Xcel Energy

RECORD INFORMATION SHEET

Doc Type/Sub Type: CALC

Document Number: 96-054 R5

Title: Turbine Stop ValveClosurelGenerator Load Reject Scram Bypass

☐ 1. The following record has been identified as either illegible on microfilm or identified as uncertain whether it will be legible on microfilm. A copy has been filmed for "reference only" and the originals are maintained in hard copy.

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Pages / Items	Description / Comments

Print / Sign: Bruce M. Lory / [signature] Date: 05 / 06 / 09

Form retained in accordance with record retention schedule identified in FP-G-RM-01.

Xcel Energy	Calculation Signature Sheet

Document Information

NSPM Calculation (Doc) No: 96-054	Revision: 5
Title: Turbine Stop Valve Closure/Generator Load Reject Scram Bypass	
Facility: ☒ MT ☐ PI	Unit: ☒ 1 ☐ 2
Safety Class: ☒ SR ☐ Aug Q ☐ Non SR	
Special Codes: ☐ Safeguards ☐ Proprietary	
Type: **Calc** Sub-Type:	

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

Major Revisions BMT 05/06/09

EC Number: ~~11035~~ 14252	☒ Vendor Calc
Vendor Name or Code: Sargent & Lundy	Vendor Doc No:
Description of Revision: Updates the analyzed drift values to reflect the current 24-month calibration interval.	
Prepared by: By Vendor	Date: 05/01/09
Reviewed by: [signature] (Rhon Sanderson)	Date: 05-01-09
Type of Review: ☐ Design Verification ☐ Tech Review ☒ Vendor Acceptance	
Method Used (For DV Only): ☒ Review ☐ Alternate Calc ☐ Test	
Approved by: Edward P. Watzl (Edward Watzl)	Date: 5-5-09

Minor Revisions

EC No:	☐ Vendor Calc:
Minor Rev. No:	
Description of Change:	
Pages Affected:	
Prepared by:	Date:
Reviewed by:	Date:
Type of Review: ☐ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

(continued on next page)

Record Retention: Retain this form with the associated calculation for the life of the plant.

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EC No:	☐ Vendor Calc:
Minor Rev. No:	
Description of Change:	
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Prepared by:	Date:
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Approved by:	Date:

EC No:	☐ Vendor Calc:
Minor Rev. No:	
Description of Change:	
Pages Affected:	
Prepared by:	Date:
Reviewed by:	Date:
Type of Review: ☐ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

EC No:	☐ Vendor Calc:
Minor Rev. No:	
Description of Change:	
Pages Affected:	
Prepared by:	Date:
Reviewed by:	Date:
Type of Review: ☐ Design Verification ☐ Tech Review ☐ Vendor Acceptance	
Method Used (For DV Only): ☐ Review ☐ Alternate Calc ☐ Test	
Approved by:	Date:

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NOTE:	This reference table is used for data entry into the PassPort Controlled Documents Module, reference tables (C012 Panel). It may also be used as the reference section of the calculation. The input documents, output documents and other references should all be listed here. Add additional lines as needed.

Reference Documents (PassPort C012 Panel from C020)

#	Controlled* Doc? + Type	Document Name	Document Number	Doc Rev	Ref Type** (if known)
1	☐	General Electric Instrument Setpoint Methodology	NEDC-31336P-A	1996	☒Input ☐Output
2	☐	Setpoint Calculation Guidelines for the Monticello Nuclear Generating Plant	GE-NE-901-021-0492 DRF A0001932-1	1992	☒Input ☐Output
3	☐	Guidelines for Instrument Calibration Extension/Reduction Programs	TR-103335-R1	1	☒Input ☐Output
4	☐	Task Report T0502, Nuclear Management Company Monticello Nuclear Generating Plant Extended Power Uprate	T0502		☒Input ☐Output
5	☒	Monticello Updated Safety Analysis Report. Plant Instrumentation and Control Systems: Plant Protection System	USAR-07.06	25P	☒Input ☐Output
6	☒	Operations Manual B.05.06. Plant Protection System	B.05.06		☒Input ☐Output
7	☐	Generic Letter 91-04, Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle			☒Input ☐Output
8	☐				☐Input ☐Output
10	☐				☐Input ☐Output
11	☐				☐Input ☐Output
12	☐				☐Input ☐Output

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Calculation Signature Sheet

13	☐				☐Input ☐Output
14	☐				☐Input ☐Output
15	☐				☐Input ☐Output
16	☐				☐Input ☐Output
17	☐				☐Input ☐Output

*Controlled Doc checkmark means the reference can be entered on the C012 panel in black. Unchecked lines will be yellow. If checked, also list the Doc Type, e.g., CALC, DRAW, VTM, PROC, etc.)

**Corresponds to these PassPort "Ref Type" codes: Inputs/Both = ICALC, Outputs = OCALC, Other/Unknown = blank)

Other PassPort Data

Associated System (PassPort C011, first three columns) **OR** **Equipment References** (PassPort C025, all five columns):

Facility	Unit	System	Equipment Type	Equipment Number
			PREASURE SWITCHES	PS-5-14A/B/C/D

Superseded Calculations (PassPort C019):

Facility	Calc Document Number	Title
MT	CA-96-054 Rev. 4	TURBINE STOP VALVE CLOSURE/GENERATOR LOAD REJECT SCRAM BYPASS SETPOINT CALCULATION

Record Retention: Retain this form with the associated calculation for the life of the plant.

Xcel Energy	**Calculation Signature Sheet**

Monticello Specific Information

☒ DBD Topic Code(s) (See MT Form 3805): RATE
☐ DBD Structural Code(s) (See MT Form 3805): N/A

Does the Calculation:

☐ YES ☒ No Affect the Fire Protection Program? (If Yes, Attach MT Form 3765)
☐ YES ☒ No Affect piping or supports? (If Yes, Attach MT Form 3544)
☐ YES ☒ No Affect IST Program Valve or Pump Reference Values, and/or Acceptance Criteria? (If Yes, inform IST Coordinator and provide copy of calculation)

Record Retention: Retain this form with the associated calculation for the life of the plant.

QF-0547 (FP-E-MOD-11) Rev. 1

Xcel Energy	**External Design Document Suitability Review Checklist**

External Design Document Being Reviewed:

Title: Turbine Stop Valve Closure / Generator Load Reject Scram Bypass

Number: 96-054 ~~(S&L Calc. #~~ bm 05/01/09 Rev: 5 Date: 04/21/09

This design document was received from:

Organization Name: Sargent & Lundy PO or DIA Reference: 00000983

The purpose of the suitability review is to ensure that a calculation, analysis or other design document provided by an External Design Organization complies with the conditions of the purchase order and/or Design Interface Agreement (DIA) and is appropriate for its intended use. The suitability review does not serve as an independent verification. Independent verification of the design document supplied by the External Design Organization should be evident in the document, if required.

The reviewer should use the criteria below as a guide to assess the overall quality, completeness and usefulness of the design document. The reviewer is not required to check calculations in detail.

REVIEW		**Check**
1.	Design inputs correspond to those that were transmitted to the External Design Organization.	☑
2.	Assumptions are described and reasonable.	☑
3.	Applicable codes, standards and regulations are identified and met.	☑
4.	Applicable construction and operating experience is considered.	☑
5.	Applicable structure(s), system(s), and component(s) are listed.	☑
6.	Formulae and equations are documented. Unusual symbols are defined.	☑
7.	Acceptance criteria are identified, adequate and satisfied.	☑
8.	Results are reasonable compared to inputs.	☑
9.	Source documents are referenced.	☑
10.	The document is appropriate for its intended use.	☑
11.	The document complies with the terms of the Purchase Order and/or DIA.	☑
12.	Inputs, assumptions, outputs, etc. which could affect plant operation are enforced by adequate procedural controls. List any affected procedures. OK per discussion with EC 11025	? ☑
13.	Plant impact has been identified and either implemented or controlled. (e.g., For piping analyses, the piping and support database is updated or a tracking item has been initiated.)	☑

Completed by: [signature] Date: 05-01-09

Rhon Sanderson

Calculation no. 96-054

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ISSUE SUMMARY
Form SOP-0402-07, Revision 7B

DESIGN CONTROL SUMMARY			
CLIENT:	Northern States Power Company	UNIT NO.: 1	Page No.: 1
PROJECT NAME:	**Monticello Nuclear Generating Plant**		
PROJECT NO.:	12400-009	☒ NUCLEAR SAFETY- RELATED	
CALC. NO.:	CA-96-054, Revision 5	☐ NOT NUCLEAR SAFETY-RELATED	
TITLE:	Turbine Stop Valve Closure/Generator Load Reject Scram Bypass		
EQUIPMENT NO.:	PS-5-14A,B,C,D		

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

This revision completely supersedes Revision 4

INPUTS/ ASSUMPTIONS
☐ VERIFIED
☒ UNVERIFIED

REVIEW METHOD:	Detailed	REV.	5
STATUS:	Approved	DATE FOR REV.:	4/21/2009
PREPARER	Eric Kolodziejczyk *(signature)*	DATE:	4/21/2009
REVIEWER	John O'Hara / Greg Rainey *(signatures)*	DATE:	4/21/2009
APPROVER	Steven Malak *(signature)*	DATE:	4/21/2009

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

INPUTS/ ASSUMPTIONS
☐ VERIFIED
☐ UNVERIFIED

REVIEW METHOD:		REV.	
STATUS:		DATE FOR REV.:	
PREPARER		DATE:	
REVIEWER		DATE:	
APPROVER		DATE:	

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INPUTS/ ASSUMPTIONS
☐ VERIFIED
☐ UNVERIFIED

REVIEW METHOD:		REV.	
STATUS:		DATE FOR REV.:	
PREPARER		DATE:	
REVIEWER		DATE:	
APPROVER		DATE:	

NOTE: PRINT AND SIGN IN THE SIGNATURE AREAS

1. PURPOSE

This calculation performs a setpoint calculation for the turbine stop valve closure and generator load reject scram bypass signal provided by pressure switches PS-5-14A/B/C/D. This calculation affects the Reactor Protection System and ensures that above P_{bypass} (Input 4.7) reactor thermal power the scram bypass signal is deactivated.

Revision 5 of this calculation updates the analyzed drift values to reflect the current 24-month calibration interval.

Revision 4 of this calculation reflects turbine replacement for both EPU (Extended Power Uprate) and CLTP (Current Licensed Thermal Power) and adjusts the operation setpoint to reflect the new turbine first stage pressure curve. Additionally, revisions are incorporated to meet the current setpoint control program standards with the guidance of ESM-03.02-APP-I (Input 4.1).

Revision 3 of this calculation reflected the results of turbine testing during startup from the 1998 refueling outage and adjusts the setpoints for the higher steam flow/1st stage turbine pressure resulting from rerate.

2. METHODOLOGY

This calculation is performed using the GE Setpoint Methodology as a guide as described in Appendix I to Engineering Standards Manual Section ESM-03.02, Revision 4, Design Requirements, Practices, & Topics (Instrumentation and Controls) (Input 4.1). This methodology utilizes statistical estimates of the various instrument errors to achieve conservative, but reasonable, predictions of instrument channel uncertainties. The objective of the statistical approach to setpoint calculations is to achieve a workable compromise between the need to ensure instrument trips when appropriate, and the need to avoid spurious trips that may unnecessarily challenge safety systems or disrupt plant operation.

The setpoint established in this calculation is considered a non-safety related setpoint. An Analytical Limit and Allowable Value (Tech Spec value) are typically only associated with safety-related setpoints. The GE methodology does not clearly discuss the treatment of non-safety-related setpoints; however, the MNGP methodology states that the Allowable Value calculation does not apply to setpoints for which an AV is not documented in the Tech Spec. The previous revision of this calculation establishes an Analytical Limit and calculates an Allowable Value. Therefore, this calculation will retain the AL terminology and AV calculation.

Per Input 4.1, the Spurious Trip Avoidance Evaluation is satisfied using engineering judgment. See Section 6.5.8 for more details.

The determination of the pressure switch drift value used in this calculation is performed in accordance with ESM-03.02-APP-III (Input 4.2).

3. ACCEPTANCE CRITERIA

The Nominal Trip Setpoint (NTSP), Allowable Value (AV) and instrument settings should be established such that the Analytical Limit will not be exceeded when all applicable instrumentation uncertainties are considered. The existing setpoints and As-found/As-left ranges will be verified to provide sufficient margin using the GE methodology as a guide. A setpoint value will be established with a 95%/95% tolerance interval as a criteria of uncertainties (Input 4.2). That is, there is a 95% probability that the constructed limits contain 95% of the population of interest for a 24-month +25% calibration interval (Reference 10.7) for the pressure switches. If the existing setpoint and ranges do not provide sufficient margin, new setpoints or ranges will be specified by this calculation.

4. INPUTS

4.1 Engineering Standards Manual ESM-03.02-APP-I, Revision 4, GE Methodology (Instrumentation and Controls). The ESM provides plant specific guidance on the implementation of the General Electric methodology (Reference 10.1) and guidelines (Reference 10.2).

4.2 Engineering Standards Manual ESM-03.02-APP-III, Revision 5, Drift Analysis (Instrumentation and Controls). The ESM provides plant specific guidance on the implementation of the EPRI guidelines on drift analysis (Reference 10.3).

95%/95% Tolerance Factor for 44 data points (Table 9.1)	2.445
99%/95% Tolerance Factor for 44 data points (Table 9.1)	2.677

4.3 Monticello Component Master List (CML). The CML contains information regarding the pressure switches and calibration tools listed in this calculation.

Device	Calibration Interval
PS-5-14A,B,C,D	24 months

Calibration Device	Description
XPI-9021	Ashcroft 2089
XPS-95171	Mansfield and Green TQ-50

4.4 Calculation CA-98-010, Revision 6, Environmental Qualification (DOR) of Barksdale Pressure Switches. EQ Calculation File 0910-106EQ-05.

4.5 Calculation CA-95-027, Revision 1, Determination of Instruments Service Conditions for Input Into Setpoint Calculations. MO4230-0065. Data obtained from this input is listed in Section 6.2.2.

4.6 MNGP EPU Task Report T0700: EC 12473, Letter GE-MNGP-AEP-196, 1st Stage Shell Pressure curve, dated August 1, 2007 (Attachment 3).

% Rated Thermal Power (Input 4.7)		**1st Stage Shell Pressure**
25% (EPU)	28.2% (CLTP)	140.0 psia (125.3 psig)

4.7 MNGP EPU Task Report T0900: Transient Analysis EC11830. GE-NE-0000-0062-2932 OPL-3, Transient Protection Parameters Verification for Reload Licensing Analysis.

Parameter	**CLTP**	**EPU**
Rated Power	1775 MWt	2004 MWt
P_{bypass}	45% RTP	40% RTP

4.8 Memo from John Hess (GE) to Jim Devine (MNGP) dated March 15, 1996 (Attachment 4).

4.9 MNGP EPU Task Report T1004: Environmental Qualification EC11836, Rev. 0. March 2008. This Input demonstrates environmental conditions used in the evaluation of Inputs 4.4 and 4.5 will not change due to EPU.

4.10 NX-63626, Ashcroft Digital Test Gauge Operating Instructions.

Calibration Device	**Range**	**Accuracy**
XPI-9021 (Ashcroft 2089)	0-500 psig	0.05% Full Scale

4.11 NX-17448, Mansfield and Green Pneumatic Dead Weight Tester.

Calibration Device	**Range**	**Accuracy**
XPS-95171 (Mansfield and Green TQ-50)	100-5000 psig	0.025% Reading

5. ASSUMPTIONS

Validated Assumptions:

5.1 The GE memo from John Hess to Jim Devine of MNGP (Attachment 4) cites a 3% process measurement uncertainty based on unexpected changes in flow coefficients and tolerances on machining. The memo discusses tolerances prior to EPU. However, the tolerances on machining are not dependant on pressure or flow. Therefore, this process measurement uncertainty is assumed to remain applicable at EPU conditions.

5.2 No seismic data is available for the Barksdale Switches. Per Input 4.5, the Zero Period Acceleration at the switches is 0.26g. This value is low enough to consider normal vibration effects negligible. Therefore, SE is taken to be 0.

5.3 Error effects due to Static Pressure Effects (SPE), typically associated with differential pressure instruments, are assumed negligible for Gauge pressure instruments since ambient pressure is considered constant.

5.4 No vendor specification is available for Accuracy Temperature Effect (ATE). ATE will be considered included in the vendor accuracy. Since normal temperature range is within the vendor specified temperature limits, effects due to normal temperature variations are considered to be included in the Analyzed Drift.

5.5 The Readability Error associated with reading the impulse pressure curve in Attachment 3 is taken to be one quarter of one minor division.

Unvalidated Assumptions:

5.6 The first stage pressure and thermal power relationship according to Input 4.6 needs to be validated during start-up testing.

Note: The percent power relationship given in Attachment 3 assumes that the reactor is providing steam to the turbine and that other auxiliary steam loads are not significantly affecting thermal power. This may require procedural changes to assure that auxiliary steam loads are secured during start up testing.

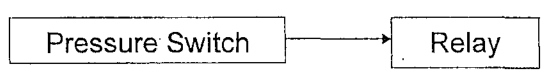
6. ANALYSIS

6.1 Instrument Channel Arrangement

6.1.1 Loop Information:

Definition of Channel:
Each instrument channel is comprised of a turbine first stage pressure switch and an associated relay. Each relay provides input to the Reactor Protection System (RPS) scram logic in order to bypass scrams initiated by turbine stop valve closure and control valve fast closure during low reactor power conditions. At these low reactor power conditions, the turbine bypass valves have sufficient capacity to bypass the steam without increasing reactor vessel pressure to unsafe levels. The bypass signal logic is two out of two once. The reactor power level associated with the bypass signal is established at the same thermal power as prior to EPU (30% of 1775 MWt). This corresponds to an EPU reactor power of 26.6% at 2004 MWt. However, the Analytical Limit will be taken as a more conservative 25% reactor power (28.2% CLTP) for the purposes of this calculation. Once the switch pressure setpoint is exceeded, the scram bypass signal is deactivated. The scram bypass signal is reactivated on decreasing reactor power, once the switch reset limit has been reached.

6.1.2 Loop Diagram:



6.2 Instrument Definition and Determination of Device Error Terms

6.2.1 Instrument Definition:

		Reference
Component ID:	PS-5-14A,B,C,D	
Location:	East Shield Wall (TB-951)	4.3
Manufacturer:	Barksdale	4.3
Model Number:	B2T-A12SS	4.3
Upper Range Limit (URL):	1200 psig	4.3
Adjustable Range	50-1200 psig	4.3

Vendor Performance Specs	±0.5% of Adjustable Range		Att. 2
PS-5-14A,B,C,D:	<u>Input Signal</u> First Stage Turbine Pressure	<u>Output Signal</u> Contact Closure at setpoint	4.3

6.2.2 Process and Physical Interfaces:

Calibration Conditions:		**Reference**
Calibration Temperature Range:	65 to 90°F	4.5, 4.9
Calibration/Surveillance Interval:	24 months ±25%	4.3

Normal Plant Conditions:		
Temperature:	60 to 104°F	4.5, 4.9
Radiation:	Negligible	4.5, 4.9
Pressure:	Ambient	4.5, 4.9
Humidity:	20-100%	4.5, 4.9

Trip Environment Conditions:		
Temperature:	60-104°F	4.5, 4.9
Radiation:	Negligible	4.5, 4.9
Pressure:	Ambient	4.5, 4.9
Humidity:	100%	4.5, 4.9

Seismic ZPA:		
PS-5-14A/B	0.26g	4.5
PS-5-14C/D	0.24g	4.5

Process Conditions;		
During Calibration:	Not Applicable	
Worst Case:	Not Applicable	

6.2.3 Device Accuracy:

		Sigma	Reference
Vendor Accuracy:	VA ±0.5% (Full Scale)	3	Att. 2, Note 1
Accuracy Temperature Effect:	ATE=0.0		5.4, Note 2
Over Pressure Effect:	OPE=0.0		Note 3
Static Pressure Effect:	SPE=Not applicable		5.3, Note 4
Seismic Effect:	SE=0.0		5.2, Note 5
Radiation Effect:	RE=Not applicable		Note 6
Humidity Effect:	HE=Included in VA		4.4, Note 7
Power Supply Effect:	PSE=Not applicable		Note 8
Radio/EM Interference	REE=Not applicable		Note 8

Note 1: VA = Vendor Accuracy
VA = 0.5% x Full Scale
VA = 0.005 x 1200 = 6.0 psig

Note 2: No vendor specification is available for ATE. Accuracy temperature effect will be considered included in the vendor accuracy. Since this instrument is not subject to a harsh environment, most of the temperature effect is considered in the Analyzed Drift.

Note 3: These switches have a proof pressure of 1800 psig which exceeds the pressure that they will be exposed to. As such, Over Pressure Effect is taken to be equal to 0.

Note 4: Error effects due to Static Pressure Effects (SPE) are negligible for gauge pressure instruments.

Note 5: No seismic data is available for the Barksdale Switches. Per Input 4.5, the Zero Period Acceleration is 0.26g. This value is low enough to consider normal vibration effects negligible.

Note 6: Per Input 4.5, radiation dose is considered negligible for the pressure switch location. Therefore, Radiation Effect is considered negligible.

Note 7: Per input 4.4, the Barksdale switches are Environmentally Qualified for a relative humidity of 100%. Therefore, Humidity Effect is considered included in the VA.

Note 8: Error effects due to Power Supply Effects (PSE) and RFI/EMI Effects (REE) are not applicable for bi-stable electro-mechanical devices (Reference 10.2)

6.2.4 Device Drift:

		Sigma	Reference
Analyzed Drift	AD=±23.0 psig	2	Attachment 1

A drift analysis using instrument calibration history is included in Attachment 1 for determining the 24 month plus 25% drift.

Per Section A1.8 of Attachment 1, bias will not be considered for the pressure switches.

$AD_{bias} = 0.0$

The random portion of the Analyzed Drift is calculated by multiplying the Standard Deviation (s) of the final data set by the 95%/95% Tolerance Interval Factor ($TIF_{95/95}$) and by the normality adjustment factor (NAF):

$$AD_{random} = s \times TIF_{95/95} \times NAF$$

$$AD_{random} = 8.34 \times 2.445 \times 1 \qquad \text{(23.6 months)}$$

$$AD_{random} = 20.4\,psig$$

The extended calibration interval of 24 months plus 25% is calculated by multiplying the random portion of the Analyzed drift by a scaling factor to extrapolate the drift uncertainty. See Section A1.9 of Attachment 1 for more detail.

$$AD_{E.random} = AD_{random} \times \sqrt{\frac{CI_E}{CI_O}}$$

$$AD_{E.random} = 20.4 \times \sqrt{\frac{30}{23.6}} \qquad \text{(30 months)}$$

$$AD_{E.random} = 23.0\,psig$$

Analyzed Drift $AD = D_L = \pm 23.0$ psig

6.2.5 As Left Tolerance (ALT):

The suggested limit on the magnitude of the ALT per Input 4.1 is given as:

$$ALT = \frac{2}{3}\sqrt{(VA)^2 + (C)^2 + (C_{STD})^2}$$

$$ALT = \frac{2}{3}\sqrt{(6.0)^2 + (0.25)^2 + (0.125)^2} = 4.0$$

(Calibration error terms are calculated in Section 6.2.6)

An ALT of up to 4.0 psi is acceptable based on the methodology suggested in Input 4.1. However, previous instrument performance (Input 4.3) suggests that a smaller ALT value is routinely achievable. The existing As-Left Tolerance specified on the calibration worksheet is ± 2.0 psi. The ALT will remain at ± 2.0 psi.

6.2.6 Device Calibration Error:

		Value	Sigma	Reference
Calibration Tool Error	C_i:	0.25 psi	3	4.10, Note 1
Tool Calibration Error	C_{iSTD}:	0.125 psi	3	4.11, Note 2
As Left Tolerance	ALT:	2.0 psi	2	6.2.5

Note 1: Per Input 4.3, the Barksdale pressure switches are calibrated with XPI-9021 (Ashcroft 2089). From Input 4.10, the vendor accuracy of the Ashcroft 2089 is 0.05% of full scale. Therefore, the XPI-9021 has an accuracy of 0.25 psi at 500 psi.

Calibration Device	Range	Accuracy	Reference
XPI-9021 (Ashcroft 2089)	0-500 psig	0.05% Full Scale	4.10

Note 2: Per Input 4.3, the Ashcroft 2089 is calibrated using the XPS-95171 dead weight tester. From Input 4.11, the vendor accuracy of the Mansfield and Green dead weight tester is 0.025% of output pressure. Therefore, the XPS-95171 has an accuracy of 0.125 psi at 500 psi.

Calibration Device	Range	Accuracy	Reference
XPS-95171 (Mansfield and Green Deadweight tester)	100-5000 psig	0.025% Reading	4.11

Since calibration term values are controlled by 100% testing they are assumed to represent 3 sigma values. Individual calibration error terms are combined using the SRSS method and normalized to a 2 sigma confidence level:

C_L = Device 1 Calibration Error

$$C_L = \frac{2}{3}\sqrt{C^2 + C_{STD}{}^2 + ALT^2}$$

$$C_L = \frac{2}{3}\sqrt{0.25^2 + 0.125^2 + 2^2}$$

$$C_L = 1.35\text{psi}$$

6.3 <u>Determination of Primary Element Accuracy (PEA) and Process Measurement Accuracy (PMA)</u>

Attachment 4
(Input 4.8)

PMA = Tolerances on machining, ±3% of point.
= ±3% X 125.3 psig
= ±3.8 psi

(Per Input 4.6, 25% (Section 6.1) EPU power (28.2% CLTP) corresponds to 140 psia. The conversion to gauge pressure is calculated using a 14.7 psi atmospheric pressure. This value is conservative for the site.)

6.4 <u>Determination of Other Error Terms</u>

The Analytical Limit in this calculation is based on a theoretical first stage shell pressure curve. The curve in Attachment 3 is readable to one quarter of the smallest division (Assumption 5.5). Therefore, the following readability error must be considered:

	Reference
REA = ± 5 psi	4.6, 5.5

6.5 Calculation of Allowable Value and Operating Setpoint

6.5.1 Allowable Value (AV):

Per Section 6.1.1, the Analytical Limit corresponds to 26.6% power (EPU) or 30% power (CLTP). However, the Allowable Value will be calculated using a conservative AL of 25% power (EPU) or 28.2% power (CLTP). Per Input 4.6, this AL corresponds to a first stage pressure of 140 psia (125.3 psig). The conversion to gauge pressure is calculated using a 14.7 psi atmospheric pressure. This value is conservative for the site.

$$AV \le AL - \left(\frac{1.645}{2}\right)\sqrt{\left(A_{LT}^2 + C_L^2 + PMA^2 + PEA^2 + REA^2\right)} + \text{bias terms}$$

$$AV \le 125.3 - \left(\frac{1.645}{2}\right)\left(\sqrt{6.0^2 + 1.35^2 + 3.8^2 + 0^2 + 5.0^2}\right)$$

$$AV \le 118.07$$

AV = 118 psig

6.5.2 Nominal Trip Setpoint Calculation:

$$NTSP_1 = AL - \left(\frac{1.645}{2}\right)\sqrt{A_{LT}^2 + C_L^2 + D_L^2 + PMA^2 + PEA^2 + REA^2} + \text{bias terms}$$

$$NTSP_1 = 125.3 - \left(\frac{1.645}{2}\right)\sqrt{6.0^2 + 1.35^2 + 23.0^2 + 3.8^2 + 0^2 + 5.0^2}$$

$$NTSP_1 = 105.0$$

6.5.3 Licensee Event Report (LER) Avoidance Evaluation:

The purpose of the LER Avoidance Evaluation is to ensure that there is sufficient margin provided between the AV and the NTSP to reasonably avoid violation of the AV. For a single instrument channel a Z value of greater than 1.29 provides sufficient margin between the NTSP and the AV. Although this is a multi channel loop, a Z of 1.29 will be used for conservatism. Therefore, $NTSP_2$ is calculated to provide a lower bound for the NTSP based on LER avoidance criteria.

$$Sigma(LER) = \frac{1}{2}\left(\sqrt{A_{LN}^2 + C_L^2 + D_L^2}\right) + bias$$

$$Sigma(LER) = \frac{1}{2}\left(\sqrt{6.0^2 + 1.35^2 + 23.0^2}\right)$$

$$Sigma(LER) = 11.90$$

$$NTSP_2 = AV - Z \times Sigma(LER)$$

$$NTSP_2 = 118 - (1.29 \times 11.90)$$

$$NTSP_2 = 102.6$$

Therefore, an NTSP ≤ 102.6 psig will result in a Z greater than 1.29 and provide sufficient margin between the NTSP and the AV.

6.5.4 Selection of Operating Setpoints:

$$NTSP \leq Controlling\ NTSP - ALT$$

$$NTSP \leq NTSP_2 - ALT$$

$$NTSP \leq 102.6 - 2.0$$

$$NTSP \leq 100.6$$

An instrument setting of 95.0 psig will be used for the setpoint. Since this is less than the calculated NTSP, the setpoint is acceptable.

6.5.5 Leave Alone Zone:

Leave Alone Zones are not used at MNGP (Input 4.1).

6.5.6 Establishing As Found Tolerances (AFT):

The upper limit for the As-found tolerance is 118 psig, the Allowable Value. There is no lower limit specified for this setpoint.

An as-found tolerance is calculated to provide limits for use during the surveillance testing:

$$AFT = \sqrt{ALT^2 + AD^2}$$
$$AFT = \sqrt{2.0^2 + 23.0^2}$$
$$AFT = 23.1$$

An as found tolerance ± 22 psig is considered conservative and will be used.

6.5.7 Required Limits Evaluation:

The required limits are considered to be adequate when the following equation is satisfied:

$$AV - NTSP \geq AFT$$
$$118 - 95 \geq 22$$

The equation is satisfied and the setpoint and required limits are adequate.

6.5.8 Spurious Trip Avoidance Evaluation:

The typical methodology for Spurious Trip Avoidance Evaluations is not implemented because of the nature of the setpoint. The setpoint does not cause a scram directly but is rather one of the conditions which need to be satisfied in order for the Reactor Protection System to initiate a scram. Therefore, this section will discuss the spurious enabling of the scram logic during conditions less than the Analytical Limit.

This calculation uses an AL of 25% (EPU) or 28.2% (CLTP) reactor thermal power. Based on channel uncertainties, the setpoint is set lower than this value to ensure the scram bypass signal is deactivated above the AL. The scram bypass signal is deactivated once the setpoint is reached. Therefore, a spurious scram on increasing reactor thermal power could only occur during the conditions between the switch activation and the AL.

As discussed in Section 6.1, the automatic scram bypass signal is reactivated on decreasing reactor power once the pressure switch reset is reached. Due to the deadband of the pressure switches, this bypass signal is always reactivated below the NTSP and AL. Therefore, a spurious scram can occur on decreasing power between the AL and the switch reset. The maximum deadband of the switch is 27 psi (Attachment 2) but has historically been 14 – 16 psi (Input 4.3). As such, the range of pressures at which it is possible to spuriously scram is relatively small and, due to the nature of pressure switches, is impossible to eliminate completely.

The lower as found limit of the pressure switch setpoint is 73 psig. On decreasing reactor power, the lowest condition the bypass signal would remain not active is when the first stage pressure reaches 73 – 27 = 46 psig (since the maximum deadband of the switch is 27 psi). Therefore, below 46 psig the scram bypass signal is always activated.

The as found and as left tolerance limits for the switch reset should be revised to ensure the deadband is not greater than 27 psi. This allows for the setpoint to drift within the As-Found range and ensures the deadband is not more than 27 psi lower than the setpoint.

6.5.9 Elevation Correction:

None.

6.5.10 Determination of Actual Setpoint:

The new setpoint and instrument setting will therefore be as follows:

Setpoint: 95 psig
As-Found Range: 73 to 117 psig
As-Left Range: 93 to 97 psig

Reset:
Maximum Deadband: 27 psig

7. CONCLUSIONS

The results of the calculations are as follows:

Term	Value(psig)	Reference
A_{LT}	6.0	6.2.3
A_{LN}	6.0	6.2.3
D_L	23.0	6.2.4
ALT	2.0	6.2.5
C_L	1.35	6.2.6
PEA	0.0	6.3
PMA	3.8	6.3

Term	Value(psig)	Reference
REA	± 5	6.4
NTSP	95.0	6.5.4
AV	118	6.5.1
AFT	± 22	6.5.6

8. FUTURE NEEDS

Testing should be completed during power ascension following the turbine replacement in order to verify the first stage pressure and reactor thermal power relationship. This document should be updated to reflect the testing results. The readability error in Section 6.4 would no longer be applicable. Plant procedures should be revised to reflect the new setpoint and associated as-found and as-left tolerances.

9. ATTACHMENTS

1 PS-5-14A, B, C and D drift data.

2 Barksdale Catalog Datasheets.

3 GE-MNGP-AEP-196 1st Stage Shell Pressure curve. GE. 1LX0501-07 Rev. 1

4 Memo from John Hess (GE) to Jim Devine (MNGP) dated March 15, 1996.

5 Setpoint Relationships

10. REFERENCES

10.1 NEDC-31336P-A, General Electric Instrument Setpoint Methodology, September 1996.

10.2 GE-NE-901-021-0492, DRF A0001932-1, Setpoint Calculation Guidelines for the Monticello Nuclear Generating Plant, October 1992.

10.3 EPRI Report TR-103335-R1, Guidelines for Instrument Calibration Extension/Reduction Programs, Revision 1, March, 1994.

10.4 Task Report T0502, Nuclear Management Company Monticello Nuclear Generating Plant Extended Power Uprate.

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10.5 USAR-07.06. Monticello Updated Safety Analysis Report. Plant Instrumentation and Control Systems: Plant Protection System. Revision 25P.

10.6 Operations Manual B.05.06. Plant Protection System.

10.7 Generic Letter 91-04, Changes in Technical Specification Surveillance Intervals to Accommodate a 24-Month Fuel Cycle.

A1.1 Data Grouping

The Barksdale model 2T-A12SS pressure switches presented below are included in this analysis. The current setpoints are obtained from the MNGP Component Master List (CML) Database.

Equipment ID	Range	Setpoint (desired)
PS-5-14A	50 – 1200 psig	125 psig
PS-5-14B	50 – 1200 psig	125 psig
PS-5-14C	50 – 1200 psig	125 psig
PS-5-14D	50 – 1200 psig	125 psig

As shown in section 6.2.2, the trip units are exposed to similar environmental conditions with the same calibration frequency. Therefore, the individual drift data for the trip units can be grouped without further numerical testing, following the criteria set forth in step 5.4.8 of ESM-03.02-APP-III.

A1.2 Populating the Spreadsheet

Calibration data for the pressure switches included the date of calibration, as well as the As-Found and As-Left setpoint values. This data was input into a Microsoft Excel spreadsheet, and included in this Attachment.

The calibration interval was determined by taking the difference between the current and previous calibration dates. Per step 5.3.9 of ESM-03.02-APP-III, the calibration interval was converted to months by dividing the number of days by 30.5 days per month.

The Drift value was calculated by taking the difference between the current calibration As-Found value and the previous calibration As-Left value.

Each of the pressure switches contained a discrepancy in its data set. On the calibration dates of 05/12/1996 and 06/11/1996, only the As-Found setpoint value was reported. However, each data set contained a data point for the following day (05/13/1996 and 06/12/1996, respectively) which included the As-Left setpoint value. For the purposes of this drift analysis, each of the data pairs was combined into a single data point which included both the As-Found and As-Left setpoints. This is considered reasonable, as a discrepancy of a single day is insignificant compared to the average calibration interval of approximately 15 months.

It is noted that the calibration setpoint for the pressure switches was adjusted several times during the analysis time period. However, all the pressure switches in question were adjusted uniformly, and the overall difference in setpoints is small compared to the instrument setpoint range (approximately 5%). Since the analysis deals with drift values, and not the setpoints themselves, no special considerations were made for the varying setpoints.

A1.3 Spreadsheet Performance of Basic Statistics

The following information was determined for each instrument individually:

The average or mean value ($\bar{x}$) of the drift data for each instrument was determined by using the "Average" function in Microsoft Excel. This function uses the following equation:

$$\bar{x} = \frac{\sum x_i}{n}$$

where $\bar{x}$ = average of data set
x_i = individual drift value
n = total number of values

The standard deviation of a data set returns the measure of how widely dispersed the values are in relation to the mean of the data. The standard deviation for each instrument was determined using the "STDEV" function. Microsoft Excel uses the following equation in the "STDEV" function:

$$s = \sqrt{\frac{n\sum x_i^2 - \left(\sum x_i\right)^2}{n(n-1)}}$$

where s = standard deviation of sample
x_i = individual drift value
n = total number of values

The variance (s^2) is another measure of data spread from the mean. The variance for each instrument was determined by using the "VAR" function in Microsoft Excel. The variance is calculated as follows:

$$s^2 = \frac{n\sum x_i^2 - \left(\sum x_i\right)^2}{n(n-1)}$$

where s^2 = variance of sample
x_i = individual drift value
n = total number of values

The largest positive drift value for each instrument was determined by using the "MAX" function.

The largest negative drift value for each instrument was determined by using the "MIN" function.

The number of data points (n) for each instrument was determined using the "COUNT" function.

The psig values for average, standard deviation, and largest positive and negative drift were converted to a percent of instrument span using the following formula:

$$\%\ \text{span} = \frac{\text{psig value}}{\text{psig span}} \times 100\%$$

A Drift Trend Plot was developed for each instrument by plotting the drift value versus calibration date. Bounds corresponding to ± 2s (2 standard deviations) are shown on the plot.

Page 11 presents the combined drift data statistics for the subject trip units. The combined statistics were determined using the preceding methods.

A1.4 Outlier Detection and Expulsion

Per step 5.5 of ESM-03.02-APP-III, the t-Test is used to detect the presence of outliers in the final data set. The t-Test requires the use of the following equation:

$$t = \frac{|x_i - \bar{x}|}{s}$$

where t = individual t-Test statistic
s = standard deviation of sample
x_i = individual drift value
$\bar{x}$ = individual drift value

The t-Test involves calculating the individual 't' statistics for each data point, and comparing them to a critical value. The critical value depends on the sample size, and is obtained from Table 9.2 of ESM-03.02-APP-III.

The t-Test is shown on pages 12 and 13 of this Attachment. Based on a sample size of 44, the critical value utilized in the t-Test is 2.91. None of the calculated individual t-Test statistics exceeded the critical value and therefore, no outliers were identified or removed.

A1.5 Normality Tests

Most statistical analyses make the assumption that the values in question are normally distributed. The criteria in ESM-03.02-APP-III require that the data set be tested for normality. It is recommended that for samples with less than 50 data points, the W Test be utilized.

<u>W Test</u>
The W Test calculates a test statistic value for the sample population and compares the calculated value to the critical values for W, which are tabulated in Table 9.6 of ESM-03.02-APP-III. The W Test is a lower-tailed test. Thus if the calculated value of W is less than the critical value of W, the assumption of normality would be rejected at the stated significance level. If the calculated value of W is larger than the critical value of W, there is no evidence to reject the assumption of normality.

To perform a W Test, the drift value data set is sorted and numbered in ascending order from smallest to largest.

Calculate the S^2 value for the group:

$$S^2 = (n-1) \times s^2$$

where S^2 = sum of the squares about the mean
s^2 = unbiased estimate of the sample population variance
n = total number of data points

Calculate the quantity b of the sample group:

$$b = \sum \left[a_{n-i+1} \times \left(x_{n-i+1} - x_i \right) \right]$$

where i = 1 to k, and k = n/2 if n is even or k = (n-1)/2 if n is odd
n = total number of data points
x_i = individual sample data point
a_{n-i+1} = coefficient obtained from Table 9.5 of ESM-03.02-APP-III

Calculate the W value for the sample group. The following equation is used:

$$W = \frac{b^2}{S^2}$$

Determine the critical W values based on the sample size using Table 9.6 in ESM-03.02-APP-III.

See pages 14 and 15 for the W Test of the drift data. For a sample size of 44, the critical value of the W Test is 0.944. The calculated W value was 0.982. Based on this result, there is no evidence to reject the assumption of normality.

A1.6 Selection of Final Data Set

The pressure switches in question have only one calibration setpoint. Therefore, all data points will be part utilized and no further analysis is required in determining the final data set.

A1.7 Time-Dependency Analysis

Standard statistical analyses do not consider time-dependency. The following tests attempt to uncover any time-related performance and the impact of any time-dependency on the analysis.

<u>Drift Interval Plot</u>
A drift interval plot is an XY scatter plot that shows the data set plotted against the time interval between calibrations. It relies on visual inspection to discriminate the plot for any trend in the data to exhibit a time dependency. A prediction line can be added to this plot to aid in the analysis.

Page 16 shows the drift interval plot for this data set. The drift interval plot includes the tolerance interval (TI) described in section A1.9. The plot also includes a predicted line, which in this case passes through the x-axis. Based on section 4.8.4.D.4 of ESM-03.02-APP-III, cases where the drift function crosses zero are normally established assuming no time dependency.

Standard Deviations and Means at Different Calibration Intervals (Binning Analysis)
The binning analysis is the most recommended method of determining time dependent tendencies in a given sample pool. Following the instructions in step 4.8.3 of ESM-03.02-APP-III, the drift data was segregated into different groups (bins) corresponding to different ranges of calibration intervals. In order for further analysis to be done, at least 2 valid bins must exist. In order to be considered valid, a bin must contain more than five data points and more than 10% of the total data count. The binning analysis (pages 17-18) includes 3 valid bins.

The average drift, standard deviations and average time intervals were calculated for each bin. These parameters were plotted on page 18. This plot shows the variation of the bin averages and standard deviations versus time interval. The behavior of the plot indicates no time dependency, following the criteria of step 4.8.4.D.4 of ESM-03.02-APP-III.

Regression Analysis

A regression analysis was performed on the drift data, as well as the absolute value of the drift data. This analysis is shown on pages 19 through 22.

The results of the regression analysis were compared to the criteria of step 4.8.4 from ESM-03.02-APP-III. The analytical results indicate no time dependency. However, per the instruction of step 5.8.3.E, the data will be conservatively considered to be moderately time dependent.

A1.8 Drift Bias Determination

The absolute value of the average calculated drift for the trip pressure switches is 0.2 psig, which is approximately equal to 0.02% of the calibrated span. The criteria in ESM-03.02-APP-III state that if the absolute value of the mean drift is less than 0.1% of the calibrated span, the instrument drift does not appear to have a bias. Therefore, the drift bias terms will be taken as 0 in this analysis.

A1.9 Analyzed Drift Value

Bias Term
Based on the drift data as well as section A1.8, the instruments do not have a bias. Therefore, the bias term will be equal to 0.

Random Term
The random term of the analyzed drift value is calculated with the below equation:

$$AD_{random} = s \times TIF \times NAF$$

where AD_{random} = random term for analyzed drift
s = drift standard deviation
TIF = 95%/95% tolerance interval factor
NAF = Normality Adjustment Factor

The standard deviation of the drift data is equal to 8.34 psig. The TIF for a sample size of 44 is equal to 2.445 (Table 9.1 of ESM-03.02-APP-III). Since the W Test did not reject the hypothesis of normality, a Normality Adjustment Factor was not necessary and is therefore equal to 1. Thus, the random drift term is calculated to be 20.4 psig. The random term is equal to the tolerance interval (TI) plotted on the Drift Interval Plot on page 16.

Extended Interval Predicted Drift (Random Term)
Since the drift was determined to be moderately time dependent, the following equation was used to extrapolate the drift uncertainty:

$$AD_{E.random} = AD_{random} \times \sqrt{\frac{CI_E}{CI_O}}$$

where $AD_{E.random}$ = extended period drift term
AD_{random} = random term for analyzed drift
CI_E = extended calibration interval (surveillance interval +25%)
CI_O = average observed calibration time interval from bin with longest time interval

The value of the random term for the analyzed drift was determined to be 20.4 psig. The extended calibration interval is equal to the surveillance calibration interval (24 months) plus an additional 25% (6 months). Therefore, CI_E is equal to 30 months. CI_O is determined from the bin of data that had the longest calibration interval. In this case, it is the bin with a calibration interval range of 22.5 to 30 months. The average calibration interval within this bin is equal to 23.6 months. These values produce a 30-month predicted drift term of 23.0 psig from the above equation.

The instruction in step 5.10.4.B states that the calculated extended interval predicted drift terms must be compared to the uncertainty calculated using the 99%/95% tolerance factor. The following equation is utilized to increase the TIF.

$$AD_{E.random} = AD_{random} \times \frac{TIF_{99/95}}{TIF_{95/95}}$$

where $AD_{E.random}$ = extended period drift term
AD_{random} = random term for analyzed drift
$TIF_{95/95}$ = 95%/95% tolerance interval factor
$TIF_{99/95}$ = 99%/95% tolerance interval factor

Using the random drift term of 20.4 psig, a 95%/95% TIF of 2.445 and a 99%/95% TIF of 2.677, the extended period drift term is calculated to be 22.3 psig. Therefore, 23.0 psig is the larger of the two and should be used as the 30-month predicted drift term.

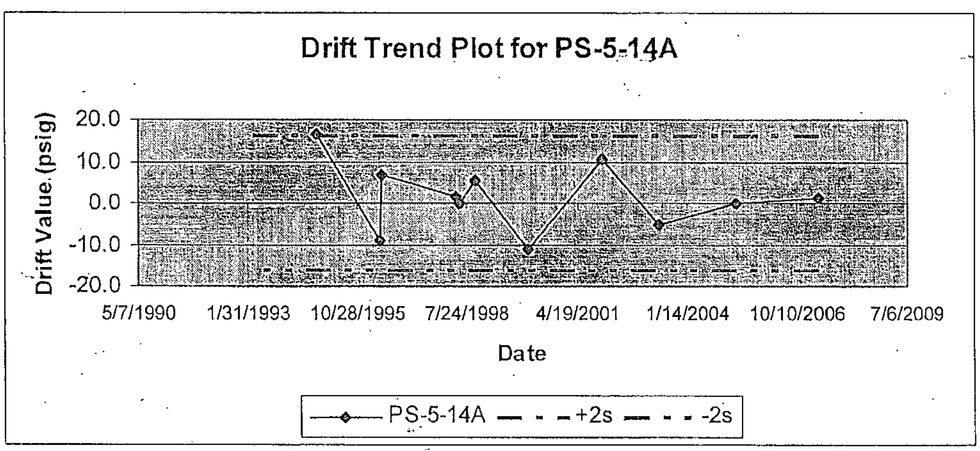
Drift Data for PS-5-14A

Date	Calibration Interval (Months)	As-Found	As-Left	Drift (psig)	Drift (%)
4/22/2007	24.4	127.8	124.6	1.3	0.11
4/9/2005	22.8	126.5	126.5	0.0	0.00
5/14/2003	17.3	120.5	126.5	-5.0	-0.43
12/2/2001	21.8	134.5	125.5	10.5	0.91
2/5/2000	16.1	114.0	124.0	-11.0	-0.96
10/1/1998	4.4	120.0	125.0	5.5	0.48
5/21/1998	1.1	139.5	114.5	0.0	0.00
4/16/1998	22.1	139.5	139.5	1.5	0.13
6/12/1996	1.0	137.0	138.0	7.0	0.61
5/13/1996	18.7	166.0	130.0	-9.0	-0.78
10/20/1994	19.9	191.0	175.0	16.5	1.43
2/20/1993		174.5	174.5		

Basic Statistics for PS-5-14A

Average	$\bar{x}$	(psig)	1.6
Standard Deviation	s	(psig)	8.2
Variance	s^2	(psig)	66.5
Largest Positive Drift		(psig)	16.5
Largest Negative Drift		(psig)	-11.0
Number of Samples	n		11

Average	$\bar{x}$	(%)	0.14
Standard Deviation	s	(%)	0.7094
Largest Positive Drift		(%)	1.43
Largest Negative Drift		(%)	-0.96



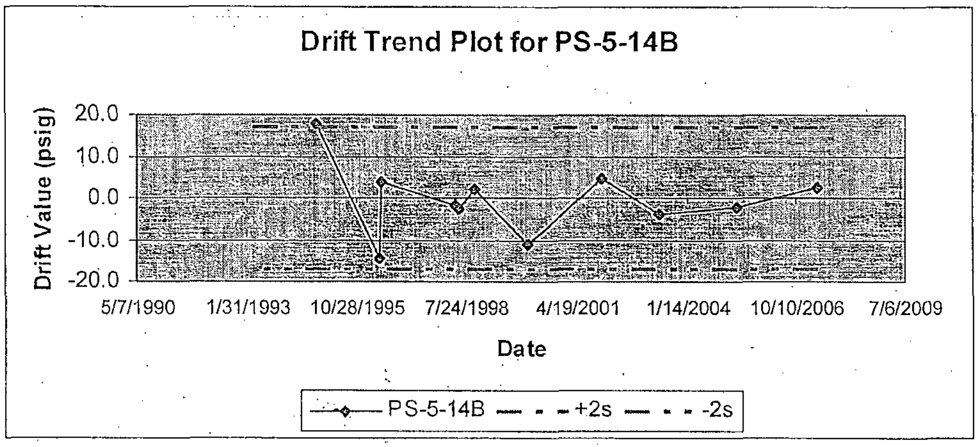
Drift Data for PS-5-14B

Date	Calibration Interval (Months)	As-Found	As-Left	Drift (psig)	Drift (%)
4/22/2007	24.4	128.5	126.3	2.5	0.22
4/9/2005	22.8	122.0	126.0	-2.0	-0.17
5/14/2003	17.3	122.0	124.0	-4.0	-0.35
12/2/2001	21.8	129.5	126.0	4.5	0.39
2/5/2000	16.1	114.0	125.0	-11.0	-0.96
10/1/1998	4.4	118.0	125.0	2.0	0.17
5/21/1998	1.1	134.0	116.0	-2.5	-0.22
4/16/1998	22.1	136.5	136.5	-1.5	-0.13
6/12/1996	1.0	134.0	138.0	4.0	0.35
5/13/1996	18.7	160.5	130.0	-14.5	-1.26
10/20/1994	19.9	193.0	175.0	18.0	1.57
2/20/1993		171.0	175.0		

Basic Statistics for PS-5-14B

Average	$\bar{x}$	(psig)	-0.4
Standard Deviation	s	(psig)	8.5
Variance	s^2	(psig)	72.8
Largest Positive Drift		(psig)	18.0
Largest Negative Drift		(psig)	-14.5
Number of Samples	n		11

Average	$\bar{x}$	(%)	-0.04
Standard Deviation	s	(%)	0.7421
Largest Positive Drift		(%)	1.57
Largest Negative Drift		(%)	-1.26



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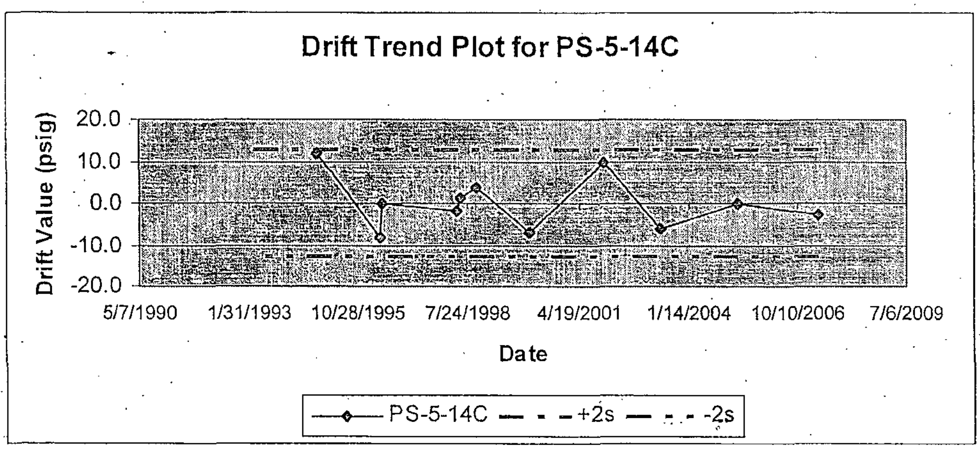
Drift Data for PS-5-14C

Date	Calibration Interval (Months)	As-Found	As-Left	Drift (psig)	Drift (%)
4/22/2007	24.4	123.1	126.3	-2.4	-0.21
4/9/2005	22.8	125.5	125.5	0.0	0.00
5/14/2003	17.3	119.0	125.5	-6.0	-0.52
12/2/2001	21.8	134.0	125.0	10.0	0.87
2/5/2000	16.1	119.0	124.0	-7.0	-0.61
10/1/1998	4.4	119.0	126.0	4.0	0.35
5/21/1998	1.1	137.8	115.0	1.3	0.11
4/16/1998	22.1	136.5	136.5	-1.6	-0.14
6/12/1996	1.0	129.5	138.1	0.0	0.00
5/13/1996	18.7	167.5	129.5	-8.0	-0.70
10/20/1994	19.9	187.0	175.5	12.0	1.04
2/20/1993		166.0	175.0		

Basic Statistics for PS-5-14C

Average	$\bar{x}$	(psig)	0.2
Standard Deviation	s	(psig)	6.5
Variance	s^2	(psig)	41.9
Largest Positive Drift		(psig)	12.0
Largest Negative Drift		(psig)	-8.0
Number of Samples	n		11

Average	$\bar{x}$	(%)	0.02
Standard Deviation	s	(%)	0.5626
Largest Positive Drift		(%)	1.04
Largest Negative Drift		(%)	-0.70



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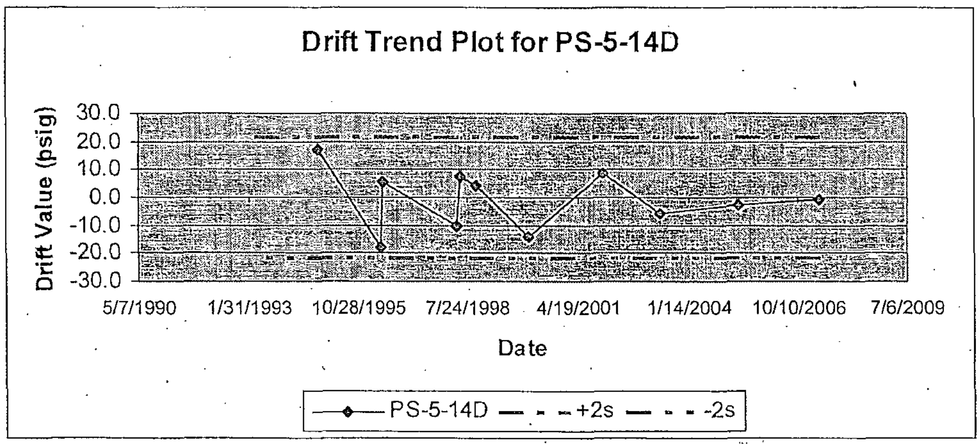
Drift Data for PS-5-14D

Date	Calibration Interval (Months)	As-Found	As-Left	Drift (psig)	Drift (%)
4/22/2007	24.4	122.3	124.8	-0.7	-0.06
4/9/2005	22.8	123.0	123.0	-2.5	-0.22
5/14/2003	17.3	119.5	125.5	-6.0	-0.52
12/2/2001	21.8	133.8	125.5	8.8	0.77
2/5/2000	16.1	110.0	125.0	-14.0	-1.22
10/1/1998	4.4	118.0	124.0	4.5	0.39
5/21/1998	1.1	145.0	113.5	7.5	0.65
4/16/1998	22.1	127.0	137.5	-10.0	-0.87
6/12/1996	1.0	135.0	137.0	5.5	0.48
5/13/1996	18.7	156.0	129.5	-18.0	-1.57
10/20/1994	19.9	193.5	174.0	17.5	1.52
2/20/1993		169.0	176.0		

Basic Statistics for PS-5-14D

Average	$\overline{x}$	(psig)	-0.7
Standard Deviation	s	(psig)	10.7
Variance	s^2	(psig)	114.8
Largest Positive Drift		(psig)	17.5
Largest Negative Drift		(psig)	-18.0
Number of Samples	n		11

Average	$\overline{x}$	(%)	-0.06
Standard Deviation	s	(%)	0.9318
Largest Positive Drift		(%)	1.52
Largest Negative Drift		(%)	-1.57



Basic Statistics for Combined Drift Data

Average	$\bar{x}$	(psig)	0.2
Standard Deviation	s	(psig)	8.34
Variance	s^2	(psig)	69.6
Largest Positive Drift		(psig)	18.0
Largest Negative Drift		(psig)	-18.0
Number of Samples	n		44

Average	$\bar{x}$	(%)	0.02
Standard Deviation	s	(%)	0.7256
Largest Positive Drift		(%)	1.57
Largest Negative Drift		(%)	-1.57

Outlier Test (t-Test) for Combined Data Set

Equipment ID	Calibration Interval (Months)	Drift (psig)	T	Outlier? YES/NO
PS-5-14A	24.4	1.3	0.13	NO
	22.8	0.0	0.02	NO
	17.3	-5.0	0.62	NO
	21.8	10.5	1.24	NO
	16.1	-11.0	1.34	NO
	4.4	5.5	0.64	NO
	1.1	0.0	0.02	NO
	22.1	1.5	0.16	NO
	1.0	7.0	0.82	NO
	18.7	-9.0	1.10	NO
	19.9	16.5	1.96	NO
PS-5-14B	24.4	2.5	0.28	NO
	22.8	-2.0	0.26	NO
	17.3	-4.0	0.50	NO
	21.8	4.5	0.52	NO
	16.1	-11.0	1.34	NO
	4.4	2.0	0.22	NO
	1.1	-2.5	0.32	NO
	22.1	-1.5	0.20	NO
	1.0	4.0	0.46	NO
	18.7	-14.5	1.76	NO
	19.9	18.0	2.14	NO
PS-5-14C	24.4	-2.4	0.31	NO
	22.8	0.0	0.02	NO
	17.3	-6.0	0.74	NO
	21.8	10.0	1.18	NO
	16.1	-7.0	0.86	NO
	4.4	4.0	0.46	NO
	1.1	1.3	0.13	NO
	22.1	-1.6	0.21	NO
	1.0	0.0	0.02	NO
	18.7	-8.0	0.98	NO
	19.9	12.0	1.42	NO
PS-5-14D	24.4	-0.7	0.10	NO
	22.8	-2.5	0.32	NO
	17.3	-6.0	0.74	NO
	21.8	8.8	1.03	NO
	16.1	-14.0	1.70	NO
	4.4	4.5	0.52	NO
	1.1	7.5	0.88	NO
	22.1	-10.0	1.22	NO

	1.0	5.5	0.64	NO
	18.7	-18.0	2.18	NO
	19.9	17.5	2.08	NO

The outlier test shows that none of the individual T-statistics exceed the critical value of 2.91. The critical value was obtained from Table 9.2 of ESM-03.02-APP-III. Therefore, the data set contains no outliers.

Normality Test – W Test

x_i	i	a_{n-i+1}	x_{n-i+1}	b_i
-18.0	1	0.3872	18.0	13.94
-14.5	2	0.2667	17.5	8.53
-14.0	3	0.2323	16.5	7.09
-11.0	4	0.2072	12.0	4.77
-11.0	5	0.1868	10.5	4.02
-10.0	6	0.1695	10.0	3.39
-9.0	7	0.1542	8.8	2.74
-8.0	8	0.1405	7.5	2.18
-7.0	9	0.1278	7.0	1.79
-6.0	10	0.1160	5.5	1.33
-6.0	11	0.1049	5.5	1.21
-5.0	12	0.0943	4.5	0.90
-4.0	13	0.0842	4.5	0.72
-2.5	14	0.0745	4.0	0.48
-2.5	15	0.0651	4.0	0.42
-2.4	16	0.0560	2.5	0.27
-2.0	17	0.0471	2.0	0.19
-1.6	18	0.0383	1.5	0.12
-1.5	19	0.0296	1.3	0.08
-0.7	20	0.0211	1.3	0.04
0.0	21	0.0126	0.0	0.00
0.0	22	0.0042	0.0	0.00
0.0	---	---	---	---
0.0	---	---	---	---
1.3	---	---	---	---
1.3	---	---	---	---
1.5	---	---	---	---
2.0	---	---	---	---
2.5	---	---	---	---
4.0	---	---	---	---
4.0	---	---	---	---
4.5	---	---	---	---
4.5	---	---	---	---
5.5	---	---	---	---
5.5	---	---	---	---
7.0	---	---	---	---
7.5	---	---	---	---
8.8	---	---	---	---
10.0	---	---	---	---
10.5	---	---	---	---
12.0	---	---	---	---

16.5	---	---	---	---
17.5	---	---	---	---
18.0	---	---	---	---

W Test Analysis

n	44
S²	2993.8
b, Σ(bi)	54.2
W	0.982
P	0.944

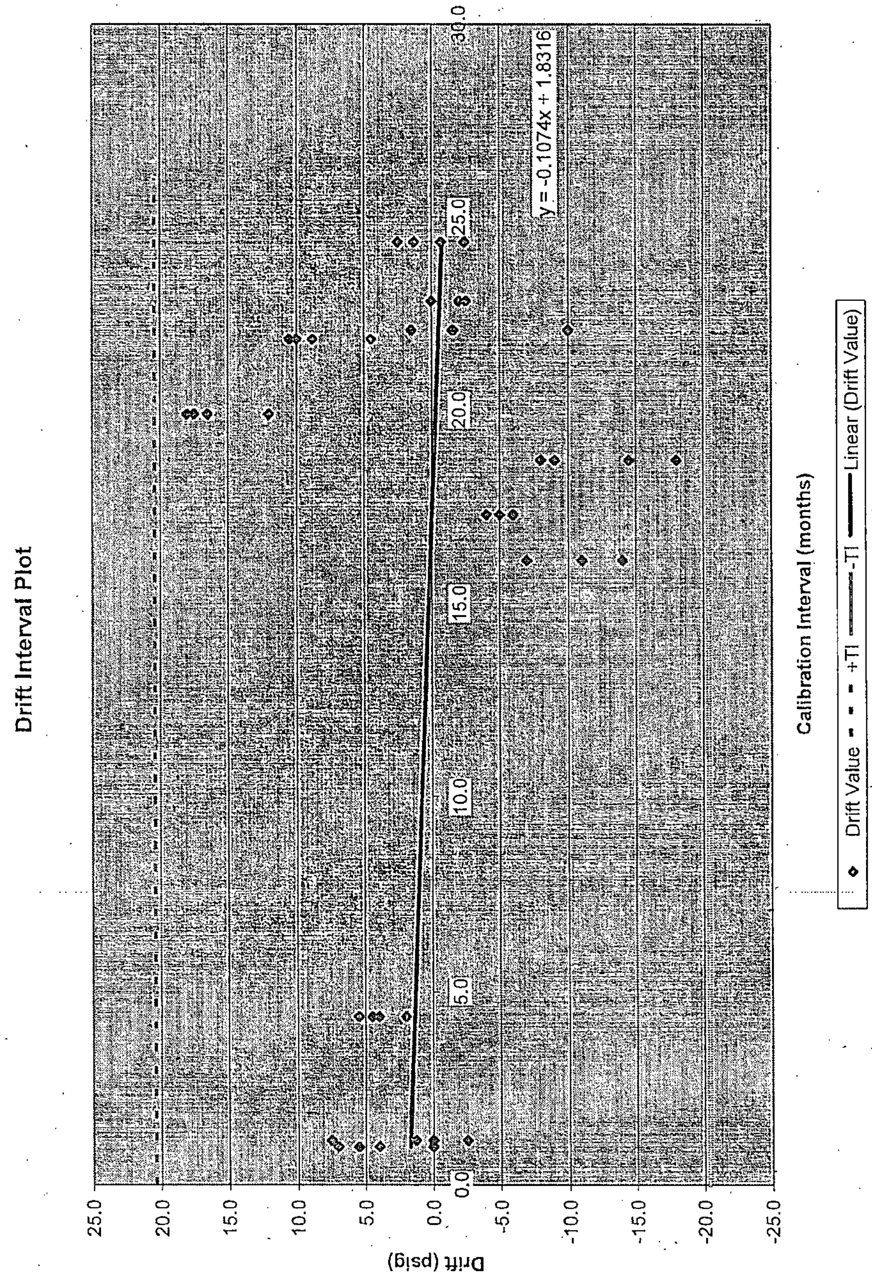
Since W > P, the results of the W Test do not provide any evidence to reject the assumption of normality.

Drift Tolerance Interval (TI)

TI = s * TIF * NAF

s	=	8.344031
TIF	=	2.445
NAF	=	1
TI	=	20.40

Time Dependency Testing – Drift Interval Plot



Time Dependency Testing – Binning Analysis

1		2		3		4		5		6	
0 to 1.25 months		> 1.25 to 3.75 months		> 3.75 to 7.5 months		> 7.5 to 15.0 months		> 15 to 22.5 months		> 22.5 to 30 months	
CI (Months)	Drift (psig)	CI (Months)	Drift (psig)	CI (Months)	Drift (psig)	CI (Months)	Drift (psig)	CI (Months)	Drift (psig)	CI (Months)	Drift (psig)
1.1	0.0			4.4	5.5			17.3	-5.0	24.4	1.3
1.0	7.0			4.4	2.0			21.8	10.5	22.8	0.0
1.1	-2.5			4.4	4.0			16.1	-11.0	24.4	2.5
1.0	4.0			4.4	4.5			22.1	1.5	22.8	-2.0
1.1	1.3							18.7	-9.0	24.4	-2.4
1.0	0.0							19.9	16.5	22.8	0.0
1.1	7.5							17.3	-4.0	24.4	-0.7
1.0	5.5							21.8	4.5	22.8	-2.5
								16.1	-11.0		
								22.1	-1.5		
								18.7	-14.5		
								19.9	18.0		
								17.3	-6.0		
								21.8	10.0		
								16.1	-7.0		
								22.1	-1.6		
								18.7	-8.0		
								19.9	12.0		
								17.3	-6.0		
								21.8	8.8		
								16.1	-14.0		
								22.1	-10.0		
								18.7	-18.0		
								19.9	17.5		

Bin #	Bin Range (months)	Count	% of Total Data	Valid? YES/NO
1	0 to 1.25	8	18.2	YES
2	> 1.25 to 3.75	0	0.0	NO
3	> 3.75 to 7.5	4	9.1	NO
4	> 7.5 to 15.0	0	0.0	NO
5	> 15 to 22.5	24	54.5	YES
6	> 22.5 to 30	8	18.2	YES

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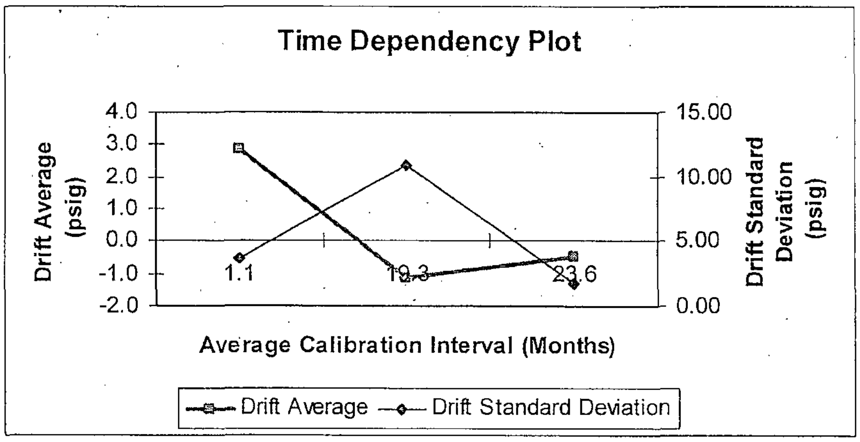
Time Dependency Testing – Binning Analysis, continued

Bin #	Drift Average	Drift Standard Deviation	Average CI	Data Count
1	2.9	3.67	1.1	8
2	---	---	---	0
3	4.0	1.47	4.4	4
4	---	---	---	0
5	-1.1	10.85	19.3	24
6	-0.5	1.80	23.6	8



Time Dependency Testing – Regression Analysis
(Final Data Set)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.110327
R Square	0.012172
Adjusted R Square	-0.01135
Standard Error	8.391239
Observations	44

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*	*Fcrit*
Regression	1	36.44073	36.44073	0.517529	0.475882	3.417947
Residual	42	2957.342	70.4129			
Total	43	2993.783				

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	1.831605	2.627369	0.697125	0.489565	-3.47064	7.13385	-3.47064	7.13385
X Variable 1	-0.10742	0.14932	-0.7194	0.475882	-0.40876	0.19392	-0.40876	0.19392

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	-0.78522	2.085216
2	-0.61968	0.619684
3	-0.02799	-4.97201
4	-0.51402	11.01402
5	0.098797	-11.0988
6	1.363183	4.136817
7	1.708336	-1.70834
8	-0.53868	2.038678
9	1.725946	5.274054
10	-0.17944	-8.82056
11	-0.30623	16.80623
12	-0.78522	3.285216
13	-0.61968	-1.38032
14	-0.02799	-3.97201
15	-0.51402	5.014025
16	0.098797	-11.0988
17	1.363183	0.636817

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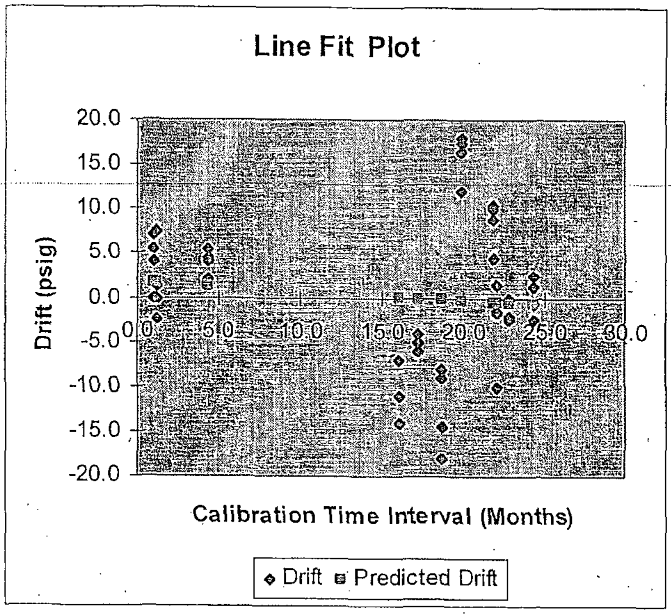
18	1.708336	-4.20834
19	-0.53868	-0.96132
20	1.725946	2.274054
21	-0.17944	-14.3206
22	-0.30623	18.30623
23	-0.78522	-1.61478
24	-0.61968	0.619684
25	-0.02799	-5.97201
26	-0.51402	10.51402
27	0.098797	-7.0988
28	1.363183	2.636817
29	1.708336	-0.40834
30	-0.53868	-1.06132
31	1.725946	-1.72595
32	-0.17944	-7.82056
33	-0.30623	12.30623
34	-0.78522	0.085216
35	-0.61968	-1.88032
36	-0.02799	-5.97201
37	-0.51402	9.314025
38	0.098797	-14.0988
39	1.363183	3.136817
40	1.708336	5.791664
41	-0.53868	-9.46132
42	-1.725946	3.774054
43	-0.17944	-17.8206
44	-0.30623	17.80623



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Time Dependency Testing – Regression Analysis
(Absolute Values of Final Data Set)

SUMMARY OUTPUT

Regression Statistics	
Multiple R	0.181127
R Square	0.032807
Adjusted R Square	0.009779
Standard Error	5.255246
Observations	44

ANOVA

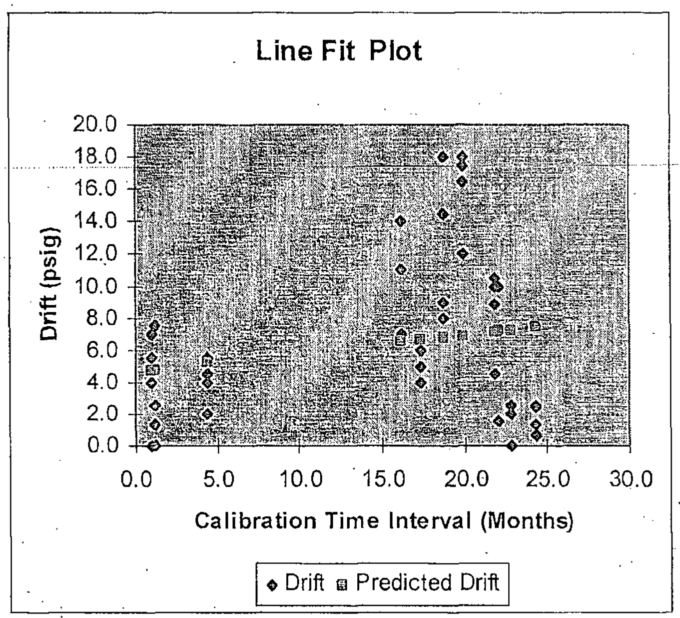
	df	*SS*	*MS*	*F*	*Significance F*	*Fcrit*
Regression	1	39.34483	39.34483	1.424629	0.239342	3.417947
Residual	42	1159.939	27.61761			
Total	43	1199.284				

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	4.667286	1.645462	2.836459	0.006991	1.346609	7.987963	1.346609	7.987963
X Variable 1	0.111618	0.093516	1.193578	0.239342	-0.0771	0.300341	-0.0771	0.300341

RESIDUAL OUTPUT

Observation	*Predicted Y*	*Residuals*
1	7.386381	-6.08638
2	7.214379	-7.21438
3	6.599563	-1.59956
4	7.10459	3.39541
5	6.467817	4.532183
6	5.154015	0.345985
7	4.795373	-4.79537
8	7.130208	-5.63021
9	4.777075	2.222925
10	6.756927	2.243073
11	6.888673	9.611327
12	7.386381	-4.88638
13	7.214379	-5.21438
14	6.599563	-2.59956
15	7.10459	-2.60459
16	6.467817	4.532183
17	5.154015	-3.15401
18	4.795373	-2.29537

19	7.130208	-5.63021
20	4.777075	-0.77707
21	6.756927	7.743073
22	6.888673	11.11133
23	7.386381	-4.98638
24	7.214379	-7.21438
25	6.599563	-0.59956
26	7.10459	2.89541
27	6.467817	0.532183
28	5.154015	-1.15401
29	4.795373	-3.49537
30	7.130208	-5.53021
31	4.777075	-4.77707
32	6.756927	1.243073
33	6.888673	5.111327
34	7.386381	-6.68638
35	7.214379	-4.71438
36	6.599563	-0.59956
37	7.10459	1.69541
38	6.467817	7.532183
39	5.154015	-0.65401
40	4.795373	2.704627
41	7.130208	2.869792
42	4.777075	0.722925
43	6.756927	11.24307
44	6.888673	10.61133



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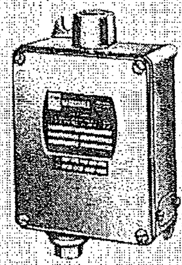
Transamerica Delaval

TRANSAMERICA DELAVAL INC., BARKSDALE CONTROLS DIVISION 5125 Alcoa Avenue, Los Angeles, California 90058

Housed Bourdon Tube Models
Water-Tight Housing (NEMA 4)
and Terminal Strip
Tamper-proof External Adjustment



B1T SINGLE SETTING B2T DUAL CONTROL

OPERATING CHARACTERISTICS • ORDERING DATA

PRESSURE SWITCHES — All values given in P.S.I. (Gauge)

Proof (Test) Pressure	Adjustable Range				Approx. Actuation Value (Differential)	Wetted Material*	B1T Catalog Number	B2T Catalog Number
	Decreasing		Increasing					
	Min.	Max.	Min.	Max.				
1800	50	1180	70	1200	10 to 20	Bronze	B1T-H12	B2T-H12
1800	50	1173	77	1200	11 to 27	316	B1T-A12SS	B2T-A12SS
4800	160	3170	190	3200	15 to 30	Bronze	B1T-H32	B2T-H32
4800	160	3161	199	3200	16 to 39	316	B1T-H32SS	B2T-H32SS
7200	240	4715	325	4800	40 to 85	316	B1T-A48SS	B2T-A48SS
**9750	325	6385	440	6500	54 to 115	316	B1T-A65SS	B2T-A65SS
**18000	600	11450	1150	12000	275 to 550	316	B1T-A120SS	B2T-A120SS
**24000	600	17450	1150	18000	275 to 550	316	B1T-A180SS	B2T-A180SS
Approximate shipping weight lbs.							2.5	2.5

*"Bronze" represents Phosphor Bronze Tube with SAE 88 Brass Socket
"316" represents 316 Stainless Steel Tube & Socket
**"AMINCO" female opening for 1/4" OD tube connection. To change -A65SS and -A120SS switches to 1/4" npt, add -P4 suffix to model number. Price addition required.

DETAIL DATA

ELECTRICAL CHARACTERISTICS: All models incorporate Underwriters' Laboratories, Inc. listed single pole double throw snap-action switching elements. Electrical rating (continuous inductive) 10 amps 125 or 250 volts AC, 3 amps 480 volts AC. Automatically reset by snap-action of switch. For more details and other switch classes, see pages 34-36.

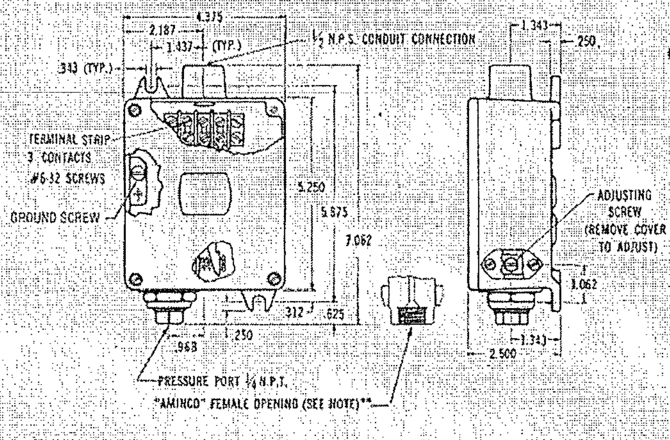
ELECTRICAL CONNECTION: To screw terminals on covered terminal strip through 1/2"nps conduit connector.

PRESSURE CONNECTION: 1/4" N.P.T. internal thread, except as noted**, models with Proof Pressures above 8,000 P.S.I. have "AMINCO" female opening for 1/4" O.D. tube connection.

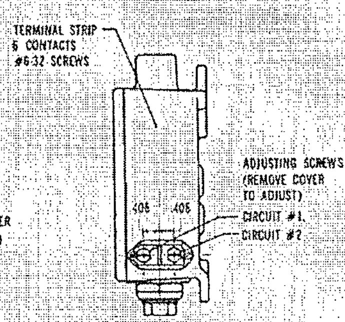
ADJUSTMENT INSTRUCTIONS
Turn adjustment screw clockwise to lower actuation point (switch setting).

WIRE CODING — PRESSURE
Circuit #1: Common — Purple
Normally Closed — Blue
Normally Open — Red
Circuit #2: Common — Brown
Normally Closed — Orange
Normally Open — Yellow

B1T



B2T



Note: All other dimensions for B2T are the same as B1T (left).

Pressure Switch Products

B1S, B2S, B1T, B2T Pressure Switch

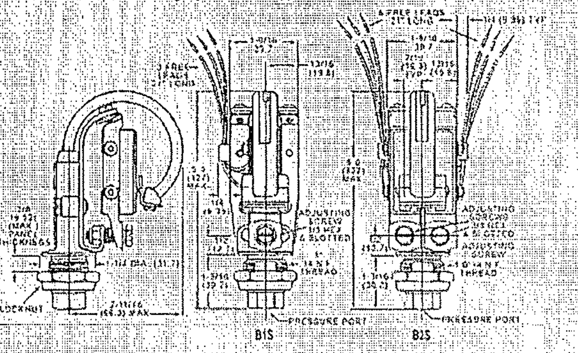
Electrical Characteristics	All models incorporate Underwriters Laboratories, Inc. and CSA Listed single pole double throw snap-action switching elements.
Performance Characteristics	
Accuracy	± 0.5% of the adjustable range
Switch	
Type	SPDT Snap Action; single or dual circuit
Rating	10 Amp @ 125/250 VAC 3 Amp @ 480 VAC 0.5 Amp @ 24 VDC
Physical	
Shipping Weight	
Stripped Model	1.5 lbs. approximate
Housed Model	2.5 lbs. approximate
Wetted Parts	
Process Fitting & Bourdon Tube	316 Series Stainless Steel
Enclosure	Anodized Aluminum
Ratings	
Stripped Model	NEMA 4
Housed Model	NEMA 1
Pressure Connection	Housed models with proof pressure up to 7,200 psi and stripped models with proof pressure up to 6,000 psi; 1/4" NPT Female; All higher pressure ranges: Superpressure Fitting for 1/4" NPT tube.
Electrical Connection	
Stripped	21" Free Leads
Housed	Internal terminal strip via conduit connection

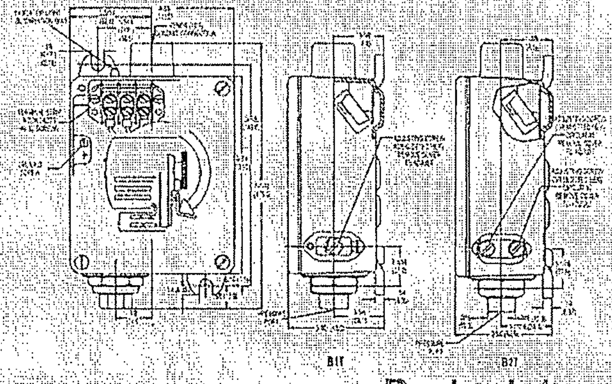
Approvals	
UL	Available upon request (consult factory)
CSA	Available upon request (consult factory)
Environmental	
Temperature Range	
Operating	-20° to +165°F (-29° to +74 °C)
Storage	-40° to +200°F (-40° to +93 °C)
Adjustment Instructions	Turn adjustment screw clockwise to lower setpoint, counterclockwise to raise setpoint

Wiring Code		
Lead	**Circuit 1**	**Circuit 2**
Normally Closed	Blue	Orange
Common	Purple	Brown
Normally Open	Red	Yellow

Consult Factory for These Options

- NEMA 4X
- Temperature stabilization and pre-cycle
- Cleaned for Oxygen Service
- Indicator light (UL and CSA approval not available on this option)





Barksdale
CONTROL PRODUCTS

NORTHERN STATES POWER CORPORATION
LOW PRESSURE TURBINE RETROFIT PROJECT
SEQUENTIAL CORRESPONDENCE

CA 96-054 Rev. 3
Attachment 3
Page 1 of 1

March 15, 1996 — Total Pages Sent: 1

NSP Project Team	
To:	
Gary Gunther FAX # 612-295-1662	Jeff Tollefson FAX # 612-295-1017
Jim Devine FAX # 612-295-1662	

GE Project Team	
Copy:	
Mark Peterson FAX # 612-542-0355	Cal Lochman 518-385-9395
Becki Meadows FAX # 518-385-9395	Bob Hottiger 518-385-9395
Jim Bounds FAX # 612-295-1662	John Panzer 518-385-9395
Randy Carding FAX #612-295-1662	

Subject: SEQUENTIAL CORRESPONDENCE — GE/NSP JH-2012

From: John Hess — Bldg. 55 - Rm. 213
1 River Road — Tel: 518-385-4141
Schenectady, NY 12345 — Fax: 518-385-4279

Jim Devine,

Reference Jim Devine's letter dated January 10, 1996 —
Monticello Nuclear Generating Plant — E-94Q135B HP/LP Turbine Replacement
First Stage Pressure Set Point at 45% Power — SFLM-4144, Revision 1

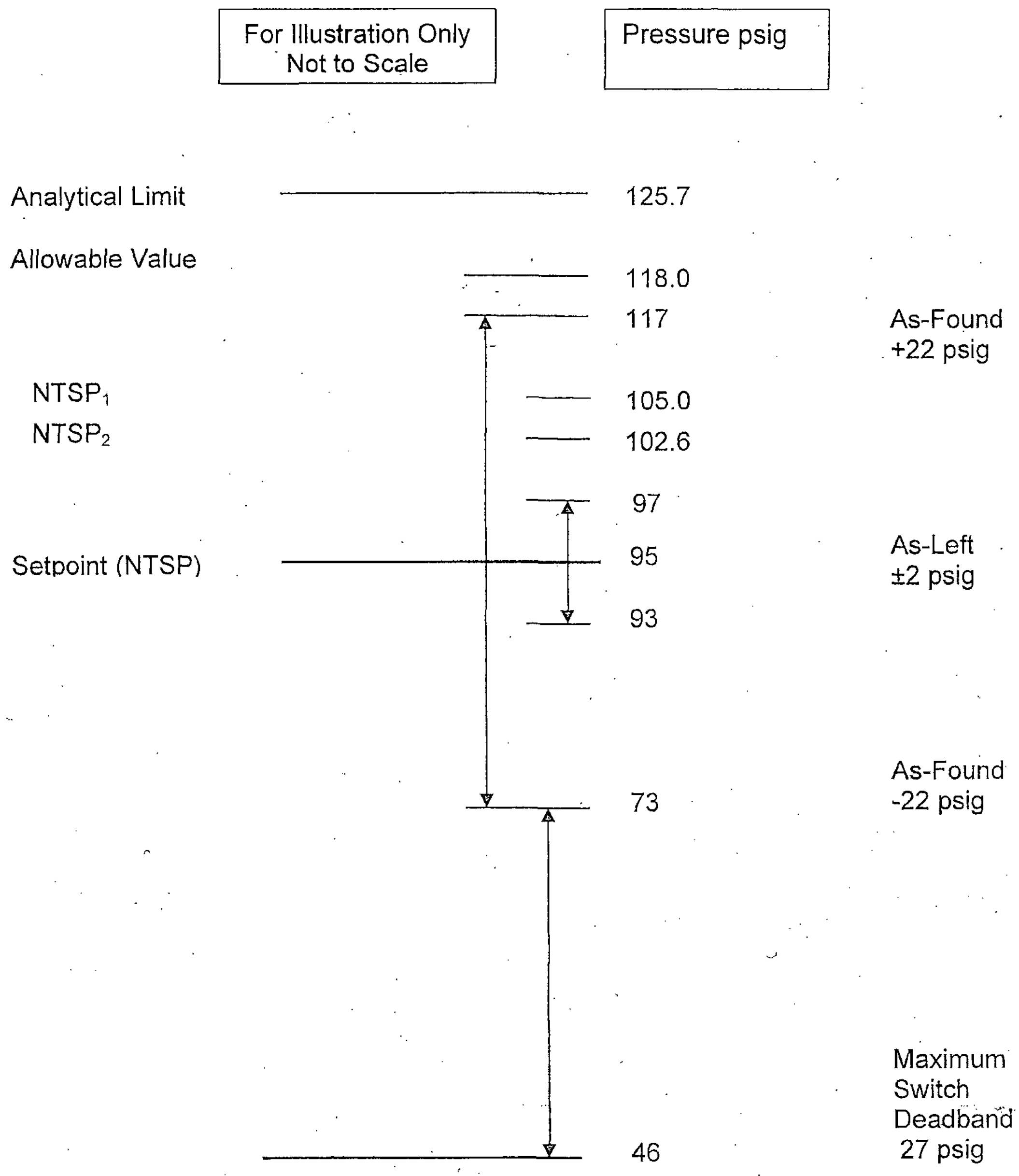
GE Engineer Larry French has reviewed your request and provides the following information: The calculated turbine bowl pressure (turbine inlet after stop and control valves) is 223.7 psia. This is based upon the 30% reactor power data provided by PT Tran of GE Nuclear. For these same "30%" conditions, the first stage shell pressure (between 1st stage buckets & 2nd stage diaph) is calculated to be 173 psia. Due to variations in flow coefficients from expected values, tolerance on machining, etc. these values could vary by +/- 3 percent.

Please give me a call if you have any questions or comments.

Best Regards,

John Hess

MONTICELLO NUCLEAR GENERATING PLANT		CA-96-054
TITLE:	Turbine Stop Valve Closure/Generator Load Reject SCRAM Bypass Drift Analysis	Revision 5
		Attachment 5 Page 1 of 1



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