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February 14, 2008
L-08-056

10 CFR 50.90

ATTN: Document Control Desk
United States Nuclear Regulatory Commission
Washington, D. C. 20555-0001

SUBJECT:
Davis-Besse Nuclear Power Station, Unit 1
Docket No. 50-346, License No. NPF-3
Reactor Protection System High Flux Trip Setpoint Calculation (TAC No. MD5240)

By letter dated April 12, 2007, the FirstEnergy Nuclear Operating Company (FENOC) submitted an amendment request for Davis-Besse Nuclear Power Station Unit No. 1 (DBNPS) for Measurement Uncertainty Recapture Power Uprate. On July 25, 2007, the Nuclear Regulatory Commission (NRC) staff submitted a request for additional information (RAI) concerning the application. By letter dated September 18, 2007, FENOC provided responses to the RAI, which included a commitment to make the Reactor Protection System High Flux Trip setpoint calculation available for NRC staff review by November 1, 2007. On November 8, 2007, FENOC informed the NRC that FENOC would not be able to produce the calculation until January 2008.

The Reactor Protection System High Flux Trip setpoint calculation has been revised and is provided in the Enclosure. Attachments 5-8 of the calculation are not included in the Enclosure. These Attachments contain spreadsheet formulas that were used for design verification of the information contained in Attachments 1-3. Additionally, the Supporting Documents referenced in the Table of Contents are primarily administrative documents used for review and approval of the setpoint calculations. The Supporting Documents are not included in the Enclosure.

Specific sections of interest include Section 4.5, “As-Left Tolerances (ALT),” Section 4.7, “Limiting Trip Setpoint Calculations,” Section 4.8, “Nominal Trip Setpoint Calculations,“ and Section 4.9, “As-Found Tolerances.” As discussed in Section 1.2.2, the calculation contains other setpoints in addition to the High Flux Trip Setpoint. These other setpoints are not relevant to the Measurement Uncertainty Recapture Power Uprate but are included in this correspondence as part of the calculation.

A001
NRR

There are no regulatory commitments contained in this letter. If there are any questions or if additional information is required, please contact Mr. Thomas A. Lentz, Manager – Fleet Licensing, at (330) 761-6071.

I declare under penalty of perjury that the foregoing is true and correct. Executed on Feb. 14, 2008.

Sincerely,

Mark B. Bezilla

cc: NRC Region III Administrator
NRC Resident Inspector
NRR Project Manager
Utility Radiological Safety Board
Executive Director, Ohio Emergency Management Agency,
State of Ohio (NRC Liaison)

RPS [Reactor Protection System] Reactor Power Related Field Trip Setpoints

FirstEnergy

CALCULATION

NOP-CC-3002-01 Rev. 03

CALCULATION NO.	INITIATING DOCUMENT	[ ] VENDOR CALC SUMMARY
C-ICE-058.01-008	600387414	VENDOR CALCULATION NO. N/A

☐ BV1 | ☐ BV2 | ☒ DB | ☐ PY

Title/Subject:
RPS Reactor Power Related Field Trip Setpoints

Category	☒ Active	☐ Historical	☐ Study
Classification	☒ Tier 1 Calculation	☒ Safety-Related/Augmented Quality	☐ Nonsafety-Related
Open Assumptions?	☐ Yes ☒ No	If Yes, Enter Tracking Number	N/A
System Number	058-01		
Functional Location	DB-RPS1NI1604, DB-RPS2NI1604, DB-RPS3NI1704, DB-RPS4NI1704, DB-RPS1NI1607, DB-RPS2NI1607, DB-RPS3NI1707, DB-RPS4NI1707, DB-RPS1NI1701, DB-RPS2NI1701, DB-RPS3NI1801, DB-RPS4NI1801, DB-NSHNI6A-1, DB-NSHNI6A-2, DB-NSHNI5A-1, DB-NSHNI5A-2, DB-NSHNI8A-1, DB-NSHNI8A-2, DB-NSHNI7A-1, DB-NSHNI7A-2, DB-RPS1RC1304, DB-RPS2RC1304, DB-RPS3RC1404, DB-RPS4RC1404, DB-QSNI6-01, DB-QSNI6-02, DB-QSNI6-03, DB-QSNI5-01, DB-QSNI5-02, DB-QSNI5-03, DB-QSNI8-01, DB-QSNI8-02, DB-QSNI8-03, DB-QSNI7-01, DB-QSNI7-02, DB-QSNI7-03, DB-FYRC1B1, DB-FYRC1B2, DB-FYRC1B3, DB-FYRC1B4, DB-FYRC1A1, DB-FYRC1A2, DB-FYRC1A3, DB-FYRC1A4, DB-RPS1RC1407, DB-RPS2RC1407, DB-RPS3RC1507, DB-RPS4RC1507, DB-RPS1RC1404, DB-RPS2RC1404, DB-RPS3RC1504, DB-RPS4RC1504, DB-RPS1NI1704, DB-RPS2NI1704, DB-RPS3NI1804, DB-RPS4NI1804, DB-RPS1NI1707, DB-RPS2NI1707, DB-RPS3NI1807, DB-RPS4NI1807, DB-FYRC1-1, DB-FYRC1-2, DB-FYRC1-3, DB-FYRC1-4, DB-QSRC1-1, DB-QSRC1-2, DB-QSRC1-3, DB-QSRC1-4		
Commitments:	A21935		
(Perry & Davis-Besse Only)	Calculation Type: N/A	Referenced In Atlas? ☐ Yes ☒ No	
(Perry Only)	Referenced In USAR Validation Database ☐ Yes ☐ No		

Computer Program(s)

Program Name	Version / Revision	Category	Status	Description
MS Office	2003	C	Active	Word Processor, Spreadsheets

Revision Record

Rev.	Affected Pages	Originator/Date	Reviewer/Design Verifier/Date	Approver/Date
1	1,2,4,5,8 & 9	Gabriel Barteck 10/16/01	R. A. Florian 12/19/01	G. N. Leblanc 1/2/02
	Description of Change: Issued to support power uprate for the Caldon Leading Edge Flowmeter (LEFM) allowed by LAR 00-0006.			
	Describe where the calculation will be evaluated for 10CFR50.59 applicability.			
Rev.	Affected Pages	Originator/Date	Reviewer/Design Verifier/Date	Approver/Date
2	1 & 8	Gabriel Barteck 3/19/02	R. A. Florian 3/19/02	G. N. Leblanc 3/19/02
	Description of Change: Issued to correct an editorial error from Rev 1. The Margin parameter was reduced to 0.05% for Overpower only. Margin parameter remains at 0.1% for other functions.			
	Describe where the calculation will be evaluated for 10CFR50.59 applicability.			
Rev.	Affected Pages	Originator/Date	Reviewer/Design Verifier/Date	Approver/Date
3	All	R. Mann 02/02/06	W. Brown 02/03/06	Steve Black 02/03/06
	Description of Change: Evaluate impact of Cycle 15 new core design on Power/Imbalance Flow setpoints and upgrade entire calculation to current format requirements.			

FirstEnergy	CALCULATION
	NOP-CC-3002-01 Rev. 03

CALCULATION NO.	INITIATING DOCUMENT	[ ] VENDOR CALC SUMMARY
C-ICE-058.01-008	600387414	VENDOR CALCULATION NO. N/A

Rev.	Affected Pages	Originator (Print, Sign & Date)	Reviewer/Design Verifier (Print, Sign & Date)	Approver (Print, Sign & Date)
	Describe where the calculation will be evaluated for 10CFR50.59 applicability. 06-00771			
4	Numerous. See rev. bars	C. E. Rupp C. E. Rupp 12-19-07	A. G. Migas A.G. Migas 12/19/07	C. J. Bleau C.J. Bleau 12/20/07
	Description of Change: Incorporates a second AV for the RPS High Flux Trip for LAR 05-0007 and establishes the As-Found and As-Left values in accordance with Technical Specification Task Force (TSTF) Traveler 493 (DIN 64) and Regulatory Issue Summary 2006-17 (DIN 63)			Initiating Document: 600387414
	Describe where the calculation will be evaluated for 10CFR50.59 applicability. 07-03797			

FirstEnergy	CALCULATION NOP-CC-3002-01 Rev. 03	
CALCULATION NO. C-ICE-058.01-008	**INITIATING DOCUMENT** 600387414	**[ ] VENDOR CALC SUMMARY** **VENDOR CALCULATION NO.** N/A

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NOP-CC-3002-01 Rev. 03

CALCULATION NO.	INITIATING DOCUMENT	[ ] VENDOR CALC SUMMARY
C-ICE-058.01-008	600387414	VENDOR CALCULATION NO. N/A

OBJECTIVE OR PURPOSE:

The purpose of this calculation is to determine the field setpoints for the Reactor Protection System (RPS) Reactor High Flux, Power/Imbalance/Flow and Power/Pumps Trip functions. This includes calculated drift for the associated equipment consistent with the time interval allowed in the Technical Specifications. The As-Found and As-Left equipment performance values are also derived. See Section 1.1 for the affected bistable equipment identification numbers.

SCOPE OF CALCULATION/REVISION:

This revision is needed to support License Amendment Request 05-0007 (Serial 3198) "License Amendment Application for Measurement Uncertainty Recapture Power Uprate" (DIN 55). Revision 04 incorporates a second Allowable Value (AV) for the RPS High Flux Trip. This second AV shall be used when the Ultrasonic Flow Meter instrumentation is inoperable or not used in the performance of the daily heat balance (DIN 55 and 56). Also, former Attachments are being replaced with more current component drift evaluations.

Consistent with Serial 3198, As-Found and As-Left values used for evaluating equipment performance will be derived.

SUMMARY OF RESULTS/CONCLUSIONS:

The field setpoints for the Reactor Protection System (RPS) Reactor High Flux, Power/Imbalance/Flow and Power/Pumps Trip functions are as follows:

Parameter	Nominal Trip Setpoint
High Flux (4 Pump Operation WITH Ultrasonic Flow Meter)	104.5% Power
High Flux (4 Pump Operation WITHOUT Ultrasonic Flow Meter)	102.9% Power
High Flux (3 Pump Operation)	80.1% Power
Power/Pumps	54.5% Power

Power/Imbalance/Flow
First column is % of Axial Power Imbalance
Second column is % of Rated Thermal Power

$$\begin{pmatrix} -30.1 & 93.5 \\ -16.5 & 107.1 \\ 16.5 & 107.1 \\ 30.1 & 76.2 \end{pmatrix}$$

As-Left Tolerances (ALT):

High Flux ALT: = +/- 0.0875% Power
Power/Pumps ALT: = +/- 0.225% Power
Power/Imbalance/Flow :
Power/Imbalance ALT = +/- 0.15% Power
Power/Flow ALT = +/- 0.5125% Power

As-Found Tolerances (AFT):

High Flux AFT = +/- 0.3125% Power

As-Found Acceptance Criteria Band:

$|\text{previous As-Left} - \text{current As-Found}| \le 0.3125\%$ Power (or 0.025 Vdc)

Power/Pumps AFT = +/- 0.4500% Power
Power/Imbalance/Flow:
Power/Imbalance AFT = +/- 0.3750% Power
Power/Flow AFT = +/- 0.7375% Power

CALCULATION NO.	INITIATING DOCUMENT	[ ] VENDOR CALC SUMMARY
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LIMITATIONS OR RESTRICTIONS ON CALCULATION APPLICABILITY:

This calculation is not intended to include accident and abnormal conditions. Those are accounted for in determining the Technical Specification Allowable Values which are determined external to this calculation.

This calculation is not applicable until LAR 05-0007 (DIN 55) is approved by the NRC.

IMPACT ON OUTPUT DOCUMENTS:

A second RPS High Flux Trip Setpoint is being documented in this design basis calculation. The actual field implementation will be provided by an Engineering Change Package tracked by Notification 600387414.

As stated in License Amendment Request 05-0007 (Serial 3198) "License Amendment Application for Measurement Uncertainty Recapture Power Uprate" (DIN 55), an As-Found Acceptance Criteria Band shall be determined for the RPS High Flux string and placed in the Technical Requirements Manual (TRM). The shift of the instrument setpoint between calibrations will be compared to the As-Found Acceptance Criteria Band and shall be a requirement in the functional test procedures. Changes to the TRM will be followed by Commitment A21933 (DIN 74).

FirstEnergy	CALCULATION NOP-CC-3002-01 Rev. 03	
CALCULATION NO. C-ICE-058.01-008	**INITIATING DOCUMENT** 600387414	**[ ] VENDOR CALC SUMMARY** **VENDOR CALCULATION NO.** N/A

DOCUMENT INDEX

DIN No.	Document Number/Title	Revision, Edition, Date	Reference	Input	Output
1.	Davis-Besse Nuclear Power Station, Unit No. 1, Technical Specifications - TABLE 2.2-1.	Amendment 310	☒	☐	☐
2.	LAR 90-0002, License Amendment Request to Increase the Reactor Protection System (RPS) and Anticipatory Reactor Trip System (ARTS) Channel Functional Test Surveillance Interval and Channel Bypass Allowed -Out-of-Service Time.	1990	☒	☐	☐
3.	Updated Safety Analysis Report for Davis-Besse Nuclear Power Station, Section 7.2	Rev. 25	☒	☐	☐
4.	Updated Safety Analysis Report for Davis-Besse Nuclear Power Station, Appendix 4B, Reload Report, ANP-2514, Rev 1, 103-2514-001	Rev. 25	☐	☒	☐
5.	Framatome ANP 51-5012682-02, D-B Caldon Power Uprate Project Evaluation Summary Report	Rev. 2	☒	☐	☐
6.	Regulatory Guide 1.105, Instrument Setpoints for Safety Related Instrumentation	Rev. 3	☒	☐	☐
7.	System Description for Nuclear Instrumentation / Reactor Protection System, SD-044	Rev. 3	☒	☐	☐
8.	ISA-67.04.01-2000, Setpoints for Nuclear Safety Related Instrumentation	Jan. 2000	☒	☐	☐
9.	ISA-RP67.04.02-2000, Determination of Setpoints for Nuclear Safety Related Instrumentation	Jan. 2000	☒	☐	☐
10.	ISA S51.1-1979, Process Instrumentation Terminology	1979	☒	☐	☐
11.	Surveillance Procedure DB-SC-04117, RPS Channel 1 Flow Scaling Factor Determination	Rev. 8	☒	☐	☐
12.	Surveillance Procedure DB-SC-04118, RPS Channel 2 Flow Scaling Factor Determination	Rev. 8	☒	☐	☐
13.	Surveillance Procedure DB-SC-04119, RPS Channel 3 Flow Scaling Factor Determination	Rev. 8	☒	☐	☐
14.	Surveillance Procedure DB-SC-04120, RPS Channel 4 Flow Scaling Factor Determination	Rev. 8	☒	☐	☐
15.	B & W 32-1172392-03, TED-1 Reactor Protection System String Error Calculations	Rev. 3	☐	☒	☐
16.	Framatome Calculation Summary Sheet 32-1257719-02, Davis-Besse Unit 1 RPS Setpoint Allowable Values Calculation (EXT-96-02166)	9/25/96	☐	☒	☐
17.	DWG. M-720I / SAP – Functional Location	Rev. 50 / N/A	☐	☒	☒

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18.	AREVA 86-5057366-003, DB Cycle 15 Task 14 Input to Fuels	Rev. 3	☒	☐	☐
19.	LAR 00-0006, License Amendment Request to Increase Allowable Power	2000	☒	☐	☐
20.	Walpole, R.E. & Myers, R. H, Probability and Statistics for Engineers and Scientists, New York, NY: Macmillan Publishing Company	Dated 1998	☒	☐	☐
21.	Beggs, W.J., "Statistics for Nuclear Engineers and Scientists, Part 1: Basic Statistical Inference," DOE Research and Development Report No. WAPD-TM-1292	Dated February, 1981	☒	☐	☐
22.	Metrology Specification Sheet: Fluke 8840A/AF (applicable to the 8840AF also per T. Baker 1/31/06)	Rev. 0 (dated 10/28/94)	☐	☒	☐
23.	C-ICE-058.01-011, Calculation of Acceptable As-Found Values for Safety Related Trip Setpoints	Rev. 0	☒	☐	☐
24.	M-324AQ-331, Composite Instruction Book for Post Accident Panel	Rev 3	☐	☒	☐
25.	M-536-101, Bailey Meter Company., Nuclear Instrumentation and Reactor Protection System Technical Data	Rev. 9	☐	☒	☐
26.	"Guidelines for Instrumentation Calibration Extension/Reduction Programs", Electrical Power Research Institute, EPRI TR-103335-R1, Final Report	Rev. 1 Dated October 1998	☒	☐	☐
27.	Instrument String Data Package, 58A – NSH-NI05A		☐	☐	☒
28.	Instrument String Data Package, 58A – NSH-NI06A		☐	☐	☒
29.	Instrument String Data Package, 58A – NSH-NI07A		☐	☐	☒
30.	Instrument String Data Package, 58A – NSH-NI08A		☐	☐	☒
31.	AREVA 32-5057192-00, DB Cycle 15 Task 14 Reload Evaluation	Rev. 0	☒	☐	☐
32.	Instrument String Data Package, 58A – QS-NI05		☐	☐	☒
33.	Instrument String Data Package, 58A – QS-NI06		☐	☐	☒
34.	Instrument String Data Package, 58A – QS-NI07		☐	☐	☒
35.	Instrument String Data Package, 58A – QS-NI08		☐	☐	☒
36.	Instrument String Data Package, 58A – QS-RC01-1		☐	☐	☒
37.	Instrument String Data Package, 58A – QS-RC01-2		☐	☐	☒
38.	Instrument String Data Package, 58A – QS-RC01-3		☐	☐	☒

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39.	Instrument String Data Package, 58A – QS-RC01-4		☐	☐	☒
40.	Surveillance Test Procedure, DB-MI-03057, RPS Channel 1 Calibration of High Flux, Power/Imbalance/Flow, Power/Pumps Trip Functions		☐	☐	☒
41.	Surveillance Test Procedure, DB-MI-03058, RPS Channel 2 Calibration of High Flux, Power/Imbalance/Flow, Power/Pumps Trip Functions		☐	☐	☒
42.	Surveillance Test Procedure, DB-MI-03059, RPS Channel 3 Calibration of High Flux, Power/Imbalance/Flow, Power/Pumps Trip Functions		☐	☐	☒
43.	Surveillance Test Procedure, DB-MI-3060, RPS Channel 4 Calibration of High Flux, Power/Imbalance/Flow, Power/Pumps Trip Functions		☐	☐	☒
44.	System Work Package DB-MI-03057 QTR		☐	☐	☒
45.	System Work Package DB-MI-03058 QTR		☐	☐	☒
46.	System Work Package DB-MI-03059 QTR		☐	☐	☒
47.	System Work Package DB-MI-03060 QTR		☐	☐	☒
48.	NOP-CC-3002, Nuclear Operating Administrative Procedure, Calculation	Rev. 4	☒	☐	☐
49.	Core Operating Limits Report (COLR)		☐	☐	☒
50.	C-NRE-062.02-164, Cycle 14 RPS Imbalance Trip Comparison	Rev. 0	☒	☐	☐
51.	DB-SC-04121, RPS Channel 1 Power-Flow and Power-Imbalance Variable Setpoint Calculations		☐	☐	☒
52.	DB-SC-04122, RPS Channel 2 Power-Flow and Power-Imbalance Variable Setpoint Calculations		☐	☐	☒
53.	DB-SC-04123, RPS Channel 3 Power-Flow and Power-Imbalance Variable Setpoint Calculations		☐	☐	☒
54.	DB-SC-04124, RPS Channel 4 Power-Flow and Power-Imbalance Variable Setpoint Calculations		☐	☐	☒
55.	Serial 3198 (LAR 05-0007) Measurement Uncertainty Recapture Power Uprate	4/12/07	☐	☒	☐
56.	AREVA 51-9004090-005 Davis-Besse MUR Power Uprate Summary Report. (Notification 600376458)	Rev. 005	☐	☒	☐
57.	Vendor Drawing M-536-00039	Rev. 13	☒	☐	☐
58.	Vendor Drawing M-536-00040	Rev. 4	☒	☐	☐
59.	Vendor Drawing M-536-00042	Rev. 4	☒	☐	☐
60.	Vendor Drawing M-536-00043	Rev. 6	☒	☐	☐

CALCULATION NO.	INITIATING DOCUMENT	[ ] VENDOR CALC SUMMARY
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61.	Drawing J-0111 sheet 1	Rev. 1	☒	☐	☐
62.	Drawing J-0111 sheet 2	Rev. 1	☒	☐	☐
63.	Regulatory Issue Summary (RIS) 2006-17, NRC Staff Position on the Requirements of 10CFR50.36, "Technical Specifications," Regarding Limiting Safety System Settings During Periodic Testing and Calibration of Instrument Channels	8/24/2006	☒	☐	☐
64.	Technical Specification Task Force (TSTF) Improved Standard Technical Specifications Change Traveler 493 (TSTF-493), Rev 2, Dated April 16, 2007 in letter to NRC, Clarify Application of Setpoint Methodology for LSSS Functions	Rev. 2	☒	☐	☐
65.	Calculation C-ICE-058.01-005	Rev. 5	☒	☐	☐
66.	ICDP RPS1NI1704	Rev. 6	☒	☐	☐
67.	ICDP RPS2NI1704	Rev. 7	☒	☐	☐
68.	ICDP RPS3NI1804	Rev. 6	☒	☐	☐
69.	ICDP RPS4NI1804	Rev. 7	☒	☐	☐
70.	ICDP RPS1RC1410	Rev. 5	☒	☐	☐
71.	ICDP RPS2RC1410	Rev. 6	☒	☐	☐
72.	ICDP RPS3RC1510	Rev. 5	☒	☐	☐
73.	ICDP RPS4RC1510	Rev. 6	☒	☐	☐
74.	Commitment A21933	N/A	☒	☐	☐
75.			☐	☐	☐

1. ANALYSIS METHODOLOGY

ISA-67.04.01-2000 (DIN 8) develops a basis for establishing setpoints for nuclear safety-related instrumentation. This document was prepared by the Instrument Society of America (ISA) with a goal of providing uniformity in the field of instrumentation. ISA-RP67.04.02-2000 (DIN 9) presents guidelines and examples of methods for the implementation of ISA-67.04.01-2000. Regulatory Guide 1.105 (DIN 6) endorses the use of the 1994 version of the ISA standard as an acceptable method for determining safety-related setpoints. The 2000 version of the ISA standard is identical to the 1994 version with respect to the RG 1.105 technical review issues. While RG 1.105 is specifically applicable to safety-related setpoints, it also recognizes that the standard "is also appropriate for non-safety system instrumentation for maintaining design limits described in the Technical Specifications".

Several methods for determining the Allowable Value (AV) have been developed and are presently in use. This calculation utilizes Method 1 from ISA-RP67.04.02–2000, Section 7.3. "Method 1" determines the AV by calculating the instrument channel uncertainties that are NOT "tested" during the Channel Functional testing and includes those uncertainties between the Analytical Limit and the AV. All other "tested" uncertainties, including drift of control room cabinet equipment, calibration uncertainties, and uncertainties observed during normal operation are included between the AV and the Limiting Trip Setpoint. Those uncertainties that are NOT "tested" include, but are not limited to, drift of non-control room cabinet equipment such as transmitters, other uncertainties of the equipment that would be tested on a 24 month cycle, and other effects that are not testable by a surveillance test such as DBE effects.

The Limiting Trip Setpoint (LTSP) will be calculated by combining the computed sum of several terms with the Technical Specification Allowable Value. These terms include the As-Left Tolerance (which includes accuracy and Calibration Uncertainty) and Drift Allowance (see Sections 4.5 and 4.4). In addition, margin will be included to establish a Nominal Trip Setpoint (Section 4.8). The sum may be computed by the use of the Square Root Sum of the Squares (SRSS) method (DIN 9), by a simple arithmetic addition of terms or by a combination of both. SRSS is an accepted method for summing independent uncertainties/inaccuracies associated with an instrument setpoint calculation. Arithmetic summation yields a larger number and is used to sum terms which are dependent on the same uncertainty source or as desired.

The As-Left Tolerance is an allowance made for acceptance of the calibration of the instrument string. The As-Left Tolerance is controlled and declared here, and implemented by the calibration/functional test procedures (DIN 40, 41, 42, and 43).

The As-Found tolerance is an allowance made to determine if the instrument string is exhibiting expected behaviors between calibrations. The As-Found Tolerance is controlled and declared here and implemented by the calibration/functional test procedures (DIN 40, 41, 42, and 43).

Per Serial 3198 (LAR 05-0007), Measurement Uncertainty Recapture Power Uprate, the shift of the RPS High Flux instrument string setpoint shall be evaluated and documented in the surveillance test procedures. The As-Found setpoint will be subtracted from the As-Left setpoint from the previous surveillance and the result shall be less than or equal to the As-Found Acceptance Criteria Band. This comparison shall be contained and documented in the RPS Surveillance Procedures (DIN 40, 41, 42, and 43). The As-Found Acceptance Criteria Band is calculated in Section 4.9.

Drift Allowance will be calculated for 3 month string drift for compliance with the required 92 day Functional testing of the RPS Functional Units. Drift allowances are calculated in Attachments 1, 2, and 3.

Calibration Uncertainty is the inaccuracy of the calibration device and/or reference standard, which in this analysis is a digital multimeter and/or precision resistor. The devices used are declared and controlled in this calculation. Procedures and Data Packages shall maintain the device inaccuracy to be consistent with or better than the value used in this calculation.

Conservative margin is included, as any setpoint calculation is just a documented use of a selected method to arrive at a best estimate of a field setpoint. Periodic channel functional testing validates the method used. Should a surveillance result in violation of the Technical Specification Limit an evaluation is required to determine that the Safety Limit was being preserved. The evaluation will determine if the problem affects safety and if it is caused by equipment malfunction, calibration method, measurement and test equipment or by an inadequate field setpoint methodology.

The effects of all other sources of instrument inaccuracy are included in the Technical Specification Allowable Values which are determined external to this calculation. Framatome ANP / AREVA reports / calculations ANP-2514, 51-5012682-02, 32-1172392-03, 32-1257719-02, 86-5057366-003, 32-5057192-00, and 51-9004090-005 (DINs 4, 5, 15, 16, 18, 31, and 56) contain information pertinent to the calculation of those Allowable Values.

This calculation models drift as a linear function of time. In practice this is reasonable and conservative. Verification of individual string component performance within SAP assigned tolerances is not necessary to support this setpoint calculation provided the overall string performance is within the As-Found and As-Left Setting Tolerances declared in this calculation and implemented in the respective calibration/channel functional procedures.

1.1 Affected Instrument Strings (DIN 17, 44, 45, 46, and 47)

Below is a list of the associated SAP Functional Location numbers (DIN 17) for the trip bistables. See Tables 1, 2, and 3 in Section 4.1 for a complete list of all equipment included in this calculation.

CHANNEL	HIGH FLUX *	POWER/PUMPS *	POWER/IMBALANCE
1	DB-NSHNI6A-1 DB-NSHNI6A-2	DB-QSNI6-01 DB-QSNI6-02 DB-QSNI6-03	DB-QSRC1-1
2	DB-NSHNI5A-1 DB-NSHNI5A-2	DB-QSNI5-01 DB-QSNI5-02 DB-QSNI5-03	DB-QSRC1-2
3	DB-NSHNI8A-1 DB-NSHNI8A-2	DB-QSNI8-01 DB-QSNI8-02 DB-QSNI8-03	DB-QSRC1-3
4	DB-NSHNI7A-1 DB-NSHNI7A-2	DB-QSNI7-01 DB-QSNI7-02 DB-QSNI7-03	DB-QSRC1-4

* - The High Flux and Power/Pumps bistables are only one bistable. The equipment number is broken into several sub numbers to identify setpoints for different operation configurations, specifically for the number of pumps running.

1.2 Functional Description/Design Basis

1.2.1 Background Discussion

This calculation is developed in accordance with the Tier-1 requirements of NOP-CC-3002 (DIN 48); therefore, information from previous revisions has been design verified.

This calculation is not intended to include accident and abnormal conditions. Those are accounted for in determining the Technical Specification Allowable Values which are determined external to this calculation. See Section 1.1 for the affected bistable equipment identification numbers and Section 4.1 for all equipment associated with this calculation.

1.2.2 Reactor Protection System (RPS) Function (DIN 3 & 7)

The purpose of the RPS is to initiate a reactor trip when a sensed parameter (or group of parameters) exceeds a setpoint value indicating the approach of an unsafe condition. In this manner, the reactor core is protected from exceeding design limits and the Reactor Coolant System (RCS) is protected from high pressure.

The RPS consists of four identical protection channels which are redundant and independent. Each channel is served by its own independent sensors which are physically isolated from the sensors of the other protective channels. Each sensor supplies an input signal to one or more signal processing strings in the RPS channel. Each signal processing string terminates in a bistable which electronically compares the processed signal with trip setpoints. All bistable trip contacts are connected in series. In the normal untripped state, the contact associated with each bistable will be closed, thereby energizing the channel terminating relay.

Contacts from eight trip bistables are normally in series with the power supply to each of the protective channel trip relays. The trip bistables included are RCS high pressure, low pressure, pressure-temperature, power/imbalance/flow, high flux, power-pumps, high temperature, and containment vessel (CV) high pressure. The first three compare RC pressure with fixed high and low pressure setpoints and a pressure setpoint which is a function of RC outlet temperature. The second three compare the output of the power range neutron flux monitor related to the protective channel with the total RC flow and core imbalance, a fixed high power setpoint, and a high power setpoint which is a function of the pump configuration. The seventh trip bistable compares RC outlet temperature with a high temperature setpoint. The eighth compares the CV pressure with a high pressure setpoint.

The trip functions of RPS which are affected by this calculation are as follows (See Section 4.1 for instrument string diagrams):

A. High Flux

The High Flux trip function, Functional Unit 2 in Technical Specification Section 3/4.3.1, is also referred to as Overpower. For the remainder of the calculation, it will be referred to as High Flux.

Each RPS channel contains a two-section power range neutron flux detector. The signals from each half are summed to produce a total power signal. This power signal is sent to the high flux, power/pump, and power/imbalance/flow bistables. When the total power signal exceeds the high flux trip setpoint of the bistable, its relay contact will open, de-energizing (tripping) the channel terminating relay. During the high flux functional test, the power range test module sends two test signals, which represent power levels in the upper and lower half of the reactor core, to two linear amps. The outputs of the linear amps are then summed in the Sum/Diff amp and its resultant, representing total core power, is sent to the High Flux bistable (DIN 57, 58).

B. Power/Pumps

The High Flux / Number of Reactor Coolant Pumps On trip function, Functional Unit 8 in Technical Specification Section 3/4.3.1, is also referred to as Power/Pumps For the remainder of the calculation, it will be referred to as Power/Pumps.

Reactor Coolant Pump (RCP) status (on-off) and information as to the loops in which pumps are operating, is monitored by pump monitors. The pump monitors provide an open or closed contact as the input to the RPS. The pump contact monitor module provides a variable signal which is a function of the number of running pumps and the loop in which they are running. This signal is used as a variable setpoint signal in the power/pumps bistable. If the total reactor power exceeds the power/pumps setpoint, as determined by the pump configuration, the bistable will cause its associated relay contact to open, de-energizing (tripping) the channel terminating relay. During functional tests, test signals are produced in the power range and contact monitor test modules. Similar to the high flux functional test, the power range test module sends two signals to two linear amps and then into one Sum/Diff amp. The contact monitor test module outputs contact logic, simulating Reactor Coolant Pump status, to the contact monitor module. The outputs from the Sum/Diff amp and the contact monitor are then compared in the Power/Pumps bistable (DIN 57 and 59).

C. Power/Imbalance/Flow

The Flux / Δ Flux / Flow trip function, Functional Unit 4 in Technical Specification Section 3/4.3.1, is also referred to as Power/Imbalance/Flow. For the remainder of the calculation, it will be referred to as Power/Imbalance/ Flow.

Each RPS channel receives two differential pressure signals (one from each reactor coolant loop) for flow. The signals are developed by differential pressure transmitters that measure pressure drop across gentile tubes mounted in the two reactor coolant loops. The analog output of the transmitters is proportional to flow squared. The output is processed by a current to voltage (I/E) converter and is input to a square root extractor which converts the signal to one directly proportional to flow. The proportional flow signals from both RC loops are summed to produce a total RC flow signal in the buffer amplifier. Each RPS channel monitors reactor power imbalance. This is the difference between the power measured in the top half of the core and the power measured in the bottom half of the core by the two separate power range neutron flux detectors. The imbalance signal and the flow signal are combined in a Function Generator and the resultant function signal is compared with the total power signal in a bistable. The bistable will trip when the total reactor power signal exceeds the trip envelope limit in the Core Operating Limits Report (DIN 49). When this bistable trips, its relay contact opens, de-energizing (tripping) the channel terminating relay. During functional tests, test signals are produced in the power range test module and by two flow transmitter simulators. Similar to the high flux functional test, the power range test module sends two signals to two linear amps. The two linear amps output to a difference amp to determine power imbalance. The flow transmitter simulators, simulating flow in each hot leg, send current signals to two current-to-voltage converters, to two square root extractors, and are then combined in a buffer amp. The resultants of the difference (power imbalance) and buffer amps (flow) are combined in the function generator. The output of the function generator is finally compared to total flux in the Power/Imbalance/Flow bistable (DIN 57, 58, 60, 61, and 62).

D. Design Requirements

The RPS is classified as a "Q" quality system and this calculation is Nuclear Safety Related. The RPS is designed to maintain the capability to perform its protective function during and after an earthquake. The vessel containing the equipment will protect it from flood, lightning, and wind. The RPS cabinets are housed in the control room where they are protected against fire, explosion, and missiles. All sensors and cables are located to minimize damage caused by fire, explosion, or missiles. The redundancy of the system will satisfactorily operate under all conditions. The system cabinets provide protection against mechanical damage and spread of fires between RPS channels. All sensors, signal transmission circuits, and signal conditioning devices are designed to function in postulated deteriorated environments to which they may be subjected for the length of time required to provide the protective action (DIN 3).

2. ASSUMPTIONS

Any assumptions, implied or otherwise, are verified each time the respective channel passes its periodic surveillance test. No assumptions are made that require additional activity to verify prior to implementation of these setpoints.

3. ACCEPTANCE CRITERIA

There are no numeric acceptance criteria associated with this calculation. The acceptance criteria are:

1. The calculation complies with the ISA Standard and Recommended Practice (DINs 8 and 9). The trip setpoints will be derived in accordance with these documents and Acceptance Criteria #2. The setpoint when combined with the instrument uncertainties contained in B&W/Framatome calculation 32-1172392-03 (DIN 15), include all required instrument uncertainties for the instrument string.

2. Appropriate Limiting Trip Setpoint, Nominal Trip Setpoint, As-Found value and As-Left value are derived in compliance with the Technical Specification Task Force (TSTF) Traveler 493 (DIN 64) and the NRC Regulatory Issue Summary (RIS) 2006-17 (DIN 63).

3. There are no unacceptable operational burdens associated with the setpoints.

4. COMPUTATION

4.1 Loop Diagrams

The loops will be broken into pieces similar to the method used in Framatome calculation 32-1172392-03 (DIN 15). The uncertainties and the testing will be discussed with these diagrams as reference.

Figure 1 – RPS Nuclear High Flux Trip String

Figure 1
RPS Nuclear High Flux Trip String

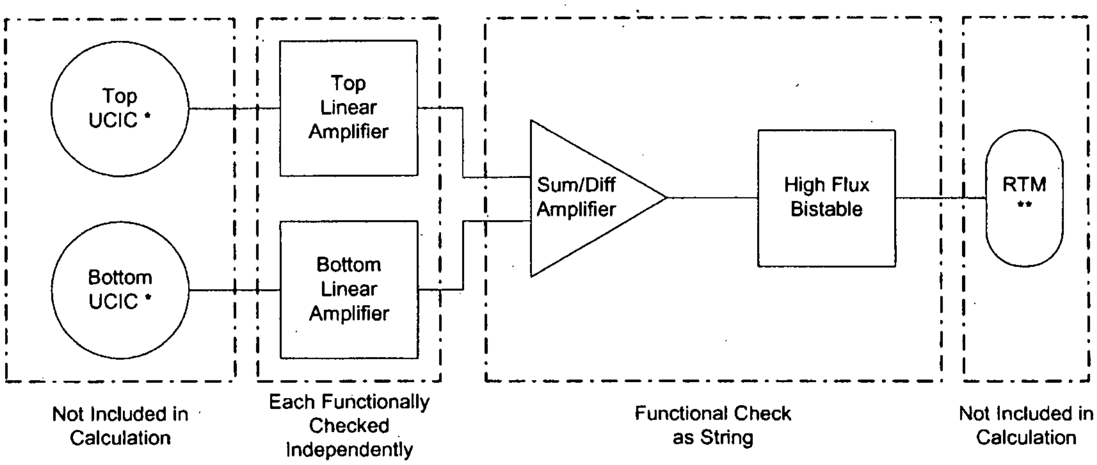


Table 1 - Equipment List

Channel	Top Linear Amplifier	Bottom Linear Amplifier	Sum/Diff Amplifier	High Flux Bistable
1	DB-RPS1NI1604	DB-RPS1NI1607	DB-RPS1NI1701	DB-NSHNI6A-1, -2
2	DB-RPS2NI1604	DB-RPS2NI1607	DB-RPS2NI1701	DB-NSHNI5A-1, -2
3	DB-RPS3NI1704	DB-RPS3NI1707	DB-RPS3NI1801	DB-NSHNI8A-1, -2
4	DB-RPS4NI1704	DB-RPS4NI1707	DB-RPS4NI1801	DB-NSHNI7A-1, -2

* UCIC = Uncompensated Ion Chamber
** RTM = Reactor Trip Module

CALCULATION NO.:	REVISION:
C-ICE-058.01-008	4

Figure 2 – RPS Power to Reactor Coolant Pumps Trip String

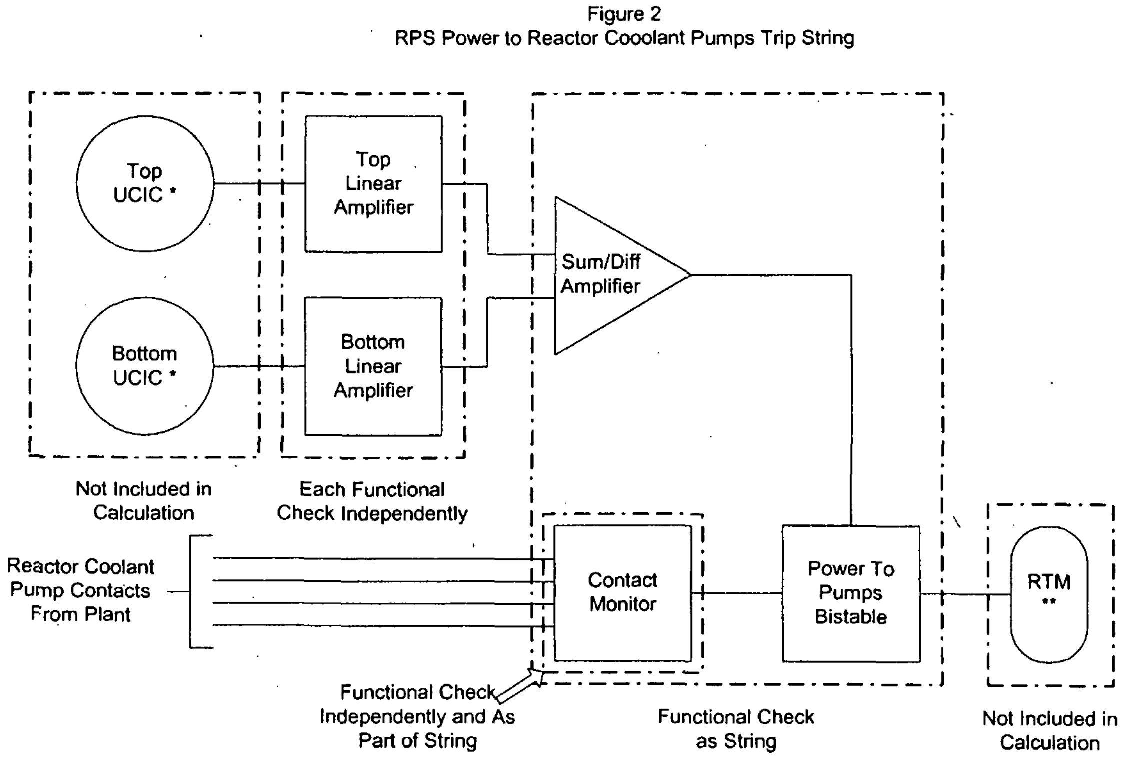


Table 2 - Equipment List

For Linear Amplifiers and Sum/Diff Amplifier, See Table 1

Channel	Contact Monitor	Power to Pumps Bistable
1	DB-RPS1RC1304	DB-QSNI6-1, -2, -3
2	DB-RPS2RC1304	DB-QSNI5-1, -2, -3
3	DB-RPS3RC1404	DB-QSNI8-1, -2, -3
4	DB-RPS4RC1404	DB-QSNI7-1, -2, -3

* UCIC = Uncompensated Ion Chamber
** RTM = Reactor Trip Module

CALCULATION NO.:	REVISION:
C-ICE-058.01-008	4

Figure 3 – RPS Power/Imbalance Trip String

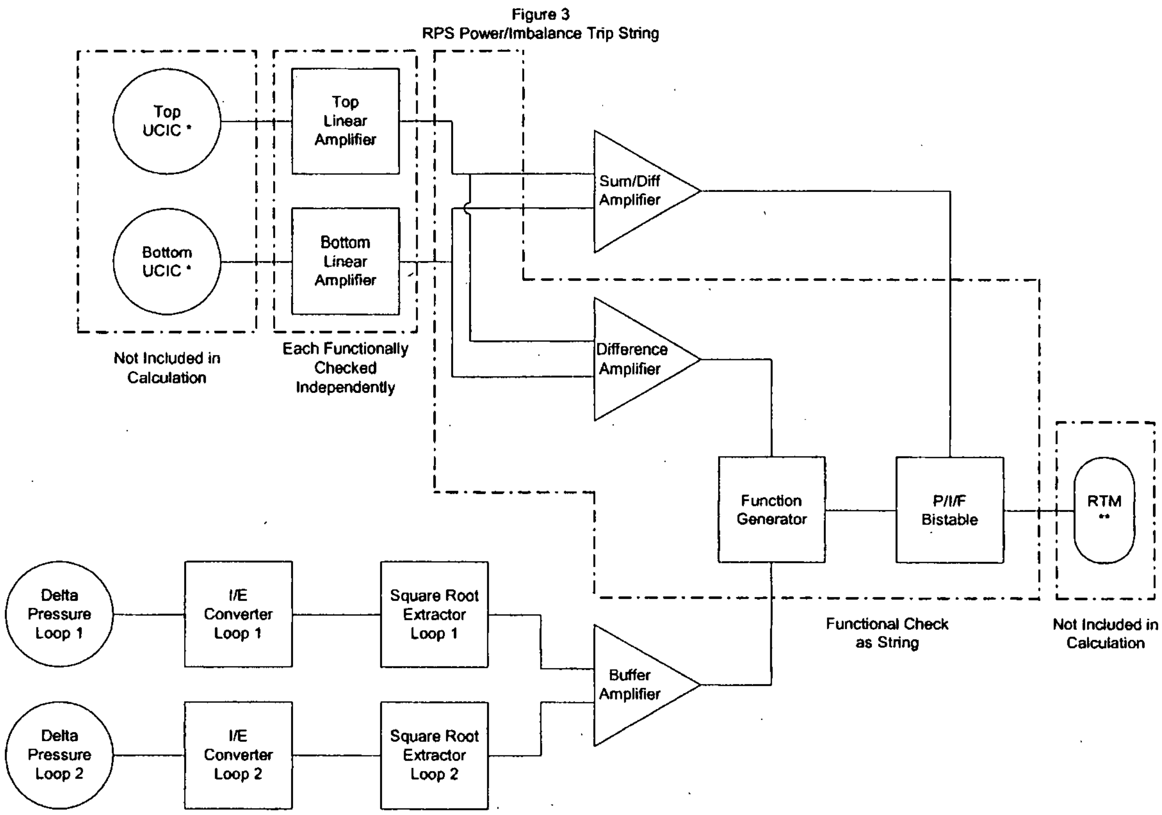


Table 3 - Equipment List

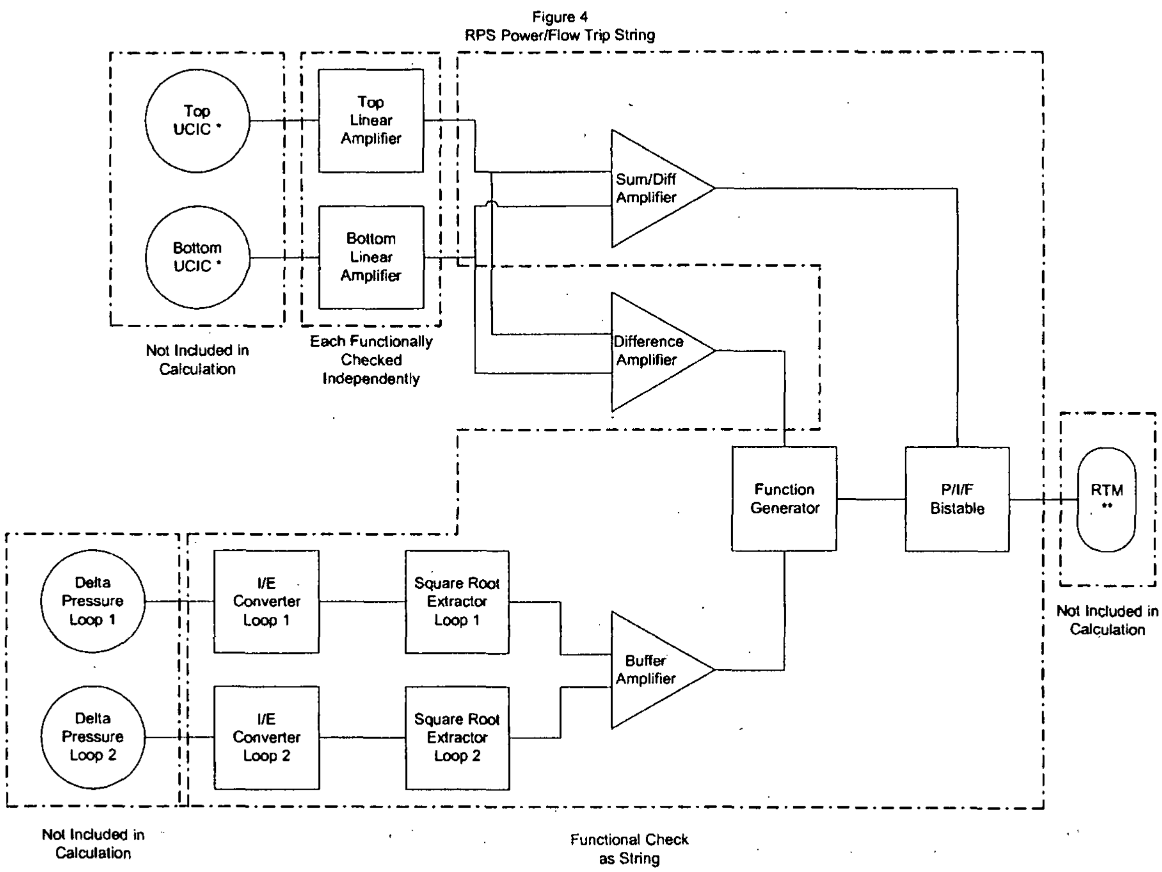
For Linear Amplifiers and Sum/Diff Amplifier, See Table 1

Channel	I/E Converter Loop 1	I/E Converter Loop 2	Square Root Extractor Loop 1	Square Root Extractor Loop 2
1	DB-FYRC1B1	DB-FYRC1A1	DB-RPS1RC1407	DB-RPS1RC1404
2	DB-FYRC1B2	DB-FYRC1A2	DB-RPS2RC1407	DB-RPS2RC1404
3	DB-FYRC1B3	DB-FYRC1A3	DB-RPS3RC1507	DB-RPS3RC1504
4	DB-FYRC1B4	DB-FYRC1A4	DB-RPS4RC1507	DB-RPS4RC1504

Channel	Difference Amplifier	Buffer Amplifier	Function Generator	Imbalance Bistable
1	DB-RPS1NI1704	DB-FYRC1-1	DB-RPS1NI1707	DB-QSRC1-1
2	DB-RPS2NI1704	DB-FYRC1-2	DB-RPS2NI1707	DB-QSRC1-2
3	DB-RPS3NI1804	DB-FYRC1-3	DB-RPS3NI1807	DB-QSRC1-3
4	DB-RPS4NI1804	DB-FYRC1-4	DB-RPS4NI1807	DB-QSRC1-4

* UCIC = Uncompensated Ion Chamber
** RTM = Reactor Trip Module

Figure 4 – RPS Power/Flow Trip String



Equipment List, For Linear Amplifiers and Sum/Diff Amplifier, See Table 1. For all other equipment, See Table 3.

* UCIC = Uncompensated Ion Chamber
** RTM = Reactor Trip Module

4.2 Design Information

4.2.1 Units

% Power = Percent Rated Reactor Thermal Power
% Span = Percent uncertainty of the component or string

Note: % Span will be converted to % Power for the final calculated values.

4.2.2 Symbology

ALT = As-Left Tolerance
AFT = As-Found Tolerance
CAL = Calibration Equipment Tolerance
Drift = Drift Allowance

4.2.3 Power - Voltage Conversion Functions

The following functions are used to convert from percent power to bistable input voltage. The Bistable input voltage is a 0-10 Vdc signal corresponding to 0-125% Reactor Power.

Vdc = (% Power / 125 %) * 10 Vdc

% Power = (Vdc / 10 Vdc) * 125 % Power

4.2.4 Testing

The testing of the instrument strings for the 92 day Channel Functional test interval is accomplished by procedures DB-MI-03057, DB-MI-03058, DB-MI-03059, and DB-MI-03060 (DINs 40, 41, 42, and 43). These procedures also perform the Channel Calibration of the instruments, if required by the testing interval. This calculation evaluates the uncertainties associated with the Channel Functional test (92 days) for compliance with the Technical Specifications. Any uncertainty associated with Channel Calibration that is not bounded by the Channel Functional testing is included between the Analytical Limit and the Allowable Value. This calculation establishes the uncertainties between the Allowable Value and the trip setpoints. The Data Packages associated with the 92 day test, DB-MI-03057 QTR, DB-MI-03058 QTR, DB-MI-03059 QTR, and DB-MI-03060 QTR (DINs 44, 45, 46, and 47) compliment the above procedures.

4.2.5 Equipment Location

All equipment included in this calculation is located in the controlled environment of the control room cabinet area. No environmental effects will be included in this calculation since they are included, if applicable, in Framatome calculation 32-1172392-03 (DIN 15).

4.3 Uncertainties

4.3.1 Component/String Accuracies

The accuracies of the equipment included in this calculation are typically included between the Allowable Value and the Limiting Trip Setpoint in compliance with ISA-RP67.04.02 (DIN 9). However, they are included in Framatome calculation 32-1172392-03 (DIN 15), which calculates the uncertainties included between the Analytical Limit and the Allowable Value. Based on this, the accuracies will be included for the establishment of the As-Found and As-Left values, but will not be included as an accuracy value in establishing the Limiting Trip Setpoint. The only effects to be considered in this calculation are the drift and the As-Left values (including accuracies and calibration uncertainties) for establishment of the Limiting Trip Setpoint.

In some cases, the manufacturer has specified a "Typical" (smaller) and a "Worst Case" (larger) accuracy uncertainty. Since the accuracy values being developed in this calculation are for the establishment of As-Found and As-Left values, using either the "Typical" or "Worst Case" accuracy will either increase or reduce the calculated uncertainty. When including the As-Left value in establishing the trip setpoint, larger or "Worst Case" accuracies would be conservative. When using the accuracy for establishing the As-Found and As-Left value for evaluation of the equipment performance, a smaller accuracy would be conservative. Since this calculation is establishing the As-Found and As-Left values, and the accuracy component is already included between the Analytical Limit and the Allowable Value by the Framatome / AREVA calculations, the smaller accuracy values will be used in the calculations to ensure equipment performance is maintained at the highest level.

The effects of all other sources of instrument uncertainties are included in the Technical Specification Allowable Values which are determined external to this calculation. Framatome ANP / AREVA reports / calculations ANP-2514, 51-5012682-02, 32-1172392-03, 32-1257719-02, 86-5057366-003, 32-5057192-00, and 51-9004090-005 (DINs 4, 5, 15, 16, 18, 31, and 56) contain information pertinent to the calculation of those Allowable Values.

The following accuracies will be used in this calculation:

RPS Component	Accuracy (% Full Scale or Span)	Source	Comments
Bistable	0.15%	DIN 25, E92-341, page 14	
Linear Amp	0.05%	DIN 25, E92-315, page 10	
Sum/Diff Amp	0.15%	DIN 25, E92-317, page 12	Scaled output, WO Ref Power Supply
Contact Monitor	0.3%	DIN 25, E92-343, page 15	
Scaled Difference Amp	0.04%	DIN 25, E92-410, page 7	
Function Generator			
Breakpoints 2 & 3	0.2%	DIN 25, E92-358, page 14	
Breakpoints 1 & 4	0.4%	DIN 25, E92-358, page 14	
Slope	1.0%	DIN 25, E92-358, page 14	
I/E Converter	0.25%	Attachment 4, page 2,	
Buffer Amp	0.05%	DIN 25, E92-316, page10	
Square Root Extractor	0.40%	DIN 25, E92-345, page 14	

4.3.2 Uncertainty Propagation Through Modules

Per ISA-RP67.04-02-2000 (DIN 9, Section 6.3.1), if signal conditioning modules are used in the instrument channel, the propagation of uncertainties through the modules must be taken into account. Equations have been developed to determine the output uncertainties for several common types of signal conditioning modules and are presented in ISA-RP67.04-02-2000, Section 6.3.1 Table 1. The following equations are applicable to RPS modules included in this calculation:

Fixed Gain Amplifier $e_{random} = K * e_{input}$
Square Root Extraction $e_{random} = (e_{input1}) / (2 * input)^{1/2}$

Where:
K = multipliers of input signals (dimensionless gain)
e_{input}, e_{input1} = uncertainty of input signal(s)
input = input signal

The summing amplifier equation from the ISA Recommended Practice is not included in this calculation since the Sum/Diff Amplifier acts as a fixed gain amplifier (gains are the same) with two inputs. Based on that, the fixed gain amplifier equation will be used with two linear amplifier inputs.

Since the accuracy values being developed in this calculation are for the establishment of As-Found and As-Left values, adjustable gains will either increase or reduce the calculated uncertainty. When including the As-Left value in establishing the trip setpoint, larger gains would be conservative. When using the gain for establishing the As-Found and As-Left value for evaluation of the equipment performance, a smaller gain would be conservative. Since the accuracy values are already included between the Analytical Limit and Allowable Value, a value smaller than the values currently included in the Data Packages (Dins 66, 67, 68, 69, 70, 71, 72, and 73) will be used to reduce the As-Found and As-Left values to ensure equipment performance is maintained at the highest level.

The function generator is not included in the propagation of uncertainties. For the breakpoints on the sides (See Section 4.10.2), if beyond those points, a saturation value is added to the flow value to produce an output. Based on this, it does not modify the uncertainties input to the module similar to an amplifier. Similarly, the breakpoints across the top will provide only the flow component as an output, thus not modifying the uncertainties from the flow input. The slopes are the only portion of the function generator that could cause the input uncertainties to be modified. The slope error is discussed in Section 4.5, which determines that a more conservative value than the calculated values will be used. Since the values calculated in Section 4.5, are for the development of an As-Left Tolerance, including additional uncertainty for the function generator slope, then reducing the value back to the same more conservative values is not necessary.

4.3.3 Calculation of String Accuracies

The following section will calculate the string accuracies for use in the As-Found and As-Left tolerance calculations. As stated above, the accuracies will not be specifically included in the Limiting Trip Setpoint development since the accuracies are already included in development of the Allowable Values.

4.3.3.1 High Flux String Accuracy

As described in Section 1.2.2 and shown on Figure 1, the High Flux string consists of two signals that represent core power in the top and bottom halves of the core. The signals travel through two separate linear amps, are summed in a sum/diff amp, and the result (total power) is compared to a setpoint in a bistable. The uncertainties of the two signals from the linear amps are considered random and can be combined by SRSS technique. The linear amps are calibrated with unity gain (DIN 40, 41, 42, and 43). The sum/diff amp has an internal gain of 0.5 (DIN 25).

Sum/Diff Amp Input Uncertainty = K * e_{input} ; where K is the gain of the Sum/Diff Amp
= 0.5 * (SRSS (linear amp, linear amp)) % Span
= 0.5 * (SRSS (0.05, 0.05)) % Span
= 0.035 % Span

The Sum/Diff Amp Input Uncertainty may now be combined with the Sum/Diff Amp Accuracy and the Bistable Accuracy to calculate a total accuracy of the string. The total reference accuracy for the High Flux string is:

High Flux Accuracy = SRSS (Sum/Diff Amp Input Uncertainty, Sum/Diff Amp Accuracy, Bistable Accuracy) % Span
= SRSS (0.035, 0.15, 0.15) % Span
= 0.215 % Span

4.3.3.2 Power/Pumps String Accuracy

As described in Section 1.2.2 and shown on Figure 2, the Power/Pumps string consists of the High Flux String and input from the contact monitor. The contact monitor represents reactor coolant pump status (on or off). The output of the High Flux string and the contact monitor are compared to a setpoint in a bistable.

As input to the Power/Pumps string, the linear amplifier outputs are identical to the High Flux string. Based on that, the Sum/Diff Amp Input Uncertainty from above will be used to represent the linear amplifiers. The total reference accuracy for the Power/Pumps string is:

Power/Pumps Accuracy = SRSS (Sum/Diff Amp Input Uncertainty, Sum/Diff Amp, Contact Monitor, Bistable) % Span
= SRSS (0.035, 0.15, 0.3, 0.15) % Span
= 0.369 % Span

4.3.3.3 Power/Imbalance/Flow Accuracy

As described in Section 1.2.2 and shown on Figures 3 and 4, the Power/Imbalance/Flow consists of numerous components. The High Flux String is utilized for total reactor power and power imbalance. Power Imbalance is determined through the use of the two linear amp signals and a scaled difference amp. The scaled difference amp determines if there are differences in power level between the top and bottom halves of the core then outputs the difference (imbalance) to the function generator. The gain of the scaled difference amp for channels 1 through 4 are 1.442, 1.490, 1.478, and 1.4995 per data packages RPS1NI1704, RPS2NI1704 , RPS3NI1804 , and RPS4NI1804 (DINs 66, 67, 68, and 69), respectively. As described in Section 4.3.2, a smaller gain value of 1.25 will be used.

The Function Generator is provided with two accuracies for Breakpoint pairs 1 and 4, and 2 and 3. The calculation will calculate each independently for the Power/Imbalance (0.4%) and the Power/Flow (0.2%). These breakpoints act independent of each other as described in Section 4.3.2. There is also an accuracy associated with the slope. The slope error will be addressed in Section 4.5.

Difference Amp Input Uncertainty = K * e_{input} ; where K is the gain of the Difference Amp
= 1.25 * SRSS (linear amp, linear amp) % Span
= 1.25 * (SRSS (0.05, 0.05)) % Span
= 0.088 % Span

Power/Imbalance Accuracy = SRSS (Difference Amp Input Uncertainty, Difference Amp, Function Generator, Bistable) % Span
= SRSS (0.088, 0.04, 0.4, 0.15) % Span
= 0.438 % Span

The reactor coolant flow signal is sent through two separate current to voltage (I/E) converters and square root extractors (DIN 60). The outputs of the two square root extractors are combined in a buffer amp to determine total flow that outputs to the function generator. The gain of the buffer amp for channels 1 through 4 are currently about 0.905, 0.908, 0.904, and 0.907 per data packages RPS1RC1410 , RPS2RC1410 , RPS3RC1510 , and RPS4RC1510 (DINs 70, 71, 72, and 73). As described in Section 4.3.2, a smaller gain value of 0.75 will be used. The function generator output, representing power imbalance and flow, is sent to a bistable where it is compared to total reactor power from the High Flux string.

Square Root Ext. Input Uncertainty = $(e_{input1}) / 2 * (input)^{1/2}$; using signal units (Vdc)
= $(I/E\ (Vdc)) / 2 * (10Vdc)^{1/2}$
= $(0.25\%\ Span / 100\% * 10Vdc) / 2 * (10Vdc)^{1/2}$
=0.040 Vdc or 0.400 % Span

Buffer Amp Input Uncertainty = $K * e_{input}$; where K is the gain of the Buffer Amp
= 0.75 * SRSS (Square Root Ext Input Uncert, Square Root Ext Input Uncert) % Span
= 0.75 * SRSS (0.400, 0.400) % Span
= 0.424 % Span

The total reference accuracy for the Power/Flow function is:

Power/Flow Accuracy = SRSS (Sum/Diff Amp Input Uncertainty, Sum/Diff Amp, Buffer Amp Input Uncertainty, Buffer Amp, Function Generator, Bistable)
= SRSS (0.035, 0.15, 0.424, 0.05, 0.2, 0.15) % Span
= 0.518 % Span

4.3.4 Calibration Uncertainties (CAL)

Digital multimeters (DMM) are used for calibration of the RPS modules and precision resistors are also used during calibration of the RPS flow modules. The precision resistor and the DMM will be included for the Power/Imbalance/Flow portion (DIN 40, 41, 42, and 43). Only the DMM will be used for the other RPS strings.

Precision Resistor: 250 Ω +/- 0.01% Span (or 0.001 Vdc on a 0-10Vdc scale)

DMM Accuracy is given as +/- 0.005% of Reading + 3 counts for 6 month calibration interval and 20 Vdc Scale (DIN 20):

DMM Accuracy = 0.005% of Reading

DMM Count Accuracy = 3 (On 20 Vdc scale a count = 0.0001 Vdc)

Reading = 0-10 Vdc Maximum

Accuracies given in % are divided by 100% to convert to decimal fraction.

DMM Accuracy = [(DMM Accuracy / 100) * 10] + DMM Count Accuracy
= [(0.005% / 100) * 10] + (3 * 0.0001)
= 0.0008 Vdc

The DMM allowance is conservatively increased to 0.003 Vdc or 0.03% Span.

As the DMM uncertainty is conservatively increased, the calibration standard, i.e., the instrument used to calibrate the DMM will not be included in the calculation. Since the calibration standard is typically at least 4 times more accurate than the DMM, the conservative increase of the DMM uncertainty would bound the calibration standard uncertainty.

4.3.4.1 High Flux Calibration Uncertainties

In surveillance procedures DB-MI-03057, DB-MI-03058, DB-MI-03059, and DB-MI-03060 (DINs 40, 41, 42, and 43), the linear amplifiers are calibrated with 2 digital multimeters each. The remainder of the high flux string is calibrated with 2 digital multimeters connected to the output of the linear amplifiers. The bistable trip is verified based on the linear amplifier outputs. The multimeters used for the calibrations could be the same devices for each of the linear amplifiers and the high flux string. If the multimeter is off in one direction, then the same effect would be contributed to each calibration. Based on that, the three sets of multimeter uncertainties will be considered to be dependent uncertainties and accounted for as such in the equation. The propagation of the uncertainties through the modules will be combined similar to the accuracies above. This results in:

Sum/Diff Amp Input CAL Uncertainty = K * e_{input} ; where K is the gain of the Sum/Diff Amp
= 0.5 * (SRSS ((DMM11 + DMM21) , (DMM12 + DMM22))) % Span
= 0.5 * (SRSS ((0.03 + 0.03) , (0.03 + 0.03))) % Span
= 0.5 * (SRSS ((0.0600) , (0.0600))) % Span
= 0.0424 % Span

Where:

DMM11 = DMM1 used for calibrating Linear Amp 1
DMM21 = DMM2 used for calibrating Linear Amp 1
DMM12 = DMM1 used for calibrating Linear Amp 2
DMM22 = DMM2 used for calibrating Linear Amp 2

The output of the Sum/Diff Amp Input CAL Uncertainty may now be combined with the Sum/Diff Amp / Bistable calibration uncertainty. The total calibration uncertainty for the High Flux string is:

High Flux CAL Uncertainty = SRSS (Sum/Diff Amp Input CAL Uncertainty, Sum/Diff Amp / Bistable CAL Uncertainty) % Span
= SRSS (0.0424, (DMM1 + DMM2) % Span
= SRSS (0.0424, (0.03 + 0.03) % Span
= 0.0735 % Span

4.3.4.2 Power to Pumps Calibration Uncertainties

For the Power to Pumps trip, the value from the High Flux uncertainties for the Sum/Diff Amp Input CAL Uncertainty may be used since the same output from the Sum/Diff Amplifier is input to both the High Flux and Power to Pumps bistables. The remainder of the instrument string is calibrated with two DMMs at the output of the linear amplifiers. Since this is identical to the test configuration for the High Flux Trip, the same value will be used.

Power to Pumps CAL Uncertainty = 0.0735% Span

The Contact Monitor total uncertainty is included in the string uncertainty described above since the dry contact inputs are simulated and included as part of the string calibration.

4.3.4.3 Power/Imbalance/Flow Calibration Uncertainties

The Power/Imbalance/Flow will be broken into two strings similar to the function generator curve. The Power/Imbalance is protected by the sides of the function generator curve and the Power/Flow is protected by the top of the function generator curve. The Sum/Diff Amplifier Calibration Uncertainty described above is used as an input to the Power/Imbalance/Flow Bistable. This uncertainty will be identical to the uncertainties calculated above.

Sum/Diff Amp Input CAL Uncertainty = 0.0424 % Span

The Difference Amplifier uses the input from the Linear Amplifiers and inverts one input, sums the two to create the difference and multiplies that value by the gain. The calibration uncertainty associate with that is:

Difference Amp Input CAL Uncertainty = K * e_{input} ; where K is the gain of the Difference Amp
= 1.25 * (SRSS ((DMM11 + DMM21) , (DMM12 + DMM22))) % Span
= 1.25 * (SRSS ((0.03 + 0.03) , (0.03 + 0.03))) % Span
= 1.25 * (SRSS ((0.0600) , (0.0600))) % Span
= 0.1061 % Span

The reactor coolant flow signal is measured with two DMMs and two precision resistors. The propagation of the uncertainties through the square root extractors results in:

Square Root Ext. CAL Uncertainty = (e_{input1}) / 2 * $(input)^{1/2}$; using signal units (Vdc)
= (SRSS (DMM1, DMM2, RES1, RES2) (Vdc)) / 2 * $(10Vdc)^{1/2}$
= (SRSS (0.03, 0.03, 0.01, 0.01)% Span /100% * 10Vdc) / 2 * $(10Vdc)^{1/2}$
= 0.007 Vdc or 0.070 % Span

Buffer Amp CAL Uncertainty = K * e_{input} ; where K is the gain of the Buffer Amp
= 0.75 * SRSS (Square Root Ext CAL Uncert, Square Root Ext CAL Uncert) % Span
= 0.75 * SRSS (0.070, 0.070) % Span
= 0.074 % Span

The total calibration uncertainty for the Power/Imbalance function is:

Power/Imbalance CAL Uncertainty = SRSS (Sum/Diff Amp Input CAL Uncertainty, Difference Amp Input CAL Uncert)
= SRSS (0.0424, 0.1061) % Span
= 0.114 % Span

The total calibration uncertainty for the Power/Flow function is:

Power/Flow CAL Uncertainty = SRSS (Sum/Diff Amp Input Uncertainty, Buffer Amp CAL Uncert)
= SRSS (0.035, 0.074) % Span
= 0.082 % Span

4.4 Drift

Drift values for the instrument strings are determined in Attachments 1, 2, and 3 of this calculation. The linear amplifier drift is included in calculation 32-1172392-03 (DIN 15). The calculated uncertainty values in that calculation are included between the Analytical Limit and the Allowable Value. Based on that, the drift for the linear amplifiers, although normally included between the Allowable Value and the trip setpoint, will not be included in this calculation. The calculated drift values for the remainders of the instrument strings are:

High Flux	Bias: -0.000291 Vdc	Random: 0.009346 Vdc
Power to Pumps	Bias: 0.000249 Vdc	Random: 0.012871 Vdc
Power/Imbalance/Flow	Bias: -0.000094 Vdc	Random: 0.008268 Vdc

The worst case from above would be Power to Pumps with a summed total of 0.013120. The Technical Specifications allow the three month surveillance period plus a 25% extension for total time to test. To correct for the extension, the 0.013120 volt value will be multiplied by 1.25. This yields 0.016400 Vdc. A conservative value of 0.018 Vdc will be used. As the drift analysis determined the drifts to be not normally distributed, the drift will be added in the As-Left Tolerance calculation instead of using the square root sum of the squares method.

Drift = 0.018 Vdc

Drift = (0.018 Vdc/ 10 Vdc) * 125% Power
= 0.225% Power

4.5 As-Left Tolerances (ALT)

The As-Left Tolerance is controlled and declared here, and implemented by the calibration/functional test procedures and System Work Packages (DIN 40, 41, 42, 43, 44, 45, 46, and 47).

Per the TSTF Improved Technical Specification Traveler 493, (DIN 63, page 7) the As-Left tolerance must be calculated to include only uncertainties of reference accuracy, M&TE accuracy, and M&TE readability.

Regulatory Issue Summary (RIS) 2006-17 (DIN 62) page 5, states:

Additionally, the TSTF did not sufficiently address the NRC staff concern with the practice of using Nominal Setpoints (NSPs) for establishing the test acceptance criteria band for as-found instrument values. The NRC staff concern was that excessive changes in the Trip Setpoints (TSP) could go undetected and also that a high incidence of false detections could result from such a practice. Subsequently, the NRC staff investigated the acceptability of basing operability determinations for as-found instrument values on NSP values. The NRC staff review concluded that if specific conditions are met, then the NRC staff would find a NSP-based assessment of as-found values acceptable. Those conditions are: (1) the setting tolerance band is less than or equal to the square root of the sum of the squares of reference accuracy, measurement and test equipment, and readability uncertainties; (2) the *setting tolerance is included in the total loop uncertainty, and (3) the pre-defined test acceptance criteria band for the as-found value includes either, the setting tolerance or the uncertainties associated with the setting tolerance band, but not both of these.*

As described above, the ALT is determined by using the RPS string accuracy calculation (Section 4.2.4) and adding the calibration uncertainty (Section 4.3.4). The values for the accuracy and calibration uncertainty are developed in % Span. They must be converted to % Power by multiplying the values by 1.25 (125%). As discussed in Section 4.4, the drifts will be added since they are not normally distributed.

High Flux ALT = High Flux Accuracy + High Flux CAL Uncertainty
= ((0.215% Span x 1.25) + (0.0735% span x 1.25)) % Power
= 0.3606% Power

Power/Pumps ALT = Power/Pumps Accuracy + Power to Pumps CAL Uncertainty
= ((0.369% Span x 1.25) + (0.0735% Span x 1.25))% Power
= 0.5531% Power

Power/Imbalance/Flow:

Power/Imbalance ALT = Power/Imbalance Accuracy + Power/Imbalance CAL Uncert
= ((0.438% Span x 1.25) + (0.114% Span x 1.25)) % Power
= 0.69% Power

Power/Flow ALT = Power/Flow Accuracy + Power/Flow CAL Uncert
= ((0.518% Span x 1.25) + (0.082% Span x 1.25)) % Power
= 0.750% Power

As stated in Section 4.3.3.3, the slope accuracy will be included after establishing the As-Left Tolerances and the Breakpoint locations. Instead of using the calculated As-Left Tolerances, the smaller, more restrictive As-Left Tolerances currently in use in the surveillance procedures will be used. This is conservative, since using a smaller As-Left Tolerance ensures the setpoint will be continuously close to its nominal setpoint and poorly performing equipment will be readily detected. Based on this, adding additional uncertainty due to slope to the calculated values, then reducing the ALT values to provide a more restrictive ALT is unnecessary. This is acceptable since the slope accuracy is already included between the Analytical Limit and the Allowable Value as documented in Framatome calculation 32-1257719-02 (DIN 16), Section 10. As stated above, the more restrictive As-Left Tolerance values currently used in surveillance procedures will be retained. Those ALT values are:

High Flux ALT:		=	+/- 0.0875% Power
Power/Pumps ALT:		=	+/- 0.225% Power
Power/Imbalance/Flow :	Power/Imbalance ALT	=	+/- 0.15% Power
	Power/Flow ALT	=	+/- 0.5125% Power

4.6 Technical Specification (TS) Allowable Values

The following TS Allowable Values will be used in this calculation.

High Flux with ULTRASONIC FLOW METER	≤ 104.9% Power with 4 pumps operating *
High Flux without ULTRASONIC FLOW METER	≤ 103.3% Power with 4 pumps operating *
High Flux	≤ 80.6% Power with 3 pumps operating (DIN 16)
Power/Pumps	≤ 55.1% Power with one pump in each loop (DIN 16)

NOTE: The Power/Pumps setpoint is ≤ 0% Power for no pumps, one pump/loop or two pumps in one loop operating. This is also the field setpoint for these conditions.

* The TS Allowable Values of 104.9% Power and 103.3% Power are contained in Serial 3198 (DIN 55), 'Measurement Uncertainty Recapture Power Uprate.'

Table 2.2-1 of the TS references the Core Operating Limits Report (DIN 49) which contains the TS Allowable Value curve for the Power/Imbalance/Flow (Flux - Delta Flux/Flow). This curve is directly proportional to actual reactor coolant flow. The TS Allowable Value point coordinates are given for 100% flow:

First column is % of Axial Power Imbalance
Second column is % of Rated Thermal Power

Power/Imbalance/Flow TS Allowable Values [Output to the COLR (DIN 49)] =

$$\begin{pmatrix} -30.6 & 94.4 \\ -17 & 108 \\ 17 & 108 \\ 30.6 & 77.1 \end{pmatrix}$$

Note: The TS Allowable Values shown above were determined for Cycle 9 and evaluated in this calculation as being more conservative than the current calculated TS Allowable Values from the Reload Report (DIN 4). See Section 4.10.2 for correlations between current Reload Report calculated values, Cycle 9 values, and field setpoints. Therefore, this calculation declares that Cycle 9 TS Allowable Values will be utilized as the basis for determination of Power/Imbalance/Flow field setpoints in this calculation. As a result, these are the TS Allowable Values to be published in the Core Operating Limits Report (Output DIN 49).

With this additional margin, future cycle analyses that impact the current values in the Reload Report, but that remain bounded by Cycle 9 TS Allowable Values, may not require field setpoint changes for Power/Imbalance/Flow. This calculation shall be updated each Cycle to document that the Cycle 9 values remain bounding, or modify the Tech Spec values accordingly.

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4.7 Limiting Trip Setpoint Calculations.

4.7.1 High Flux Setpoint

4 Pump Operation **with** ULTRASONIC FLOW METER used for heat balance calculations:

Limiting Trip Setpoint (% Power) = Tech Spec Allowable Value – ALT – Drift
= 104.9 – 0.0875 – 0.225
= 104.5875% Power

4 Pump Operation **without** ULTRASONIC FLOW METER for heat balance calculations or inoperable:

Limiting Trip Setpoint (% Power) = Tech Spec Allowable Value – ALT – Drift
= 103.3 – 0.0875 – 0.225
= 102.9875% Power

3 Pump Operation:

Limiting Trip Setpoint (% Power) = Tech Spec Allowable Value – ALT – Drift
= 80.6 – 0.0875 – 0.225
= 80.2875% Power

4.7.2 Power/Pumps Setpoint

Limiting Trip Setpoint (% Power) = Tech Spec Allowable Value - ALT - Drift
= 55.1 – 0.225 – 0.225
= 54.65% Power

4.7.3 Power/Imbalance/Flow Setpoint

Power/Imbalance Setpoints for Breakpoints (Bp) 1-4.

Bp1_P/I, Limiting Trip Setpoint = Tech Spec Allowable Value + ALT + Drift
= -30.6 + 0.15 + 0.225
Bp1_P/I = -30.225% Power

Bp 2_P/I, Limiting Trip Setpoint = Tech Spec Allowable Value + ALT + Drift
= -17 + 0.15 + 0.225
Bp 2_P/I = -16.625% Power

Bp 3_P/I, Limiting Trip Setpoint = Tech Spec Allowable Value - ALT - Drift
= 17 - 0.15 - 0.225
Bp 3_P/I = 16.625% Power

Bp 4_P/I, Limiting Trip Setpoint = Tech Spec Allowable Value - ALT - Drift
= 30.6 - 0.15 - 0.225
Bp 4_P/I = 30.225% Power

Power/Flow Setpoints for Breakpoints (Bp) 1-4.

Bp 1_P/F, Limiting Trip Setpoint = Tech Spec Allowable Value - ALT - Drift
= 94.4 - 0.5125 - 0.225
Bp 1_P/F = 93.6625% Power

Bp 2_P/F, Limiting Trip Setpoint = Tech Spec Allowable Value - ALT - Drift
= 108 - 0.5125 - 0.225
Bp 2_P/F = 107.2625% Power

Bp 3_P/F, Limiting Trip Setpoint = Tech Spec Allowable Value - ALT - Drift
= 108 - 0.5125 - 0.225
Bp 3_P/F = 107.2625% Power

Bp 4_P/F, Limiting Trip Setpoint = Tech Spec Allowable Value - ALT - Drift
= 77.1 - 0.5125 - 0.225
Bp 4_P/F = 76.3625% Power

4.8 Nominal Trip Setpoint Calculations.

The Nominal Trip Setpoints are calculated by including margin to the Limiting Trip Setpoint in a manner that will move the Nominal Trip Setpoint away from the Analytical Limit. There is no specific basis for the amount of margin included other than to round the values to a more conservative value. The Nominal Trip Setpoints shall be implemented in the field by SAP and M-720I setpoint data.

4.8.1 High Flux Setpoint

4 Pump Operation **with** ULTRASONIC FLOW METER used for heat balance calculations:

Nominal Trip Setpoint (%) = Limiting Trip Setpoint – Margin
= 104.5875 – 0.0875
= 104.5% Power

4 Pump Operation **without** ULTRASONIC FLOW METER for heat balance calculations or inoperable:

Nominal Trip Setpoint (%) = Limiting Trip Setpoint – Margin
= 102.9875– 0.0875
= 102.9% Power

3 Pump Operation:

Nominal Trip Setpoint (%) = Limiting Trip Setpoint – Margin
= 80.2875 – 0.1875
= 80.1% Power

4.8.2 Power/Pumps Setpoint

Nominal Trip Setpoint (%) = Limiting Trip Setpoint – Margin
= 54.65 – 0.1500
= 54.5% Power

4.8.3 Power/Imbalance/Flow Setpoint

Using the Break Points calculated in Section 4.7.3 as the Limiting Trip Setpoints results in:

Power/Imbalance Setpoints for Breakpoints (Bp) 1-4.

Bp1_P/I, Nominal Trip Setpoint = Limiting Trip Setpoint + Margin
= -30.225 + 0.1250
Bp1_P/I = -30.1% Power

Bp 2_P/I, Nominal Trip Setpoint = Limiting Trip Setpoint + Margin
= -16.625 + 0.1250
Bp 2_P/I = -16.5% Power

Bp 3_P/I, Nominal Trip Setpoint = Limiting Trip Setpoint - Margin
= 16.625 - 0.1250
Bp 3_P/I = 16.5% Power

Bp 4_P/I, Nominal Trip Setpoint = Limiting Trip Setpoint - Margin
= 30.225 - 0.1250
Bp 4_P/I = 30.1% Power

Power/Flow Setpoints for Breakpoints (Bp) 1-4.

Bp 1_P/F, Nominal Trip Setpoint = Limiting Trip Setpoint - Margin
= 93.6625 - 0.1625
Bp 1_P/F = 93.5% Power

Bp 2_P/F, Nominal Trip Setpoint = Limiting Trip Setpoint - Margin
= 107.2625 - 0.1625
Bp 2_P/F = 107.1% Power

Bp 3_P/F, Nominal Trip Setpoint = Limiting Trip Setpoint - Margin
= 107.2625 - 0.1625
Bp 3_P/F = 107.1% Power

Bp 4_P/F, Nominal Trip Setpoint = Limiting Trip Setpoint - Margin
= 76.3625 - 0.1625
Bp 4_P/F = 76.2% Power

4.9 As-Found Tolerances (AFT)

The following As-Found Tolerances account for the uncertainties associated with the As-Left Tolerance plus the Drift Allowance. This is consistent with the guidance in TSTF Improved Technical Specification Traveler 493, (DIN 63, page 7). Per the TSTF Improved Technical Specification Traveler 493, (DIN 63, page 7) the As-Found Tolerance must be calculated to include only uncertainties of reference accuracy, M&TE accuracy, M&TE readability, and drift or the combination of the As-Left Tolerance and drift. The latter approach will be used because using the string accuracies (Section 4.2.4) would allow the as-found setpoint to be non-conservative with respect to the Allowable Value. Using the ALT ensures that the Tech Spec Allowable Value is protected.

Any As-Found value that exceeds the As-Found Tolerance requires recalibration to within the As-Left Tolerance around the Nominal Trip Setpoint prior to return to service.

4.9.1 High Flux As-Found Tolerance

The As-Found Acceptance Criteria Band is determined by taking the High Flux string As-Left Tolerance (Section 4.2.4) and drift. The equipment accuracies and calibration uncertainties are included in the As-Left Tolerance, so they will not be listed separately. **During surveillance testing, the absolute value of the previous As-Left minus the current As-Found shall be less than or equal to the As-Found Acceptance Criteria Band. If outside the As-Found Acceptance Criteria Band, the equipment shall be recalibrated to within the As-Left Tolerance around the Nominal Trip Setpoint and evaluated to verify it is functioning as required prior to return to service.**

$$|\text{previous As-Left} - \text{current As-Found}| \leq \text{As-Found Acceptance Criteria Band}$$

This approach is consistent with the methodology contained in a similar RPS Technical Requirements Manual LCO 3.3.1.2 and ensures that the components are exhibiting expected behaviors. This method for determining compliance with the As-Found Acceptance Criteria Band shall be contained in the RPS Surveillance Procedures (DINs 40, 41, 42, and 43).

As-Found Acceptance Criteria Band = High Flux ALT + Drift
= 0.0875% + 0.225%
= 0.3125% Power

OR

= (0.3125%/125%) * 10 Vdc
= 0.025 Vdc

4.9.2 Power/Pumps As-Found Tolerance

Power/Pumps AFT = Power/Pumps ALT + Drift
= 0.225% + 0.225%
= 0.4500% Power

4.9.3 Power/Imbalance/Flow As-Found Tolerance

Power/Imbalance As-Found Tolerance

Power/Imbalance = Power/Imbalance ALT + Drift
= 0.15% + 0.225%
= 0.3750% Power

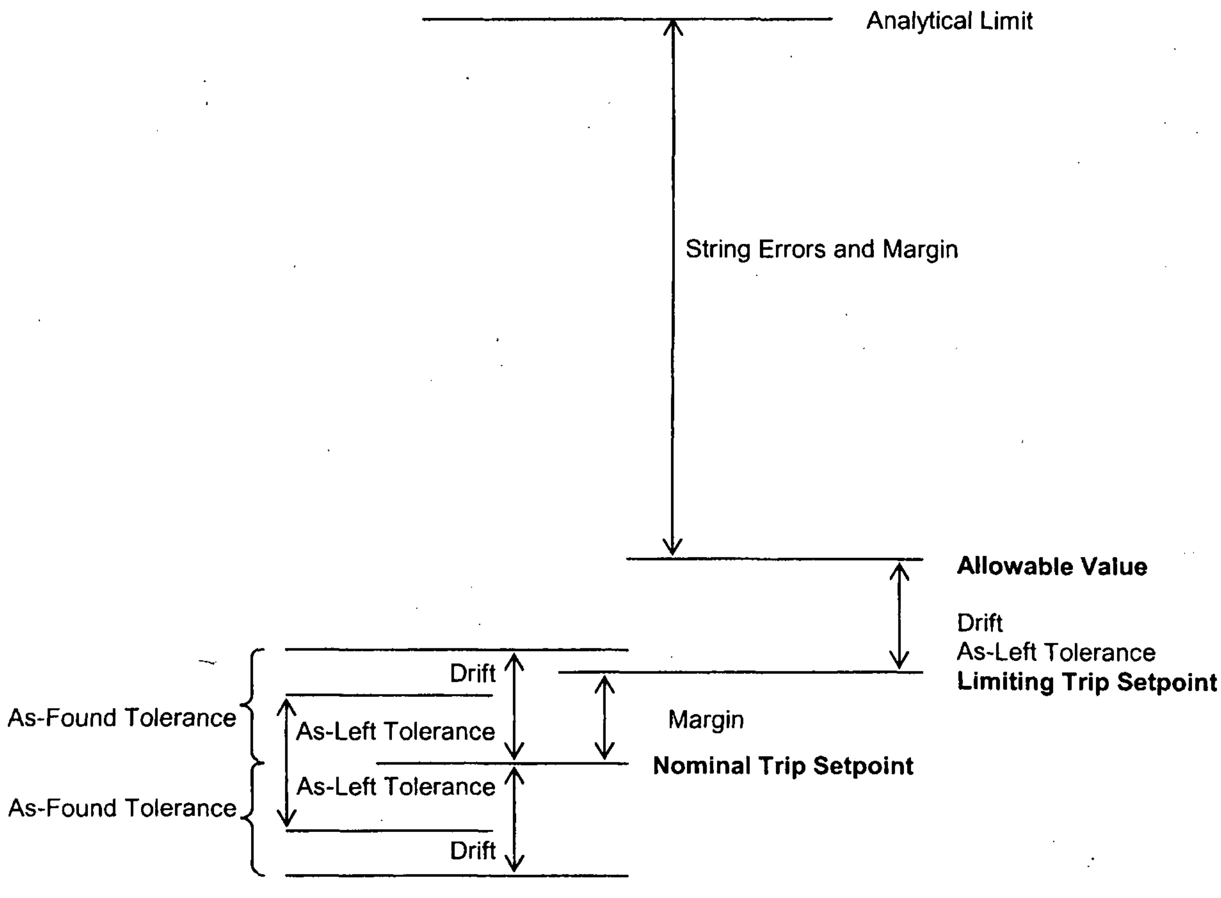
Power/Flow As-Found Tolerance

Power/Flow = Power/Flow ALT + Drift
= 0.5125% + 0.225%
= 0.7375% Power

4.10 Illustrations

4.10.1 Locations of Calculated Uncertainties

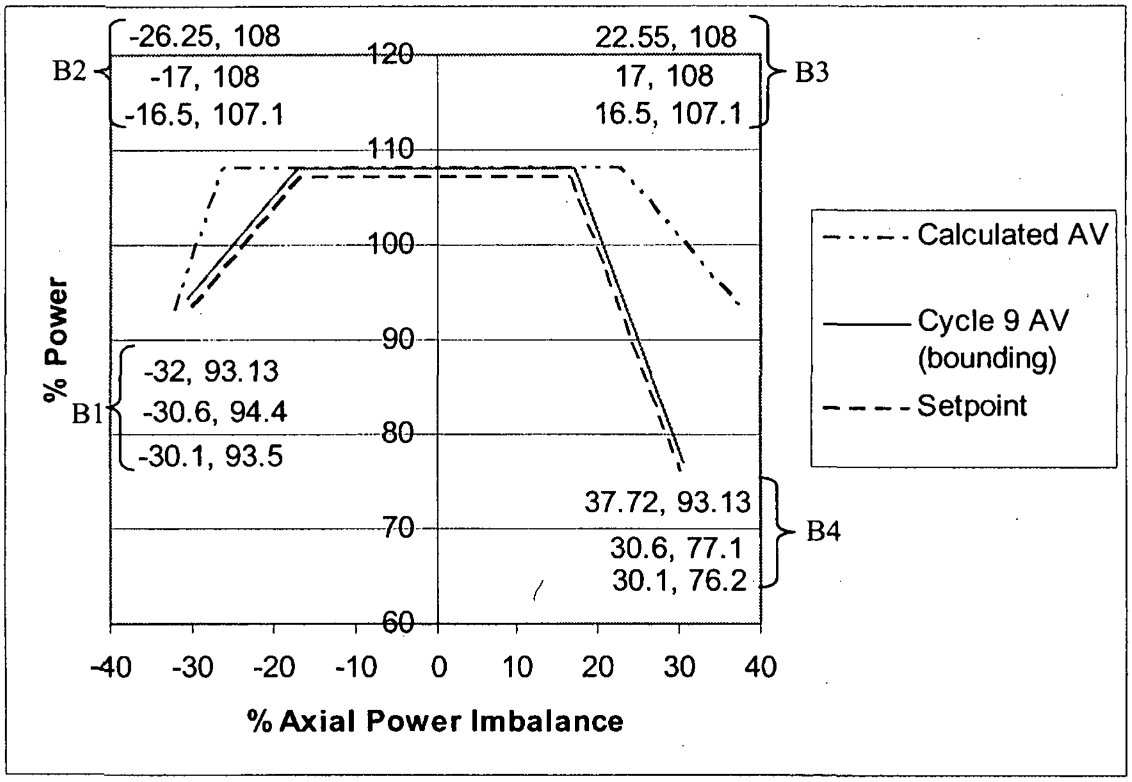
This figure illustrates the methodology/location of uncertainties and margins used to calculation the Limiting and Nominal Trip Setpoints for the High Flux, Power/Pumps, and Power/Imbalance/Flow with respect to the Analytical Limits.



4.10.2 Power/Imbalance/Flow Trip Curve

The following two graphs are developed with the Calculated Allowable Values from the Reload Report, Figure 8-14 (DIN 4); the Allowable Values from Section 4.6; and the Setpoints from Section 4.8.3. Graphs have been provided for both the current 2772MWt licensed power level, as well as the proposed 2817MWt power uprate. Therefore, Allowable Values and field setpoints are demonstrated as conservative and bounding for both cases. This is consistent with the approach documented in AREVA Document 86-5057366-003 (DIN 18).

Thermal Power of 2772 MWt:



Where at each point of interest, the breakpoint values for the Calculated AVs are on top, the AVs are below the Calculated AVs, and the Setpoint Values are below the AVs.

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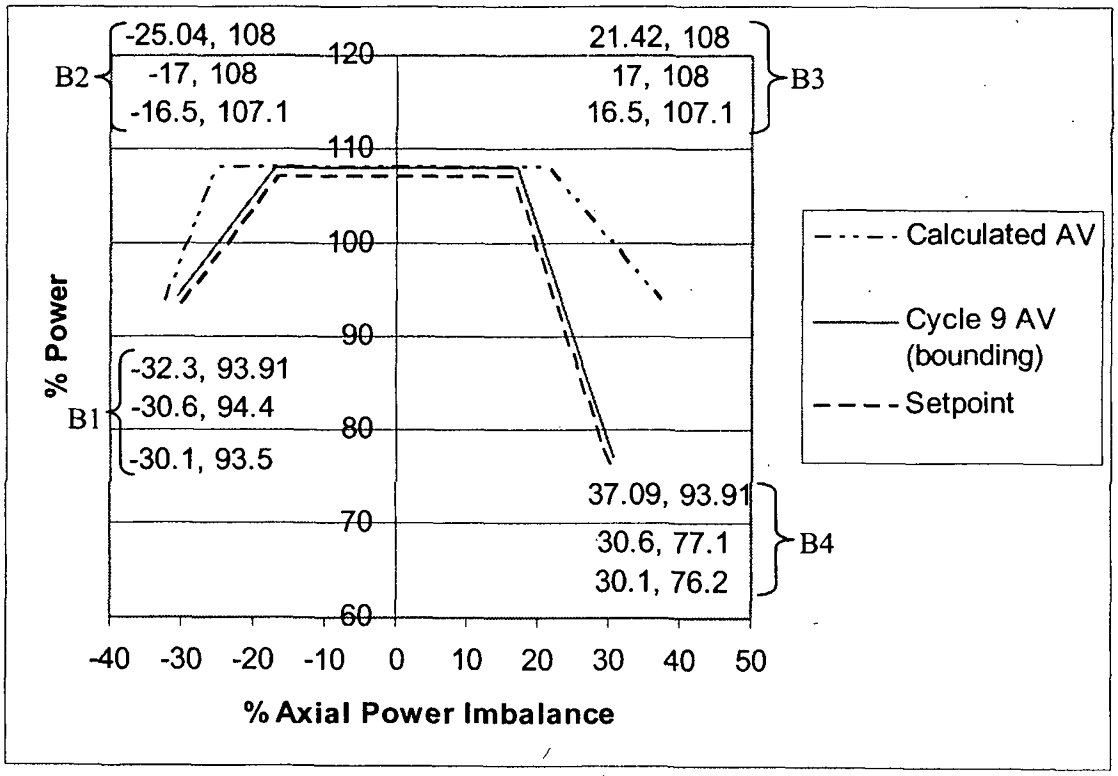
Thermal Power of 2817 MWt:



From the above graphs, it is evident that the values are equivalent or there is margin between the Calculated AV and the Cycle 9 AV.

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5. RESULTS

Nominal Trip Setpoints for the Reactor Protection System (RPS) Reactor High Flux, Power/Imbalance/Flow and Power/Pumps Trip functions are as follows:

Parameter	Nominal Trip Setpoint
High Flux WITH Ultrasonic Flow Meter (4 Pump Operation)	104.5% Power
High Flux WITHOUT Ultrasonic Flow Meter (4 Pump Operation)	102.9% Power
High Flux (3 Pump Operation)	80.1% Power
Power/Pumps	54.5% Power

Power/Imbalance/Flow
First column is % of Axial Power Imbalance
Second column is % of Rated Thermal Power

$$\begin{pmatrix} -30.1 & 93.5 \\ -16.5 & 107.1 \\ 16.5 & 107.1 \\ 30.1 & 76.2 \end{pmatrix}$$

As-Left Tolerances:

High Flux ALT: = +/- 0.0875% Power
Power/Pumps ALT: = +/- 0.225% Power
Power/Imbalance/Flow :
Power/Imbalance ALT = +/- 0.15% Power
Power/Flow ALT = +/- 0.5125% Power

As-Found Tolerances:

High Flux AFT = +/- 0.3125% Power

As-Found Acceptance Criteria Band (High Flux String):

| previous As-Left – current As-Found | ≤ 0.3125% Power (or 0.025 Vdc)

Power/Pumps = +/- 0.4500% Power
Power/Imbalance/Flow
Power/Imbalance = +/- 0.3750% Power
Power/Flow = +/- 0.7375% Power

6. CONCLUSIONS

The Nominal Trip Setpoints identified above are based on Allowable Values from Serial 3198 (DIN 55) and AREVA 51-9004090-005 (DIN 56) with the exception of the Allowable Values for Power/Imbalance/Flow which are based on the Reload Report (DIN 4). The methodology for determining the setpoints is in compliance with ISA 67.04 requirements. Additionally, the As-Left and As-Found Tolerances are calculated based on the Technical Specification Task Force (TSTF) Traveler 493 (DIN 62) and the NRC Regulatory Issue Summary (RIS) 2006-17 (DIN 61). The calculated values are identical to the current operating values and no operator burdens have been identified with the setpoints. Based on this, the acceptance criteria outlined in Section 3 have been met.

Attachment 1 – Drift Analysis for High Flux

Analysis Methodology

The method used to determine the drift for the bistables is to analyze the as-found as-left (AFAL) setpoint data of the subject instruments. The statistical analysis will be based on TR-103335-R1, "Guidelines for Instrument Calibration Extension Reduction Programs — Revision 1: Statistical Analysis of Instrument Calibration Data" (DIN 26), with the following clarifications:

1. The calibration data was taken during a functional check. The procedures from which the data was retrieved are:

   - DB-MI-03057, RPS Channel 1 Calibration of High Flux, Power/Imbalance/Flow, Power/Pumps Trip Functions (Din 40)
   - DB-MI-03058, RPS Channel 2 Calibration of High Flux, Power/Imbalance/Flow, Power/Pumps Trip Functions (Din 41)
   - DB-MI-03059, RPS Channel 3 Calibration of High Flux, Power/Imbalance/Flow, Power/Pumps Trip Functions (Din 42)
   - DB-MI-03060, RPS Channel 4 Calibration of High Flux, Power/Imbalance/Flow, Power/Pumps Trip Functions (Din 43)

   The instrument was adjusted if the as-found data was outside the tolerance and, in some cases, was adjusted even when within the tolerance.

2. The three-month drift was calculated using the following formula for a time period for which no replacements were made to the instrument. If adjustments were made, these were factored into the formula as follows:

   $D_i = AF - AF_{i\text{-}92} + \text{Adjustment(s)}$

   Where:
   D_i = Drift for the time period
   AF = As-Found during current calibration check
   AL_{i92} = As-Left of approximately 92 days previous

3. Since the duration (d_i) of the calculated three-month drift (D_i) was not always comprised of the same number of days and the Technical Specification defines three months as 92 days, for all durations less than or equal to 92 days, the calculated three-month drift was corrected based on the following equation:

   $Dci = D_i\,(92/d_i)$; where Dci is corrected drift

   If the duration was greater than 92 days, the value would be decreased if the above equation were used. For conservatism, the value collected during the surveillance test was used as the normalized data (i.e., no interpolation of data).

   For durations that were less than 46 days (92/2) or greater than 115 days (92 x 1.25) the data was not used since it would not be reflective of the 92 day drift.

4. The data will be evaluated for outliers and for normality.

5. The tolerance interval will be calculated for a confidence level of 95% with 95% of the population contained within the tolerance interval (TI) using the following equation:

$$TI_{(95/95)} = xbar \pm ks$$

Where,

$TI_{(95/95)}$ = Tolerance interval for 95%/95%
xbar = Sample mean
k = Tolerance factor (95/95)
s = Sample standard deviation

6. The following equations will be used to determine the mean and standard deviation:

Mean = xbar = $(\Sigma\ D_{ci}) / N$, where N = sample count, and I = 1 to N

Sample standard deviation = s = $[(1/(N - 1))\ ((\Sigma\ (D_{ci})^2) - N\ (xbar^2))]^{1/2}$

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Compilation of Drift Data - High Flux

Channel 1	Channel 2	Channel 3	Channel 4
0.000000	0.003680	0.003366	0.003286
-0.002190	-0.001095	-0.003286	-0.002190
-0.001095	-0.002190	0.000000	**
-0.002190	0.000000	-0.020092	**
0.000000	**	-0.001136	0.000000
-0.002272	**	-0.002190	0.006732
-0.001057	0.001082	0.008762	0.009200
-0.001136	**	-0.002190	0.001704
0.001095	0.004381	0.001070	-0.015153
-0.001095	0.001095	-0.001122	0.003325
0.000000	-0.003286	0.002140	-0.003286
**	0.001095	**	0.014071
-0.001000	-0.001095	0.002000	**
0.000000	**	**	0.000000
**	-0.001000	-0.002000	0.000000
-0.002272	0.000000	**	**
-0.002190	**	0.000000	0.000000
0.000000	**	0.001108	-0.005412
0.000000	0.001070	-0.004279	0.001095
0.000000	-0.002244	0.000000	-0.003366
-0.001122	0.001095	0.001082	0.002244
-0.001095	-0.001095	0.001122	-0.001057
-0.001000	0.001057	0.001122	**
0.004678	0.001000	-0.001057	0.003407
0.000000	-0.005041	**	0.004000
0.000000	0.005041	-0.006571	0.001227
	-0.001000	-0.001108	-0.012000
	0.000000	0.002000	
	-0.002190		

Calculation of Mean and Standard Deviation - High Flux

Mean (Drift (Bias))	-0.000291
Standard Dev.	0.004160

Sample Size	93
K Factor	2.2468
Drift (Random)	0.009346

T-Test - High Flux

The T-Test determines if a data point is able to be considered an outlier from all other data. This is accomplished by finding the worst case value in either the positive or negative direction, subtracting the mean from that value, taking the absolute value of the results, and dividing the resulting value by the standard deviation. This gives a result of the number of standard deviations the value is away from the mean. If the value is determined to be greater than the "Critical Value", the data point may be considered an outlier and removed from the data if there is a basis for removal. If the data is removed, the T-Test is repeated with revised worst case value, mean, and standard deviation, until the worst case data point is either less than the Critical Value or has no basis for removal.

Max value from Table =	0.014071	Min value from Table =	-0.020092

Critical value for T-Test with a sample size of 96 and a Upper 5% Significance = 3.21

Standard Dev =	0.004160	Mean=	-0.000291
T-Test for Max value	0.014071	T-Test for Min value	-0.020092
T-Test =	3.4523	T-Test =	4.7601

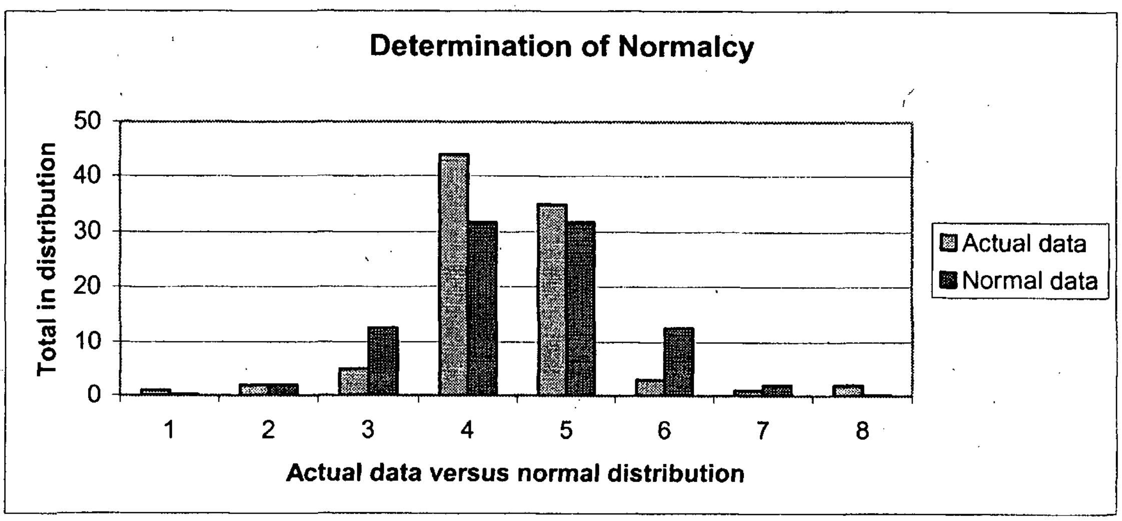
Because the T-Test for both the Max and the Min values is higher than the 3.21 value, they could be considered outliers and excluded from the sample. Due to there being no basis for removal, they will not be excluded. No further tests for outliers are required.

Normalcy Test - High Flux

Using the Chi-squared test for normalcy results in: 47.64 based on groupings of bins below.

As there are 8 bins, a normal distributed data set would be below 8. Since it is above 8, the data is determined to be NOT normally distributed. Graphing the data results in a display of data that has a high kurtosis (middle peak) and 3 data values outside of 3 standard deviations. To graphically display the data, a series is established starting at the Mean and moving away from the Mean by the Standard Deviation. The number of data sets in each series are determined to be able to plot a normalcy graph. The following table displays the series boundaries and the number of data sets in each series and compares that to the normal distribution value. Due to the high kurtosis and the 3 values that are more than 3 standard deviations away from the mean, the data will be considered to be NOT normally distributed and will be included as a bias in the calculation.

				Actual Dist	Normal Dist	Chi-Squared
Data Sets between	0.024669	and	0.012189	1	0.14	5.31
Data Sets between	0.012189	and	0.008029	2	1.98	0.00
Data Sets between	0.008029	and	0.003869	5	12.64	4.62
Data Sets between	0.003869	and	-0.000291	44	31.74	4.73
Data Sets between	-0.000291	and	-0.004450	35	31.74	0.33
Data Sets between	-0.004450	and	-0.008610	3	12.64	7.35
Data Sets between	-0.008610	and	-0.012770	1	1.98	0.49
Data Sets between	-0.012770	and	-0.025250	2	0.14	24.81
						47.64



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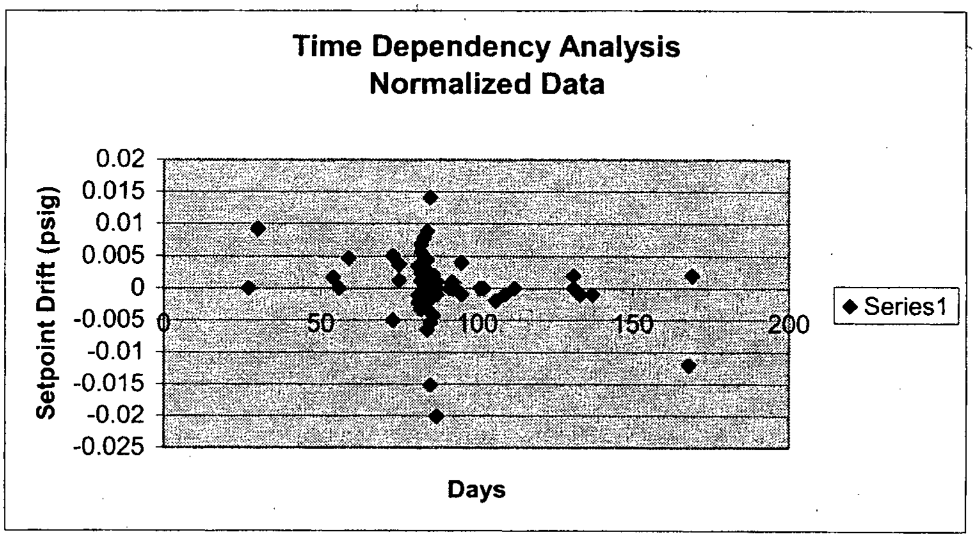
Time Dependency Analysis - High Flux

Time dependency analysis is used to determine if there is a correlation between the period between calibrations and the resulting change in setpoint. Each data point has been calculated along with the associated time duration between calibrations. Each of the data points used have been included in the plot below. As can be seen from the plot, there are no discernable indications that the drift is in any one direction based on a given time period. For example, if there were a significant number of data points in the positive region from the period of 100 - 150 days with no corresponding data points in the negative region, this would indicate a time dependency with respect to the drift. Since this, nor any other similar correlation is evident, it is concluded there is no time dependency to the drift.



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1	High Flux Trip - Channel 1									
2							D_i	d_i	D_{ci}	
3					Re-		3 Month	3 Month	Corrected 3	
4	Date	Desired	As-Found	As-Left	calibrated Difference	Re-calibrated	Drift Value (V_{DC})	Duration (Days)	Month Drift Value (VDC)	Comments
5	7/13/99	8.360	8.361	8.361						
6	10/5/99	8.360	8.361	8.361			0.00000	84	0.000000	
7	12/28/99	8.360	8.359	8.359			-0.00200	84	-0.002190	
8	3/21/00	8.360	8.358	8.358			-0.00100	84	-0.001095	
9	6/13/00	8.360	8.356	8.356			-0.00200	84	-0.002190	
10	9/8/00	8.360	8.356	8.356			0.00000	87	0.000000	
11	11/28/00	8.360	8.354	8.354			-0.00200	81	-0.002272	
12	2/23/01	8.360	8.353	8.353			-0.00100	87	-0.001057	
13	5/15/01	8.360	8.352	8.352			-0.00100	81	-0.001136	
14	8/7/01	8.360	8.353	8.353			0.00100	84	0.001095	
15	10/30/01	8.360	8.352	8.352			-0.00100	84	-0.001095	
16	1/22/02	8.360	8.352	8.352			0.00000	84	0.000000	
17	6/27/03	0.320	0.326	0.326			**	**	**	Desired Value Change
18	11/11/03	0.320	0.325	0.325			-0.00100	137	-0.001000	
19	2/20/04	0.320	0.325	0.325			0.00000	101	0.000000	
20	5/14/04	8.360	8.369	8.369			**	**	**	Desired Value Change
21	8/3/04	8.360	8.367	8.367			-0.00200	81	-0.002272	
22	10/26/04	8.360	8.365	8.365			-0.00200	84	-0.002190	
23	2/15/2005	8.360	8.365	8.365			0.00000	112	0.000000	
24	4/12/2005	8.360	8.365	8.365			0.00000	56	0.000000	
25	7/8/2005	8.360	8.365	8.365			0.00000	87	0.000000	
26	9/28/2005	8.360	8.364	8.364			-0.00100	82	-0.001122	
27	12/21/2005	8.360	8.363	8.363			-0.00100	84	-0.001095	
28	4/9/2006	8.360	8.362	8.362			-0.00100	109	-0.001000	
29	6/7/2006	8.360	8.365	8.365			0.00300	59	0.004678	
30	8/29/2006	8.360	8.365	8.365			0.00000	83	0.000000	
31	11/29/2006	8.360	8.365	8.365			0.00000	92	0.000000	

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1	High Flux Trip - Channel 2									
2							D_i	d_i	D_{ci}	
3					Re-		3 Month	3 Month	Corrected 3	
4	Date	Desired	As-Found	As-Left	calibrated Difference	Re-calibrated	Drift Value (V_{DC})	Duration (Days)	Month Drift Value (VDC)	Comments
5	6/10/1999	8.360	8.364	8.364						
6	8/24/1999	8.360	8.367	8.367			0.00300	75.00	0.003680	
7	11/16/1999	8.360	8.366	8.366			-0.00100	84.00	-0.001095	
8	2/8/2000	8.360	8.364	8.364			-0.00200	84.00	-0.002190	
9	3/6/2000	8.360	8.364	8.364			0.00000	27.00	0.000000	
10	5/5/2000	7.969	7.970	7.970			**	**	**	Desired Value Change
11	7/24/2000	8.360	8.363	8.363			**	**	**	Desired Value Change
12	10/17/2000	8.360	8.364	8.364			0.00100	85.00	0.001082	
13	11/3/2000	8.360	8.365	8.365			**	17.00	**	Duration too short
14	1/9/2001	8.360	8.368	8.361	-0.00700	X	0.00400	84.00	0.004381	Uses 10/17/2000 data
15	4/3/2001	8.360	8.362	8.362			0.00100	84.00	0.001095	
16	6/26/2001	8.360	8.359	8.359			-0.00300	84.00	-0.003286	
17	9/18/2001	8.360	8.360	8.360			0.00100	84.00	0.001095	
18	12/11/2001	8.360	8.359	8.359			-0.00100	84.00	-0.001095	
19	7/3/2003	0.320	0.322	0.322			**	**	**	Desired Value Change
20	11/13/2003	0.320	0.321	0.321			-0.00100	133.00	-0.001000	
21	2/12/2004	0.320	0.321	0.321			0.00000	91.00	0.000000	
22	3/14/2004	4.800	4.798	4.800	0.00200	X	**	**	**	Desired Value Change
23	6/22/2004	8.360	8.360	8.360			**	**	**	Desired Value Change
24	9/16/2004	8.360	8.361	8.361			0.00100	86.00	0.001070	
25	12/7/2004	8.360	8.359	8.359			-0.00200	82.00	-0.002244	
26	3/1/2005	8.360	8.360	8.360			0.00100	84.00	0.001095	
27	5/24/2005	8.360	8.359	8.359			-0.00100	84.00	-0.001095	
28	8/19/2005	8.360	8.360	8.360			0.00100	87.00	0.001057	
29	11/19/2005	8.360	8.361	8.361			0.00100	92.00	0.001000	
30	1/31/2006	8.360	8.357	8.357			-0.00400	73.00	-0.005041	
31	4/14/2006	8.360	8.361	8.361			0.00400	73.00	0.005041	
32	7/18/2006	8.360	8.360	8.360			-0.00100	95.00	-0.001000	
33	10/11/2006	8.360	8.360	8.360			0.00000	85.00	0.000000	
34	1/3/2007	8.360	8.358	8.358			-0.00200	84.00	-0.002190	

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1	High Flux Trip - Channel 3									
2							Di	di	Dci	
3					Re-		3 Month	3 Month	Corrected 3	
4	Date	Desired	As-Found	As-Left	calibrated Difference	Re-calibrated	Drift Value (VDC)	Duration (Days)	Month Drift Value (VDC)	Comments
5	6/24/1999	8.360	8.357	8.357						
6	9/14/1999	8.360	8.360	8.360			0.00300	82.00	0.003366	
7	12/7/1999	8.360	8.357	8.357			-0.00300	84.00	-0.003286	
8	2/29/2000	8.360	8.357	8.367	0.01000	X	0.00000	84.00	0.000000	
9	5/26/2000	8.360	8.348	8.348			-0.01900	87.00	-0.020092	
10	8/15/2000	8.360	8.347	8.347			-0.00100	81.00	-0.001136	
11	11/7/2000	8.360	8.345	8.368	0.02300	X	-0.00200	84.00	-0.002190	
12	1/30/2001	8.360	8.376	8.361	-0.01500	X	0.00800	84.00	0.008762	
13	4/24/2001	8.360	8.359	8.359			-0.00200	84.00	-0.002190	
14	7/19/2001	8.360	8.360	8.360			0.00100	86.00	0.001070	
15	10/9/2001	8.360	8.359	8.359			-0.00100	82.00	-0.001122	
16	1/3/2002	8.360	8.361	8.361			0.00200	86.00	0.002140	
17	7/4/2003	0.320	0.314	0.314			**	**	**	Desired Value Change
18	11/12/2003	0.320	0.316	0.316			0.00200	131.00	0.002000	
19	11/20/2003	0.320	0.315	0.315			**	8.00	**	Duration too short
20	2/26/2004	0.320	0.314	0.314			-0.00200	106.00	-0.002000	Uses 11/12/2003 data
21	4/22/2004	8.360	8.369	8.369			**	**	**	Desired Value Change
22	7/14/2004	8.360	8.369	8.369			0.00000	83.00	0.000000	
23	10/5/2004	8.360	8.370	8.370			0.00100	83.00	0.001108	
24	12/30/2004	8.360	8.366	8.366			-0.00400	86.00	-0.004279	
25	3/24/2005	8.360	8.366	8.366			0.00000	84.00	0.000000	
26	6/17/2005	8.360	8.367	8.367			0.00100	85.00	0.001082	
27	9/7/2005	8.360	8.368	8.368			0.00100	82.00	0.001122	
28	11/28/2005	8.360	8.369	8.369			0.00100	82.00	0.001122	
29	2/23/2006	8.360	8.368	8.368			-0.00100	87.00	-0.001057	
30	4/10/2006	8.360	8.361	8.361			**	46.00	**	Duration too short
31	5/18/2006	8.360	8.362	8.362			-0.00600	84.00	-0.006571	Uses 2/23/2006 data
32	8/9/2006	8.360	8.361	8.361			-0.00100	83.00	-0.001108	
33	1/25/2007	8.360	8.363	8.363			0.00200	169.00	0.002000	

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1	High Flux Trip - Channel 4									
2							D_i	d_i	D_{ci}	
3					Re-		3 Month	3 Month	Corrected 3	
4	Date	Desired	As-Found	As-Left	calibrated Difference	Re-calibrated	Drift Value (V_{DC})	Duration (Days)	Month Drift Value (VDC)	Comments
5	8/3/1999	8.360	8.351	8.351						
6	10/26/1999	8.360	8.354	8.354			0.00300	84.00	0.003286	
7	1/18/2000	8.360	8.352	8.352			-0.00200	84.00	-0.002190	
8	5/8/2000	7.969	7.971	7.971			**	**	**	Desired Value Change
9	7/6/2000	8.360	8.359	8.359			**	**	**	Desired Value Change
10	9/28/2000	8.360	8.359	8.366	0.00700		0.00000	84.00	0.000000	
11	12/19/2000	8.360	8.372	8.372			0.00600	82.00	0.006732	
12	1/18/2001	8.360	8.375	8.369	-0.00600	X	0.00300	30.00	0.009200	
13	3/13/2001	8.360	8.370	8.370			0.00100	54.00	0.001704	
14	6/6/2001	8.360	8.356	8.356			-0.01400	85.00	-0.015153	
15	8/28/2001	8.360	8.359	8.359			0.00300	83.00	0.003325	
16	11/20/2001	8.360	8.356	8.356			-0.00300	84.00	-0.003286	
17	2/13/2002	8.360	8.369	8.369			0.01300	85.00	0.014071	
18	7/9/2003	0.320	0.325	0.325			**	**	**	Desired Value Change
19	11/17/2003	0.320	0.325	0.325			0.00000	131.00	0.000000	
20	2/27/2004	0.320	0.325	0.325			0.00000	102.00	0.000000	
21	5/25/2004	8.360	8.360	8.360			**	**	**	Desired Value Change
22	8/26/2004	8.360	8.360	8.360			0.00000	93.00	0.000000	
23	11/19/2004	8.360	8.355	8.355			-0.00500	85.00	-0.005412	
24	2/11/2005	8.360	8.356	8.356			0.00100	84.00	0.001095	
25	5/4/2005	8.360	8.353	8.353			-0.00300	82.00	-0.003366	
26	7/25/2005	8.360	8.355	8.355			0.00200	82.00	0.002244	
27	10/20/2005	8.360	8.354	8.354			-0.00100	87.00	-0.001057	
28	11/9/2005	8.360	8.355	8.355			**	20.00	**	Duration too short
29	1/9/2006	8.360	8.357	8.357			0.00300	81.00	0.003407	Uses 10/20/2005 data
30	4/14/2006	8.360	8.361	8.361			0.00400	95.00	0.004000	
31	6/28/2006	8.360	8.362	8.362			0.00100	75.00	0.001227	
32	12/13/2006	8.360	8.350	8.350			-0.01200	168.00	-0.012000	

Attachment 2 - Drift Analysis for Power/Pumps

(See Attachment 1 for Methodology)

Compilation of Drift Data - Power/Pumps

Channel 1	Channel 2	Channel 3	Channel 4
0.004381	0.000000	-0.002244	0.004381
**	-0.001095	-0.002190	-0.006571
-0.005476	0.000000	0.009000	-0.005000
-0.001095	0.000000	-0.003407	0.008903
0.000000	-0.018098	0.002190	0.000000
0.000000	0.014950	0.001095	0.001095
0.002115	-0.009741	-0.002044	**
-0.002272	**	-0.001150	0.002190
0.001095	**	-0.001122	-0.007576
0.000000	0.004381	0.003209	0.000000
-0.002190	0.001095	**	0.000000
**	-0.004381	0.007000	0.007576
0.001000	0.000000	0.004000	**
0.003000	0.002190	-0.003286	0.002000
0.002190	**	0.002217	0.003000
-0.002272	0.001000	0.000000	0.000000
0.000000	0.013289	-0.002140	-0.002000
-0.001000	0.002968	0.000000	0.001082
0.001643	-0.003000	0.000000	-0.001095
-0.003172	0.003172	0.002244	-0.002244
0.002244	-0.002272	-0.003366	0.002244
0.000000	0.001095	0.001057	0.000000
-0.004000	-0.002190	-0.012000	**
0.004678	0.001057	0.007263	-0.001136
0.002217	0.002000	0.002217	-0.005000
-0.001000	-0.001260	-0.001000	0.006133
	-0.020164		0.002000
	0.030000		
	-0.010824		
	0.001095		

Calculation of Mean and Standard Deviation - Power/Pumps

Mean (Drift (Bias))	0.000249
Standard Dev.	0.005772

Sample Size	100
K Factor	2.2300
Drift (Random)	0.012871

T-Test - Power/Pumps

The T-Test determines if a data point is able to be considered an outlier from all other data. This is accomplished by finding the worst case value in either the positive or negative direction, subtracting the mean from that value, taking the absolute value of the results, and dividing the resulting value by the standard deviation. This gives a result of the number of standard deviations the value is away from the mean. If the value is determined to be greater than the "Critical Value" , the data point may be considered an outlier and removed from the data if there is a basis for removal. If the data is removed, the T-Test is repeated with revised worst case value, mean, and standard deviation, until the worst case data point is either less than the Critical Value or has no basis for removal.

Max value from Table =	0.030000	Min value from Table =	-0.020164

Critical value for T-Test with a sample size of 96 and a Upper 5% Significance = 3.21

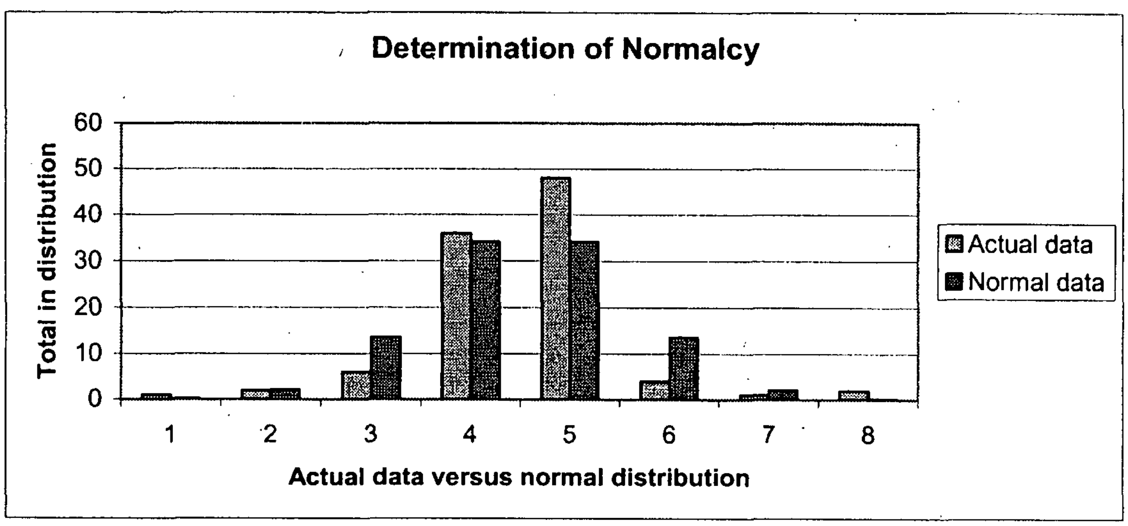
Standard Dev =	0.005772	Mean=	0.000249
T-Test for Max value	0.030000	T-Test for Min value	-0.020164
T-Test =	5.1547	T-Test =	3.5368

Because the T-Test for the Min and Max values are higher than the 3.21 value, they could be considered outliers and excluded from the sample. Due to there being no basis for removal, they will not be excluded. No further tests for outliers are required.

Normalcy Test - Power/Pumps

Using the Chi-squared test for normalcy results in: 44.99 based on groupings of bins below. As there are 8 bins, a normal distributed data set would be below 8. Since it is above 8, the data is determined to be NOT normally distributed. Graphing the data results in a display of data that has a high kurtosis (middle peak) and 3 data values outside of 3 standard deviations. To graphically display the data, a series is established starting at the Mean and moving away from the Mean by the Standard Deviation. The number of data sets in each series are determined to be able to plot a normalcy graph. The following table displays the series boundaries and the number of data sets in each series and compares that to the normal distribution value. Due to the high kurtosis and the 3 values that are more than 3 standard deviations away from the mean, the data will be considered to be NOT normally distributed and will be included as a bias in the calculation.

				Actual Dist	Normal Dist	Chi-Squared
Data Sets between	0.034879	and	0.017564	1	0.15	4.82
Data Sets between	0.017564	and	0.011792	2	2.13	0.01
Data Sets between	0.011792	and	0.006020	6	13.59	4.24
Data Sets between	0.006020	and	0.000249	36	34.13	0.10
Data Sets between	0.000249	and	-0.005523	48	34.13	5.64
Data Sets between	-0.005523	and	-0.011295	4	13.59	6.77
Data Sets between	-0.011295	and	-0.017066	1	2.13	0.60
Data Sets between	-0.017066	and	-0.034381	2	0.15	22.82
						44.99



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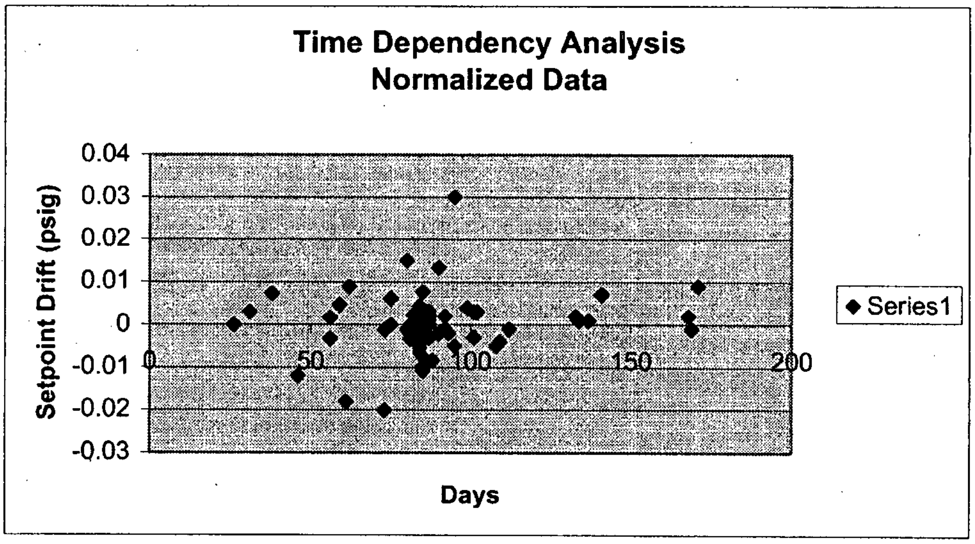
Time Dependency Analysis - Power/Pumps

Time dependency analysis is used to determine if there is a correlation between the period between calibrations and the resulting change in setpoint. Each data point has been calculated along with the associated time duration between calibrations. Each of the data points used have been included in the plot below. As can be seen from the plot, there are no discernable indications that the drift is in any one direction based on a given time period. For example, if there were a significant number of data points in the positive region from the period of 100 - 150 days with no corresponding data points in the negative region, this would indicate a time dependency with respect to the drift. Since this, nor any other similar correlation is evident, it is concluded there is no time dependency to the drift.



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1	Power/Pumps Trip - Channel 1									
2							D_i	d_i	D_{ci}	
3					Re-		3 Month	3 Month	Corrected 3	
4	Date	Desired	As-Found	As-Left	calibrated Difference	Re-calibrated	Drift Value (VDC)	Duration (Days)	Month Drift Value (VDC)	Comments
5	10/5/1999	4.360	4.353	4.353						
6	12/28/1999	4.360	4.357	4.357			0.00400	84	0.004381	
7	1/20/2000	4.360	4.354	4.354			**	23	**	Duration too short
8	3/21/2000	4.360	4.352	4.352			-0.00500	84	-0.005476	Uses 12/28/1999 data
9	6/13/2000	4.360	4.351	4.351			-0.00100	84	-0.001095	
10	9/8/2000	4.360	4.351	4.351			0.00000	87	0.000000	
11	11/28/2000	4.360	4.351	4.351			0.00000	81	0.000000	
12	2/23/2001	4.360	4.353	4.353			0.00200	87	0.002115	
13	5/15/2001	4.360	4.351	4.351			-0.00200	81	-0.002272	
14	8/7/2001	4.360	4.352	4.352			0.00100	84	0.001095	
15	10/30/2001	4.360	4.352	4.352			0.00000	84	0.000000	
16	1/22/2002	4.360	4.350	4.350			-0.00200	84	-0.002190	
17	6/27/2003	4.360	4.348	4.348			**	521	**	Extended Outage
18	11/11/2003	4.360	4.349	4.347	-0.00200		0.00100	137	0.001000	
19	2/20/2004	4.360	4.350	4.350			0.00300	101	0.003000	
20	5/14/2004	4.360	4.352	4.352			0.00200	84	0.002190	
21	8/3/2004	4.360	4.350	4.350			-0.00200	81	-0.002272	
22	10/26/2004	4.360	4.350	4.350			0.00000	84	0.000000	
23	2/15/2005	4.360	4.349	4.349			-0.00100	112	-0.001000	
24	4/12/2005	4.360	4.350	4.350			0.00100	56	0.001643	
25	7/8/2005	4.360	4.347	4.347			-0.00300	87	-0.003172	
26	9/28/2005	4.360	4.349	4.349			0.00200	82	0.002244	
27	12/21/2005	4.360	4.349	4.349			0.00000	84	0.000000	
28	4/9/2006	4.360	4.345	4.345			-0.00400	109	-0.004000	
29	6/7/2006	4.360	4.348	4.348			0.00300	59	0.004678	
30	8/29/2006	4.360	4.350	4.350			0.00200	83	0.002217	
31	11/29/2006	4.360	4.349	4.349			-0.00100	92	-0.001000	

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1	Power/Pumps Trip - Channel 2									
2							D_i	d_i	D_{ci}	
3					Re-		3 Month	3 Month	Corrected 3	
4	Date	Desired	As-Found	As-Left	calibrated Difference	Re-calibrated	Drift Value (V_{DC})	Duration (Days)	Month Drift Value (VDC)	Comments
5	6/10/1999	4.360	4.367	4.367						
6	8/24/1999	4.360	4.367	4.367			0.00000	75.00	0.000000	
7	11/16/1999	4.360	4.366	4.366			-0.00100	84.00	-0.001095	
8	2/8/2000	4.360	4.366	4.366			0.00000	84.00	0.000000	
9	3/5/2000	4.360	4.366	4.366			0.00000	26.00	0.000000	
10	5/5/2000	4.360	4.354	4.358	0.00400	X	-0.01200	61.00	-0.018098	
11	7/24/2000	4.360	4.371	4.365	-0.00600	X	0.01300	80.00	0.014950	
12	10/17/2000	4.360	4.356	4.365	0.00900	X	-0.00900	85.00	-0.009741	
13	11/3/2000	4.360	4.366	4.366			**	17.00	**	Duration too short
14	11/15/2000	4.360	4.368	4.368			**	12.00	**	Duration too short
15	1/9/2001	4.360	4.369	4.364	-0.00500	X	0.00400	84.00	0.004381	Uses 10/17/2000 data
16	4/3/2001	4.360	4.365	4.365			0.00100	84.00	0.001095	
17	6/26/2001	4.360	4.361	4.361			-0.00400	84.00	-0.004381	
18	9/18/2001	4.360	4.361	4.361			0.00000	84.00	0.000000	
19	12/11/2001	4.360	4.363	4.363			0.00200	84.00	0.002190	
20	7/2/2003	4.360	4.349	4.362	0.01300	X	**	568.00	**	Extended Outage
21	11/13/2003	4.360	4.363	4.363			0.00100	134.00	0.001000	
22	2/11/2004	4.360	4.376	4.359	-0.01700	X	0.01300	90.00	0.013289	
23	3/13/2004	4.360	4.360	4.360			0.00100	31.00	0.002968	
24	6/22/2004	4.360	4.357	4.357			-0.00300	101.00	-0.003000	
25	9/17/2004	4.360	4.360	4.360			0.00300	87.00	0.003172	
26	12/7/2004	4.360	4.358	4.358			-0.00200	81.00	-0.002272	
27	3/1/2005	4.360	4.359	4.359			0.00100	84.00	0.001095	
28	5/24/2005	4.360	4.357	4.357			-0.00200	84.00	-0.002190	
29	8/19/2005	4.360	4.358	4.358			0.00100	87.00	0.001057	
30	11/19/2005	4.360	4.360	4.360			0.00200	92.00	0.002000	
31	1/31/2006	4.360	4.359	4.359			-0.00100	73.00	-0.001260	
32	4/14/2006	4.360	4.343	4.343			-0.01600	73.00	-0.020164	
33	7/18/2006	4.360	4.373	4.373			0.03000	95.00	0.030000	
34	10/11/2006	4.360	4.363	4.363			-0.01000	85.00	-0.010824	
35	1/3/2007	4.360	4.364	4.364			0.00100	84.00	0.001095	

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1	Power/Pumps Trip - Channel 3									
2							D_i	d_i	D_{ci}	
3					Re-		3 Month	3 Month	Corrected 3	
4	Date	Desired	As-Found	As-Left	calibrated Difference	Re-calibrated	Drift Value (VDC)	Duration (Days)	Month Drift Value (VDC)	Comments
5	6/24/1999	4.360	4.341	4.341						
6	9/14/1999	4.360	4.339	4.339			-0.00200	82.00	-0.002244	
7	12/7/1999	4.360	4.337	4.337			-0.00200	84.00	-0.002190	
8	5/26/2000	4.360	4.346	4.346			0.00900	171.00	0.009000	
9	8/15/2000	4.360	4.343	4.343			-0.00300	81.00	-0.003407	
10	11/7/2000	4.360	4.345	4.345			0.00200	84.00	0.002190	
11	1/30/2001	4.360	4.346	4.346			0.00100	84.00	0.001095	
12	4/30/2001	4.360	4.344	4.344			-0.00200	90.00	-0.002044	
13	7/19/2001	4.360	4.343	4.343			-0.00100	80.00	-0.001150	
14	10/9/2001	4.360	4.342	4.342			-0.00100	82.00	-0.001122	
15	1/3/2002	4.360	4.345	4.345			0.00300	86.00	0.003209	
16	7/1/2003	4.360	4.341	4.341			**	544.00	**	Extended Outage
17	11/19/2003	4.360	4.348	4.348			0.00700	141.00	0.007000	
18	2/26/2004	4.360	4.352	4.352			0.00400	99.00	0.004000	
19	4/22/2004	4.360	4.350	4.350			-0.00200	56.00	-0.003286	
20	7/14/2004	4.360	4.352	4.352			0.00200	83.00	0.002217	
21	10/5/2004	4.360	4.352	4.352			0.00000	83.00	0.000000	
22	12/30/2004	4.360	4.350	4.350			-0.00200	86.00	-0.002140	
23	3/24/2005	4.360	4.350	4.350			0.00000	84.00	0.000000	
24	6/17/2005	4.360	4.350	4.350			0.00000	85.00	0.000000	
25	9/7/2005	4.360	4.352	4.352			0.00200	82.00	0.002244	
26	11/28/2005	4.360	4.349	4.349			-0.00300	82.00	-0.003366	
27	2/23/2006	4.360	4.350	4.350			0.00100	87.00	0.001057	
28	4/10/2006	4.360	4.344	4.344			-0.00600	46.00	-0.012000	
29	5/18/2006	4.360	4.347	4.347			0.00300	38.00	0.007263	
30	8/9/2006	4.360	4.349	4.349			0.00200	83.00	0.002217	
31	1/25/2007	4.360	4.348	4.348			-0.00100	169.00	-0.001000	

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1	Power/Pumps Trip - Channel 4									
2							D_i	d_i	D_{ci}	
3					Re-		3 Month	3 Month	Corrected 3	
4	Date	Desired	As-Found	As-Left	calibrated Difference	Re-calibrated	Drift Value (VDC)	Duration (Days)	Month Drift Value (VDC)	Comments
5	8/3/1999	4.360	4.356	4.356						
6	10/26/1999	4.360	4.360	4.360			0.00400	84.00	0.004381	
7	1/18/2000	4.360	4.354	4.354			-0.00600	84.00	-0.006571	
8	5/5/2000	4.360	4.349	4.349			-0.00500	108.00	-0.005000	
9	7/6/2000	4.360	4.355	4.355			0.00600	62.00	0.008903	
10	9/26/2000	4.360	4.355	4.359	0.00400	X	0.00000	82.00	0.000000	
11	12/19/2000	4.360	4.360	4.360			0.00100	84.00	0.001095	
12	1/18/2001	4.360	4.362	4.362			**	30.00	**	Duration too short
13	3/13/2001	4.360	4.362	4.362			0.00200	84.00	0.002190	Uses 12/19/2000 data
14	6/6/2001	4.360	4.355	4.355			-0.00700	85.00	-0.007576	
15	8/28/2001	4.360	4.355	4.355			0.00000	83.00	0.000000	
16	11/20/2001	4.360	4.355	4.355			0.00000	84.00	0.000000	
17	2/13/2002	4.360	4.362	4.362			0.00700	85.00	0.007576	
18	7/7/2003	4.360	4.352	4.356	0.00400	X	**	509.00	**	Extended Outage
19	11/17/2003	4.360	4.358	4.358			0.00200	133.00	0.002000	
20	2/27/2004	4.360	4.361	4.353	-0.00800		0.00300	102.00	0.003000	
21	5/25/2004	4.360	4.353	4.353			0.00000	88.00	0.000000	
22	8/26/2004	4.360	4.351	4.351			-0.00200	93.00	-0.002000	
23	11/19/2004	4.360	4.352	4.352			0.00100	85.00	0.001082	
24	2/11/2005	4.360	4.351	4.351			-0.00100	84.00	-0.001095	
25	5/4/2005	4.360	4.349	4.349			-0.00200	82.00	-0.002244	
26	7/25/2005	4.360	4.351	4.351			0.00200	82.00	0.002244	
27	10/20/2005	4.360	4.351	4.351			0.00000	87.00	0.000000	
28	11/9/2005	4.360	4.351	4.351			**	20.00	**	Duration too short
29	1/9/2006	4.360	4.350	4.350			-0.00100	81.00	-0.001136	Uses 10/20/2005 data
30	4/14/2006	4.360	4.345	4.345			-0.00500	95.00	-0.005000	
31	6/28/2006	4.360	4.350	4.350			0.00500	75.00	0.006133	
32	12/13/2006	4.360	4.352	4.352			0.00200	168.00	0.002000	

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Attachment 3 – Drift Analysis for Power / Imbalance / Flow

(See Attachment 1 for Methodology)

Compilation of Drift Data - P/I/F

Channel 1	-0.001095	0.003286	-0.001095	0.001095	0.000000	-0.001095
	0.004381	0.004381	0.000000	0.000000	0.007667	0.003286
	-0.005476	-0.004381	0.001095	-0.001095	-0.009857	-0.004381
	N/A	N/A	0.001095	0.002190	0.001095	0.002190
	0.000000	-0.001057	-0.001057	0.000000	0.001057	0.001057
	0.002272	0.002272	-0.001136	-0.001136	-0.002272	-0.004543
	0.002115	0.001057	0.000000	-0.001057	-0.001057	0.001057
	-0.006815	-0.005679	0.002272	0.002272	0.000000	-0.001136
	-0.002190	-0.002190	0.001095	0.001095	0.003286	0.003286
	0.002190	0.003286	-0.003286	-0.003286	-0.003286	-0.002190
	0.006571	0.004381	0.000000	0.000000	0.000000	-0.001095
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A
	-0.005000	-0.005000	0.006000	0.001000	0.000000	0.001000
	N/A	N/A	N/A	N/A	N/A	N/A
	-0.003407	-0.002272	-0.002272	0.004543	0.000000	0.000000
	-0.003286	-0.006571	0.002190	0.005476	0.004381	0.005476
	0.004000	0.008000	-0.002000	-0.002000	-0.002000	-0.001000
	-0.001643	0.000000	0.001643	-0.001643	-0.001643	-0.003286
	-0.006345	-0.006345	0.000000	0.001057	-0.001057	-0.001057
	0.000000	0.001122	0.000000	0.000000	-0.001122	0.000000
	0.007667	0.005476	-0.001095	0.000000	0.002190	0.002190
	0.000000	0.000000	-0.001000	-0.002000	-0.003000	-0.004000
	N/A	N/A	-0.004678	-0.004678	-0.009356	-0.009356
	-0.003325	-0.001108	-0.002217	-0.002217	-0.003325	-0.004434
	0.002000	0.000000	0.001000	0.001000	0.003000	0.004000

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Channel 2	-0.006133	-0.002453	0.006133	0.001227	0.001227	0.003680
	0.014238	0.000000	-0.003286	-0.001095	-0.002190	-0.002190
	-0.007667	0.004381	-0.001095	0.001095	0.003286	0.002190
	N/A	N/A	N/A	N/A	N/A	N/A
	0.003172	0.001057	0.001057	-0.001057	0.000000	0.000000
	N/A	N/A	0.001150	0.002300	-0.001150	-0.001150
	0.001082	-0.001082	0.000000	-0.001082	0.000000	0.001082
	N/A	N/A	N/A	N/A	N/A	N/A
	0.003286	0.003286	0.007667	0.009857	0.013143	0.013143
	-0.005476	-0.003286	0.000000	0.002190	0.000000	-0.001095
	0.001095	0.000000	-0.001095	-0.007667	-0.008762	-0.008762
	0.000000	0.001095	-0.001095	0.002190	-0.002190	-0.001095
	-0.001095	0.000000	0.001095	0.002190	0.001095	0.000000
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	-0.007077	0.001011	0.002022	0.000000
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	-0.001095	0.000000	0.000000	0.000000
	0.001070	0.000000	0.004279	0.001070	0.000000	0.001070
	0.000000	-0.002244	-0.001122	0.000000	-0.001122	-0.001122
	0.002190	0.002190	-0.003286	-0.002190	0.000000	0.000000
	0.002190	N/A	-0.001095	0.001095	0.000000	-0.001095
	-0.006345	-0.005287	0.003172	0.002115	0.000000	0.001057
	0.004000	0.002000	-0.001000	-0.001000	0.000000	0.001000
	0.000000	0.001260	-0.001260	0.003781	0.001260	0.000000
	0.001260	0.001260	-0.002521	-0.001260	-0.003781	0.000000
	N/A	N/A	-0.001000	-0.001000	0.002000	0.000000
	-0.001082	-0.002165	0.004329	-0.008659	0.000000	-0.001082
	-0.001095	-0.002190	-0.002190	0.007667	-0.001095	0.001095

Channel 3	0.001122	0.001122	0.001122	0.000000	0.000000	0.001122
	-0.001095	-0.002190	-0.001095	-0.001095	0.000000	-0.001095
	0.001095	0.002190	0.000000	0.001095	0.000000	0.000000
	N/A	N/A	0.002115	0.002115	0.001057	0.001057
	-0.001136	-0.013630	-0.002272	-0.005679	-0.002272	-0.004543
	0.000000	0.001095	0.005476	0.005476	-0.001095	0.003286
	0.002190	0.000000	-0.003286	-0.001095	0.002190	0.000000
	-0.003286	-0.002190	0.001095	0.000000	0.000000	0.000000
	0.001070	0.002140	-0.001070	0.001070	0.000000	0.000000
	-0.001122	-0.002244	0.000000	-0.001122	-0.001122	0.000000
	0.002140	-0.004279	0.000000	0.001070	0.000000	0.000000
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	-0.003000	0.000000	0.000000	0.000000
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A
	-0.011084	-0.007759	0.001108	0.000000	0.000000	0.000000
	0.004434	0.002217	0.000000	0.000000	0.000000	0.000000
	-0.001070	-0.002140	0.000000	0.001070	0.000000	-0.001070
	0.000000	0.001095	0.000000	-0.001095	-0.001095	0.001095
	-0.003247	-0.001082	0.000000	-0.001082	0.001082	-0.001082
	0.001122	0.000000	0.000000	0.001122	0.000000	0.001122
	0.002244	0.001122	0.001122	0.001122	0.000000	0.000000
	0.001057	0.000000	-0.002115	-0.001057	-0.001057	-0.001057
	-0.004000	0.002000	0.002000	0.000000	0.000000	0.000000
	N/A	N/A	N/A	N/A	N/A	N/A
	0.001108	0.002217	0.000000	-0.001108	0.000000	0.000000
	N/A	N/A	N/A	N/A	N/A	N/A

Channel 4	0.004381	0.003286	-0.003286	0.000000	-0.001095	0.001095
	0.009857	0.003286	0.001095	0.000000	-0.001095	0.002190
	-0.001000	0.003000	-0.011000	-0.005000	0.002000	-0.003000
	N/A	N/A	0.017806	0.001484	0.001484	0.000000
	0.001122	0.002244	-0.001122	0.001122	0.001122	-0.002244
	-0.004381	-0.002190	0.001095	0.002190	-0.005476	0.000000
	N/A	N/A	N/A	N/A	N/A	N/A
	-0.026286	-0.020810	0.010952	0.003286	0.001095	0.000000
	0.012988	0.008659	-0.005412	-0.003247	0.003247	-0.001082
	-0.005542	-0.004434	0.000000	0.005542	0.002217	0.001108
	-0.005476	-0.003286	0.002190	-0.002190	-0.004381	-0.001095
	-0.005412	-0.001082	0.002165	0.000000	-0.001082	0.000000
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	-0.001000	-0.002000	-0.001000	0.001000
	N/A	N/A	N/A	N/A	N/A	N/A
	N/A	N/A	0.016727	0.001673	-0.001673	-0.003345
	0.009000	0.008000	-0.013000	-0.002000	0.001000	-0.001000
	-0.015153	-0.012988	0.006494	0.003247	-0.001082	0.002165
	0.016429	0.014238	-0.005476	-0.002190	-0.001095	0.000000
	-0.004488	-0.005610	0.002244	0.001122	0.006732	0.001122
	-0.003366	-0.001122	-0.002244	-0.001122	-0.006732	0.002244
	-0.002115	-0.003172	0.001057	-0.001057	0.000000	-0.006345
	N/A	N/A	N/A	N/A	N/A	N/A
	0.005679	0.004543	-0.002272	0.001136	0.000000	0.001136
	0.003000	0.003000	0.001000	-0.001000	0.000000	0.000000
	N/A	N/A	0.002453	0.002453	0.000000	-0.001227
	N/A	N/A	N/A	N/A	N/A	N/A

Calculation of Mean and Standard Deviation - P/I/F

Mean (Drift (Bias))	-0.000094
Standard Dev.	0.003998

Sample Size	521
K Factor	2.0679
Drift (Random)	0.008268

T-Test - P/I/F

The T-Test determines if a data point is able to be considered an outlier from all other data. This is accomplished by finding the worst case value in either the positive or negative direction, subtracting the mean from that value, taking the absolute value of the results, and dividing the resulting value by the standard deviation. This gives a result of the number of standard deviations the value is away from the mean. If the value is determined to be greater than the "Critical Value" , the data point may be considered an outlier and removed from the data if there is a basis for removal. If the data is removed, the T-Test is repeated with revised worst case value, mean, and standard deviation, until the worst case data point is either less than the Critical Value or has no basis for removal.

Max value from Table = 0.017806 Min value from Table = -0.026286

Critical value for T-Test with a sample size of 521 and a Upper 5% Significance = 3.33

Standard Dev =	0.003998	Mean=	-0.000094
T-Test for Max value	0.017806	T-Test for Min value	-0.026286
T-Test =	4.4771	T-Test =	6.5507

Because the T-Test for both the Max and Min values are higher than the 3.33 value, they could be considered outliers and excluded from the sample. Due to there being no basis for removal, they will not be excluded. No further tests for outliers are required.

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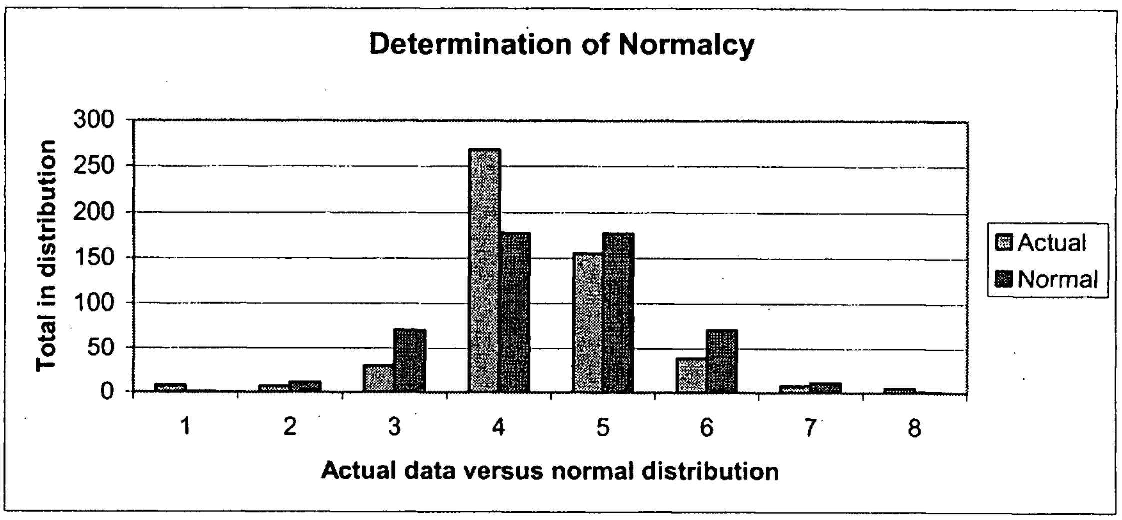
Normalcy Test - P/I/F

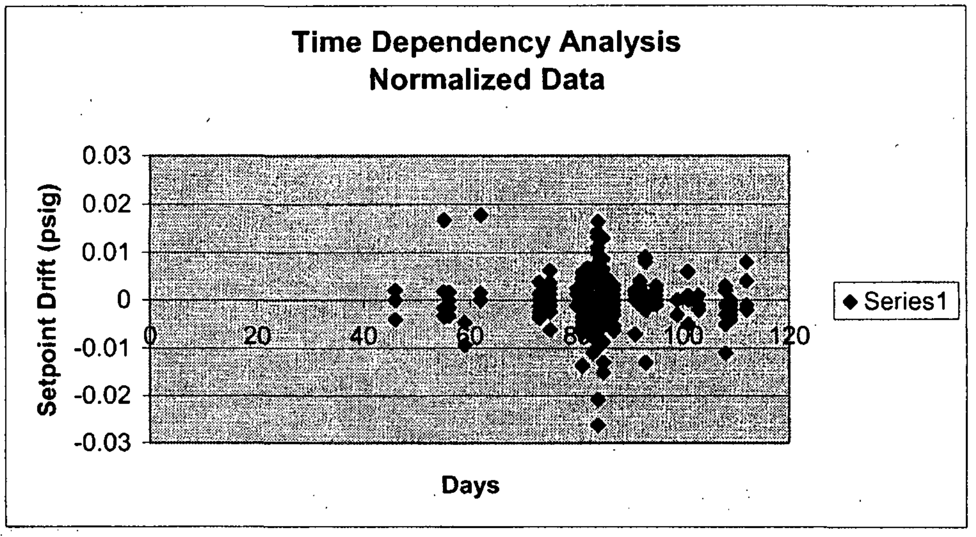
Using the Chi-squared test for normalcy results in: 178.29 based on groupings of bins below. As there are 8 bins, a normal distributed data set would be below 8. Since it is above 8, the data is determined to be NOT normally distributed. Graphing the data results in a display of data that has a high kurtosis (middle peak) and 13 data values outside of 3 standard deviations. To graphically display the data, a series is established starting at the Mean and moving away from the Mean by the Standard Deviation. The number of data sets in each series are determined to be able to plot a normalcy graph. The following table displays the series boundaries and the number of data sets in each series and compares that to the normal distribution value. Due to the high kurtosis and the 13 values that are more than 3 standard deviations away from the mean, the data will be considered to be NOT normally distributed and will be included as a bias in the calculation.

				Actual Dist	Normal Dist	Chi-Squared
Data Sets between	0.023896	and	0.011901	8	0.78	66.68
Data Sets between	0.011901	and	0.007902	7	11.10	1.51
Data Sets between	0.007902	and	0.003904	30	70.80	23.52
Data Sets between	0.003904	and	-0.000094	268	177.82	45.74
Data Sets between	-0.000094	and	-0.004093	155	177.82	2.93
Data Sets between	-0.004093	and	-0.008091	39	70.80	14.29
Data Sets between	-0.008091	and	-0.012089	8	11.10	0.86
Data Sets between	-0.012089	and	-0.024084	5	0.78	22.77
						178.29



Time Dependency Analysis - P/I/F

Time dependency analysis is used to determine if there is a correlation between the period between calibrations and the resulting change in setpoint. Each data point has been calculated along with the associated time duration between calibrations. Each of the data points used have been included in the plot below. As can be seen from the plot, there are no discernable indications that the drift is in any one direction based on a given time period. For example, if there were a significant number of data points in the positive region from the period of 100 - 120 days with no corresponding data points in the negative region, this would indicate a time dependency with respect to the drift. Since this, nor any other similar correlation is evident, it is concluded there is no time dependency to the drift.



Power / Imbalance / Flow - Channel 1

Channel 1		Data Point 1			Data Point 2			Data Point 3	
Date	Desired	As-Found	As-Left	Desired	As-Found	As-Left	Desired	As-Found	As-Left
7/13/1999	4.193	4.198	4.198	2.796	2.793	2.793	8.678	8.674	8.674
10/5/1999	4.193	4.197	4.197	2.796	2.796	2.796	8.678	8.673	8.673
12/28/1999	4.193	4.201	4.201	2.796	2.800	2.800	8.678	8.673	8.673
3/21/2000	4.193	4.196	4.196	2.796	2.796	2.796	8.678	8.674	8.674
6/13/2000	**4.190**	4.190	4.190	**2.795**	2.793	2.793	8.678	8.675	8.675
9/8/2000	4.190	4.190	4.190	2.795	2.792	2.792	8.678	8.674	8.674
11/28/2000	4.190	4.192	4.192	2.795	2.794	2.794	8.678	8.673	8.673
2/23/2001	4.190	4.194	4.194	2.795	2.795	2.795	8.678	8.673	8.673
5/15/2001	4.190	4.188	4.188	2.795	2.790	2.790	8.678	8.675	8.675
8/7/2001	4.190	4.186	4.186	2.795	2.788	2.788	8.678	8.676	8.676
10/30/2001	4.190	4.188	4.188	2.795	2.791	2.791	8.678	8.673	8.673
1/22/2002	4.190	4.194	4.194	2.795	2.795	2.795	8.678	8.673	8.673
6/26/2003	4.190	4.201	4.201	2.795	2.805	2.805	8.678	8.678	8.678
11/11/2003	4.190	4.199	4.200	2.795	2.800	2.801	8.678	8.674	8.674
2/20/2004	4.190	4.195	4.195	2.795	2.796	2.796	8.678	8.680	8.680
5/14/2004	**4.137**	4.138	4.138	**2.764**	2.766	2.766	**8.654**	8.654	8.654
8/3/2004	4.137	4.135	4.135	2.764	2.764	2.763	8.654	8.652	8.653
10/26/2004	4.137	4.132	4.132	2.764	2.757	2.757	8.654	8.655	8.655
2/15/2005	4.137	4.136	4.136	2.764	2.765	2.765	8.654	8.653	8.653
4/12/2005	4.137	4.135	4.135	2.764	2.765	2.765	8.654	8.654	8.654
7/8/2005	4.137	4.129	4.129	2.764	2.759	2.759	8.654	8.654	8.654
9/28/2005	4.137	4.129	4.129	2.764	2.760	2.760	8.654	8.654	8.654
12/21/2005	4.137	4.136	4.136	2.764	2.765	2.765	8.654	8.653	8.653
4/9/2006	4.137	4.136	4.136	2.764	2.765	2.763	8.654	8.652	8.655
6/7/2006	**4.129**	4.131	4.131	**2.760**	2.761	2.761	8.654	8.652	8.652
8/29/2006	4.129	4.128	4.128	2.760	2.760	2.760	8.654	8.650	8.650
11/29/2006	4.129	4.130	4.130	2.760	2.760	2.760	8.654	8.651	8.651

Bold Denotes change in "Desired" value from previous test

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Channel 1		Data Point 4			Data Point 5			Data Point 6	
Date	Desired	As-Found	As-Left	Desired	As-Found	As-Left	Desired	As-Found	As-Left
7/13/1999	8.564	8.561	8.561	5.665	5.664	5.664	5.665	5.669	5.669
10/5/1999	8.564	8.562	8.562	5.665	5.664	5.664	5.665	5.668	5.668
12/28/1999	8.564	8.562	8.562	5.665	5.671	5.671	5.665	5.671	5.671
3/21/2000	8.564	8.561	8.561	5.665	5.662	5.662	5.665	5.667	5.667
6/13/2000	8.564	8.563	8.563	5.665	5.663	5.663	5.665	5.669	5.669
9/8/2000	8.564	8.563	8.563	5.665	5.664	5.664	5.665	5.670	5.670
11/28/2000	8.564	8.562	8.562	5.665	5.662	5.662	5.665	5.666	5.666
2/23/2001	8.564	8.561	8.561	5.665	5.661	5.661	5.665	5.667	5.667
5/15/2001	8.564	8.563	8.563	5.665	5.661	5.661	5.665	5.666	5.666
8/7/2001	8.564	8.564	8.564	5.665	5.664	5.664	5.665	5.669	5.669
10/30/2001	8.564	8.561	8.561	5.665	5.661	5.661	5.665	5.667	5.667
1/22/2002	8.564	8.561	8.561	5.665	5.661	5.661	5.665	5.666	5.666
6/26/2003	8.564	8.561	8.561	5.665	5.663	5.663	5.665	5.669	5.669
11/11/2003	8.564	8.561	8.561	5.665	5.662	5.668	5.665	5.667	5.670
2/20/2004	8.564	8.562	8.562	5.665	5.668	5.668	5.665	5.671	5.671
5/14/2004	**8.544**	8.543	8.543	**5.635**	5.636	5.636	**5.635**	5.639	5.639
8/3/2004	8.544	8.547	8.541	5.635	5.636	5.635	5.635	5.639	5.637
10/26/2004	8.544	8.546	8.546	5.635	5.639	5.639	5.635	5.642	5.642
2/15/2005	8.544	8.544	8.544	5.635	5.637	5.637	5.635	5.641	5.641
4/12/2005	8.544	8.543	8.543	5.635	5.636	5.636	5.635	5.639	5.639
7/8/2005	8.544	8.544	8.544	5.635	5.635	5.635	5.635	5.638	5.638
9/28/2005	8.544	8.544	8.544	5.635	5.634	5.634	5.635	5.638	5.638
12/21/2005	8.544	8.544	8.544	5.635	5.636	5.636	5.635	5.640	5.640
4/9/2006	8.544	8.542	8.545	5.635	5.633	5.639	5.635	5.636	5.643
6/7/2006	8.544	8.542	8.542	5.635	5.633	5.633	5.635	5.637	5.637
8/29/2006	8.544	8.540	8.540	5.635	5.630	5.630	5.635	5.633	5.633
11/29/2006	8.544	8.541	8.541	5.635	5.633	5.633	5.635	5.637	5.637

Bold Denotes change in "Desired" value from previous test

Channel 1		Data Point						
Date	Days Between	Point 1 - 3 month	Point 2 - 3 month	Point 3 - 3 month	Point 4 - 3 month	Point 5 - 3 month	Point 6 - 3 month	Comments
7/13/1999								
10/5/1999	84	-0.001095	0.003286	-0.001095	0.001095	0.000000	-0.001095	
12/28/1999	84	0.004381	0.004381	0.000000	0.000000	0.007667	0.003286	
3/21/2000	84	-0.005476	-0.004381	0.001095	-0.001095	-0.009857	-0.004381	
6/13/2000	84	N/A	N/A	0.001095	0.002190	0.001095	0.002190	Note 1
9/8/2000	87	0.000000	-0.001057	-0.001057	0.000000	0.001057	0.001057	
11/28/2000	81	0.002272	0.002272	-0.001136	-0.001136	-0.002272	-0.004543	
2/23/2001	87	0.002115	0.001057	0.000000	-0.001057	-0.001057	0.001057	
5/15/2001	81	-0.006815	-0.005679	0.002272	0.002272	0.000000	-0.001136	
8/7/2001	84	-0.002190	-0.002190	0.001095	0.001095	0.003286	0.003286	
10/30/2001	84	0.002190	0.003286	-0.003286	-0.003286	-0.003286	-0.002190	
1/22/2002	84	0.006571	0.004381	0.000000	0.000000	0.000000	-0.001095	
6/26/2003	520	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
11/11/2003	138	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
2/20/2004	101	-0.005000	-0.005000	0.006000	0.001000	0.000000	0.001000	
5/14/2004	84	N/A	N/A	N/A	N/A	N/A	N/A	Note 1
8/3/2004	81	-0.003407	-0.002272	-0.002272	0.004543	0.000000	0.000000	
10/26/2004	84	-0.003286	-0.006571	0.002190	0.005476	0.004381	0.005476	
2/15/2005	112	0.004000	0.008000	-0.002000	-0.002000	-0.002000	-0.001000	
4/12/2005	56	-0.001643	0.000000	0.001643	-0.001643	-0.001643	-0.003286	
7/8/2005	87	-0.006345	-0.006345	0.000000	0.001057	-0.001057	-0.001057	
9/28/2005	82	0.000000	0.001122	0.000000	0.000000	-0.001122	0.000000	
12/21/2005	84	0.007667	0.005476	-0.001095	0.000000	0.002190	0.002190	
4/9/2006	109	0.000000	0.000000	-0.001000	-0.002000	-0.003000	-0.004000	
6/7/2006	59	N/A	N/A	-0.004678	-0.004678	-0.009356	-0.009356	Note 1
8/29/2006	83	-0.003325	-0.001108	-0.002217	-0.002217	-0.003325	-0.004434	
11/29/2006	92	0.002000	0.000000	0.001000	0.001000	0.003000	0.004000	

Note 1: Any surveillances immediately following a change in desired values are not considered.

Note 2: Periods over 115 days (92 * 1.25 TS Extension Allowance) or less than 46 days (92/2) are not considered since they could skew the calculated drift data.

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Power / Imbalance / Flow - Channel 2

Channel 2		Data Point 1			Data Point 2			Data Point 3	
Date	Desired	As-Found	As-Left	Desired	As-Found	As-Left	Desired	As-Found	As-Left
6/10/1999	4.186	4.185	4.185	2.792	2.793	2.793	8.674	8.671	8.671
8/24/1999	4.186	4.180	4.180	2.792	2.791	2.791	8.674	8.676	8.676
11/16/1999	4.186	4.193	4.193	2.792	2.791	2.791	8.674	8.673	8.673
2/8/2000	4.186	4.186	4.186	2.792	2.795	2.795	8.674	8.672	8.672
3/6/2000	4.186	4.186	4.186	2.792	2.792	2.792	8.674	8.671	8.671
5/5/2000	4.186	4.189	4.182	2.792	2.796	2.791	8.674	8.673	8.671
7/24/2000	**4.155**	4.151	4.151	**2.775**	2.774	2.774	8.674	8.672	8.672
10/17/2000	4.155	4.152	4.152	2.775	2.773	2.773	8.674	8.672	8.672
11/3/2000	4.155	4.151	4.154	2.775	2.773	2.776	8.674	8.674	8.676
1/9/2001	4.155	4.155	4.161	2.775	2.776	2.779	8.674	8.679	8.674
4/3/2001	4.155	4.156	4.156	2.775	2.776	2.776	8.674	8.674	8.674
6/26/2001	4.155	4.157	4.157	2.775	2.776	2.776	8.674	8.673	8.673
9/18/2001	4.155	4.157	4.157	2.775	2.777	2.777	8.674	8.672	8.676
12/11/2001	4.155	4.156	4.156	2.775	2.777	2.777	8.674	8.677	8.677
7/2/2003	4.155	4.153	4.157	2.775	2.773	2.777	8.674	8.677	8.675
11/13/2003	4.155	4.164	4.164	2.775	2.781	2.781	8.674	8.679	8.679
2/12/2004	**4.239**	4.251	4.251	**2.822**	2.831	2.831	8.674	8.672	8.672
3/13/2004	4.239	4.249	4.249	2.822	2.830	2.830	8.674	8.674	8.674
3/30/2004	4.239	4.245	4.245	2.822	2.826	2.826	**8.633**	8.634	8.634
6/22/2004	**4.139**	4.140	4.140	**2.765**	2.770	2.770	8.633	8.633	8.633
9/16/2004	4.139	4.141	4.141	2.765	2.770	2.770	8.633	8.637	8.637
12/7/2004	4.139	4.141	4.141	2.765	2.768	2.768	8.633	8.636	8.636
3/1/2005	4.139	4.143	4.143	2.765	2.770	2.770	8.633	8.633	8.633
5/24/2005	4.139	4.145	4.145	**2.763**	2.773	2.773	8.633	8.632	8.632
8/19/2005	4.139	4.139	4.139	2.763	2.768	2.768	8.633	8.635	8.635
11/19/2005	4.139	4.143	4.143	2.763	2.770	2.770	8.633	8.634	8.634
1/31/2006	4.139	4.143	4.143	2.763	2.771	2.771	8.633	8.633	8.633
4/14/2006	4.139	4.144	4.144	2.763	2.772	2.772	8.633	8.631	8.631
7/18/2006	**4.106**	4.112	4.112	**2.747**	2.754	2.754	8.633	8.630	8.630
10/11/2006	4.106	4.111	4.111	2.747	2.752	2.752	8.633	8.634	8.634
1/3/2007	4.106	4.110	4.110	2.747	2.750	2.750	8.633	8.632	8.632

Bold Denotes change in "Desired" value from previous test

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Channel 2		Data Point 4			Data Point 5			Data Point 6	
Date	Desired	As-Found	As-Left	Desired	As-Found	As-Left	Desired	As-Found	As-Left
6/10/1999	8.561	8.556	8.556	5.660	5.653	5.653	5.660	5.653	5.653
8/24/1999	8.561	8.557	8.557	5.660	5.654	5.654	5.660	5.656	5.656
11/16/1999	8.561	8.556	8.556	5.660	5.652	5.652	5.660	5.654	5.654
2/8/2000	8.561	8.557	8.557	5.660	5.655	5.655	5.660	5.656	5.656
3/6/2000	8.561	8.555	8.555	5.660	5.653	5.653	5.660	5.654	5.654
5/5/2000	8.561	8.556	8.555	5.660	5.655	5.654	5.660	5.656	5.655
7/24/2000	8.561	8.557	8.557	5.660	5.653	5.653	5.660	5.654	5.654
10/17/2000	8.561	8.556	8.556	5.660	5.653	5.653	5.660	5.655	5.655
11/3/2000	8.561	8.556	8.561	5.660	5.653	5.661	5.660	5.654	5.662
1/9/2001	8.561	8.565	8.560	5.660	5.665	5.660	5.660	5.667	5.661
4/3/2001	8.561	8.562	8.562	5.660	5.660	5.660	5.660	5.660	5.660
6/26/2001	8.561	8.555	8.555	5.660	5.652	5.652	5.660	5.652	5.652
9/18/2001	8.561	8.557	8.560	5.660	5.650	5.662	5.660	5.651	5.662
12/11/2001	8.561	8.562	8.562	5.660	5.663	5.663	5.660	5.662	5.662
7/2/2003	8.561	8.561	8.559	5.660	5.661	5.660	5.660	5.659	5.658
11/13/2003	8.561	8.557	8.557	5.660	5.661	5.661	5.660	5.660	5.660
2/12/2004	8.561	8.558	8.558	5.660	5.663	5.663	5.660	5.660	5.660
3/13/2004	8.561	8.560	8.560	5.660	5.662	5.662	5.660	5.661	5.661
3/30/2004	**8.527**	8.525	8.525	**5.608**	5.610	5.610	**5.608**	5.608	5.608
6/22/2004	8.527	8.525	8.525	5.608	5.610	5.610	5.608	5.608	5.608
9/16/2004	8.527	8.526	8.526	5.608	5.610	5.610	5.608	5.609	5.609
12/7/2004	8.527	8.526	8.526	5.608	5.609	5.609	5.608	5.608	5.608
3/1/2005	8.527	8.524	8.524	5.608	5.609	5.609	5.608	5.608	5.608
5/24/2005	8.527	8.525	8.525	5.608	5.609	5.609	5.608	5.607	5.607
8/19/2005	8.527	8.527	8.527	5.608	5.609	5.609	5.608	5.608	5.608
11/19/2005	8.527	8.526	8.526	5.608	5.609	5.609	5.608	5.609	5.609
1/31/2006	8.527	8.529	8.529	5.608	5.610	5.610	5.608	5.609	5.609
4/14/2006	8.527	8.528	8.528	5.608	5.607	5.607	5.608	5.609	5.609
7/18/2006	8.527	8.527	8.527	5.608	5.609	5.609	5.608	5.609	5.609
10/11/2006	8.527	8.519	8.519	5.608	5.609	5.609	5.608	5.608	5.608
1/3/2007	8.527	8.526	8.526	5.608	5.608	5.608	5.608	5.609	5.609

Bold Denotes change in "Desired" value from previous test

Channel 2		Data Point						
Date	Days Between	Point 1 - 3 month	Point 2 - 3 month	Point 3 - 3 month	Point 4 - 3 month	Point 5 - 3 month	Point 6 - 3 month	Comments
6/10/1999								
8/24/1999	75	-0.006133	-0.002453	0.006133	0.001227	0.001227	0.003680	
11/16/1999	84	0.014238	0.000000	-0.003286	-0.001095	-0.002190	-0.002190	
2/8/2000	84	-0.007667	0.004381	-0.001095	0.001095	0.003286	0.002190	
3/6/2000	27	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
5/5/2000	87	0.003172	0.001057	0.001057	-0.001057	0.000000	0.000000	Note 3
7/24/2000	80	N/A	N/A	0.001150	0.002300	-0.001150	-0.001150	Note 1
10/17/2000	85	0.001082	-0.001082	0.000000	-0.001082	0.000000	0.001082	
11/3/2000	17	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
1/9/2001	84	0.003286	0.003286	0.007667	0.009857	0.013143	0.013143	Note 4
4/3/2001	84	-0.005476	-0.003286	0.000000	0.002190	0.000000	-0.001095	
6/26/2001	84	0.001095	0.000000	-0.001095	-0.007667	-0.008762	-0.008762	
9/18/2001	84	0.000000	0.001095	-0.001095	0.002190	-0.002190	-0.001095	
12/11/2001	84	-0.001095	0.000000	0.001095	0.002190	0.001095	0.000000	
7/2/2003	568	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
11/13/2003	134	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
2/12/2004	91	N/A	N/A	-0.007077	0.001011	0.002022	0.000000	Note 1
3/13/2004	30	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
3/30/2004	17	N/A	N/A	N/A	N/A	N/A	N/A	Notes 1&2
6/22/2004	84	N/A	N/A	-0.001095	0.000000	0.000000	0.000000	Note 1
9/16/2004	86	0.001070	0.000000	0.004279	0.001070	0.000000	0.001070	
12/7/2004	82	0.000000	-0.002244	-0.001122	0.000000	-0.001122	-0.001122	
3/1/2005	84	0.002190	0.002190	-0.003286	-0.002190	0.000000	0.000000	
5/24/2005	84	0.002190	N/A	-0.001095	0.001095	0.000000	-0.001095	Note 1
8/19/2005	87	-0.006345	-0.005287	0.003172	0.002115	0.000000	0.001057	
11/19/2005	92	0.004000	0.002000	-0.001000	-0.001000	0.000000	0.001000	
1/31/2006	73	0.000000	0.001260	-0.001260	0.003781	0.001260	0.000000	
4/14/2006	73	0.001260	0.001260	-0.002521	-0.001260	-0.003781	0.000000	
7/18/2006	95	N/A	N/A	-0.001000	-0.001000	0.002000	0.000000	Note 1
10/11/2006	85	-0.001082	-0.002165	0.004329	-0.008659	0.000000	-0.001082	
1/3/2007	84	-0.001095	-0.002190	-0.002190	0.007667	-0.001095	0.001095	

Note 1: Any surveillances immediately following a change in desired values are not considered.

Note 2: Periods over 115 days (92 * 1.25 TS Extension Allowance) or less than 46 days (92/2) are not considered since they could skew the calculated drift data.

Note 3: Uses data from 2/8/2000

Note 4: Uses data from 10/17/2000

Power / Imbalance / Flow - Channel 3

Channel 3		Data Point 1			Data Point 2			Data Point 3	
Date	Desired	As-Found	As-Left	Desired	As-Found	As-Left	Desired	As-Found	As-Left
6/24/1999	4.172	4.159	4.159	2.784	2.781	2.781	8.671	8.674	8.674
9/14/1999	4.172	4.160	4.160	2.784	2.782	2.782	8.671	8.675	8.675
12/7/1999	4.172	4.159	4.159	2.784	2.780	2.780	8.671	8.674	8.674
2/29/2000	4.172	4.160	4.156	2.784	2.782	2.780	8.671	8.674	8.676
5/26/2000	**4.151**	4.130	4.130	**2.772**	2.776	2.776	8.671	8.678	8.678
8/15/2000	4.151	4.129	4.129	2.772	2.764	2.764	8.671	8.676	8.676
11/7/2000	4.151	4.129	4.129	2.772	2.765	2.765	8.671	8.681	8.681
1/30/2001	4.151	4.131	4.131	2.772	2.765	2.765	8.671	8.678	8.678
4/24/2001	4.151	4.128	4.128	2.772	2.763	2.763	8.671	8.679	8.679
7/19/2001	4.151	4.129	4.129	2.772	2.765	2.765	8.671	8.678	8.678
10/9/2001	4.151	4.128	4.128	2.772	2.763	2.763	8.671	8.678	8.678
1/3/2002	4.151	4.130	4.130	2.772	2.759	2.759	8.671	8.678	8.678
7/4/2003	4.151	4.131	4.131	2.772	2.766	2.766	8.671	8.679	8.679
11/19/2003	4.151	4.130	4.128	2.772	2.764	2.765	8.671	8.677	8.678
2/26/2004	**4.230**	4.215	4.215	**2.817**	2.815	2.815	8.671	8.675	8.675
3/30/2004	4.230	4.215	4.215	2.817	2.815	2.815	**8.639**	8.643	8.643
4/22/2004	**4.143**	4.126	4.126	**2.768**	2.763	2.763	8.639	8.644	8.644
7/14/2004	4.143	4.116	4.116	2.768	2.756	2.756	8.639	8.645	8.645
10/5/2004	4.143	4.120	4.120	2.768	2.758	2.758	8.639	8.645	8.645
12/30/2004	4.143	4.119	4.119	2.768	2.756	2.756	8.639	8.645	8.645
3/24/2005	4.143	4.119	4.119	2.768	2.757	2.757	8.639	8.645	8.645
6/17/2005	4.143	4.116	4.116	2.768	2.756	2.756	8.639	8.645	8.645
9/7/2005	4.143	4.117	4.117	2.768	2.756	2.756	8.639	8.645	8.645
11/28/2005	4.143	4.119	4.119	2.768	2.757	2.757	8.639	8.646	8.646
2/23/2006	4.143	4.120	4.120	2.768	2.757	2.757	8.639	8.644	8.644
4/10/2006	4.143	4.118	4.118	2.768	2.758	2.758	8.639	8.645	8.645
5/18/2006	**4.133**	4.108	4.108	**2.762**	2.751	2.751	8.639	8.645	8.645
8/9/2006	4.133	4.109	4.109	2.762	2.753	2.753	8.639	8.645	8.645
1/25/2007	4.133	4.109	4.109	2.762	2.750	2.750	8.639	8.644	8.644

Bold Denotes change in "Desired" value from previous test

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Channel 3		Data Point 4			Data Point 5			Data Point 6	
Date	Desired	As-Found	As-Left	Desired	As-Found	As-Left	Desired	As-Found	As-Left
6/24/1999	8.558	8.558	8.558	5.656	5.656	5.656	5.656	5.655	5.655
9/14/1999	8.558	8.558	8.558	5.656	5.656	5.656	5.656	5.656	5.656
12/7/1999	8.558	8.557	8.557	5.656	5.656	5.656	5.656	5.655	5.655
2/29/2000	8.558	8.558	8.558	5.656	5.656	5.656	5.656	5.655	5.655
5/26/2000	8.558	8.560	8.560	5.656	5.657	5.657	5.656	5.656	5.656
8/15/2000	8.558	8.555	8.555	5.656	5.655	5.655	5.656	5.652	5.652
11/7/2000	8.558	8.560	8.560	5.656	5.654	5.654	5.656	5.655	5.655
1/30/2001	8.558	8.559	8.559	5.656	5.656	5.656	5.656	5.655	5.655
4/24/2001	8.558	8.559	8.559	5.656	5.656	5.656	5.656	5.655	5.655
7/19/2001	8.558	8.560	8.560	5.656	5.656	5.656	5.656	5.655	5.655
10/9/2001	8.558	8.559	8.559	5.656	5.655	5.655	5.656	5.655	5.655
1/3/2002	8.558	8.560	8.560	5.656	5.655	5.655	5.656	5.655	5.655
7/4/2003	8.558	8.560	8.560	5.656	5.656	5.656	5.656	5.655	5.655
11/19/2003	8.558	8.558	8.559	5.656	5.656	5.657	5.656	5.655	5.657
2/26/2004	8.558	8.559	8.559	5.656	5.657	5.657	5.656	5.657	5.657
3/30/2004	**8.531**	8.532	**8.532**	5.614	5.615	5.615	**5.614**	5.615	5.615
4/22/2004	8.531	8.533	8.533	5.614	5.615	5.615	5.614	5.615	5.615
7/14/2004	8.531	8.533	8.533	5.614	5.615	5.615	5.614	5.615	5.615
10/5/2004	8.531	8.533	8.533	5.614	5.615	5.615	5.614	5.615	5.615
12/30/2004	8.531	8.534	8.534	5.614	5.615	5.615	5.614	5.614	5.614
3/24/2005	8.531	8.533	8.533	5.614	5.614	5.614	5.614	5.615	5.615
6/17/2005	8.531	8.532	8.532	5.614	5.615	5.615	5.614	5.614	5.614
9/7/2005	8.531	8.533	8.533	5.614	5.615	5.615	5.614	5.615	5.615
11/28/2005	8.531	8.534	8.534	5.614	5.615	5.615	5.614	5.615	5.615
2/23/2006	8.531	8.533	8.533	5.614	5.614	5.614	5.614	5.614	5.614
4/10/2006	8.531	8.533	8.533	5.614	5.614	5.614	5.614	5.614	5.614
5/18/2006	8.531	8.533	8.533	5.614	5.614	5.614	5.614	5.614	5.614
8/9/2006	8.531	8.532	8.532	5.614	5.614	5.614	5.614	5.614	5.614
1/25/2007	8.531	8.533	8.533	5.614	5.614	5.614	5.614	5.614	5.614

Bold Denotes change in "Desired" value from previous test

Channel 3		Data Point						
Date	Days Between	Point 1 - 3 month	Point 2 - 3 month	Point 3 - 3 month	Point 4 - 3 month	Point 5 - 3 month	Point 6 - 3 month	Comments
6/24/1999								
9/14/1999	82	0.001122	0.001122	0.001122	0.000000	0.000000	0.001122	
12/7/1999	84	-0.001095	-0.002190	-0.001095	-0.001095	0.000000	-0.001095	
2/29/2000	84	0.001095	0.002190	0.000000	0.001095	0.000000	0.000000	
5/26/2000	87	N/A	N/A	0.002115	0.002115	0.001057	0.001057	Note 1
8/15/2000	81	-0.001136	-0.013630	-0.002272	-0.005679	-0.002272	-0.004543	
11/7/2000	84	0.000000	0.001095	0.005476	0.005476	-0.001095	0.003286	
1/30/2001	84	0.002190	0.000000	-0.003286	-0.001095	0.002190	0.000000	
4/24/2001	84	-0.003286	-0.002190	0.001095	0.000000	0.000000	0.000000	
7/19/2001	86	0.001070	0.002140	-0.001070	0.001070	0.000000	0.000000	
10/9/2001	82	-0.001122	-0.002244	0.000000	-0.001122	-0.001122	0.000000	
1/3/2002	86	0.002140	-0.004279	0.000000	0.001070	0.000000	0.000000	
7/4/2003	547	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
11/19/2003	138	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
2/26/2004	99	N/A	N/A	-0.003000	0.000000	0.000000	0.000000	Note 1
3/30/2004	33	N/A	N/A	N/A	N/A	N/A	N/A	Notes 1&2
4/22/2004	23	N/A	N/A	N/A	N/A	N/A	N/A	Notes 1&2
7/14/2004	83	-0.011084	-0.007759	0.001108	0.000000	0.000000	0.000000	
10/5/2004	83	0.004434	0.002217	0.000000	0.000000	0.000000	0.000000	
12/30/2004	86	-0.001070	-0.002140	0.000000	0.001070	0.000000	-0.001070	
3/24/2005	84	0.000000	0.001095	0.000000	-0.001095	-0.001095	0.001095	
6/17/2005	85	-0.003247	-0.001082	0.000000	-0.001082	0.001082	-0.001082	
9/7/2005	82	0.001122	0.000000	0.000000	0.001122	0.000000	0.001122	
11/28/2005	82	0.002244	0.001122	0.001122	0.001122	0.000000	0.000000	
2/23/2006	87	0.001057	0.000000	-0.002115	-0.001057	-0.001057	-0.001057	
4/10/2006	46	-0.004000	0.002000	0.002000	0.000000	0.000000	0.000000	
5/18/2006	38	N/A	N/A	N/A	N/A	N/A	N/A	Notes 1&2
8/9/2006	83	0.001108	0.002217	0.000000	-0.001108	0.000000	0.000000	
1/25/2007	169	N/A	N/A	N/A	N/A	N/A	N/A	

Note 1: Any surveillances immediately following a change in desired values are not considered.

Note 2: Periods over 115 days (92 * 1.25 TS Extension Allowance) or less than 46 days (92/2) are not considered since they could skew the calculated drift data.

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Power / Imbalance / Flow - Channel 4

Channel 4		Data Point 1			Data Point 2			Data Point 3	
Date	Desired	As-Found	As-Left	Desired	As-Found	As-Left	Desired	As-Found	As-Left
8/3/1999	4.139	4.128	4.128	2.766	2.752	2.752	8.679	8.692	8.692
10/26/1999	4.139	4.132	4.132	2.766	2.755	2.755	8.679	8.689	8.689
1/18/2000	4.139	4.141	4.141	2.766	2.758	2.758	8.679	8.690	8.690
5/5/2000	4.139	4.140	4.140	2.766	2.761	2.761	8.679	8.679	8.679
7/6/2000	**4.180**	4.178	4.178	**2.789**	2.782	2.782	8.679	8.691	8.691
9/26/2000	4.180	4.179	4.181	2.789	2.784	2.790	8.679	8.690	8.678
12/19/2000	4.180	4.177	4.177	2.789	2.788	2.788	8.679	8.679	8.679
1/17/2001	4.180	4.155	4.155	2.789	2.772	2.772	8.679	8.688	8.688
3/13/2001	4.180	4.153	4.153	2.789	2.769	2.769	8.679	8.689	8.689
6/6/2001	4.180	4.165	4.165	2.789	2.777	2.777	8.679	8.684	8.684
8/28/2001	4.180	4.160	4.160	2.789	2.773	2.773	8.679	8.684	8.684
11/20/2001	4.180	4.155	4.155	2.789	2.770	2.770	8.679	8.686	8.686
2/13/2002	4.180	4.150	4.150	2.789	2.769	2.769	8.679	8.688	8.688
7/4/2003	4.180	4.161	4.154	2.789	2.774	2.769	8.679	8.685	8.690
11/16/2003	4.180	4.156	4.156	2.789	2.771	2.771	8.679	8.687	8.687
2/27/2004	**4.243**	4.223	4.223	**2.824**	2.812	2.812	8.679	8.686	8.686
3/31/2004	4.243	4.233	4.233	2.824	2.820	2.820	**8.629**	8.633	8.633
5/25/2004	**4.138**	4.120	4.120	**2.765**	2.751	2.751	8.629	8.643	8.643
8/26/2004	4.138	4.129	4.129	2.765	2.759	2.759	8.629	8.630	8.630
11/19/2004	4.138	4.115	4.115	2.765	2.747	2.747	8.629	8.636	8.636
2/11/2005	4.138	4.130	4.130	2.765	2.760	2.760	8.629	8.631	8.631
5/4/2005	4.138	4.126	4.126	2.765	2.755	2.755	8.629	8.633	8.633
7/25/2005	4.138	4.123	4.123	2.765	2.754	2.754	8.629	8.631	8.631
10/20/2005	4.138	4.121	4.121	2.765	2.751	2.751	8.629	8.632	8.632
11/9/2005	4.138	4.125	4.125	2.765	2.755	2.755	8.629	8.632	8.632
1/9/2006	4.138	4.126	4.126	2.765	2.755	2.755	8.629	8.630	8.630
4/14/2006	4.138	4.129	4.128	2.765	2.758	2.754	8.629	8.631	8.633
6/28/2006	**4.114**	4.099	4.099	**2.752**	2.740	2.740	8.629	8.635	8.635
12/13/2006	4.114	4.090	4.090	2.752	2.733	2.733	8.629	8.635	8.635

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Channel 4		Data Point 4			Data Point 5			Data Point 6	
Date	Desired	As-Found	As-Left	Desired	As-Found	As-Left	Desired	As-Found	As-Left
8/3/1999	8.565	8.563	8.563	5.667	5.672	5.672	5.667	5.660	5.660
10/26/1999	8.565	8.563	8.563	5.667	5.671	5.671	5.667	5.661	5.661
1/18/2000	8.565	8.563	8.563	5.667	5.670	5.670	5.667	5.663	5.663
5/5/2000	8.565	8.558	8.558	5.667	5.672	5.672	5.667	5.660	5.660
7/6/2000	8.565	8.559	8.559	5.667	5.673	5.673	5.667	5.660	5.660
9/26/2000	8.565	8.560	8.566	5.667	5.674	5.667	5.667	5.658	5.667
12/19/2000	8.565	8.568	8.568	5.667	5.662	5.662	5.667	5.667	5.667
1/17/2001	8.565	8.573	8.573	5.667	5.664	5.664	5.667	5.667	5.667
3/13/2001	8.565	8.571	8.571	5.667	5.663	5.663	5.667	5.667	5.667
6/6/2001	8.565	8.568	8.568	5.667	5.666	5.666	5.667	5.666	5.666
8/28/2001	8.565	8.573	8.573	5.667	5.668	5.668	5.667	5.667	5.667
11/20/2001	8.565	8.571	8.571	5.667	5.664	5.664	5.667	5.666	5.666
2/13/2002	8.565	8.571	8.571	5.667	5.663	5.663	5.667	5.666	5.666
7/4/2003	8.565	8.567	8.570	5.667	5.666	5.669	5.667	5.663	5.664
11/16/2003	8.565	8.571	8.571	5.667	5.666	5.666	5.667	5.663	5.663
2/27/2004	8.565	8.569	8.569	5.667	5.665	5.665	5.667	5.664	5.664
3/31/2004	**8.523**	8.524	8.524	**5.603**	5.602	5.602	**5.603**	5.600	5.600
5/25/2004	8.523	8.525	8.525	5.603	5.601	5.601	5.603	5.598	5.598
8/26/2004	8.523	8.523	8.523	5.603	5.602	5.602	5.603	5.597	5.597
11/19/2004	8.523	8.526	8.526	5.603	5.601	5.601	5.603	5.599	5.599
2/11/2005	8.523	8.524	8.524	5.603	5.600	5.600	5.603	5.599	5.599
5/4/2005	8.523	8.525	8.525	5.603	5.606	5.606	5.603	5.600	5.600
7/25/2005	8.523	8.524	8.524	5.603	5.600	5.600	5.603	5.602	5.602
10/20/2005	8.523	8.523	8.523	5.603	5.600	5.600	5.603	5.596	5.596
11/9/2005	8.523	8.523	8.523	5.603	5.600	5.600	5.603	5.597	5.597
1/9/2006	8.523	8.524	8.524	5.603	5.600	5.600	5.603	5.597	5.597
4/14/2006	8.523	8.523	8.523	5.603	5.600	5.602	5.603	5.597	5.598
6/28/2006	8.523	8.525	8.525	5.603	5.602	5.602	5.603	5.597	5.587
12/13/2006	8.523	8.524	8.524	5.603	5.608	5.608	5.603	5.598	5.598

Bold Denotes change in "Desired" value from previous test

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Channel 4		Data Point						
Date	Days Between	Point 1 - 3 month	Point 2 - 3 month	Point 3 - 3 month	Point 4 - 3 month	Point 5 - 3 month	Point 6 - 3 month	Comments
8/3/1999								
10/26/1999	84	0.004381	0.003286	-0.003286	0.000000	-0.001095	0.001095	
1/18/2000	84	0.009857	0.003286	0.001095	0.000000	-0.001095	0.002190	
5/5/2000	108	-0.001000	0.003000	-0.011000	-0.005000	0.002000	-0.003000	
7/6/2000	62	N/A	N/A	0.017806	0.001484	0.001484	0.000000	Note 1
9/26/2000	82	0.001122	0.002244	-0.001122	0.001122	0.001122	-0.002244	
12/19/2000	84	-0.004381	-0.002190	0.001095	0.002190	-0.005476	0.000000	
1/17/2001	29	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
3/13/2001	84	-0.026286	-0.020810	0.010952	0.003286	0.001095	0.000000	Note 3
6/6/2001	85	0.012988	0.008659	-0.005412	-0.003247	0.003247	-0.001082	
8/28/2001	83	-0.005542	-0.004434	0.000000	0.005542	0.002217	0.001108	
11/20/2001	84	-0.005476	-0.003286	0.002190	-0.002190	-0.004381	-0.001095	
2/13/2002	85	-0.005412	-0.001082	0.002165	0.000000	-0.001082	0.000000	
7/4/2003	506	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
11/16/2003	135	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
2/27/2004	103	N/A	N/A	-0.001000	-0.002000	-0.001000	0.001000	Note 1
3/31/2004	33	N/A	N/A	N/A	N/A	N/A	N/A	Notes 1&2
5/25/2004	55	N/A	N/A	0.016727	0.001673	-0.001673	-0.003345	Note 1
8/26/2004	93	0.009000	0.008000	-0.013000	-0.002000	0.001000	-0.001000	
11/19/2004	85	-0.015153	-0.012988	0.006494	0.003247	-0.001082	0.002165	
2/11/2005	84	0.016429	0.014238	-0.005476	-0.002190	-0.001095	0.000000	
5/4/2005	82	-0.004488	-0.005610	0.002244	0.001122	0.006732	0.001122	
7/25/2005	82	-0.003366	-0.001122	-0.002244	-0.001122	-0.006732	0.002244	
10/20/2005	87	-0.002115	-0.003172	0.001057	-0.001057	0.000000	-0.006345	
11/9/2005	20	N/A	N/A	N/A	N/A	N/A	N/A	Note 2
1/9/2006	81	0.005679	0.004543	-0.002272	0.001136	0.000000	0.001136	Note 4
4/14/2006	95	0.003000	0.003000	0.001000	-0.001000	0.000000	0.000000	
6/28/2006	75	N/A	N/A	0.002453	0.002453	0.000000	-0.001227	Note 1
12/13/2006	168	N/A	N/A	N/A	N/A	N/A	N/A	Note 2

Note 1: Any surveillances immediately following a change in desired values are not considered.

Note 2: Periods over 115 days (92 * 1.25 TS Extension Allowance) or less than 46 days (92/2) are not considered since they could skew the calculated drift data.

Note 3: Uses data from 12/19/2000

Note 4: Uses data from 10/20/2005

Attachment 4 – Foxboro Technical Information Document TI-2AI-130

Technical Information

TI
2AI-130
March 1972

SPEC 200
CURRENT TO VOLTAGE CONVERTERS

5/72

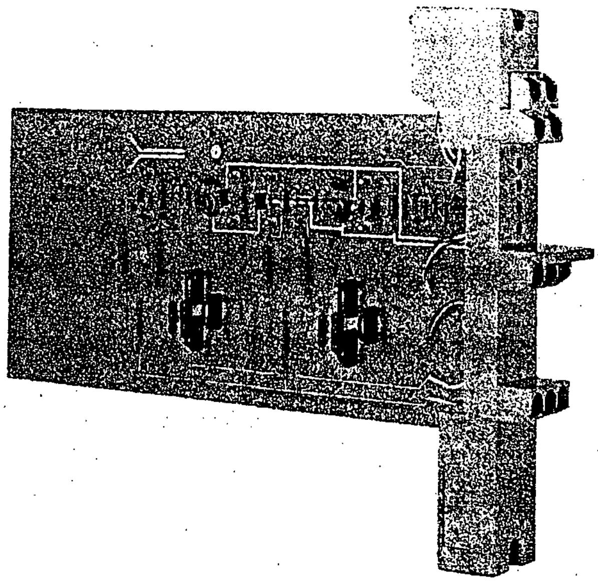


Figure 1

GENERAL

SPEC 200 Current-to-Voltage Converters, Figure 1, provide the interface between field current signals (4-20 mA dc or 10-50 mA dc) and SPEC 200 System Voltage Signals (0-10 V dc). There are four versions of the converters which will be identified for discussion purposes by the following partial model numbers. For complete model numbers, see Specifications section.

I2V: 4-20 mA dc to 0-10 V dc Dual Converter with inputs galvanically isolated from outputs. Transmitter is powered from +15 and -15 V dc nest field bus or external power supply in series with field transmitters.

I3V: 4-20 mA dc to 0-10 V dc Dual Converter with nonisolated inputs and outputs. Transmitter is powered from +15 and -15 V dc nest field bus or external power supply in series with field transmitter.

H2V: 10-50 mA dc to 0-10 V dc Dual Converter with inputs galvanically isolated from outputs. Transmitter is powered from 40-100 V dc nest field bus or from 40-100 V remote power supply in series with field transmitter.

I4V: 4-20 mA dc to 0-10 V dc Dual Converter with nonisolated inputs and outputs. Transmitter is powered from 24 V dc nest field bus or from 24 V dc remote power supply in series with field transmitter.

I2V and I3V Converters require, when used with Foxboro E Series Transmitters, that at least 30 V dc (+15 and -15 V) be used to power the transmitter circuit. At this voltage the load in series with the associated transmitter (including lead resistance) may be up to 50 ohms maximum. The I4V Converter requires that a minimum 24 V dc be used to power an E Series Transmitter. When it is powered by 30 V dc (+15 and -15 V), the external load (including lead resistance) that may be added in series with the transmitter is 300 ohms maximum. H2V Converters with transmitters powered from 40 V dc may have up to 150 ohms (including lead resistance) in series with E Series Transmitters.

REFERENCE DOCUMENT
TI 200-205

FOXBORO

Two of the converters, the I2V and the I3V, with load circuits powered from a nest mounted DP10-ULB Power Distribution Panel via the nest field bus, limit energy to the field transmitters to intrinsically safe levels. For a discussion on SPEC 200 Intrinsically Safe Systems, see TI 200-255.

SPECIFICATIONS

Model Number:

2AI-I2V: 4-20 mA to 0-10 V (Isolated)

2AI-I2V-ULB: 4-20 mA to 0-10 V Intrinsically Safe (Isolated)

2AI-I3V: 4-20 mA to 0-10 V (Nonisolated)

2AI-I3V-ULB: 4-20 mA to 0-10 V Intrinsically Safe (Nonisolated)

2AI-H2V: 10-50 mA to 0-10 V (Isolated)

2AI-I4V: 4-20 mA to 0-10 V (Nonisolated), 24 V dc Power

Mounting:

Mounts directly in SPEC 200 Nest and occupies one nest space. See Mounting Equipment, TI 200-275.

Electrical Classification:

Ordinary locations. Suitable for Class I, Groups B, C, D, Division 2, if suitably enclosed. For suitable enclosures, see TI 200-250.

Intrinsic Safety:

See prior text and TI 200-255.

Power Requirements:

(For both converters not including transmitter overrange requirements)

I2V: +15 V dc ±5% at 70 mA, and -15 V dc ±5% at 80 mA when totally powered from system supply via nest bus.

+15 V dc ±5% at 40 mA required from component bus in nest when external power supply in series with field transmitter is used.

I3V: +15 V dc ±5% at 44 mA, and -15 V dc ±5% at 52 mA when totally powered from system supply via nest bus.

+15 V dc ±5% at 4 mA, and -15 V dc ±5% at 12 mA from component bus in nest when external power supply in series with field transmitter is used.

H2V: +15 V dc ±5% at 15 mA, and -15 V dc ±5% at 25 mA from nest component bus. 40-100 V dc at 100 mA from nest field bus or power supply in series with field transmitter.

I4V: +15 V dc ±5% at 4 mA, and -15 V dc ±5% at 12 mA from component bus in nest. 24 V dc at 40 mA from nest field bus or power supply in series with field transmitter.

Input Signals:

I2V, I3V, I4V: 4-20 mA dc
H2V: 10-50 mA dc

Input Resistance:

When powered from power supplies in series with transmitter.

I2V: 40 ohms maximum
I3V: 250 ohms
H2V: 35 ohms maximum
I4V: 250 ohms

Output Signals:

0-10 V dc

Output Loads:

2000 ohms minimum

Adjustments: (Located at front panel)

I2V: Zero (each input) ±2% of output span minimum
Span (each input) ±5% of output span minimum
I3V: Zero (each input) ±3.5% of output span minimum
H2V: Zero (each input) ±2.5% of output span minimum
Span (each input) ±3.5% of output span minimum
I4V: Zero (each input) ±3.5% of output span minimum

Open Circuit Conditions:

When inputs are open circuited, the corresponding outputs will go to -2.5 V dc ±0.2 V.

Accuracy:

±0.25% of output span

Supply Voltage Effect:

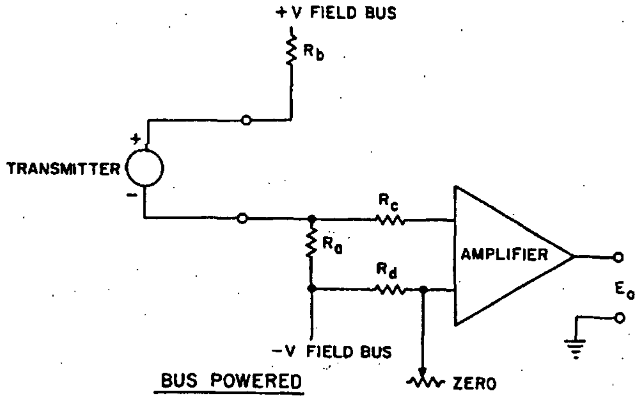
I2V: ±0.2% of output span maximum for a ±5% change within normal operating units.
I3V, H2V, I4V: ±0.1% of output span maximum for a ±5% change within normal operating limits.

Ambient Temperature Range:

+40 to 120 F (+5 to 50 C)

Ambient Temperature Error:

±0.5% of output span maximum for a 50 F (28 C) change within normal operating limits.



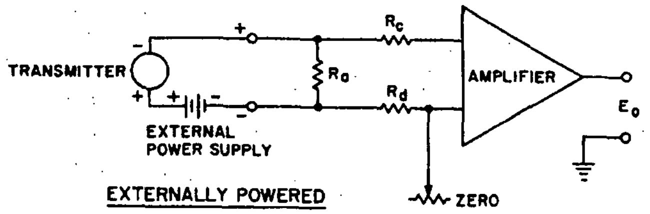


Figure 2. I3V and I4V Converter Schematic

PRINCIPLE OF OPERATION

I3V and I4V: The principle of operation for these converters is basically the same. The differences are certain component values and the power to the field circuits.

Figure 2 shows one simplified schematic for the Current-to-Voltage Converters when the field circuit is bus powered and another one when they are powered externally. The arrangement desired is selected by jumpers on the printed circuit board. The +V and -V field bus supply is +15 and -15 V dc minimum for the I3V and 24 V dc minimum for the I4V. Note: There is only one field bus in the SPEC 200 nest. One cannot mix +15 and -15 V and any other field bus voltage such as 24 V dc in the same nest.

The transmitted current, in both diagrams in Figure 2, develops a voltage across Resistor R_a which is proportional to the measurement signal. This voltage is biased to take out the elevation of the input signal and attentuated in the integrated circuit amplifier to produce an output (E_o) of 0-10 V dc.

For intrinsic safety applications, only the bus powered version of the I3V may be used. The +15 and -15 V bus voltage is limited by a specially designed high voltage limiting circuit in the power distribution panel which distributes the power to the nest field bus. The current is limited by Resistors R_b and R_a. Resistors R_c and R_d protect the field circuit from accidental fault voltages up to 250 volts nominal from the amplifier circuits.

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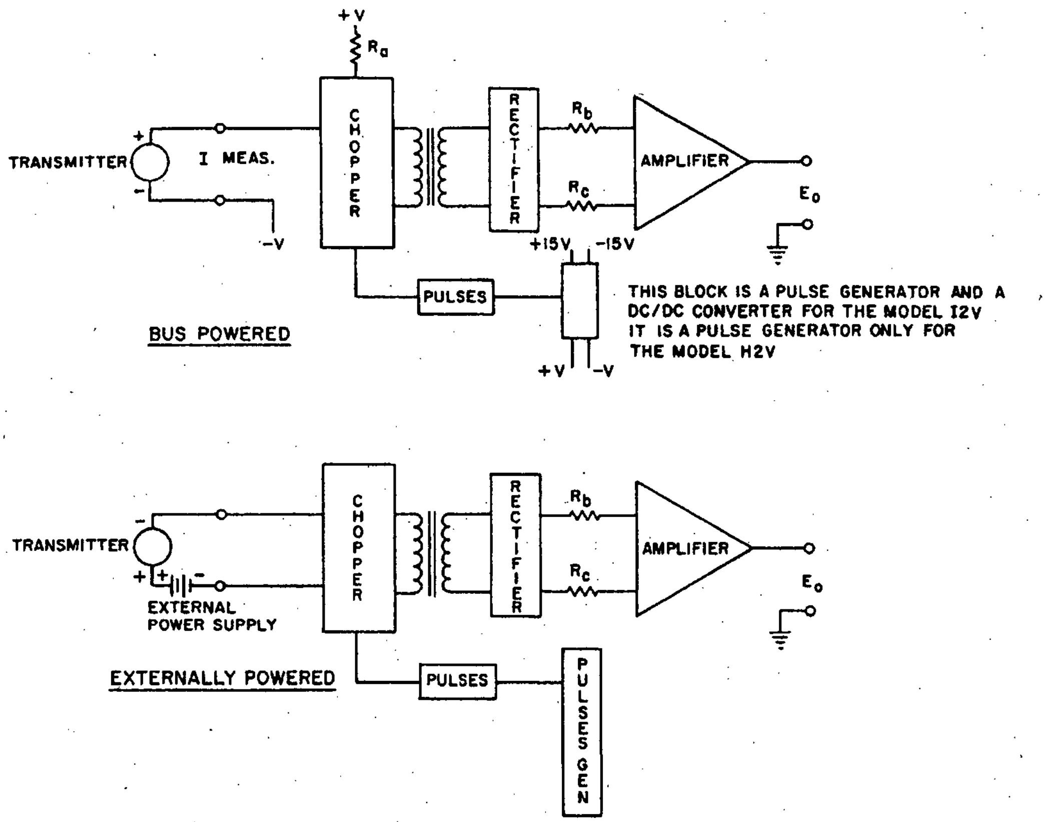

Figure 3. I2V and H2V Converter Schematic

I2V and H2V: The principle of operation for these converters is basically the same. Referring to Figure 3, the main difference between the two is that when bus powered, in the I2V, the voltage (+V and -V) feeding the field circuit is 24 V dc as developed in the DC/DC Converter which is powered by the +15 and -15 V nest field bus. The H2V, on the other hand, receives power for the field circuit directly from the field bus (40-100 V dc). Also the pulses to the chopper are developed by different circuits in the two units.

The transmitted current is converted in the chopper circuits to a square wave signal which can be transformer coupled (providing isolation) to the rectifier circuit. The rectified signal is connected to the amplifier which produces output signal E_0 (0-10 V dc).

When the circuits are externally powered, the principle of operation is similar. In this mode of operation the H2V is totally disconnected from the nest field bus. The I2V, however, still is connected to the field bus and requires the +15 and -15 V dc power for pulse generation. Here again, it is important to remember that only one voltage may exist on a field bus in a given SPEC 200 Nest. Note that H2V's and I2V's may never be combined in the same nest.

In the intrinsically safe version of the I2V (bus powered only), Resistor R_a limits the current, from the voltage limited field bus, that can flow in the field circuit. Isolation and Resistors R_b and R_c limit the energy that can reach the field circuits to intrinsically safe levels from the amplifier circuits. This protection included accidental fault voltages up to 250 volts nominal.

All of the SPEC 200 Voltage-to-Current Converters have a nominal frequency response such that the output is down 3 dB at 10 Hz. This response may be altered by changing capacitor values on the printed circuit card. Additional details are given in the master instructions for the various converters.