

$$m_{45} = \pm\sqrt{0.025^2 + 0^2 + 0.003^2} = \pm 0.025 \text{ mAdc}$$

HP 34401A multimeter (6.5 digit display, 100 mAdc range)

RA_{mte} = ± (0.050 % reading + 0.005 % range)
RA_{mte} = ± [0.050 % (50 mAdc) + 0.005 % (100 mAdc)]
RA_{mte} = ± 0.030 mAdc
RA_{std} = 0
RD_{mte} = ± 0.0001 mAdc

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

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

$$m_{HP} = \pm\sqrt{0.030^2 + 0^2 + 0.0001^2} = \pm 0.030 \text{ mAdc}$$

The uncertainty of HP 34401A (m_{HP} = ± 0.030 mAdc) is used as the bounding input M&TE because it is the less accurate of the two M&TE.

Converting to % span,

m_{HP} = ± (0.030 mAdc / 40 mAdc) * 100 % span

m_{HP} = ± 0.075 % span

Therefore, the M&TE uncertainty for the calibration of the PPCS is:

PPCSm = ± 0.075 % span

8.1.42 PPCS Setting Tolerance (PPCSv)

Per Ref. P.1, P.2 and Assumption 5.1.11, PPCS setting tolerance is ±7.0 psi.

PPCSv = calibration tolerance * (100% span / calibrated span)
PPCSv = ± 7.0 psi * (100% span /1400 psi)

PPCSv = ± 0.500% span

8.1.43 PPCS Power Supply Effect (PPCSp)

Per Assumption 5.1.9, the power supply effect for the PPCS is included in the accuracy term. Therefore,

PPCSp = ± 0.000% span

8.1.44 PPCS Temperature Effect (PPCSt)

Per Assumption 5.1.9, the temperature effect for the PPCS is included in the accuracy term. Therefore,

PPCSt = ± 0.000% span

8.1.45 PPCS Humidity Effect (PPCSh)

Per Assumption 5.1.9, the humidity effect for the PPCS is included in the accuracy term. Therefore,

PPCSh = ± 0.000% span

8.1.46 PPCS Radiation Effect (PPCSr)

Per Assumption 5.1.9, the radiation effect for the PPCS is included in the accuracy term. Therefore,

PPCSr = ± 0.000% span

8.1.47 PPCS Seismic Effect (PPCSs)

Per Assumption 5.1.9, the seismic effect for the PPCS is included in the accuracy term. Therefore,

$PPCSs_n = \pm$ 0.000% span

$PPCSs_a = \pm$ 0.000% span

8.1.48 PPCS Readability Effect (PPCSrea)

Per References P.1 and P.2, the PPCS display has 1 decimal place and the span is 1400 psi. Per Reference G.1, Section 3.3.5.3, the readability error for a digital display is the least significant digit. Therefore,

PPCSrea = ± (reading error / calibrated span) * 100%
PPCSrea = ± (0.1 psi / 1400 psi) * 100%

PPCSrea = ± 0.007% span

8.1.49 Indicator Accuracy (Ia)

Ref. C.3 has determined the historical drift values for the Indicator. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the accuracy of the indicator is included in the drift value. Therefore,

Ia = 0.000% span

8.1.50 Indicator Drift (Id)

Per Ref. P.1 and P.2, the indicators are Westinghouse HX-252 and they are calibrated individually. Reference C.3 is the As-Found/As-Left drift analysis for Westinghouse HX-252 indicators that are either string calibrated with Foxboro 66BC-O Isolators or individually calibrated. Although the drift analysis performed in Reference C.3 does not include the As-Found/As-Left data of the Steam Line Pressure indicator, the individually calibrated Westinghouse HX-252 Indicator therein is considered representative of the indicators experienced at PBNP (Ref. C.6). Since the Steam Line Pressure indicators are calibrated every 18 months (Ref. P.1 and P.2), the 100%, 2-year 95%/95% drift value is conservatively used. Therefore,

d = ± 1.028% span

Bias = ± 0.000% span

8.1.51 Indicator M&TE (Im)

Ref. C.3 has determined the historical drift values for the indicator. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the M&TE effect of the indicator is included in the drift value. Therefore,

Im = 0.000% span

8.1.52 Indicator Setting Tolerance (Iv)

Per Ref. P.1, P.2 and Assumption 5.1.11, the setting tolerance is ± 0.8 mAdc, and the calibrated span is 40 mA. Therefore,

Iv = ± (setting tolerance / calibrated span) * 100%
Iv = ± (0.8 mA / 40 mA) * 100%

Iv = ± 2.000% span

8.1.53 Indicator Power Supply Effect (Ip)

Ref. C.3 has determined the historical drift values for the indicator. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the power supply effect of the indicator is included in the drift value. Therefore,

Ip = ± 0.000% span

8.1.54 Indicator Temperature Effect (It)

Per Section 6.6.2, the indicators are rack components located in the Control Room, which is environmentally controlled between 65 °F to 120 °F. Per Reference V.12, the vendor does not provide temperature effects for the indicators. Therefore, the temperature effect is considered included in the indicator drift.

It = ± 0.000% span

8.1.55 Indicator Humidity Effect (Ih)

Per Section 3.3.3.20 of Reference G.1, changes in ambient humidity have a negligible effect on the uncertainty of the instruments used in this calculation. Therefore,

Ih = 0.000% span

8.1.56 Indicator Radiation Effect (Ir)

Per Section 6.6.2, the indicators are rack components located in the Control Room, which is a radiological mild environment. Reference C.3 has determined the historical drift values for the indicator. Per Section 3.3.4.3 of Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the radiation effect of the indicator is included in the drift value. Therefore,

Ir = ± 0.000% span

8.1.57 Indicator Seismic Effect (Is)

There is no seismic effect provided by the vendor for the indicators (Ref. V.12). Per Section 3.3.4.10 of Ref. G.1, the effects of seismic or vibration events are considered zero unless vendor or industry experience indicates otherwise. Vendor information shows that the indicators are seismically qualified (Ref. V.12), with no additional seismic effect specified. Therefore,

Is = ± 0.000% span

8.1.58 Indicator Readability Effect (Irea)

Ref. C.3 has determined the historical drift values for the indicator. Per Ref. G.1, when drift error values have been statistically derived from As-Found/As-Left calibration data, the readability effect of the indicator is included in the drift value. Therefore,

Irea = ± 0.000% span

8.1.59 Process Error (PE)

According to Ref. G.54, the elevation of the Loop A Steam Line Pressure transmitters for Units 1 & 2 is approximately 50' 1.25". The elevation of the Loop B Steam Line Pressure transmitters for Units 1 & 2 is approximately 70' 1.25". Per Reference D.12 – D.15, the top of the water leg elevation is 88'-0" for both Loops A and B. Under normal operating conditions, the density difference due to a change in temperatures results in an error so small that it would be rounded off per section 7.1 (B). Therefore, only the PE due to abnormal temperature is determined. Loop A sensing lines are located in a non-harsh area and are exposed to normal temperature conditions. The density changes of the Loop B instruments, which are located in a SLB area, are considered to be greater and will be conservatively used to determine the process error applicable for both loops.

The minimum height from the top of water leg to transmitters (Loop B) is:

h_B = Top of water leg elevation – Loop B Transmitter Height

h_B = 88'-0" - 70' 1.25"
h_B = 17.896'

Converting from height to pressure under normal atmospheric condition at 68 °F:

psi per foot of water = 0.4335 psi/ftH_2O (Ref. G.5, Table 2-3)

Loop B $dP_{head\_correction}$ = h_B * 0.4335 psi/ftH_2O

Loop B $dP_{head\_correction}$ = 17.896 ft * 0.4335 psi/ftH_2O
= 7.758 psi

Per Ref. G.5, the specific volume of compressed water @ 500 psig (AL):

@ 68 °F	=	0.0160234	(v_1)
@ 298 °F	=	0.0173978	(v_2)

specific gravity @ 68 °F = (v @ 68 °F) / (v_1)
= 0.0160234 / 0.0160234
= 1.0

specific gravity @ 298 °F = (v @ 68 °F) / (v_2)
= 0.0160234 / 0.0173978
= 0.921

Difference of specific gravity (Δv) from 68 °F to 298 °F is 0.079.

Using Equation 7.6-1,

dP Error = [(Δv * $dP_{head\_correction}$) / PS] * 100%

Loop B PE = [(0.079 * 7.758 psi) / 1400 psi] * 100%
PE = 0.044 %

As the temperature increases, the density of the static leg will decrease. Therefore, PE will be a negative error and treated as a bias.

PE = - 0.044% span

8.1.60 Insulation Resistance Effect (IR)

Leakage currents during accident conditions (HELB) could cause a reduction in insulation resistance of the cables and splices for the Steam Line Pressure loop configuration. The instrument loop is a 10 to 50 mAdc current loop with a Foxboro N-E11GM transmitter. If the leakage current develops in the loop due to cable insulation degradation, the path is represented as a shunt resistance in parallel to the transmitter. The Steam Line Pressure circuit can be represented as follows:

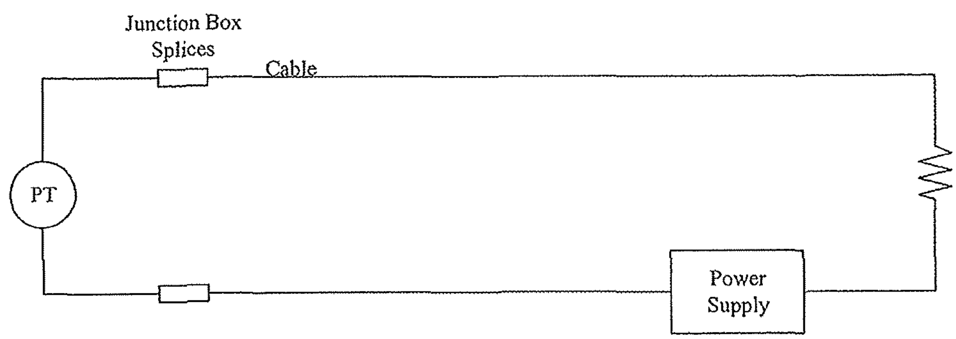


Figure 8.1.60-1, Signal Transmission Component

The signal transmission components (transmitters) are subject to IR degradation during an accident.

The equivalent circuit schematic representing the above wiring diagram showing the IR leakage path is shown below:

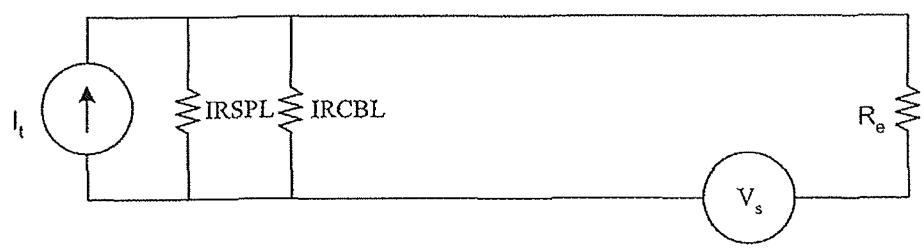


Figure 8.1.60-2 Equivalent Circuit Schematic

Where:

I_t	= Device output current at point of interest
IRSPL	= IR value of the splice at the transmitter junction box.
IRCBL	= IR value of the signal cable.
V_s	= Power Supply
R_e	= Load resistor

The above circuit (Figure 8.1.60-2) can be simplified as follows:

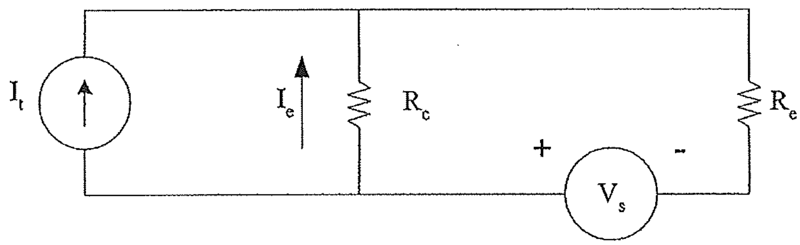


Figure 8.1.60-3, Simplified Circuit

where,

$$\frac{1}{R_c} = \frac{1}{IRSPL} + \frac{1}{IRCBL} \qquad \text{(Eq. 8.1.60-1)}$$

From Section 6.6.1, only transmitters 1(2)PT-478, 1(2)PT-479, and 1(2)PT-483 are located in the fan room. Therefore, only these transmitters are exposed to accident conditions and contribute IR effects. For conservatism, the IR effect is determined from the maximum cable length of each transmitter from Ref. G.16. From table 6.5-1, the applicable transmitters have four different types of cables as analyzed below.

- Installation procedures (Ref P.15 and P.17 - P.27) indicate that the splices at the transmitter junction box use Raychem Type ACSF-N Sleeves. Tyco Electronics (Raychem) Report EDR-5336 (Ref. G.40) evaluates Raychem Type WCSF-N Splices and determines that the IR value is $2.5 \times 10^6\ \Omega$ at 500 Vdc. Therefore,

  IRSPL= $2.5 \times 10^6\ \Omega$

- There are four different types of cable used for the loops evaluated in this calculation, each with differing IR values. Each cable type is evaluated and the worst case is used as the total IR effect. From Appendix G of Ref. G.1, the following equation is used to determine the effective resistance when an IR value is given for a test length of cable.

  R_l = (IR)(L_{IR}) / L_C (Eq. 8.1.60-2)

  where:

  R_l = Effective Resistance (IRCBL)

IR = cable IR value per unit length
L_{IR} = vendor test cable length
L_C = installed cable length

The results calculated according to cable length and manufacturer are presented in Table 8.1.60-1.

Reference G.23 provides the equation for the Rockbestos cable insulation resistance as follows.

$$IRCBL_{Rock} = \left[4.0x10^{15} * e^{-0.079*T} * \log\left(\frac{D}{d}\right) M\Omega \text{ for} 1000ft \right] / \text{ x ft}$$

The equation is evaluated at the maximum accident steam line break temperature (T) of 298 °F (421 Kelvin). Per Ref. G.23, the insulation diameter (D) is 0.096 inches; 16 AWG wire has a conductor diameter (d) of 0.056 inches. The cable length for each transmitter is substituted as 'x' into the equation. From Table 6.5-1, the only applicable Rockbestos cable comes from 2PT-483 and is 375 ft long. Therefore,

$$IRCBL_{Rock} = \left[4.0x10^{15} * e^{-0.079*421} * \log\left(\frac{0.096 \text{ in.}}{0.056 \text{ in.}}\right) M\Omega \text{ for} 1000ft \right] / 375 \text{ ft}$$

$IRCBL_{Rock} = 8.98 \times 10^6 \Omega$ for 1000ft

This method of calculation corresponds only to the cable coming from 2PT-483 and the value can be found in Table 8.1.60-1 below.

Information from Table 6.5-1 and the manufacturer IR values below are substituted into Eq 8.1.60-2 to calculate the specific IR value of each of the remaining cables. The results are presented below in Table 8.1.60-1.

From Reference G.41, the lowest cable insulation resistance for Brand Rex cables measured during testing at 317 °F (this bounds the maximum accident temperature of 298 °F) for specimen 5-2 is $3.2 \times 10^7 \Omega$ for 30 ft of test cable. Therefore,

IR_{BR} = $3.2 \times 10^7 \Omega$ for 30 ft.

From Reference G.46, the lowest cable insulation resistance for Okonite cables measured during LOCA testing at 315 °F (this bounds the maximum accident temperature of 298 °F) for specimen 4B is $1.9 \text{x} 10^6 \Omega$ for 20 feet of cable (Section 4.2 of Ref. G.46). Therefore,

$IR_{Okonite} = 1.9 \times 10^6 \Omega$ for 20 ft

From References G.44 and G.59, the results of a simulated LOCA test for BIW cables at 316 °F (this bounds the maximum accident temperature of 298 °F) show that the lowest measured IR value is $8.0 \times 10^7 \Omega$ for 10 ft of cable. Therefore,

IR_{BIW} $= 8.0 \times 10^7\ \Omega$ for 10 ft

Table 8.1.60-1, Equivalent Resistance Values

Transmitter	$IRCBL_{Rock}$	$IRCBL_{BR}$	$IRCBL_{Okonite}$	$IRCBL_{BIW}$	IRSPL	R_c (Eq. 8.1.60-1)
1PT-478			$1.3x10^5$		$2.5x10^6$	$1.2x10^5$
1PT-479			$1.2x10^5$		$2.5x10^6$	$1.1x10^5$
1PT-483		$3.0x10^6$			$2.5x10^6$	$1.4x10^6$
2PT-478				$3.7x10^6$	$2.5x10^6$	$1.5x10^6$
2PT-479				$3.1x10^6$	$2.5x10^6$	$1.4x10^6$
2PT-483	$8.98x10^6$				$2.5x10^6$	$1.9x10^6$

From the above table, the worst case IR effect is for the cable from 1PT-479. Therefore,

$\mathbf{R_c}$ $\mathbf{= 1.1 \times 10^5\ \Omega}$

- Per Reference V.10, the load of the power supply must be at least 600Ω. Otherwise, the potentiometer must be adjusted to account for the current. From Figure 6.2-1 and 6.2-2, the only loop loads on the power supply are the Current Converter and the Lead/Lag Module; the transmitter load is considered 0 Ω (Ref. V.11). The Current Converter load is 100 Ω (Ref. V.7) and the Lead/Lag Module load is 200 Ω (Ref. V.9). As a result, the voltage in the transmitter loop is 84 ± 2 Vdc (Ref V.10). Therefore,

  $\mathbf{V_s}$ $\mathbf{= 86\ Vdc}$

- Per References V.11, the minimum transmitter load around the loop is 600Ω. As previously stated, 300 Ω from the loop components and the other 300 Ω comes from the potentiometer adjustment on the power supply. Therefore,

  $\mathbf{R_e}$ $\mathbf{= 600\ \Omega}$

  Substituting the above values, together with the minimum input current of 10 mA (for maximum error) to Equation 1, Appendix G of Reference G.1:

$$I_e = \frac{V_s - I_t(R_e)}{(R_c + R_e)}$$

$$I_e = \frac{86 - (10x10^{-3})(600)}{(1.1x10^5 + 600)}$$

$$I_e = 0.723 \text{ mA}$$

Substituting in Equation 2, Appendix G of Reference G.1 to obtain the error in percent span.

$$IR = \frac{I_e}{I_{MAX} - I_{MIN}} * 100\%$$

$$IR = \frac{0.723}{50 - 10} * 100\%$$

$$IR_a = 1.808 \text{ \% span}$$

The error due to reduction in insulation resistance for accident conditions is a positive bias. This error is only applicable to accident conditions.

$$\mathbf{IR_a = +1.808 \text{ \% span}}$$

8.2 Device Uncertainty Summary

8.2.1 Sensor Uncertainties

Parameter	Uncertainty (% span) (95/95)		Reference Section
	Normal Conditions	Accident Conditions	
Sensor Accuracy (Sa)	± 0.000 % span	± 0.000 % span	8.1.1
Sensor Drift (Sd) Bias (B_S)	± 0.518 % span ± 0.000 % span	± 0.518 % span ± 0.000 % span	8.1.2
Sensor M&TE (Sm)	± 0.000 % span	± 0.000 % span	8.1.3
Sensor Setting Tolerance (Sv)	± 0.500 % span	± 0.500 % span	8.1.4
Sensor Power Supply Effect (Sp)	± 0.000 % span	± 0.000 % span	8.1.5
Sensor Temperature Effect (St)	St_{n1}: ± 0.762% span St_{n2}: ± 1.074 % span	St_a: ± 8.000 % span	8.1.6
Sensor Humidity Effect (Sh)	± 0.000 % span	± 0.000 % span	8.1.7
Sensor Radiation Effect (Sr)	± 0.000 % span	± 0.000 % span	8.1.8
Sensor Seismic Effect (Ss)	± 0.000 % span	± 0.000 % span	8.1.9
Sensor Static Pressure Effect (Sspe)	± 0.000 % span	± 0.000 % span	8.1.10
Sensor Overpressure Effect (Sope)	± 0.000 % span	± 0.000 % span	8.1.11

8.2.2 Current-to-Current Converter Uncertainties

Parameter	Uncertainty (% span) (95/95)		Reference Section
	Normal Conditions	Accident Conditions	
Current-to-Current Converter Accuracy (I/Ia)	± 0.500 % span	± 0.500 % span	8.1.12
Current-to-Current Converter Drift (I/Id)	± 0.500 % span	± 0.500 % span	8.1.13
Current-to-Current Converter M&TE (I/Im)	± 0.095 % span	± 0.095 % span	8.1.14
Current-to-Current Converter Setting Tolerance (I/Iv)	± 0.500 % span	± 0.500 % span	8.1.15
Current-to-Current Converter Power Supply Effect (I/Ip)	± 1.000 % span	± 1.000 % span	8.1.16
Current-to-Current Converter Temperature Effect (I/It)	± 0.000% span	± 0.000 % span	8.1.17
Current-to-Current Converter Humidity Effect (I/Ih)	± 0.000 % span	± 0.000 % span	8.1.18
Current-to-Current Converter Radiation Effect (I/Ir)	± 0.000 % span	± 0.000 % span	8.1.19
Current-to-Current Converter Seismic Effect (I/Is)	± 0.000 % span	± 0.000 % span	8.1.20

8.2.3 Lead/Lag Module Uncertainties

Parameter	Uncertainty (% span) (95/95)		Reference Section
	Normal Conditions	Accident Conditions	
Lead/Lag Module Accuracy (LLa)	± 0.500 % span	± 0.500 % span	8.1.21
Lead/Lag Module Drift (LLd)	± 0.500 % span	± 0.500 % span	8.1.22
Lead/Lag Module M&TE (LLm)	± 0.083 % span	± 0.083 % span	8.1.23
Lead/Lag Module Setting Tolerance (LLv)	± 0.500 % span	± 0.500 % span	8.1.24
Lead/Lag Module Power Supply Effect (LLp)	± 0.000 % span	± 0.000 % span	8.1.25
Lead/Lag Module Temperature Effect (LLt)	± 0.000 % span	± 0.000 % span	8.1.26
Lead/Lag Module Humidity Effect (LLh)	± 0.000 % span	± 0.000 % span	8.1.27
Lead/Lag Module Radiation Effect (LLr)	± 0.000 % span	± 0.000 % span	8.1.28
Lead/Lag Module Seismic Effect (LLs)	± 0.000 % span	± 0.000 % span	8.1.29

8.2.4 Bistable Uncertainties

Parameter	Uncertainty (% span) (95/95)		Reference Section
	Normal Conditions	Accident Conditions	
Bistable Accuracy (Ba)	± 0.000 % span	± 0.000 % span	8.1.30
Bistable Drift (Bd)	± 0.212 % span	± 0.212 % span	8.1.31
Bistable M&TE (Bm)	± 0.000% span	± 0.000 % span	8.1.32
Bistable Setting Tolerance (Bv)	± 0.500 % span	± 0.500 % span	8.1.33
Bistable Power Supply Effect (Bp)	± 0.000 % span	± 0.000 % span	8.1.34
Bistable Temperature Effect (Bt)	± 0.000 % span	± 0.000 % span	8.1.35
Bistable Humidity Effect (Bh)	± 0.000 % span	± 0.000 % span	8.1.36
Bistable Radiation Effect (Br)	± 0.000 % span	± 0.000 % span	8.1.37
Bistable Seismic Effect (Bs)	± 0.000 % span	± 0.000 % span	8.1.38

8.2.5 PPCS Uncertainties

Parameter	Uncertainty (% span) (95/95)		Reference Section
	Normal Conditions	Accident Conditions	
PPCS Accuracy (PPCSa)	± 0.510 % span	± 0.510 % span	8.1.39
PPCS Drift (PPCSd)	± 0.000 % span	± 0.000 % span	8.1.40
PPCS M&TE (PPCSm)	± 0.075 % span	± 0.075 % span	8.1.41
PPCS Setting Tolerance (PPCSv)	± 0.500 % span	± 0.500 % span	8.1.42
PPCS Power Supply Effect (PPCSp)	± 0.000 % span	± 0.000 % span	8.1.43
PPCS Temperature Effect (PPCSt)	± 0.000 % span	± 0.000 % span	8.1.44
PPCS Humidity Effect (PPCSh)	± 0.000 % span	± 0.000 % span	8.1.45
PPCS Radiation Effect (PPCSr)	± 0.000 % span	± 0.000 % span	8.1.46
PPCS Seismic Effect (PPCSs)	± 0.000 % span	± 0.000 % span	8.1.47
PPCS Readability Effect (PPCSrea)	± 0.007 % span	± 0.007 % span	8.1.48

8.2.6 Indicator Uncertainties

Parameter	Uncertainty (% span) (95/95)	Reference Section
	Normal Conditions	
Indicator Accuracy (Ia)	± 0.000 % span	8.1.49
Indicator Drift (Id) Bias (B_d)	± 1.028 % span ± 0.000 % span	8.1.50
Indicator M&TE (Im)	± 0.000 % span	8.1.51
Indicator Setting Tolerance (Iv)	± 2.000 % span	8.1.52
Indicator Power Supply Effect (Ip)	± 0.000 % span	8.1.53
Indicator Temperature Effect (It)	± 0.000 % span	8.1.54
Indicator Humidity Effect (Ih)	± 0.000 % span	8.1.55
Indicator Radiation Effect (Ir)	± 0.000 % span	8.1.56
Indicator Seismic Effect (Is)	± 0.000 % span	8.1.57
Indicator Readability Effect (Irea)	± 0.000 % span	8.1.58

8.2.7 Process Considerations

Parameter	Normal Conditions	Accident Conditions	Reference Section
Process Error (PE)	N/A	-0.044 % span	8.1.59
Insulation Resistance (IR)	N/A	+1.808 % span	8.1.60

8.3 Total Loop Error

8.3.1 Accident Total Bistable Loop Error (TLE_{1a})

Low Steam Line Pressure Safety Injection is a decreasing setpoint. Per Section 7.4, it is only necessary to calculate the positive TLE with separate random and bias portions.

Using Eq. 7.1.2.1,

$$TLE_{1a\text{-}rdm}^{+} = \sqrt{\begin{aligned}&Sa^2 + LLa^2 + Ba^2 + Sd^2 + LLd^2 + Bd^2 + Sm^2 + LLm^2 \\ &+ Bm^2 + Sv^2 + LLv^2 + Bv^2 + Sp^2 + LLp^2 + Bp^2 + St_a^{\,2} \\ &+ LLt^2 + Bt^2 + Sh_a^{\,2} + LLh^2 + Bh^2 + Sr_a^{\,2} + LLr^2 + Br^2 \\ &+ Ss^2 + LLs^2 + Bs^2 + Sspe_a^{\,2} + Sope_a^{\,2}\end{aligned}}$$

$$TLE_{1a\text{-}rdm}^{+} = \sqrt{\begin{aligned}&0.000^2 + 0.500^2 + 0.000^2 + 0.518^2 + 0.500^2 + 0.212^2 \\ &+ 0.00^2 + 0.083^2 + 0.00^2 + 0.500^2 + 0.500^2 + 0.500^2 \\ &+ 0.000^2 + 0.000^2 + 0.000^2 + 8.000^2 + 0.00^2 + 0.00^2 \\ &+ 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 \\ &+ 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2\end{aligned}}$$

$TLE_{1a\text{-}rdm}^{+}$ = + 8.097% span (95/95)

From Section 8, insulation resistance is the only positive bias. Therefore,

$TLE_{1a\text{-}bias}$ = $Biases^{+}$ = IR

$TLE_{1a\text{-}bias}^{+}$ = + 1.808% span (95/95)

8.3.2 Normal Total PPCS Loop Error (TLE_{2n})

Using equation 7.1.2.2,

$$TLE_{2n} = \sqrt{\begin{array}{l} Sa^2 + I/Ia^2 + PPCSa^2 + Sd^2 + I/Id^2 + PPCSd^2 + Sm^2 \\ + I/Im^2 + PPCSm^2 + Sv^2 + I/Iv^2 + PPCSv^2 + Sp^2 + I/Ip^2 \\ + PPCSp^2 + St_{n1}^2 + I/It^2 + PPCSt^2 + Sh_n^2 + I/Ih^2 + PPCSh^2 \\ + Sr_n^2 + I/Ir^2 + PPCSr^2 + Ss^2 + I/Is^2 + PPCSs^2 + PPCSrea^2 \\ + Sspe_n^2 + Sope_n^2 \end{array}} + Bias$$

$$TLE_{2n} = \sqrt{\begin{array}{l} 0.000^2 + 0.500^2 + 0.510^2 + 0.518^2 + 0.500^2 + 0.000^2 \\ + 0.000^2 + 0.095^2 + 0.075^2 + 0.500^2 + 0.500^2 + 0.500^2 \\ + 0.000^2 + 1.000^2 + 0.000^2 + 0.762^2 + 0.000^2 + 0.000^2 \\ + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 \\ + 0.000^2 + 0.000^2 + 0.000^2 + 0.000^2 + 0.007^2 + 0.000^2 \\ + 0.000^2 \end{array}} + 0.00$$

$TLE_{2n} = \pm 1.837\%$ span (95/95)

Converting to process units,

TLE_{2n} = (±1.837% span) * (1400 psi)/100%

TLE_{2n} = ± 25.72 psi (95/95)

Convert to 75/75 error:
$error_{75/75} = (1.15/1.96) * error_{95/95}$ (Section 3.3.3.13 of Ref. G.1)
TLE_2 = (1.15/1.96) * ±1.837 % span = ±1.078 % span

TLE_{2n} = ± 1.078 % span (75/75)

Converting to process units,

TLE_{2n} = (±1.078% span) * (1400 psi)/100%

TLE_{2n} = ± 15.09 psi (75/75)

8.3.3 Normal Total Indicator Loop Error for EOP Input (TLE_{3n})

Using Equation 7.1.2.3-1,

$$TLE_{3n} = \sqrt{\begin{array}{l} Sa^2 + I/Ia^2 + Ia^2 + Sd^2 + I/Id^2 + Id^2 + Sm^2 \\ + I/Im^2 + Im^2 + Sv^2 + I/Iv^2 + Iv^2 + Sp^2 + I/Ip^2 \\ + Ip^2 + St_{n2}{}^2 + I/It^2 + It^2 + Sh_n{}^2 + I/Ih^2 + Ih^2 \\ + Sr_n{}^2 + I/Ir^2 + Ir^2 + Ss^2 + I/Is^2 + Is^2 + Sspe_n{}^2 \\ + Sope_n{}^2 \end{array}} + Bias$$

$$TLE_{3n} = \sqrt{\begin{array}{l} 0.00^2 + 0.500^2 + 0.00^2 + 0.518^2 + 0.500^2 + 1.028^2 \\ + 0.00^2 + 0.095^2 + 0.00^2 + 0.500^2 + 0.500^2 \\ + 2.000^2 + 0.00^2 + 1.000^2 + 0.00^2 + 1.074^2 \\ + 0.000^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 \\ + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 \\ + 0.00^2 + 0.00^2 \end{array}} + 0.00$$

$TLE_{3n} = \pm 2.913\%$ span (95/95)

Converting to process units,

$TLE_{3n} = (\pm 2.913\%\ \text{span}) * (1400\ \text{psi})/100\%$

$TLE_{3n} = \pm$ 40.78 psi (95/95)

Convert to 75/75 error:
$error_{75/75} = (1.15/1.96) * error_{95/95}$ (Section 3.3.3.13 of Ref. G.1)
$TLE_{3n} = (1.15/1.96) * \pm 2.913\ \%\ \text{span} = \pm 1.710\ \%\ \text{span}$

$TLE_{3n} = \pm 1.710\%$ span (75/75)

Converting to process units,

$TLE_{3n} = (\pm 1.710\%\ \text{span}) * (1400\ \text{psi})/100\%$

$TLE_{3n} = \pm$ 23.94 psi (75/75)

8.3.4 Accident Total Indicator Loop Error For EOP Input (TLE_{3a})

The reduction factor to convert a 95/95 variable to a 75/75 variable should only be applied to the random portion of the TLE that has been statistically derived using the SRSS method. Therefore, the random and bias portions of the TLE are separate.

Using Equation 7.1.2.3-2,

$$TLE_{3a\text{-}rdm}^{+} = \sqrt{\begin{matrix} Sa^2 + I/Ia^2 + Ia^2 + Sd^2 + I/Id^2 + Id^2 + Sm^2 + I/Im^2 \\ + Im^2 + Sv^2 + I/Iv^2 + Iv^2 + Sp^2 + I/Ip^2 + Ip^2 + St_a^{\,2} \\ + I/It^2 + It^2 + Sh_a^{\,2} + I/Ih^2 + Ih^2 + Sr_a^{\,2} + I/Ir^2 + Ir^2 \\ + Ss^2 + I/Is^2 + Is^2 + Sspe_a^{\,2} + Sope_a^{\,2} \end{matrix}}$$

$$TLE_{3a\text{-}rdm}^{+} = \sqrt{\begin{matrix} 0.00^2 + 0.500^2 + 0.00^2 + 0.518^2 + 0.500^2 \\ + 1.028^2 + 0.00^2 + 0.095^2 + 0.00^2 + 0.500^2 \\ + 0.500^2 + 2.000^2 + 0.00^2 + 1.000^2 + 0.00^2 \\ + 8.000^2 + 0.000^2 + 0.00^2 + 0.00^2 + 0.00^2 \\ + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 \\ + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 \end{matrix}}$$

$TLE_{3a\text{-}rdm}$ = ± 8.446% span (95/95)

From Section 8, insulation resistance is the only positive bias and the process error is the only negative bias. Therefore,

$TLE_{3a\text{-}bias}^{+}$ = $Biases^{+}$ = IR

$TLE_{3a\text{-}bias}^{+}$ = + 1.808% span (95/95)

$TLE_{3a\text{-}bias}^{-}$ = $Biases^{-}$ = PE

$TLE_{3a\text{-}bias}^{-}$ = - 0.044% span (95/95)

To determine the total TLE, the random and bias portions of like sign are combined as follows:

$TLE_{3a}^{+} = TLE_{3a\text{-}rdm}^{+} + TLE_{3a\text{-}bias}^{+}$ = + 8.446% span + 1.808% span

TLE_{3a}^{+} = + 10.254% span

$TLE_{3a}^{-} = TLE_{3a\text{-}rdm}^{-} + TLE_{3a\text{-}bias}^{-}$ = - 8.446% span – 0.044% span

$\mathbf{TLE_{3a}^{-} = -8.490\%\ span}$

Converting to process units,

$TLE_{3a}^{+} = (TLE_{3a}^{+}) * PS$

$TLE_{3a}^{+} = (+10.254\%) * 1400\ psi \qquad = +143.56\ psi$

$TLE_{3a}^{-} = (TLE_{3a}^{-}) * PS$

$TLE_{3a}^{-} = (-8.490\%) * 1400\ psi \qquad = -118.86\ psi$

Therefore,

$\mathbf{TLE_{3a} = +143.56\ psi, -118.86\ psi}$ **(95/95)**

Convert to a 75/75 error:
$Error_{75/75} = [(1.15/1.96) * error\text{-}rdm_{95/95}] + error\text{-}bias_{95/95}$

Substituting the values from above to find the positive TLE,

$TLE_{3a}^{+} = [(1.15/1.96) * 8.446\%] + 1.808\%$

$\mathbf{TLE_{3a}^{+} = +6.764\%\ span}$

Substituting the values from above to find the negative TLE,

$TLE_{3a}^{-} = [(1.15/1.96) * -8.446\%] - 0.044\%$

$\mathbf{TLE_{3a}^{-} = -5.000\%\ span}$

Converting to process units,

$TLE_{3a}^{+} = (+6.764\%\ span) * (1400psi/100\%)$

$TLE_{3a}^{+} = +94.70\ psi$

$TLE_{3a}^{-} = (-5.000\%\ span) * (1400psi/100\%)$

$TLE_{3a}^{-} = -70.00\ psi$

Therefore,

$\mathbf{TLE_{3a} = +94.70\ psi, -70.00\ psi}$ (75/75)

The choice of whether to use the positive or negative TLE is dependent upon the process being considered for EOP. Therefore, discretion should be exercised in the Steam Line Pressure EOP Setpoint calculation WEP-SPT-20.

8.3.5 Total Indicator Loop Error for Parametric (TLE_{3p})

Using Equation 7.1.2.3-3,

$$TLE_{3p} = \sqrt{\begin{aligned}&Sa^2 + I/Ia^2 + Ia^2 + Sd^2 + I/Id^2 + Id^2 + Sm^2 + I/Im^2 \\ &+ Im^2 + Sv^2 + I/Iv^2 + Iv^2 + Sp^2 + I/Ip^2 + Ip^2 + St_{nl}{}^2 \\ &+ I/It^2 + It^2 + Sh_n{}^2 + I/Ih^2 + Ih^2 + Sr_n{}^2 + I/Ir^2 + Ir^2 \\ &+ Ss^2 + I/Is^2 + Is^2 + Sspe_n{}^2 + Sope_n{}^2\end{aligned}} + Bias$$

$$TLE_{3p} = \sqrt{\begin{aligned}&0.00^2 + 0.500^2 + 0.00^2 + 0.518^2 + 0.500^2 + 1.028^2 \\ &+ 0.00^2 + 0.095^2 + 0.00^2 + 0.500^2 + 0.500^2 \\ &+ 2.000^2 + 0.00^2 + 1.000^2 + 0.00^2 + 0.762^2 \\ &+ 0.000^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 \\ &+ 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 + 0.00^2 \\ &+ 0.00^2 + 0.00^2\end{aligned}} + 0.00$$

TLE_{3p} = ±2.813% span (95/95)

Converting to process units,

TLE_{3p} = (±2.813% span) * (1400 psi)/100%

TLE_{3p} = ± 39.39 psi (95/95)

Convert to 75/75 error:
$error_{75/75}$ = (1.15/1.96) * $error_{95/95}$ (Section 3.3.3.13 of Ref. G.1)
TLE_{3p} = (1.15/1.96) * ±2.813% span = ±1.651 % span

TLE_{3p} = ±1.651% span (75/75)

Converting to process units,

TLE_{3p} = (±1.651% span) * (1400 psi)/100%

TLE_{3p} = ± 23.11 psi (75/75)

8.4 Acceptable As-Found and As-Left Calibration Tolerances

8.4.1 Acceptable As-Left Calibration Tolerances

8.4.1.1 Sensor As-Left Tolerances (SAL)

SAL = ± Sv	Section 7.1.4.1
SAL = ± 0.500% span	Section 8.1.4

Converting from % span to mAdc and rounding to procedure precision:

SAL = ± 0.500% span * (40 mAdc / 100 % span)

SAL = ± 0.20 mAdc

8.4.1.2 Current-to-Current Converter As-Left Tolerances (I/IAL)

I/IAL = ± I/Iv	Section 7.1.4.2
I/IAL = ± 0.500 % span	Section 8.1.15

Converting from % span to mAdc and rounding to procedure precision:

I/IAL = ± 0.500% span * (40.00 mAdc / 100 % span)

I/IAL = ± 0.20 mAdc

8.4.1.3 Lead/Lag Module As-Left Tolerances (LLAL)

LLAL = ± LLv	Section 7.1.4.3
LLAL = ± 0.500 % span	Section 8.1.24

Converting from % span to Vdc and rounding to procedure precision:

LLAL = ± 0.500% span * (0.40 Vdc / 100 % span)

LLAL = ± 0.002 Vdc

8.4.1.4 Indicator As-Left Tolerances (IAL)

IAL = ± Iv	Section 7.1.4.4
IAL = ± 2.000 % span	Section 8.1.52

Converting from % span to Vdc and rounding to procedure precision:

IAL = ± 2.000 % span * (40.00 mAdc / 100 % span)

IAL = ± 0.80 mAdc

8.4.1.5 PPCS As-Left Tolerances (PPCSAL)

PPCSAL = ± PPCSv	Section 7.1.4.5
PPCSAL = ± 0.500 % span	Section 8.1.42

Converting from % span to psi and rounding to procedure precision:

PPCSAL = ± 0.500 % span * (1400 psi / 100 % span)

PPCSAL = ± 7.00 psi

8.4.1.6 Bistable As-Left Tolerances (BAL)

BAL = ± Bv	Section 7.1.4.6
BAL = ± 0.500% span	Section 8.1.33

Converting to Vdc and rounding to procedure precision (BAL is in Vdc due to the 10Ω loop series test point resistor):

BAL = ± 0.500% span * (0.40 Vdc / 100 % span)

BAL = ± 0.0020 Vdc

Converting to process units,

BAL = (±0.500% span) * (1400 psi) / 100%

BAL = ± 7.0 psi

8.4.2 Acceptable As-Found Calibration Tolerances

8.4.2.1 Sensor As-Found Tolerance (SAF)

Using Equation 7.1.3.1,

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

where:

Sv	= ± 0.500 % span	Section 8.1.4
Sd	= ± 0.518 % span	Section 8.1.2
Sm	= ± 0.000 % span	Section 8.1.3

$$SAF = \pm \sqrt{0.500^2 + 0.518^2 + 0.000^2} \pm 0$$

SAF $= \pm$ **0.720 % span**

Converting to mA and rounding to procedure precision:

SAF $= \pm$ 0.720 % span * (40.00 mAdc / 100 %)

SAF $= \pm$ **0.29 mAdc**

8.4.2.2 Current-to-Current Converter As-Found Tolerance (I/IAF)

Using Equation 7.1.3.2,

$$I/IAF = \pm \sqrt{I/Iv^2 + I/Id^2 + I/Im^2}$$

where:

I/Iv	$= \pm$ 0.500 % span	Section 8.1.15
I/Id	$= \pm$ 0.500 % span	Section 8.1.13
I/Im	$= \pm$ 0.095 % span	Section 8.1.14

$$I/IAF = \pm \sqrt{0.500^2 + 0.500^2 + 0.095^2} + 0$$

I/IAF $= \pm$ **0.713 % span**

Converting to mA and rounding to procedure precision:

I/IAF $= \pm$ 0.713 % span * (40.00 mAdc / 100 %)

I/IAF $= \pm$ **0.29 mAdc**

8.4.2.3 Lead/Lag Module As-Found Tolerance (LLAF)

Using Equation 7.1.3.3,

$$LLAF = \pm \sqrt{LLv^2 + LLd^2 + LLm^2}$$

where:

LLv	$= \pm$ 0.500 % span	Section 8.1.24
LLd	$= \pm$ 0.500 % span	Section 8.1.22
LLm	$= \pm$ 0.083 % span	Section 8.1.23

$$LLAF = \pm \sqrt{0.500^2 + 0.500^2 + 0.083^2} + 0$$

LLAF $= \pm$ **0.712 % span**

Converting to Vdc and rounding to procedure precision:

LLAF $= \pm$ 0.7120 % span * (0.40 Vdc / 100 %)

LLAF $= \pm$ 0.0028 Vdc

8.4.2.4 Indicator As-Found Tolerance (IAF)

Using Equation 7.1.3.4,

$$IAF = \pm\sqrt{Iv^2 + Id^2 + Im^2}$$

where:

Iv	$= \pm$ 2.000 % span	Section 8.1.52
Id	$= \pm$ 1.028 % span	Section 8.1.50
Im	$= \pm$ 0.000 % span	Section 8.1.51

$$IAF = \pm\sqrt{2.000^2 + 1.028^2 + 0^2} + 0$$

IAF $= \pm$ 2.249 % span

Converting to Vdc and rounding to procedure precision:

IAF $= \pm$ 2.249 % span * (40.00 mAdc / 100 %)

IAF $= \pm$ 0.90 mAdc

8.4.2.5 PPCS As-Found Tolerance (PPCSAF)

Using Equation 7.1.3.5,

$$PPCSAF = \pm\sqrt{PPCSv^2 + PPCSd^2 + PPCSm^2}$$

where:

PPCSv	$= \pm$ 0.500 % span	Section 8.1.42
PPCSd	$= \pm$ 0.000 % span	Section 8.1.40
PPCSm	$= \pm$ 0.075 % span	Section 8.1.41

$$PPCSAF = \pm\sqrt{0.500^2 + 0.000^2 + 0.075^2} + 0$$

PPCSAF $= \pm$ 0.506 % span

Converting to psi and rounding to procedure precision:

PPCSAF $= \pm$ 0.506 % span * (1400 psi / 100 %)

PPCSAF $= \pm$ 7.1 psi

8.4.2.6 Bistable As-Found Tolerance (BAF)

Using Equation 7.1.3.6,

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

where:

Bv	= ± 0.500 % span	Section 8.1.33
Bd	= ± 0.212 % span	Section 8.1.31
Bm	= ± 0.000 % span	Section 8.1.32

$$BAF = \pm\sqrt{0.500^2 + 0.212^2 + 0.000^2} + 0$$

BAF = ± 0.543 % span

Converting to Vdc and rounding to procedure precision:

BAF = ± 0.543 % span * (0.4000 Vdc / 100 %)

BAF = ± 0.0022 Vdc

Converting to process units,

BAF = (±0.543% span) * (1400 psi) / 100%

BAF = ± 7.6 psi

8.5 Channel Check Tolerance

From Section 7.3, the Channel Check Tolerance (CCT) is calculated for two indication loops using the SRSS combination of the allowances (accuracy, drift, setting tolerances, and the readability effect for the sensor, the I/I converter and the indicator) for each of the Indicators.

Using Equation 7.3-1:

$$CCT = \sqrt{\begin{array}{l} Sa_1^2 + I/Ia_1^2 + Ia_1^2 + Sv_1^2 + I/Iv_1^2 + Iv_1^2 + Sd_1^2 + I/Id_1^2 \\ + Id_1^2 + Irea_1^2 + Sa_2^2 + I/Ia_2^2 + Ia_2^2 + Sv_2^2 + I/Iv_2^2 \\ + Iv_2^2 + Sd_2^2 + I/Id_2^2 + Id_2^2 + Irea_2^2 \end{array}}$$

Substituting from Section 8.2,

$$CCT = \sqrt{\begin{array}{l} 0.00^2 + 0.500^2 + 0.00^2 + 0.500^2 + 0.500^2 + 2.000^2 + 0.518^2 + 0.500^2 \\ + 1.028^2 + 0.00^2 + 0.00^2 + 0.500^2 + 0.00^2 + 0.500^2 + 0.500^2 \\ + 2.000^2 + 0.518^2 + 0.500^2 + 1.028^2 + 0.00^2 \end{array}}$$

CCT = ±3.557% span (95/95)

Converting from % span to process units and rounding to procedure precision:
CCT = ± 3.557 % span * (1400 psi / 100 % span)
CCT = ± 49.798 psi (95/95)

Per Reference G.26, the Control Room Indication for Low Steam Line Pressure (1(2)PT-468, 1(2)PT-469, 1(2)PT-482, 1(2)PT-478, 1(2)PT-479, and 1(2)PT-483) has minor divisions, with each representing 20 psig. Per Section 7.3, the CCT value should be rounded up to the precision that is readable on the associated loop indicator. Per Section 3.3.5.3 of Reference G.1, the readability of these indicators is ± ½ the smallest division (or 10 psig). Therefore, the CCT value is rounded to the nearest 10 psig interval.

CCT = ± 50.00 psi (95/95)

8.6 Low Steam Line Pressure Safety Injection Setpoints

According to Section 7.4, for decreasing setpoints:

$$LTSP\downarrow = AL + [(0.839)^* \, TLE_{1a\text{-}rdm}^{+} + TLE_{1a\text{-}bias}^{+}]PS$$

Where:

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

Combine TLE to be used in the equation for single sided setpoints:

$0.839 * TLE_{1a\text{-}rdm}^{+}$ = 0.839 * 8.097%
= 6.793%

$TLE_{1a\text{-}bias}^{+}$ = 1.808%

TLE_{1a} = 6.793% + 1.808%

TLE_{1a} = 8.601% span

Converting to process units,

TLE_{1a} = 8.601% * (1400 psi/100%)

TLE_{1a} = 120.41 psi

Substituting this value

LTSP = 320.3 (Existing) 395.3; psig (EPU) + 120.41 psi

LTSP = 440.71psig (Existing); 515.71 psig (EPU)

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

The margin between LTSP and FTSP is calculated in accordance with Section 3.3.8.5 of Reference G.1:

Margin = FTSP – LTSP

Where:

LTSP = 440.71 psig (Existing); 515.71 psig (EPU)
FTSP = 530 psig (Section 6.7)

Substituting,

Margin = 530 psig – 440.71 psig (Existing); 515.71 psig (EPU)

Margin= 89.29 psi (Existing) 14.29 psi (EPU)

8.7.1 Low Steam Line Pressure Safety Injection Trip Operability Limit

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

$Rd_{3\sigma}$ = (1.5) $Rd_{2\sigma}$ (Eq. 7.1.6-3)
$Rd_{3\sigma}$ = (1.5) 0.212 % span ($Rd_{2\sigma}$ from Section 8.1.31)
$Rd_{3\sigma}$ = ± 0.318 % span

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

FTSP = ([530 – 0] ÷ 1400) * 100 = 37.86 % span

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

$OL^+ = FTSP + [RAL^2 + Rd_{3\sigma}^2]^{½}$ (Eq. 7.1.6-1)
$OL^+ = 37.86\,\% + (0.500^2 + 0.318^2)^{½}$ (RAL is B_v from Section 8.1.33)
$OL^+ = 37.86\,\% + 0.59$
$OL^+ = 38.45$ % span

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

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

$$OL^- = FTSP - [RAL^2 + Rd_{3\sigma}{}^2]^{1/2} \quad \text{(Eq. 7.1.6-2)}$$

$$OL^- = 37.86\,\% - (0.500^2 + 0.318^2)^{1/2}$$

$$OL^- = 37.86\,\% - 0.59$$

$$OL^- = 37.27\,\%\ \text{span}$$

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

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

From Section 8.6, the most restrictive Limiting Trip Setpoint for the Low Steam Line Pressure Safety Injection Trip is 515.71 psig for EPU. For this decreasing trip, the OL^- value of 522 psig is more conservative (i.e., restrictive) than the LTSP. Per Section 2.4, the OL^- value is acceptable to use for channel operability determination during COT.

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

Solving for the equivalent signal in mAdc corresponding to the Existing & EPU FTSP of 530 psig (Section 6.7) using Equation 7.1.7-3,

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

where:

x = 530 psig
x_1 = 0 psig
y = FTSP (in Vdc)
y_1 = 0.1 Vdc

Substituting,

y = [(0.4 Vdc/ 1400 psi) * (530 psig – 0 psig)] + 0.1 Vdc

y = 0.2514 Vdc

For an OL^+ of 538 psig (Section 8.7.1), the equivalent equation is:

y = [(0.4Vdc/ 1400 psi) * (538 psig – 0 psig)] + 0.1 Vdc

y = 0.2537 Vdc

For an OL^- of 522 psig (Section 8.7.1), the equivalent equation is:

y = [(0.4 Vdc/ 1400 psi) * (522 psig – 0 psig)] + 0.1 Vdc

y = 0.2491 Vdc

For an AF^+ of 537.6 psig (Section 8.7), the equivalent equation is:

y = [(0.4 Vdc/ 1400 psi) * (537.6 psig – 0 psig)] + 0.1 Vdc

y = 0.2536 Vdc

For an AF^- of 522.4 psig (Section 8.6), the equivalent equation is:

y = [(0.4 Vdc/ 1400 psi) * (522.4 psig – 0 psig)] + 0.1 Vdc

y = 0.2493 Vdc

For an AL^+ of 537.0 psig (Section 8.7), the equivalent equation is:

y = [(0.4 Vdc/ 1400 psi) * (537.0 psig – 0 psig)] + 0.1 Vdc

y = 0.2534 Vdc

For an AL^- of 523.0 psig (Section 8.6), the equivalent equation is:

y = [(0.4 Vdc/ 1400 psi) * (523 psig – 0 psig)] + 0.1 Vdc

y = 0.2494 Vdc

For a T.S. AV of 500.0 psig (Section 8.7), the equivalent equation is:

y = [(0.4 Vdc/ 1400 psi) * (500.0 psig – 0 psig)] + 0.1 Vdc

y = 0.2429 Vdc

For a T.S. AV of 520.0 psig (Section 8.7), the equivalent equation is:

y = [(0.4 Vdc/ 1400 psi) * (520.0 psig – 0 psig)] + 0.1 Vdc

y = 0.2486 Vdc

Table 8.7-1
1(2) PC-468, 469, 478, 482, 483 – Low Steam Line Pressure Safety Injection Bistable Calibration

Function	Input (psig)	Output (Vdc)
OL^+	538	0.2537
AF^+	537.6	0.2536
AL^+	537.0	0.2534
FTSP↓	530.0	0.2514
AL^-	523.0	0.2494
AF^-	522.4	0.2493
OL^-	522	0.2491

8.8 Parametric Value Evaluation

According to Section 7.1.5,

Parametric Values = Tech Spec Limits + TLE

The Technical Requirements Manual (TRM) establishes a limit on the steam generator pressure. The limit per TSR 3.7.3.1 of Ref. G.58 is steam generator pressure ≤ 200 psig when the Steam Generator vessel shell temperature is < 70 °F. Per the daily logsheets (Ref. G.56 and G.57), this steam generator pressure limit is only checked when the plant is in modes 4 – 6. However, in any of these modes, there is little to no steam flow, resulting in a negligible pressure drop from the steam generator to the steam line pressure transmitters. Therefore, although the measurement of interest is Steam Generator Pressure, the steam line pressure measurement is an accurate representation of the pressure in the steam generator in these modes.

In this case, Steam Line Pressure is an increasing process, so the negative TLE is used to determine the parametric value per Section 2.0. From Section 7.1.5,

Steam Line pressure limit = ≤ (200 psig + TLE_{3p})

TLE_{3p} = - 23.11 psi (Section 8.3.5)

Substituting into the above equation:

Steam Line pressure limit = ≤ (200 psig + -23.11)

Steam Line pressure limit = ≤ 176.89 psig

Per Ref G.26, the smallest division on the indicators is 20 psig. Per Section 3.3.5.3 of Reference G.1, the readability of these indicators is ± ½ the smallest division (or 10 psig). Therefore, the parametric value is rounded down to the nearest 10 psig interval.

Steam Line pressure limit = ≤ 170 psig

This parametric value of 170 psig ensures compliance with TSR 3.7.3.1 (Ref G.58) by having the operator verify the steam generator vessel shell temperature is >70 °F if steam line pressure is >169 psig.

Therefore, although 169 psig cannot be read on the indicators, the >169 psig value from the logsheets is still acceptable because 170 psig can be read, and if the indicator reads 170 psig or above, the log sheet dictates that the steam generator vessel shell temperature must be verified to be >70 °F. Therefore, both the parametric value and log sheet limits are acceptable to ensure compliance with TSR 3.7.3.1 (Ref G.58).

9.0 RESULTS AND CONCLUSIONS

9.1 Total Loop Error

Total Loop Errors calculated in Section 8.3 are shown below:

Table 9.1-1, Total Loop Errors

	NORMAL				ACCIDENT				Ref. Section
	95/95		75/75		95/95		75/75		
	Span	psi	Span	psi	Span	psi	Span	psi	
Total Bistable Loop Error (TLE_{1a})	N/A	N/A	N/A	N/A	+8.601%	+120.41	N/A	N/A	8.6
Total PPCS Loop Error (TLE_{2n})	±1.837%	± 25.72	±1.078%	± 15.09	N/A	N/A	N/A	N/A	8.3.2
Total Indicator Loop Parametric Error (TLE_{3p})	±2.813%	± 39.39	±1.651%	± 23.11	N/A	N/A	N/A	N/A	8.3.5
Total Indicator (EOP) Loop Error (TLE_{3n} & TLE_{3a})	±2.913%	± 40.78	±1.710%	± 23.94	+10.254% -8.490%	+143.56 -118.86	+6.764% -5.000%	+94.70 -70.00	8.3.3 8.3.4

9.2 Acceptable As-Left and As-Found Tolerances

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

Table 9.2-1, Acceptable As-Found and As-Left Tolerances

Instrument	As-Found	Tolerance	Reference
1(2)PT-468, 469 & 482 1(2)PT-478, 479 & 483	SAF	± 0.29 mAdc	Section 8.4.2.1
1(2)PM-468B, 469B & 482B 1(2)PM-478B, 479B & 483B	I/IAF	± 0.29 mAdc	Section 8.4.2.2
1(2)PM-468A, 469A & 482A 1(2)PM-478A, 479A & 483A	LLAF	± 0.0028 Vdc	Section 8.4.2.3
1(2)PI-468,469 & 482A 1(2)PI-478,479 & 483A	IAF	± 0.90 mAdc	Section 8.4.2.4
1(2)P-469 & 482 1(2)P-479 & 483	PPCSAF	± 7.1 psi	Section 8.4.2.5
1(2)PC-468A/B, 469A/B & 482A/B 1(2)PC-478A/B,479A/B & 483A/B	BAF	± 0.0022 Vdc ±7.6 psi	Section 8.4.2.6
Instrument	**As-Left**	**Tolerance**	**Reference**
1(2)PT-468, 469 & 482 1(2)PT-478, 479 & 483	SAL	± 0.20 mAdc	Section 8.4.1.1
1(2)PM-468B, 469B & 482B 1(2)PM-478B, 479B & 483B	I/IAL	± 0.20 mAdc	Section 8.4.1.2
1(2)PM-468A, 469A & 482A 1(2)PM-478A, 479A & 483A	LLAL	± 0.0020 Vdc	Section 8.4.1.3
1(2)PI-468,469 & 482A 1(2)PI-478,479 & 483A	IAL	± 0.80 mAdc	Section 8.4.1.4
1(2)P-469 & 482 1(2)P-479 & 483	PPCSAL	± 7.0 psi	Section 8.4.1.5
1(2)PC-468A/B, 469A/B & 482A/B 1(2)PC-478A/B,479A/B & 483A/B	BAL	± 0.0020 Vdc ±7.0 psi	Section 8.4.1.6

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

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

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

Operability Limits have been determined for all trip functions (primary trips, backup trips, and the SI Block/Unblock function). The OLs provide new limits to be applied in the I&C

calibration procedures for establishing Technical Specification operability of the trip channels during Channel Operational Testing (COT).

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

It is also recommended that a license amendment be submitted to revise the Low Steam Line Pressure Safety Injection Trip Allowable Value (currently ≥500 psig in TS Table 3.3.2-1) with a new Allowable Value of ≥520 based on conservatively selecting a value above the LTSP of 516 psig for this decreasing setpoint.

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

Table 9.2-1 Operability Limits for Existing and EPU Conditions

Function	**Calculated OL^+ and OL^-**	**Reference**
Low Steam Line Pressure Safety Injection Trip	OL^+ 538 psig OL^- 522 psig	**Section 8.7.1**

9.3 Channel Check Tolerance

This calculation determined the Channel Check Tolerance for the Steam Line Pressure Indicators. The existing CCT is less than the calculated CCT and therefore may be retained.

Table 9.3-1, Channel Check Tolerances

	CCT	Reference
Existing	30 psig	G.56, G.57
Calculated	50 psig	Section 8.5

9.4 Setpoint Evaluations

Per Section 8.6 and 2.0, the Existing and EPU LTSP's and FTSP's with associated Margins are provided in Table 9.4-1 (Below).

Table 9.4-1, Setpoints

Existing Limiting Trip Setpoints	Existing Field Trip Setpoint	Existing Margin	Reference
440.71 psig	530 psig	89.29 psi	Section 8.6

EPU Limiting Trip Setpoints	EPU Field Trip Setpoint	EPU Margin	Reference
515.71 psig	530 psig	14.29 psi	Section 8.6

9.5 Technical Specification Allowable Values

Per Section 8.7 and 2.0, the following Technical Specification Allowable Values (AV) have been determined for Existing and EPU operations.

Table 9.5-1, Calculated Allowable Values

Existing Allowable Value	Calculated Allowable Value	Reference
≥500 psig	428.66 psig	Section 8.7

EPU Allowable Value	Reference
≥520 psig	Section 8.7

9.6 Parametric Value Evaluation

Per Section 8.8 and 2.0, the existing Parametric value is acceptable. Therefore, no changes are required.

Table 9.6-1, Calculated Parametric Value

Existing Parametric Value	Calculated Parametric Value	Reference
≤170 psig	176.89 psig	Section 8.8

9.7 Limitations

9.7.1 M&TE Limitations

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

Table 9.6-1, Limitations

M&TE	Range	Accuracy	Reference
Current-to-Current Converters, Lead/Lag (output) and PPCS (Ref. P.1 and P.2)			
Fluke 45	0-3.0 Vdc	±0.000236 Vdc (± 0.025 % RDG + 2 DGTS)	8.1.23
HP 34401A	0-100 mAdc	±0.030 mAdc (± 0.050 % RDG + 0.005% RNG)	8.1.14 8.1.41
Current-to-Current Converters, Lead/Lag (input) (Ref. P.1 and P.2)			
HP 34401A	0-1.0 Vdc	±0.000027 Vdc (± 0.004 % RDG + 0.0007% RNG)	8.1.14
Fluke 45	0-3.0 Vdc	±0.000236 Vdc (± 0.025 % RDG + 2 DGTS)	8.1.23

9.7.2 Temperature Limitations

The results of this calculation are valid only if the temperature inside the Control/Computer Room instrumentation panels does not exceed 120 °F (For EOP inputs and trips). GAR 01031656 has been generated to track this limitation.

9.7.3 Implementation Limitation

Changes recommended by this calculation, such as As-Found and As-Left Tolerances are NOT to be implemented without approval of the PBNP Design Authority or the appointed designee.

9.8 Graphical Representation of Setpoints

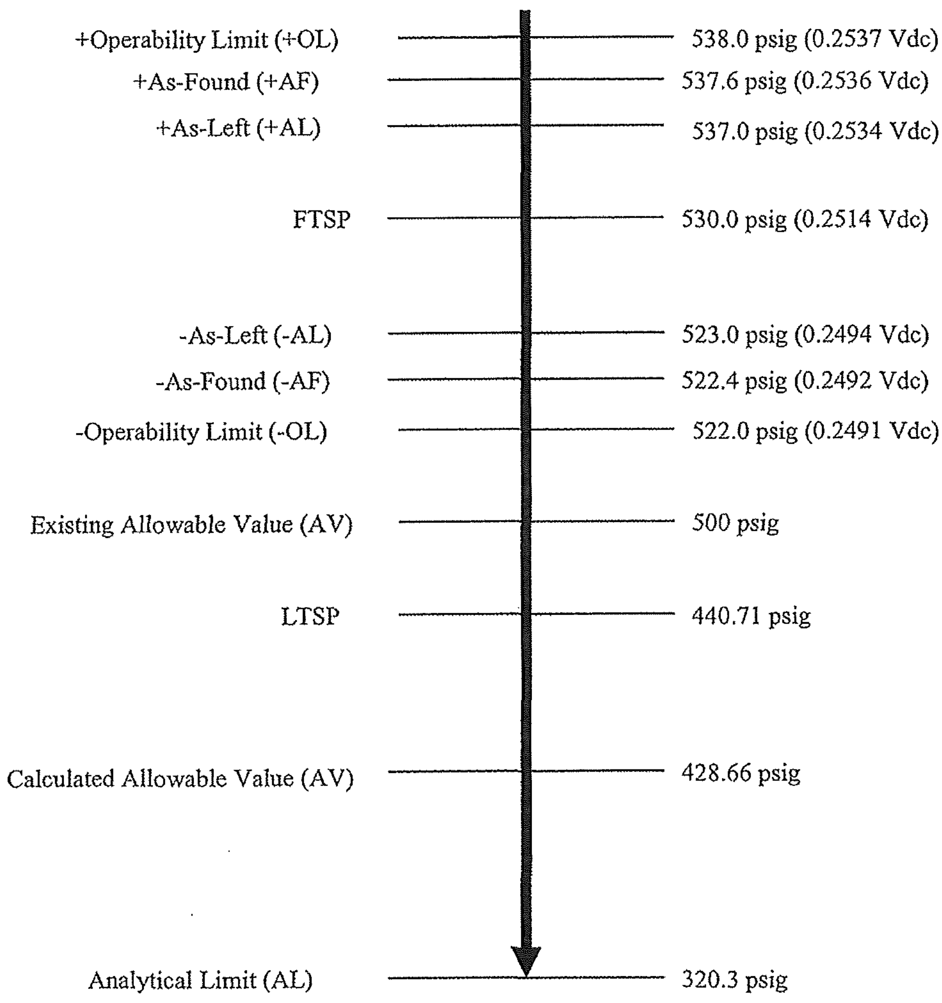


Figure 9.8.1-1, Low Steam Line Pressure Safety Injection Setpoint (Existing)

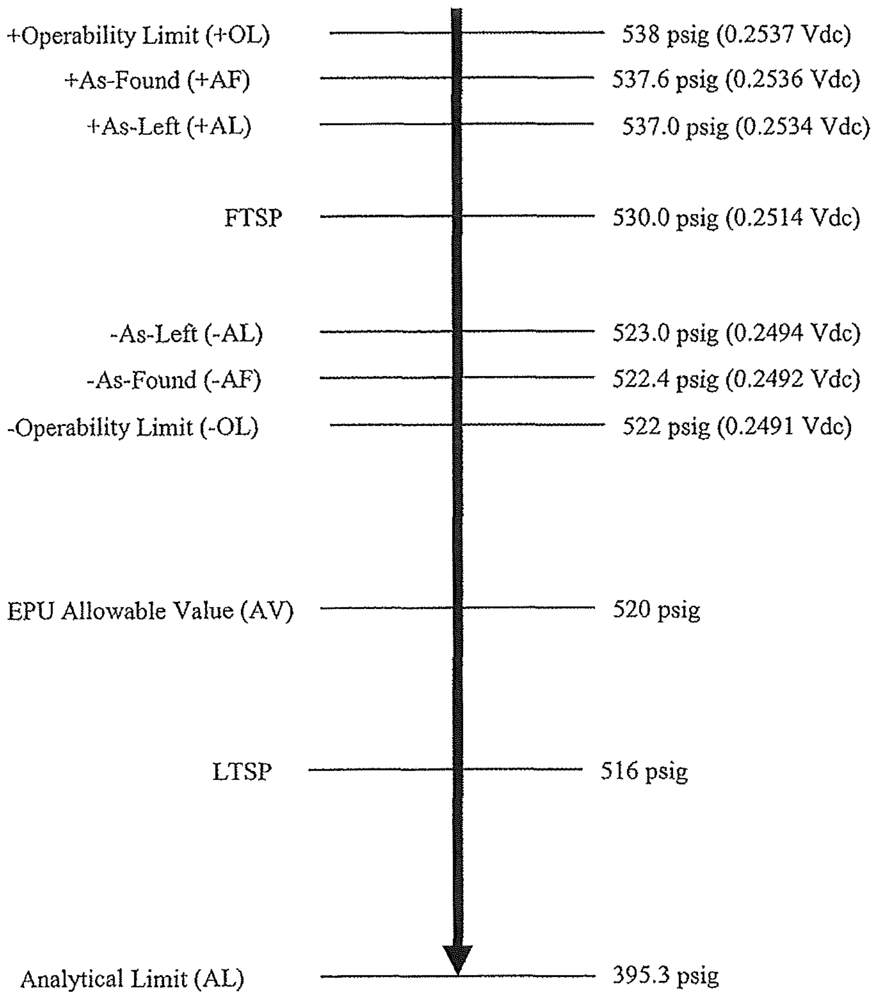


Figure 9.8.2-2, Low Steam Line Pressure Safety Injection Setpoint (EPU)

10.0 IMPACT ON PLANT DOCUMENTS

Note 1: Passport Engineering Change (EC) Number for Calculation PBNP-IC-39 Rev. 4 is 13207

10.1 1ICP 04.001E, "Reactor Protection and Safeguards Analog Racks Steam Pressure Refueling Calibration," Rev. 8

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.2 2ICP 04.001E, "Reactor Protection and Safeguards Analog Racks Steam Pressure Refueling Calibration," Rev. 8

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.3 1ICP 02.001RD, "Reactor Protection and Engineered Safety Features Red Channel Analog 92 Day Surveillance Test", Rev. 11

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.4 1ICP 02.001BL, "Reactor Protection and Engineered Safety Features Blue Channel Analog 92 Day Surveillance Test", Rev. 13

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.5 1ICP 02.001WH, "Reactor Protection and Engineered Safety Features White Channel Analog 92 Day Surveillance Test", Rev. 12

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.6 1ICP 02.001YL, "Reactor Protection and Engineered Safety Features Yellow Channel Analog 92 Day Surveillance Test", Rev. 11

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.7 2ICP 02.001RD, "Reactor Protection and Engineered Safety Features Red Channel Analog 92 Day Surveillance Test", Rev. 11

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.8 2ICP 02.001BL, "Reactor Protection and Engineered Safety Features Blue Channel Analog 92 Day Surveillance Test", Rev. 14

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.9 2ICP 02.001WH, "Reactor Protection and Engineered Safety Features White Channel Analog 92 Day Surveillance Test", Rev. 11

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.10 1ICP 02.020RD, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test", Rev. 11

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.11 2ICP 02.020RD, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test", Rev. 10

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.12 1ICP 02.020BL, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test", Rev. 10

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.13 2ICP 02.020BL, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test", Rev. 10

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.14 1ICP 02.020WH, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test", Rev. 10

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.15 2ICP 02.020WH, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test", Rev. 10

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.16 1ICP 02.020YL, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test", Rev. 10

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.17 2ICP 02.020YL, "Post-Refueling Pre-Startup RPS and ESF Red Channel Analog Surveillance Test", Rev. 10

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.18 2ICP 02.001YL, "Reactor Protection and Engineered Safety Features Yellow Channel Analog 92 Day Surveillance Test", Rev. 12

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.19 Point Beach Nuclear Plant Technical Specifications, Section 3.3.2, B3.3.2, Amendment 201(U1) and Amendment 206 (U2), Rev. 0

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

10.20 PBNP Setpoint Document STPT 2.1, "Safety Injection", Rev. 2

Add new Operability Limits for the Low Steam Line Pressure Safety Injection Safety Analysis Setpoint.

11.0 ATTACHMENT LIST

11.1 Attachment A - Instrument Scaling for Calibration Procedure 1(2)ICP 04.004-2, 1(2)ICP 04.001E, 1(2) 02.002RD, 1(2) 02.002BL, 1(2) 02.002WH, 1(2) 02.002YL, 1(2) 02.020RD, 1(2) 02.020BL, 1(2) 02.020WH, and 1(2) 02.020YL (21 pages)

11.2 Attachment B - Walkdown Calculation No. PBNP-IC-39, dated 6/12/06 (2 pages)

11.3 Attachment C - Walkdown Calculation No. PBNP-IC-39, dated 7/17/06 (2 pages)

This calculation has determined Acceptable As-Found Tolerances for all instruments identified in Section 1.5. The following tables illustrate the necessary modifications to calibration procedures P.1 through P.3, P.5 through P.9, and P.11 through P.14 to account for these new tolerance values per Rev. 2 of this calculation. The area within the bolded box represent the necessary changes, all other fields are provided for convenience only.

1(2)ICP 04.004-2

EQUIPMENT ID: 1(2)PT-468					MANUFACTURER: Foxboro Company		
DESCRIPTION: HX-1A SG Steam Pressure Transmitter					MODEL NUMBER: N-E11GM		
LOCATION: 46′, Unit 1 PAB / Unit 2 PAB					SCALING: 0.0-1400.0 psig / 9.50-49.50 mAdc		
INPUT (psig)	OUTPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	9.50		9.21	9.79		9.30	9.70
350.0	19.50		19.21	19.79		19.30	19.70
700.0	29.50		29.21	29.79		29.30	29.70
1050.0	39.50		39.21	39.79		39.30	39.70
1400.0	49.50		49.21	49.79		49.30	49.70
1050.0	39.50		39.21	39.79		39.30	39.70
700.0	29.50		29.21	29.79		29.30	29.70
350.0	19.50		19.21	19.79		19.30	19.70
0.0	9.50		9.21	9.79		9.30	9.70

1(2)ICP 04.004-2

EQUIPMENT ID: 1(2)PT-469					MANUFACTURER: Foxboro Company		
DESCRIPTION: HX-1A SG Steam Pressure Transmitter					MODEL NUMBER: N-E11GM		
LOCATION: 46′, Unit 1 PAB / Unit 2 PAB					SCALING: 0.0-1400.0 psig / 9.50-49.50 mAdc		
INPUT (psig)	OUTPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	9.50		9.21	9.79		9.30	9.70
350.0	19.50		19.21	19.79		19.30	19.70
700.0	29.50		29.21	29.79		29.30	29.70
1050.0	39.50		39.21	39.79		39.30	39.70
1400.0	49.50		49.21	49.79		49.30	49.70
1050.0	39.50		39.21	39.79		39.30	39.70
700.0	29.50		29.21	29.79		29.30	29.70
350.0	19.50		19.21	19.79		19.30	19.70
0.0	9.50		9.21	9.79		9.30	9.70

1(2)ICP 04.004-2

EQUIPMENT ID: 1(2)PT-478					MANUFACTURER: Foxboro Company		
DESCRIPTION: HX-1B SG Steam Pressure Transmitter					MODEL NUMBER: N-E11GM		
LOCATION: 66', Unit 1 Fan Room / Unit 2 Fan Room					SCALING: 0.0-1400.0 psig / 9.74-49.74 mAdc		
INPUT (psig)	OUTPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	9.74		9.45	10.03		9.54	9.94
350.0	19.74		19.45	20.03		19.54	19.94
700.0	29.74		29.45	30.03		29.54	29.94
1050.0	39.74		39.45	40.03		39.54	39.94
1400.0	49.74		49.45	50.03		49.54	49.94
1050.0	39.74		39.45	40.03		39.54	39.94
700.0	29.74		29.45	30.03		29.54	29.94
350.0	19.74		19.45	20.03		19.54	19.94
0.0	9.74		9.45	10.03		9.54	9.94

1(2)ICP 04.004-2

EQUIPMENT ID: 1(2)PT-479					MANUFACTURER: Foxboro Company		
DESCRIPTION: HX-1B SG Steam Pressure Transmitter					MODEL NUMBER: N-E11GM		
LOCATION: 66', Unit 1 Fan Room / Unit 2 Fan Room					SCALING: 0.0-1400.0 psig / 9.74-49.74 mAdc		
INPUT (psig)	OUTPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	9.74		9.45	10.03		9.54	9.94
350.0	19.74		19.45	20.03		19.54	19.94
700.0	29.74		29.45	30.03		29.54	29.94
1050.0	39.74		39.45	40.03		39.54	39.94
1400.0	49.74		49.45	50.03		49.54	49.94
1050.0	39.74		39.45	40.03		39.54	39.94
700.0	29.74		29.45	30.03		29.54	29.94
350.0	19.74		19.45	20.03		19.54	19.94
0.0	9.74		9.45	10.03		9.54	9.94

1(2)ICP 04.004-2

EQUIPMENT ID: 1(2)PT-482					MANUFACTURER: Foxboro Company		
DESCRIPTION: HX-1A SG Steam Pressure Transmitter					MODEL NUMBER: N-E11GM		
LOCATION: 46′, Unit 1 PAB / Unit 2 PAB					SCALING: 0.0-1400.0 psig / 9.50-49.50 mAdc		
INPUT (psig)	OUTPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	9.50		9.21	9.79		9.30	9.70
350.0	19.50		19.21	19.79		19.30	19.70
700.0	29.50		29.21	29.79		29.30	29.70
1050.0	39.50		39.21	39.79		39.30	39.70
1400.0	49.50		49.21	49.79		49.30	49.70
1050.0	39.50		39.21	39.79		39.30	39.70
700.0	29.50		29.21	29.79		29.30	29.70
350.0	19.50		19.21	19.79		19.30	19.70
0.0	9.50		9.21	9.79		9.30	9.70

1(2)ICP 04.004-2

EQUIPMENT ID: 1(2)PT-483					MANUFACTURER: Foxboro Company		
DESCRIPTION: HX-1B SG Steam Pressure Transmitter					MODEL NUMBER: N-E11GM		
LOCATION: 66′, Unit 1 Fan Room / Unit 2 Fan Room					SCALING: 0.0-1400.0 psig / 9.74-49.74 mAdc		
INPUT (psig)	OUTPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	9.74		9.45	10.03		9.54	9.94
350.0	19.74		19. 45	20.03		19. 54	19. 94
700.0	29. 74		29. 45	30.03		29. 54	29. 94
1050.0	39. 74		39. 45	40.03		39. 54	39. 94
1400.0	49. 74		49. 45	50.03		49. 54	49. 94
1050.0	39. 74		39. 45	40.03		39. 54	39. 94
700.0	29. 74		29. 45	30.03		29. 54	29. 94
350.0	19. 74		19. 45	20.03		19. 54	19. 94
0.0	9. 74		9. 45	10.03		9. 54	9. 94

1(2)ICP 04.001E

Equipment ID: 1(2)PM-468A					Manufacturer: Foxboro		
Description: HX-1A SG Stm Press Compensator					Model Number: 66RC-OLA		
Scaling: .1000-.5000 Vdc / .1000-.5000 Vdc					Location: El. 44′, CB, CR, 1C112 / 2C112		
STM PRESS INPUT (Vdc)	COMP STM PRESS OUTPUT				LIMITS		
	IDEAL (Vdc)	AS FOUND (Vdc)	As-Found Tolerance (Vdc)		AS LEFT (Vdc)	As-Left Tolerance (Vdc)	
.1000	.1000		.0972	.1028		.0980	.1020
.2000	.2000		.1972	.2028		.1980	.2020
.3000	.3000		.2972	.3028		.2980	.3020
.4000	.4000		.3972	.4028		.3980	.4020
.5000	.5000		.4972	.5028		.4980	.5020

1(2)ICP 04.001E

Equipment ID: *1(2)PM-468B						Manufacturer: Foxboro		
Description: Steam Pressure I/I Converter						Model Number: 66BC-O		
Scaling: .1000-.5000 Vdc / 10.00-50.00 mAdc						Location: El. 44′, CB, CR, 1C112 / 2C112		
STM PRESS INPUT (Vdc)	OUTPUT					LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		Adjustment Potentiometer	AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
.1000	10.00		9.71	10.29	zero		9.80	10.20
.2000	20.00		19.71	20.29			19.80	20.20
.3000	30.00		29.71	30.29			29.80	30.20
.4000	40.00		39.71	40.29			39.80	40.20
.5000	50.00		49.71	50.29	span		49.80	50.20

1(2)ICP 04.001E

Equipment ID: 1(2)PI-468					Manufacturer: Westinghouse		
Description: SG A Pressure Indicator					Model Number: HX-252		
Scaling: 10.00-50.00 mAdc / 0.0-1400.0 psig					Location: El. 44′, CB, CR, 1C03 / 2C03		
OUTPUT (psig)	INPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	10.00		9.10	10.90		9.20	10.80
360.0	20.29		19.39	21.19		19.49	21.09
700.0	30.00		29.10	30.90		29.20	30.80
1060.0	40.29		39.39	41.19		39.49	41.09
1400.0	50.00		49.10	50.90		49.20	50.80
1060.0	40.29		39.39	41.19		39.49	41.09
700.0	30.00		29.10	30.90		29.20	30.80
360.0	20.29		19.39	21.19		19.49	21.09
0.0	10.00		9.10	10.90		9.20	10.80

Attachment A

1(2)ICP 04.001E

Equipment ID: 1(2)PM-483A					Manufacturer: Foxboro		
Description: HX-1B SG Stm Press Compensator					Model Number: 66RC-OLA		
Scaling: .1000-.5000 Vdc / .1000-.5000 Vdc					Location: El. 44', CB, CR, 1C112 / 2C112		
STM PRESS INPUT (Vdc)	COMP STM PRESS OUTPUT				LIMITS		
	IDEAL (Vdc)	AS FOUND (Vdc)	As-Found Tolerance (Vdc)		AS LEFT (Vdc)	As-Left Tolerance (Vdc)	
.1000	.1000		.0972	.1028		.0980	.1020
.2000	.2000		.1972	.2028		.1980	.2020
.3000	.3000		.2972	.3028		.2980	.3020
.4000	.4000		.3972	.4028		.3980	.4020
.5000	.5000		.4972	.5028		.4980	.5020

1(2)ICP 04.001E

Equipment ID: *1(2)PM-483B						Manufacturer: Foxboro		
Description: Steam Pressure I/I Converter						Model Number: 66BC-O		
Scaling: .1000-.5000 Vdc / 10.00-50.00 mAdc						Location: El. 44', CB, CR, 1C112 / 2C112		
STM PRESS INPUT (Vdc)	OUTPUT					LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		Adjustment Potentiometer	AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
.1000	10.00		9.71	10.29	zero		9.80	10.20
.2000	20.00		19.71	20.29			19.80	20.20
.3000	30.00		29.71	30.29			29.80	30.20
.4000	40.00		39.71	40.29			39.80	40.20
.5000	50.00		49.71	50.29	span		49.80	50.20

1(2)ICP 04.001E

Equipment ID: 1(2)PI-483A					Manufacturer: Westinghouse		
Description: SG B Pressure Indicator					Model Number: HX-252		
Scaling: 10.00-50.00 mAdc / 0.0-1400.0 psig					Location: El. 44', CB, CR, 1C03 / 2C03		
OUTPUT (psig)	INPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	10.00		9.10	10.90		9.20	10.80
360.0	20.29		19.39	21.19		19.49	21.09
700.0	30.00		29.10	30.90		29.20	30.80
1060.0	40.29		39.39	41.19		39.49	41.09
1400.0	50.00		49.10	50.90		49.20	50.80
1060.0	40.29		39.39	41.19		39.49	41.09
700.0	30.00		29.10	30.90		29.20	30.80
360.0	20.29		19.39	21.19		19.49	21.09
0.0	10.00		9.10	10.90		9.20	10.80

1(2)ICP 04.001E

Equipment ID: *P-483 PPCS Point ID							
Description: SG Press B-3 Red							
Scaling: 10.00-50.00 mAdc / 0.0-1400.0 psig							
INPUT (mAdc)	OUTPUT				LIMITS		
	IDEAL (psig)	AS FOUND (psig)	As-Found Tolerance (psig)		AS LEFT (psig)	As-Left Tolerance (psig)	
10.00	0.0		-7.1	7.1		-7.0	7.0
20.00	350.0		342.9	357.1		343.0	357.0
30.00	700.0		692.9	707.1		693.0	707.0
40.00	1050.0		1042.9	1057.1		1043.0	1057.0
50.00	1400.0		1392.9	1407.1		1393.0	1407.0

1(2)ICP 04.001E

Equipment ID: 1(2)PM-469A				Manufacturer: Foxboro			
Description: HX-1A SG Stm Press Compensator				Model Number: 66RC-OLA			
Scaling: .1000-.5000 Vdc / .1000-.5000 Vdc				Location: El. 44', CB, CR, 1C114 / 2C114			
STM PRESS INPUT (Vdc)	COMP STM PRESS OUTPUT				LIMITS		
	IDEAL (Vdc)	AS FOUND (Vdc)	As-Found Tolerance (Vdc)		AS LEFT (Vdc)	As-Left Tolerance (Vdc)	
.1000	.1000		.0972	.1028		.0980	.1020
.2000	.2000		.1972	.2028		.1980	.2020
.3000	.3000		.2972	.3028		.2980	.3020
.4000	.4000		.3972	.4028		.3980	.4020
.5000	.5000		.4972	.5028		.4980	.5020

1(2)ICP 04.001E

Equipment ID: *1(2)PM-469B					Manufacturer: Foxboro			
Description: Steam Pressure I/I Converter					Model Number: 66BC-O			
Scaling: .1000-.5000 Vdc / 10.00-50.00 mAdc					Location: El. 44', CB, CR, 1C114 / 2C114			
STM PRESS INPUT (Vdc)	OUTPUT					LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		Adjustment Potentiometer	AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
.1000	10.00		9.71	10.29	zero		9.80	10.20
.2000	20.00		19.71	20.29			19.80	20.20
.3000	30.00		29.71	30.29			29.80	30.20
.4000	40.00		39.71	40.29			39.80	40.20
.5000	50.00		49.71	50.29	span		49.80	50.20

1(2)ICP 04.001E

Equipment ID: 1(2)PI-469					Manufacturer: Westinghouse		
Description: SG A Pressure Indicator					Model Number: HX-252		
Scaling: 10.00-50.00 mAdc / 0.0-1400.0 psig					Location: El. 44′, CB, CR, 1C112 / 2C112		
OUTPUT (psig)	INPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	10.00		9.10	10.90		9.20	10.80
360.0	20.29		19.39	21.19		19.49	21.09
700.0	30.00		29.10	30.90		29.20	30.80
1060.0	40.29		39.39	41.19		39.49	41.09
1400.0	50.00		49.10	50.90		49.20	50.80
1060.0	40.29		39.39	41.19		39.49	41.09
700.0	30.00		29.10	30.90		29.20	30.80
360.0	20.29		19.39	21.19		19.49	21.09
0.0	10.00		9.10	10.90		9.20	10.80

1(2)ICP 04.001E

Equipment ID: *P-469 PPCS Point ID							
Description: SG Press A-2 WHT							
Scaling: 10.00-50.00 mAdc / 0.0-1400.0 psig							
INPUT (mAdc)	OUTPUT				LIMITS		
	IDEAL (psig)	AS FOUND (psig)	As-Found Tolerance (psig)		AS LEFT (psig)	As-Left Tolerance (psig)	
10.00	0.0		-7.1	7.1		-7.0	7.0
20.00	350.0		342.9	357.1		343.0	357.0
30.00	700.0		692.9	707.1		693.0	707.0
40.00	1050.0		1042.9	1057.1		1043.0	1057.0
50.00	1400.0		1392.9	1407.1		1393.0	1407.0

1(2)ICP 04.001E

Equipment ID: 1(2)PM-482A					Manufacturer: Foxboro		
Description: HX-1A SG Stm Press Compensator					Model Number: 66RC-OLA		
Scaling: .1000-.5000 Vdc / .1000-.5000 Vdc					Location: El. 44′, CB, CR, 1C115 / 2C115		
STM PRESS INPUT (Vdc)	COMP STM PRESS OUTPUT				LIMITS		
	IDEAL (Vdc)	AS FOUND (Vdc)	As-Found Tolerance (Vdc)		AS LEFT (Vdc)	As-Left Tolerance (Vdc)	
.1000	.1000		.0972	.1028		.0980	.1020
.2000	.2000		.1972	.2028		.1980	.2020
.3000	.3000		.2972	.3028		.2980	.3020
.4000	.4000		.3972	.4028		.3980	.4020
.5000	.5000		.4972	.5028		.4980	.5020

1(2)ICP 04.001E

Equipment ID: *1(2)PM-482B									Manufacturer: Foxboro
Description: Steam Pressure I/I Converter									Model Number: 66BC-O
Scaling: .1000-.5000 Vdc / 10.00-50.00 mAdc									Location: El. 44', CB, CR, 1C112 / 2C112
STM PRESS INPUT (Vdc)	OUTPUT					LIMITS			
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		Adjustment Potentiometer	AS LEFT (mAdc)	As-Left Tolerance (mAdc)		
.1000	10.00		9.71	10.29	zero		9.80	10.20	
.2000	20.00		19.71	20.29			19.80	20.20	
.3000	30.00		29.71	30.29			29.80	30.20	
.4000	40.00		39.71	40.29			39.80	40.20	
.5000	50.00		49.71	50.29	span		49.80	50.20	

1(2)ICP 04.001E

Equipment ID: 1(2)PI-482A					Manufacturer: Westinghouse		
Description: SG A Pressure Indicator					Model Number: HX-252		
Scaling: 10.00-50.00 mAdc / 0.0-1400.0 psig					Location: El. 44', CB, CR, 1C03 / 2C03		
OUTPUT (psig)	INPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	10.00		9.10	10.90		9.20	10.80
360.0	20.29		19.39	21.19		19.49	21.09
700.0	30.00		29.10	30.90		29.20	30.80
1060.0	40.29		39.39	41.19		39.49	41.09
1400.0	50.00		49.10	50.90		49.20	50.80
1060.0	40.29		39.39	41.19		39.49	41.09
700.0	30.00		29.10	30.90		29.20	30.80
360.0	20.29		19.39	21.19		19.49	21.09
0.0	10.00		9.10	10.90		9.20	10.80

1(2)ICP 04.001E

Equipment ID: *P-482 PPCS Point ID							
Description: SG Press A-3 BLU							
Scaling: 10.00-50.00 mAdc / 0.0-1400.0 psig							
INPUT (mAdc)	OUTPUT				LIMITS		
	IDEAL (psig)	AS FOUND (psig)	As-Found Tolerance (psig)		AS LEFT (psig)	As-Left Tolerance (psig)	
10.00	0.0		-7.1	7.1		-7.0	7.0
20.00	350.0		342.9	357.1		343.0	357.0
30.00	700.0		692.9	707.1		693.0	707.0
40.00	1050.0		1042.9	1057.1		1043.0	1057.0
50.00	1400.0		1392.9	1407.1		1393.0	1407.0

Attachment A

1(2)ICP 04.001E

Equipment ID: 1(2)PM-478A								Manufacturer: Foxboro
Description: HX-1B SG Stm Press Compensator								Model Number: 66RC-OLA
Scaling: .1000-.5000 Vdc / .1000-.5000 Vdc								Location: El. 44′, CB, CR, 1C115 / 2C115
STM PRESS INPUT (Vdc)	COMP STM PRESS OUTPUT				LIMITS			
	IDEAL (Vdc)	AS FOUND (Vdc)	As-Found Tolerance (Vdc)		AS LEFT (Vdc)	As-Left Tolerance (Vdc)		
.1000	.1000		.0972	.1028		.0980	.1020	
.2000	.2000		.1972	.2028		.1980	.2020	
.3000	.3000		.2972	.3028		.2980	.3020	
.4000	.4000		.3972	.4028		.3980	.4020	
.5000	.5000		.4972	.5028		.4980	.5020	

1(2)ICP 04.001E

Equipment ID: *1(2)PM-478B								Manufacturer: Foxboro
Description: Steam Pressure I/I Converter								Model Number: 66BC-O
Scaling: .1000-.5000 Vdc / 10.00-50.00 mAdc								Location: El. 44′, CB, CR, 1C115 / 2C115
STM PRESS INPUT (Vdc)	OUTPUT					LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		Adjustment Potentiometer	AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
.1000	10.00		9.71	10.29	zero		9.80	10.20
.2000	20.00		19.71	20.29			19.80	20.20
.3000	30.00		29.71	30.29			29.80	30.20
.4000	40.00		39.71	40.29			39.80	40.20
.5000	50.00		49.71	50.29	span		49.80	50.20

1(2)ICP 04.001E

Equipment ID: 1(2)PI-478							Manufacturer: Westinghouse
Description: SG B Pressure Indicator							Model Number: HX-252
Scaling: 10.00-50.00 mAdc / 0.0-1400.0 psig							Location: El. 44′, CB, CR, 1C03/2C03
OUTPUT (psig)	INPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	10.00		9.10	10.90		9.20	10.80
360.0	20.29		19.39	21.19		19.49	21.09
700.0	30.00		29.10	30.90		29.20	30.80
1060.0	40.29		39.39	41.19		39.49	41.09
1400.0	50.00		49.10	50.90		49.20	50.80
1060.0	40.29		39.39	41.19		39.49	41.09
700.0	30.00		29.10	30.90		29.20	30.80
360.0	20.29		19.39	21.19		19.49	21.09
0.0	10.00		9.10	10.90		9.20	10.80

1(2)ICP 04.001E

Equipment ID: 1(2)PM-479A					Manufacturer: Foxboro		
Description: HX-1B SG Stm Press Compensator					Model Number: 66RC-OLA		
Scaling: .1000-.5000 Vdc / .1000-.5000 Vdc					Location: El. 44', CB, CR, 1C117 / 2C117		
STM PRESS INPUT (Vdc)	COMP STM PRESS OUTPUT				LIMITS		
	IDEAL (Vdc)	AS FOUND (Vdc)	As-Found Tolerance (Vdc)		AS LEFT (Vdc)	As-Left Tolerance (Vdc)	
.1000	.1000		.0972	.1028		.0980	.1020
.2000	.2000		.1972	.2028		.1980	.2020
.3000	.3000		.2972	.3028		.2980	.3020
.4000	.4000		.3972	.4028		.3980	.4020
.5000	.5000		.4972	.5028		.4980	.5020

1(2)ICP 04.001E

Equipment ID: *1(2)PM-479B						Manufacturer: Foxboro		
Description: Steam Pressure I/I Converter						Model Number: 66BC-O		
Scaling: .1000-.5000 Vdc / 10.00-50.00 mAdc						Location: El. 44', CB, CR, 1C117 / 2C117		
STM PRESS INPUT (Vdc)	OUTPUT					LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		Adjustment Potentiometer	AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
.1000	10.00		9.71	10.29	zero		9.80	10.20
.2000	20.00		19.71	20.29			19.80	20.20
.3000	30.00		29.71	30.29			29.80	30.20
.4000	40.00		39.71	40.29			39.80	40.20
.5000	50.00		49.71	50.29	span		49.80	50.20

1(2)ICP 04.001E

Equipment ID: 1(2)PI-479					Manufacturer: Westinghouse		
Description: SG B Pressure Indicator					Model Number: HX-252		
Scaling: 10.00-50.00 mAdc / 0.0-1400.0 psig					Location: El. 44', CB, CR, 1C03 / 2C03		
OUTPUT (psig)	INPUT				LIMITS		
	IDEAL (mAdc)	AS FOUND (mAdc)	As-Found Tolerance (mAdc)		AS LEFT (mAdc)	As-Left Tolerance (mAdc)	
0.0	10.00		9.10	10.90		9.20	10.80
360.0	20.29		19.39	21.19		19.49	21.09
700.0	30.00		29.10	30.90		29.20	30.80
1060.0	40.29		39.39	41.19		39.49	41.09
1400.0	50.00		49.10	50.90		49.20	50.80
1060.0	40.29		39.39	41.19		39.49	41.09
700.0	30.00		29.10	30.90		29.20	30.80
360.0	20.29		19.39	21.19		19.49	21.09
0.0	10.00		9.10	10.90		9.20	10.80

1(2)ICP 04.001E

Equipment ID: *P-479 PPCS Point ID							
Description: SG Press B-2 YLW							
Scaling: 10.00-50.00 mAdc / 0.0-1400.0 psig							
INPUT (mAdc)	OUTPUT				LIMITS		
	IDEAL (psig)	AS FOUND (psig)	As-Found Tolerance (psig)		AS LEFT (psig)	As-Left Tolerance (psig)	
10.00	0.0		-7.1	7.1		-7.0	7.0
20.00	350.0		342.9	357.1		343.0	357.0
30.00	700.0		692.9	707.1		693.0	707.0
40.00	1050.0		1042.9	1057.1		1043.0	1057.0
50.00	1400.0		1392.9	1407.1		1393.0	1407.0

1(2)ICP 02.001RD (Existing)

STEAM GENERATOR PRESSURE 1(2)PC-468 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2429 Vdc (≥500.0 psig)										

1(2)ICP 02.001RD (Uprate)

STEAM GENERATOR PRESSURE 1(2)PC-468 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2486 Vdc (≥520.0 psig)										

1(2)ICP 02.001RD (Existing)

STEAM GENERATOR PRESSURE 1(2)PC-483 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2429 Vdc (≥500.0 psig)										

1(2)ICP 02.001RD (Uprate)

STEAM GENERATOR PRESSURE 1(2)PC-483 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2486 Vdc (≥520.0 psig)										

1(2)ICP 02.001WH (Existing)

STEAM GENERATOR PRESSURE 1(2)PC-469 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2429 Vdc (≥500.0 psig)										

1(2)ICP 02.001WH (Uprate)

STEAM GENERATOR PRESSURE 1(2)PC-469 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2486 Vdc (≥520.0 psig)										

1(2)ICP 02.001BL (Existing)

STEAM GENERATOR PRESSURE 1(2)PC-478 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2429 Vdc (≥500.0 psig)										

1(2)ICP 02.001BL (Uprate)

STEAM GENERATOR PRESSURE 1(2)PC-478 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2486 Vdc (≥520.0 psig)										

1(2)ICP 02.001BL (Existing)

STEAM GENERATOR PRESSURE 1(2)PC-468 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2429 Vdc (≥500.0 psig)										

1(2)ICP 02.001BL (Uprate)

STEAM GENERATOR PRESSURE 1(2)PC-468 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2486 Vdc (≥520.0 psig)										

Attachment A

1(2)ICP 02.001YL (Existing)

STEAM GENERATOR PRESSURE 1(2)PC-479 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2429 Vdc (≥500.0 psig)										

1(2)ICP 02.001YL (Uprate)

STEAM GENERATOR PRESSURE 1(2)PC-479 A/B	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)			AS-FOUND LIMITS		AS-LEFT LIMITS		Operability Limits	
		SETPOINT Vdc	AS-FOUND Vdc	AS-LEFT Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	600.0	0.2714 ↓			0.2692	0.2736	0.2694	0.2734	N/A	N/A
Safety Injection	530.0	0.2514 ↓			0.2492	0.2536	0.2494	0.2534	0.2491	0.2537
•Technical Specification Limit •PC-468A ≥0.2486 Vdc (≥520.0 psig)										

1(2)ICP 02.020RD (Existing)

STEAM GENERATOR PRESSURE 1-PC-468A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2429Vdc (≥500.0 psig)											

1(2)ICP 02.020RD (EPU)

STEAM GENERATOR PRESSURE 1-PC-468A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2486 Vdc (≥520.0 psig)											

1(2)ICP 02.020RD (Existing)

STEAM GENERATOR PRESSURE 1-PC-483A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2429Vdc (≥500.0 psig)											

1(2)ICP 02.020RD (EPU)

STEAM GENERATOR PRESSURE 1-PC-483A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2486Vdc (≥520.0 psig)											

1(2)ICP 02.020WH (Existing)

STEAM GENERATOR PRESSURE 1-PC-469A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2429Vdc (≥500.0 psig)											

1(2)ICP 02.020WH (EPU)

STEAM GENERATOR PRESSURE 1-PC-469A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2486Vdc (≥520.0 psig)											

Attachment A

1(2)ICP 02.020BL (Existing)

STEAM GENERATOR PRESSURE 1-PC-478A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2429Vdc (≥500.0 psig)											

1(2)ICP 02.020BL (EPU)

STEAM GENERATOR PRESSURE 1-PC-478A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2486Vdc (≥520.0 psig)											

Attachment A

1(2)ICP 02.020BL (Existing)

STEAM GENERATOR PRESSURE 1-PC-482A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2429Vdc (≥500.0 psig)											

1(2)ICP 02.020BL (EPU)

STEAM GENERATOR PRESSURE 1-PC-482A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2486Vdc (≥520.0 psig)											

Attachment A

1(2)ICP 02.020YL (Existing)

STEAM GENERATOR PRESSURE 1-PC-479A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2429Vdc (≥500.0 psig)											

1(2)ICP 02.020YL (EPU)

STEAM GENERATOR PRESSURE 1-PC-479A/B	BISTABLE LIGHT	PROCESS SETPOINT psig	OUTPUT (COMP STM PRESS)								
			SETPOINT Vdc	AS-FOUND Vdc	As-Found Limits		AS-LEFT Vdc	As-Left Limits		Operability Limits	
					Low Vdc	High Vdc		Low Vdc	High Vdc	Low Vdc	High Vdc
Alarm	Low Press (B)R	600.0	0.2714↓		0.2692	0.2736		0.2694	0.2734	N/A	N/A
Reset B(R)											
Safety Injection	Safeguard Actuation A(G)	530.0	0.2514↓		0.2492	0.2536		0.2494	0.2534	0.2491	0.2537
Reset A(G)											
•Technical Specification Limit •1-PC-468A≥0.2486Vdc (≥520.0 psig)											

Attachment A

Per Section 9.6, to preserve the validity of this calculation's results, this calculation requires that all future calibrations of the equipment (addressed in this calculation) be performed using the M&TE mentioned below (or better). This table needs to be implemented in calibration procedures 1(2)ICP 04.004-2, 1(2)ICP 04.001E, 1(2)ICP 02.001RD, 1(2)ICP 02.001BL, 1(2)ICP 02.001WH, and 1(2)ICP 02.001YL to provide the calibrator with a list of acceptable M&TE equipment.

Table A-1, M&TE Equipment

M&TE	Range	Accuracy
Fluke 45 (fast rate)	0 – 100 mAdc	± 0.025 mAdc (± 0.05 % RDG + 3 DGTS)
Fluke 45	0 – 3.0 Vdc	± 0.000236 Vdc (± 0.025 % RDG + 2 DGTS)
Fluke 8842A	0 – 2.0 Vdc	± 0.000025 Vdc (± 0.025 % RDG + 2 DGTS)
HP 34401A	0 – 100 mAdc	±0.030 mAdc (± 0.050 % RDG + 0.005% RNG)
HP 34401A	0 – 1.0 Vdc	±0.000027 Vdc (± 0.004 % RDG + 0.0007% RNG)

Attachment B

PART 1 - WALKDOWN REQUEST FORM

Calculation No. PBNP-IC-39

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

El. 44', CB, CR, 1C03 / 2C03

Scope

Describe or illustrate the minor divisions associated with the Low Steam Line (Steam Generator) Pressure Indicators: 1(2)PI-468, 1(2)PI-469, 1(2)PI-482A, 1(2)PI-478, 1(2)PI-479, and 1(2)PI-483A.

References:

Data Tolerance Requirements

S&L Lead W. Barasa Signature [signature] Date 6-12-06

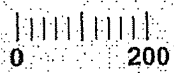
Attachment B

PART 2 - WALKDOWN DATA COLLECTION FORM

Results

Pressure Indicators 1(2)PI-468, 1(2)PI-469, 1(2)PI-482A, 1(2)PI-478, 1(2)PI-479, and 1(2)PI-483A are identical to one another. Each instrument is a horizontal gauge with a needle indicator. The indicated process range is 0 – 1400 PSIG uniformly distributed over the scale, with minor divisions of 20 PSIG. See illustration below for sample.

The divisions appear as follows:



Nick Villione	[signature]	6/12/06
Data Taker Name	Signature	Date
Mark S. Foley	[signature]	6/12/06
Independent Verifier Name	Signature	Date

Attachment C

PART 1 - WALKDOWN REQUEST FORM

Calculation No. PBNP-IC-39

Walkdown Location (Bldg/Elev/Room/Column Lines)
1HX-1A SG Pressure Transmitters: 46', Spent Fuel Pool Room, PAB
1HX-1B SG Pressure Transmitters: 66', Fan Room, PAB

Scope

Determine the distance of floor elevation (46') to 1HX-1A SG Pressure Transmitters (1(2)PT-468, 1(2)PT-469, and 1(2)PT-482).

Determine the distance of floor elevation (66') to 1HX-1B SG Pressure Transmitters (1(2)PT-478, 1(2)PT-479, and 1(2)PT-483).

References:

Data Tolerance Requirements

S&L Lead W. Barasa Signature *WABarasa* Date 7-20-06

Attachment C

PART 2 - WALKDOWN DATA COLLECTION FORM

Results

For 11 of the 12 transmitters, the sensing line enters the transmitter at an elevation 49-1/4 (± 1/4) inches above the floor.

For 1PT-469, the sensing line enters the transmitter at an elevation 49-3/8 (± 1/4) inches above the floor.

ROBERT L. MARSH	Robert L. Marsh	07-17-06
Data Taker Name	Signature	Date
NICK VILIONE	N. Vil	7/20/06
Independent Verifier Name	Signature	Date