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.:	11972-049	☒ NUCLEAR SAFETY- RELATED	
CALC. NO.:	CA-95-073 Rev. 4	☐ NOT NUCLEAR SAFETY-RELATED	
TITLE:	Reactor Low Water Level SCRAM Setpoint		
EQUIPMENT NO.:	LT-2-3-57A/B, LT-2-3-58A/B, LIS-2-3-657A/B, LIS-2-3-658A/B		

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

This revision completely supersedes Rev. 3

INPUTS/ ASSUMPTIONS
☒ VERIFIED ESK 1/22/09
☐ UNVERIFIED RMV 1/24/09

REVIEW METHOD:	Detailed	REV.	4
STATUS:	Approved	DATE FOR REV.:	12/19/2008
PREPARER	Eric Kolodziejczyk *Eric Kolodziejczyk*	DATE:	12/18/2008
REVIEWER	John O'Hara / Greg Rainey *John O'Hara / [signature]*	DATE:	12/18/2008
APPROVER	Steven Malak *Raj Dhuman for S. MALAK*	DATE:	12/19/2008

IDENTIFICATION OF PAGES ADDED/REVISED/SUPERSEDED/VOIDED & REVIEW METHOD

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APPROVER		DATE:	

NOTE: PRINT AND SIGN IN THE SIGNATURE AREAS

MONTICELLO NUCLEAR GENERATING PLANT		3494
TITLE:	CALCULATION COVER SHEET	Revision 17
		Page 1 of 1

Title *Reactor Low Water Level SCRAM Setpoint* CA- *95* - *073* Rev. *4*

10 CFR50.59 Screening or Evaluation No: ____________

Associated Reference(s): ____________

Does this calculation:	YES	NO	Calc No(s), Rev(s), Add(s)
Supercede another calculation?	☒	☐	*CA-95-073 Rev. 3*
Augment (credited by) another calculation?	☐	☒	
Affect the Fire Protection Program per Form 3765?	☐	☒	If Yes, attach Form 3765
Affect piping or supports?	☐	☒	If Yes, attach Form 3544
Affect IST Program Valve or Pump Reference Values, and/or Acceptance Criteria?	☐	☒	If Yes, inform IST Coordinator and provide copy of calculation

What systems are affected?

DBD Section (if any): B.1.1

Topic Code (See Form 3805): ____________

Structure Code (See Form 3805): ____________

Other Comments:

Prepared by: ____________ Date: ____________

Print/Signature

M/cah

1. PURPOSE

The purpose of this calculation is to establish setpoint and instrument settings for the Reactor Low Water Level SCRAM instrument loop. This calculation affects the Reactor Coolant System by determining the low water level setpoint.

Revision 4 is performed in response to the Extended Power Uprate (EPU) from 1775 MWt to 2004 MWt. This revision includes the change in the Analytical Limit from 0.0" to -2.5" and the change in the maximum Bernoulli error from 5.4" to 7.03". 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 is performed to include the Bernoulli error due to steam flow past the reference leg instrument tap. Since the Analytical Limit is below the steam separator skirt, water level may drop below the skirt and allow steam to flow past the water level reference leg tap causing an error in the indicated water level reading. This issue is addressed in ARs 01079568 and 01082169, Reference 10.17 and GE-NE-0000-0066-0631-R0 (superseded by Input 4.4 in Rev. 4 of this calculation.)

Revision 2 of this calculation is performed to include the revised transmitter calibration scaling, as determined in CA-03-032, Revision 0 (2DO 03009554), and to support the extended calibration and surveillance intervals of the level transmitters as part of the 24-Month Fuel Cycle Extension project, by incorporating the 30-Month drift values determined by CA-03-019 (2DO 03009053). This revision also addresses Action 03010447 in CR 03009528 for this calculation, to include revised transmitter calibration determined in CA-03-032.

Revision 1 of this calculation considered the effects of feedwater flow mixing in the annulus. This issue was brought up by the re-rate submittal review. This issue is fully addressed by the revised transmitter scaling calculation, CA-03-032, and Revision 2 incorporates the results of CA-03-032 into this calculation. Therefore, no bias error due to improper transmitter calibration is necessary, and those terms have been removed.

2. METHODOLOGY

This calculation is performed in accordance with ESM-03.02-APP-I (Input 4.1). The General Electric Setpoint Methodology is a statistically based methodology. It recognizes that most of the uncertainties that affect instrument performance are subject to random behavior, and utilizes statistical (probability) estimates of the various uncertainties 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 determination of trip unit drift values used in this calculation is performed in accordance with ESM-03.02-APP-III (Input 4.2). Since calibration intervals are not changing for the trip units covered by this calculation, a time dependency analysis is not required.

Drift values for the level transmitters covered by this calculation were determined per ESM-03.02-APP-III (Input 4.2) and are documented in CA-03-019 (Input 4.7).

The methodology for determining instrument setpoints is not described in the USAR or its references.

3. ACCEPTANCE CRITERIA

The Nominal Trip Setpoint (NTSP), Allowable Value (AV) and instrument settings should be established such that the Analytical Limit (Input 4.4) will not be exceeded when all applicable instrumentation uncertainties are considered. 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 3-month +25% calibration interval (Reference 10.4) for the trip units and a 24-month +25% calibration interval for the level transmitters as established by the Calibration Requirements of Input 4.3.

4. INPUTS

4.1 Engineering Standards Manual ESM-03.02-APP-I, Appendix I (GE Methodology Instrumentation & Controls), Revision 4. The ESM provides plant specific guidance on the implementation of the General Electric guidelines (Input 4.16) and methodology (Reference 10.1).

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 10.2).

95%/95% Tolerance Factor for 252 data points (Table 9.1)	2.121

4.3 Monticello Technical Specifications, Amendment 155

Section	Allowable Value	Function	Calibration Requirement
Table 3.3.1.1-1	≥ 7 inches	Reactor Protection	SR 3.3.1.1.8

Function 4.		System Instrumentation, Reactor Vessel Water Level - Low	92 days - trip unit calibration SR 3.3.1.1.11 24 months - channel calibration
Table 3.3.6.1-1 Function 2.a	≥ 7 inches	Primary Containment Isolation, Reactor Vessel Water Level - Low	SR 3.3.6.1.3 92 days - trip unit calibration SR 3.3.6.1.5 24 months - channel calibration
Table 3.3.6.1-1 Function 6.b	≥ 7 inches	Shutdown Cooling System Isolation, Reactor Vessel Water Level - Low	SR 3.3.6.1.3 92 days - trip unit calibration SR 3.3.6.1.5 24 months - channel calibration
Table 3.3.6.1-1 Function 7.a	≥ 7 inches	Traversing Incore Probe System Isolation, Reactor Vessel Water Level - Low	SR 3.3.6.1.3 92 days - trip unit calibration SR 3.3.6.1.5 24 months - channel calibration

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

Parameter	Value
2.2.C. L3 Scram Setpoint	475" Above Vessel Zero
2.3.B. L3 Trip Setpoint Analysis Basis	475" Above Vessel Zero

4.5 NX-7831-197-1, Revision D, Reactor Vessel & Internals

Reactor Vessel Zero	949' - 5"
Vessel Instrument Zero	477.5" Above Vessel Zero

4.6 Monticello Component Master List (CML). The CML contains instrument information relating to the installed equipment as listed in Section 6.2. The CML also provides the recent calibration records and maintenance history for the trip units included in this calculation. The As-Found and As-Left data for the trip units in this calculation is listed in Attachment 2.

Instrument Calibration Worksheets identify calibration tools and contain the As Found tolerances of the devices used to calibrate the instruments covered by this calculation. Data obtained from this input is listed in Sections 6.2.1.6 and 6.2.2.6:

Input Calibration Device	Description
XPC-9055A	Ashcroft 2089
XDV-9060	Fluke 8062A Multimeter
XDV-9097	Fluke 8062A Digital Voltmeter
XDV-9102	Fluke Model 189 Digital Voltmeter
XDV-9076	Rosemount Readout Assembly (Trip Unit)

Note: Per CML listings for the transmitters analyzed in this calculation, XDV-9064, XDV-9068, XPC-9055, XPC-9054A, and XPC-9058A were also used as M&TE on the transmitters. However, these devices have since been retired from service, and are therefore not analyzed per this calculation.

CML datasheets for LT-2-3-85A and LT-2-3-85B are used in determining the Operational Limit for the Spurious Trip Avoidance Evaluation (Section 6.6.8). CML specifies an As Left Tolerance of ± 0.16 mA.

4.7 Calculation CA-03-019, Revision 0, Instrument Drift Analysis, Rosemount 1153DB4RC Transmitters. CA-03-019 provides the 30-month (24 months +25%) Analyzed Drift Value for the level transmitters included in this calculation.

$AD_{E.Random}$	±0.52% of span
$AD_{E.Bias}$	None

4.8 Calculation CA-95-027, Revision 1, Determination of Instrument Service Conditions for Input to Setpoint Calculations. MO4230-0065. Data obtained from this input is listed in Sections 6.2.1.2 and 6.2.2.2.

4.9 Calculation CA-93-353, Revision 0, Pacific Nuclear Calculation MN.9304.0106-01, Reactor Vessel Water Level Instrumentation End Point Calibration Bias Determination. Operation of the backfill system results in an indicated decrease in reactor water level. Since this bias acts in the conservative direction for Low Low water level, it is not considered in this calculation.

4.10 Calculation CA-03-032, Revision 0, Determination of Instrument Calibration Parameters for Reactor Safeguards and ATWS Level Transmitters. MO5490-0720.

	Instrument	LT-2-3-57A, B	LT-2-3-58A, B
High Line Pressure Correction Factor		0.0075	0.0075
+50"	20.0 mA	-42.0"	-41.2"
0"	12.0 mA	-76.9"	-76.1"
-50"	4.0 mA	-111.8"	-111.0"

Span	16.0 mA	69.8"	69.8"

Process Measurement Accuracy (PMA)	±0.60 inches of water (±0.86 inches indicated)

4.11 Technical Manual NX-20483, Revision 5, "1153 Series B Pressure Transmitters." Instrument performance data obtained from this input is listed in Section 6.2.1.

4.12 Monticello Updated Safety Analysis Report.

This calculation uses direct input from the USAR to demonstrate the transmitters will not be exposed to pressures which would cause an Over Pressure Effect. Per Reference 10.19 the USAR is not recommended as a design input to calculations. However, because within the USAR these values do not reference a separate document, the USAR will be used as the reference.

Table 4.1-1, Revision 22, Reactor Coolant System Data.

Safety/Relief Valve Setting	1109 psig ± 1%

Section 7.6.1.2.6.c, Revision 25P, makes the following statements: "The reactor vessel low water level scram setting was selected to prevent fuel damage following those abnormal operational transients caused by single equipment malfunctions or single operator errors that result in a decreasing reactor vessel water level. Specifically, the scram setting is chosen far enough below normal operational levels to avoid spurious scrams but high enough above the top of the active fuel to assure that enough water is available to account for evaporation losses and displacements of coolant following the most severe abnormal operational transient involving a level decrease. The selected scram setting is used in the development of the thermal-hydraulic safety limit, which sets a limit on the thermal power level for various coolant flow rates."

4.13 Rosemount Report 108026, Revision None, February 4, 1981. "Type Test Report For Pressure Transmitters, Rosemount Model 1153 Series B." MO1110-0935. This report documents the results of type tests performed to demonstrate qualification of the Rosemount Model 1153 Series B pressure transmitters.

4.14 Rosemount Report D8200037, Revision A, "Qualification Report Model 710DU Trip/Calibration System." MO3147-0131. This report documents the qualification basis for the Rosemount Model 710DU Trip/Calibration System.

4.15 NSPNAD-96003, Revision 1, "Monticello Nuclear Generating Plant Safety Review for Power Rerate." Section 12.4 of this document performs a spurious trip avoidance evaluation for the reactor high and low vessel level settings. The evaluation accounts for failure of the Electrical Pressure Regulator (EPR) for the turbine control system and also accounts for a turbine bypass valve test transient. An initial level of 37 inches Above Instrument Zero (AIZ) is analyzed for each event, and in no cases did the sensed water level drop below 34.8 inches AIZ (see Figures 12.2 and 12.3). Per Section 12.4, "the maximum drop in sensed level was less than three inches." This information is used to establish an Operating Limit for the spurious trip avoidance evaluation (Section 6.6.8). The values in this document are being reviewed under GAR# 1149669 for effects due to EPU conditions.

4.16 GE-NE-901-021-0492, DRF A00-01932-1, Setpoint Calculation Guidelines for the Monticello Nuclear Generating Plant, October 1992.

4.17 Operating Experience Assessment File, High Drywell Temperature Effect On Reactor Vessel Water Level Instrumentation, General Electric SIL 299, MO2824-0250.

4.18 NX-63626, Ashcroft Digital Test Gauge Operating Instructions. The vendor accuracy of the Ashcroft 2089 is 0.05% (See Section 6.2.1.6).

4.19 NX-20382, Fluke Model 8062A Instruction Manual. The vendor accuracy of the Fluke 8062A is 0.05% of reading plus 2 least significant digits (See Section 6.2.1.6).

4.20 NX-60259, Fluke Model 189 Instruction Manual. The vendor accuracy of the Fluke 189 is 0.1% of reading plus 2 least significant digits (See Section 6.2.1.6).

4.21 NX-60222, Fluke Model 5520A Calibrator Manual. The vendor accuracy of the Fluke 5520A is 20ppm of output plus 1μV (See Section 6.2.1.6).

4.22 NX-17164, Fluke 8505A Manual. The vendor accuracy of the Fluke 8505A is 0.001% of reading plus 8 counts (See Section 6.2.2.6).

4.23 NX-63628, Model 7250 Digital Pressure Controller. The vendor accuracy of the Ruska 7250xi is 0.005% of reading (See Section 6.2.2.6).

4.24 NX-17449, Ametek, Mansfield & Green Pneumatic Dead Weight Tester. The vendor accuracy of the deadweight tester is 0.05% of reading (See Section 6.2.1.6).

4.25 NX-17059, Revision 3, Trip/Calibration System Model 710DU. The vendor accuracy of the trip calibration unit is 0.01mA (See Section 6.2.2.6).

4.26 DRF-0000-0065-8910. March 11, 2008. Monticello Bernoulli Error for EPU. This reference determines the maximum Bernoulli error due to steam flow past the reference leg tap to be 7.03 inches. This Input is also provided as Attachment 4.

4.27 Task Report T1004: Environmental Qualification EC11836, Rev. 1. This Input demonstrates the environmental conditions used in the evaluation of Inputs 4.7, 4.8, and 4.10 will not change due to EPU. These Inputs provide the environmental conditions for the instruments in this calculation.

4.28 Task Report T0100: EPU Reactor Heat Balance EC10998.

Vessel Dome Pressure	1025 psia

4.29 Task Report T0506: EC12410, Rev. 3, September 2008. This input evaluates trip avoidance margin for EPU.

5. ASSUMPTIONS

None

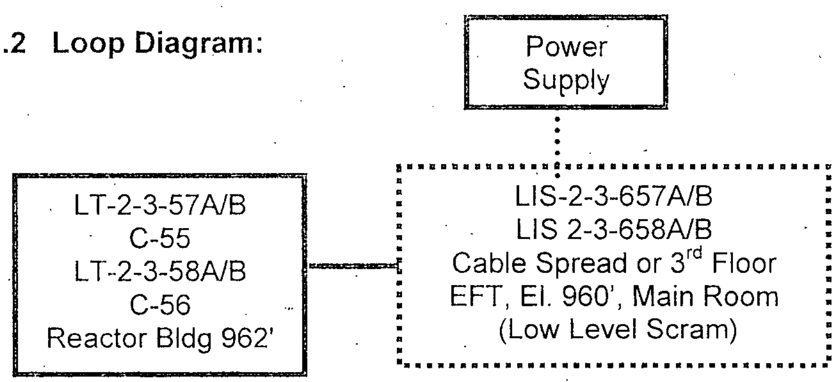
6. ANALYSIS

6.1 Instrument Channel Arrangement

6.1.1 Loop Information:

Function: This channel monitors reactor water level and initiates a SCRAM on low level. The logic is one out of two taken twice. This function also initiates a Group 2 Containment Isolation function (Input 4.3).

6.1.2 Loop Diagram:



6.2 Instrument Definition and Determination of Device Error Terms

6.2.1 DEVICE 1

6.2.1.1 Instrument Definition:

		Reference
Component ID:	LT-2-3-57A/B, LT-2-3-58A/B	
Location:	Reactor Building 962' Racks C-55 and C-56	4.6
Manufacturer:	Rosemount	4.6
Model Number:	1153DB4RC	4.6
Upper Range Limit:	150" WC	4.11
Calibrated Span:	69.8" WC	4.10
LT-2-3-57A/B:	Input Signal / Output Signal -111.8" WC / 4 mA -50" -42.0" WC / 20 mA +50"	4.10
LT-2-3-58A/B:	Input Signal / Output Signal -111.0" WC / 4 mA -50" -41.2" WC / 20 mA +50"	4.10

6.2.1.2 Process and Physical Interfaces:

Calibration Conditions:		Reference
Temperature:	65 to 90°F	4.8, 4.27
Surveillance Interval:	30 months	4.3, 10.4

Calibration of the level transmitters is required every 24 months per Input 4.3. A surveillance interval of 30 months (24 months + 25%) is used in accordance with the guidance in Generic Letter 91-04 (Reference 10.4).

Normal Plant Conditions:		Reference
Temperature:	60 to 104°F	4.8, 4.27
Radiation:	Negligible (See Note 1)	4.8, 4.27
Pressure:	Ambient	4.8, 4.27
Humidity:	20 to 100%	4.8, 4.27

Trip Environment Conditions:		Reference
Temperature:	60 to 104°F	4.8, 4.27
Radiation:	Negligible (See Note 1)	4.8, 4.27

Pressure:	Ambient	4.8, 4.27
Humidity:	20 to 100 %	4.8, 4.27

Note 1: Per Input 4.12 and Reference 10.1, these devices are generally used for operational transients. For the limited loss of coolant accident (LOCA) usage, the trip occurs prior to harsh environmental conditions and prior to core uncovery. Per Input 4.8, these instruments will respond shortly after a LOCA and will not be exposed to harsh environmental conditions.

Seismic Conditions:		**Reference**
OBE: (Instrument racks C-55, C-56)	0.42g	4.8

Process Conditions:	Drywell	Reactor Bldg.	**Reference**
During Calibration:	135°F	80°F	4.10
During Function:	100 to 170°F	60 to 104°F	4.10
Reactor vessel pressure		1025 psia	4.28

The above temperature ranges were used in Input 4.10 to determine the Process Measurement Accuracy associated with these transmitters.

6.2.1.3 Individual Device Accuracy:

Term	**Specified**	**Value (" WC)**	**Sigma**	**Reference**
VA:	± 0.25% Span	0.175	3	4.11, Note 1
ATE:	±(0.75% Upper Range Limit(URL) + 0.5% Span) per 100°F	0.21	3	4.11, Note 2
OPE:	No effect below 2000 psig	0	3	4.11
SPE_Z:	± 0.2% URL per 1000 psi	0.308	3	4.11, Note 3
SPE_S:	± 0.5% Span per 1000 psi	0.358	3	4.11, Note 4
SPE_{SB}	Span bias effect is calibrated out	NA	NA	4.10
SE:	±0.5% at ZPA = 4 g's	0	2	4.11, 4.13, Note 5
RE:	0	0	NA	Note 6
HE:	0	0	NA	4.11, Note 7
PSE:	< 0.005% per volt	0	NA	4.11, Note 8
REE:	NA	0	NA	Note 9

Note 1:

$$VA = Vendor\ \ Accuracy$$
$$VA = 0.25\% \times Span$$
$$VA = 0.0025 \times 69.8 = 0.175''\ WC$$

Note 2:

The calibration temperature range is 65°F to 90°F. Accuracy Temperature Effect (ATE) is based on the widest temperature variation outside of the calibration temperature range. Using the trip environment temperature range of 60°F to 104°F results in temperature ranges of 5° (65°F - 60°F) and 14° (104°F - 90°F). Therefore the ATE is based on the number of degrees in excess of 90°F:

$$ATE = ((0.75\% \times URL) + (0.5\% \times Span)) \times \frac{104-90}{100}$$
$$ATE = ((0.0075 \times 150) + (0.005 \times 69.8)) \times \frac{104-90}{100}$$
$$ATE = 0.21''\ WC$$

Since normal and trip conditions are equal:

$$ATE_N = ATE_T = ATE = 0.21''\ WC$$

Note 3:

$$SPE_Z = \text{Static Pressure Effect (Zero)}$$
$$SPE_Z = 0.2\% \times URL \times \frac{1025}{1000}$$
$$SPE_Z = 0.002 \times 150 \times \frac{1025}{1000}$$
$$SPE_Z = 0.308''\ \ WC$$

Note 4:

$$SPE_S = Static\ Pressure\ Effect\ (Span)$$
$$SPE_S = 0.5\% \times Span \times \frac{1025}{1000}$$
$$SPE_S = 0.005 \times 69.8 \times \frac{1025}{1000}$$
$$SPE_S = 0.358''\ \ WC$$

Note 5:

Testing documented in Input 4.13 shows minimal seismic effects following OBE testing to 2 g's Zero Period Acceleration (ZPA). Since the seismic ZPA does not exceed 2 g's, and the event is not likely to cause the trip event, the Seismic Effect (SE) is considered to be negligible (Input 4.16). Any error effect due to vibration under normal operating conditions is considered negligible and will be calibrated out during periodic calibration of the transmitter. These negligible effects are included in the Analyzed Drift term.
SE = 0

Note 6:

This trip occurs prior to core uncovery, so no significant radiation effects occur prior to the trip. Radiation dose for these transmitters is negligible (Input 4.8). Therefore, the Radiation Effect (RE) is negligible. Any error effect due to radiation under normal operating conditions is considered negligible and will be calibrated out during periodic calibration of the transmitter. These negligible effects are included in the Analyzed Drift term.
RE = 0

Note 7:

Vendor documentation shows the transmitters having a 0 – 100% relative humidity rating. Therefore, humidity effects are taken to be zero. Any error effect due to humidity variations under normal operational conditions will be calibrated out during periodic calibration. These effects are included in the Analyzed Drift term.
HE = 0

Note 8:

PSE = Power Supply Effect = 0.005% per Volt (negligible)
PSE = 0

Note 9:

RFI/EMI effect (REE) = 0 since it is addressed by design and administrative control of the area (No radio signs).

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

$A_1 = Accuracy\ of\ Device\ 1$

$$A_1 = 2 \times \sqrt{\left(\frac{VA}{3}\right)^2 + \left(\frac{ATE}{3}\right)^2 + \left(\frac{OPE}{3}\right)^2 + \left(\frac{SPE_Z}{3}\right)^2 + \left(\frac{SPE_S}{3}\right)^2 + \left(\frac{SE}{2}\right)^2 + \left(\frac{RE}{2}\right)^2 + \left(\frac{HE}{3}\right)^2 + \left(\frac{PSE}{3}\right)^2 + \left(\frac{REE}{3}\right)^2}$$

$$A_1 = 2 \times \sqrt{\left(\frac{0.175}{3}\right)^2 + \left(\frac{0.21}{3}\right)^2 + \left(\frac{0}{3}\right)^2 + \left(\frac{0.308}{3}\right)^2 + \left(\frac{0.358}{3}\right)^2 + \left(\frac{0}{2}\right)^2 + \left(\frac{0}{2}\right)^2 + \left(\frac{0}{3}\right)^2 + \left(\frac{0}{3}\right)^2 + \left(\frac{0}{3}\right)^2}$$

$A_1 = 0.37''\ WC$

$A_{1T} = A_{1N} = A_1 = 0.37''\ WC$

6.2.1.4 Individual Device Drift:

Term	Specified	Value (" WC)	Sigma	Reference
VD:	± 0.2% URL for 24 months (+-0.23% URL for 30 months)	0.35	2	4.11, Note 1
DTE:	±(0.75% URL+ 0.5% SP) per 100°F	0.37	3	4.11, Note 2

Note 1:

Vendor Drift given by Rosemount is adjusted based on a 30 month planned surveillance interval.

$$VD = \sqrt{\frac{Surveillance\ Interval}{Vendor\ Drift\ Interval}} \times (Vendor\ Drift\ Value)$$

$$VD = \sqrt{\frac{30}{24}} \times 0.2\% = 0.23\%$$

$$VD = 0.23\% \times URL$$

$$VD = 0.0023 \times 150$$

$$VD = 0.35''\ WC$$

Note 2:

$$DTE = Drift\ Temperature\ Effect$$

$$DTE = ((0.75\% \times URL) + (0.5\% \times Span)) \times \frac{90-65}{100}$$

$$DTE = ((0.0075 \times 150) + (0.005 \times 69.8)) \times \frac{90-65}{100}$$

$$DTE = 0.37''\ WC$$

Combining and normalizing to 2-sigma:

$$D = 2\sqrt{(\frac{VD}{n})^2 + (\frac{DTE}{n})^2}$$

$$D = 2\sqrt{(\frac{0.35}{2})^2 + (\frac{0.37}{3})^2}$$

$$D = 0.43''\ WC$$

A Monticello specific drift analysis of Rosemount 1153DB4RC transmitters was performed (Input 4.7) to determine the 30-month Analyzed Drift Value (AD) for these transmitters.

$$AD = \pm 0.52\%\ of\ span$$

$$AD = \pm 0.0052 \times 69.8$$

$$AD = \pm 0.37''\ WC$$

The AD is used in place of both the VD and the DTE:

$$D_1 = Device\ 1\ Drift$$

$$D_1 = 0.37''\ WC$$

6.2.1.5 <u>As-Left Tolerances: (ALT):</u>

$$ALT_1 = \frac{2}{3}\sqrt{(VA)^2 + (C)^2 + (C_{STD})^2}$$

$$ALT_1 = \frac{2}{3}\sqrt{(VA)^2 + (C_{1A})^2 + (C_{1B})^2 + (C_{1C})^2 + (C_{1ASTD})^2 + (C_{1BSTD})^2}$$

$$ALT_1 = \frac{2}{3}\sqrt{0.175^2 + 0.14^2 + 0.175^2 + 0.088^2 + 0.14^2 + 0.011^2} = 0.22''WC$$

(Calibration error terms are calculated in Section 6.2.1.6)

6.2.1.6 Device Calibration Error:

Calibration of LT-2-3-57A/B and LT-2-3-58A/B uses a pressure input (C_{1A}) and a digital multimeter (C_{1B}) to read the transmitter output across a test resistor (C_{1C}).

Term	Value	Sigma	Reference
C_{1A}:	0.14" WC	3	Note 1
C_{1ASTD}:	0.14" WC	3	Note 2
C_{1B}:	0.175" WC	3	Note 3
C_{1BSTD}:	0.011" WC	3	Note 4
C_{1C}:	0.088" WC	3	Note 5
ALT_1:	0.22" WC	2	6.2.1.5

Note 1: Per Input 4.6, the transmitters are calibrated with XPC-9055A (Ashcroft 2089). From Input 4.18, the vendor accuracy of the Ashcroft 2089 is 0.05% of full scale. Therefore, the XPC-9055A has an accuracy of 0.005 psi (0.14" WC) at 10 psig.

Input Calibration Device	Range	Accuracy	Reference
XPC-9055A (Ashcroft 2089)	0 - 10 PSIG	±0.005 PSI (±0.14" WC)	4.18

Note 2: From Reference 10.11, the input calibration device is calibrated using a pneumatic dead weight tester. The dead weight tester has a rated accuracy of 0.05% of indicated reading or 0.14" WC at 280" WC (Input 4.24). The accuracy is taken at the upper range limit of the device for conservatism.

Note 3: Per Input 4.6, Fluke 8062A and Fluke 189 model meters are used as output calibration devices. From Input 4.19, the vendor accuracy of XDV-9060/9097 is 0.05% of reading plus 2 least significant digits or 0.03 mVdc at 20 mVdc. From Input 4.20, the vendor accuracy of the XDV-9102/9114 is 0.1% of reading plus 2 least significant digits or 0.04 mVdc at 20 mVdc.

Output Calibration Device	Range	Accuracy	Reference
XDV-9060 (Fluke 8062A)	0 – 50 mVdc	±0.03 mVdc	4.19
XDV-9097 (Fluke 8062A)	0 – 50 mVdc	±0.03 mVdc	4.19
XDV-9102 (Fluke 189)	0 – 50 mVdc	±0.04 mVdc	4.20
XDV-9114 (Fluke 189)	0 – 50 mVdc	±0.04 mVdc	4.20

Transmitter output is read across a 1 ohm resistor; therefore, a 1mVdc reading equals 1mA of transmitter output.

$$C_{1B} = \pm 0.04 \times \frac{69.8}{16} = 0.175\text{" WC}$$

Note 4: From References 10.12 and 10.13 and Input 4.6, the output calibration devices are calibrated using a Fluke Model 5520A Calibrator or a Ruska 7250xi. The 5520A calibrator has a rated accuracy of 20 ppm of output plus 1 μV or 0.002 mVdc at 50 mVdc (Input 4.21). The 7250xi has a rated accuracy of 0.005% of reading or 0.0025 mVdc at 50 mVdc (Input 4.23).

$$C_{1BSTD} = \pm 0.0025 \times \frac{69.8}{16} = 0.011\text{" } WC$$

Note 5: The voltmeter is used to determine output current by measuring voltage across a 0.1% 1 ohm resistor. The calibration standard error term does not apply to the test resistor.

$$C_{1C} = \pm 0.001 \times 20\ mA \times \frac{69.8}{16} = 0.088\text{" } WC$$

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

$$C_1 = Device\ 1\ Calibration\ Error$$

$$C_1 = \frac{2}{3}\sqrt{{C_{1A}}^2 + {C_{1ASTD}}^2 + {C_{1B}}^2 + {C_{1BSTD}}^2 + {C_{1C}}^2 + {ALT_1}^2}$$

$$C_1 = \frac{2}{3}\sqrt{0.14^2 + 0.14^2 + 0.175^2 + 0.011^2 + 0.088^2 + 0.22^2}$$

$$C_1 = 0.24\text{" } WC$$

6.2.2 DEVICE 2

6.2.2.1 Instrument Definition:

		Reference
Component ID:		LIS-2-3-657A/B
Location:	Cable Spreading Room 939'	4.6
Manufacturer:	Rosemount	4.6
Model Number:	00710-0002	4.6

Calibrated Span:	4 - 20 mA (-50 to +50 inches)	4.6
13.44 mA (+9 Inches Indicated)	Input Signal / Output Signal: trip	

		Reference
Component ID:		LIS-2-3-658A/B
Location:	Bldg EFT, El. 960', 3rd Floor in the Main Room	4.6
Manufacturer:	Rosemount	4.6
Model Number:	00710-0002	4.6
Calibrated Span:	4 - 20 mA (-50 to +50 inches)	4.6
Input Signal: 13.44 mA (+9 Inches Indicated)	Output Signal: trip	

6.2.2.2 Process and Physical Interfaces:

Calibration Conditions:		**Reference**
Temperature:	65 to 90°F	4.8, 4.27
Surveillance Interval:	3 months + 25%	4.3, 10.4

Normal Plant Conditions:		**Reference**
Temperature:	60 to 104°F	4.8, 4.27
Radiation:	Negligible	4.8, 4.27
Pressure:	Ambient	4.8, 4.27
Humidity:	20 to 100%	4.8, 4.27

Trip Environment Conditions:		**Reference**
Temperature:	60 to 104°F	4.8, 4.27
Radiation:	Negligible (See Note 1)	4.8, 4.27
Pressure:	Ambient	4.8, 4.27
Humidity:	20 to 100%	4.8, 4.27

Note 1: Per Input 4.12 and Reference 10.1, these devices are generally used for operational transients. For the limited loss of coolant accident (LOCA) usage, the trip occurs prior to harsh environmental conditions and prior to core uncovery. Per Input 4.8, these instruments will respond shortly after a LOCA and will not be exposed to harsh environmental conditions.

Seismic Conditions:		Reference
OBE:	0.46g (C-304A, B) 1.66g (C-304C, D)	4.8

Process Conditions:	N/A

6.2.2.3 Individual Device Accuracy:

Term	Specified	Value (" WC)	Sigma	Reference
VA:	± 0.29% span (40° to 104° F)	0.21	3	4.16
ATE:	Included in VA	0	3	4.16
OPE:	N/A			4.16
SPE:	N/A			4.16
SE:	Negligible	0	2	4.14, Note 1
RE:	Included in VA	0	2	4.16
HE:	Included in VA	0	3	4.16
PSE:	Included in VA	0	3	4.16
REE:	0	0	3	Note 2

In accordance with the GE guidelines (Input 4.16), a Vendor Accuracy term of ±0.29% of span (3 Sigma) will be used. This term includes allowances for trip unit adjustability, trip point repeatability, analog output accuracy, temperature effects (ATE), power supply variations (PSE), normal control area radiation (RE), and humidity effects (HE) and is applicable to the combination of the Master trip unit and the Slave trip unit.

$$VA_2 = Vendor\ \ Accuracy$$
$$VA_2 = 0.29\% \times Span$$
$$VA_2 = 0.0029 \times 69.8 = 0.21''\ WC$$

Note 1: Testing documented in Input 4.14 to ZPA levels greater than the required OBE showed that trip point repeatability was within the VA. Since the seismic ZPA does not exceed 2 g's, and the event is not simultaneous with the trip event, the Seismic Effect (SE) is considered to be negligible (Input 4.16). Any error effect due to vibration under normal operating conditions is considered negligible and will be calibrated out during periodic calibration of the trip unit. These negligible effects are included in the Analyzed Drift term.
SE = 0

Note 2: RFI/EMI effect (REE) = 0 since it is addressed by design and administrative control of the area (No radio signs).

The device accuracy is adjusted to a 2-sigma term:

$$A_2 = Accuracy\ of\ Device\ 2$$
$$A_2 = \frac{2}{3} \times VA_2$$
$$A_2 = \frac{2}{3} \times 0.21$$
$$A_2 = 0.14''\ WC$$
$$A_{2T} = A_{2N} = A_2 = 0.14''\ WC$$

6.2.2.4 Individual Device Drift:

Term	Specified	Value (" WC)	Sigma	Reference
VD:	± 0.2% Span for 6 months	0.14	3	10.1
DTE:	Included in VD	0	3	10.1

In accordance with the GE guidelines (Input 4.16), a Vendor Drift term of ±0.2% of span (3 Sigma for 6 months) is used. This term includes allowance for temperature effects.

$$VD = Vendor\ Drift$$
$$VD = 0.2\% \times Span$$
$$VD = 0.002 \times 69.8$$
$$VD = 0.14''\ WC$$

The vendor drift is adjusted to a 2-sigma term:

$$D = \frac{2}{3} \times VD$$
$$D = \frac{2}{3} \times 0.14$$
$$D = 0.093''\ WC$$

The specified value is for a 6-month calibration cycle. A drift analysis using instrument calibration history is included in Attachments 1 and 2 for determination of the 3-month drift:

The absolute value of the calculated average drift for the trip units is 0 mA (A1.8, Attachment 1). Therefore, bias will not be considered for these trip units.

$AD_{bias} = 0.0$

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):

$$AD_{random} = s \times TIF_{95/95} \times NAF$$
$$AD_{random} = 0.0105 \times 2.121 \times 1.0 \qquad \text{(3 months)}$$
$$AD_{random} = 0.0223\ mA$$

The extended calibration interval of 3 months plus 25% is calculated by multiplying the random portion of the Analyzed drift by the square root of the extended calibration interval divided by the average observed time interval.

$$AD_{E,random} = AD_{random} \times \sqrt{\frac{CI_E}{CI_O}}$$
$$AD_{E.random} = 0.0223 \times \sqrt{\frac{3.75}{2.9}} \qquad \text{(3.75 months)}$$
$$AD_{E.random} = 0.0254$$

$$D_2 = Device\ 2\ Drift$$
$$D_2 = AD_{random} \times \frac{69.8''\ WC}{16\ mA}$$
$$D_2 = 0.0254\ mA \times \frac{69.8''\ WC}{16\ mA}$$
$$D_2 = 0.12''\ WC$$

6.2.2.5 <u>As-Left Tolerance: (ALT):</u>

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

$$ALT_2 = \frac{2}{3}\sqrt{(VA)^2 + (C_2)^2 + (C_{2ASTD})^2 + (C_{2BSTD})^2}$$
$$ALT_2 = \frac{2}{3}\sqrt{0.21^2 + 0.044^2 + 0.005^2 + 0.088^2} = 0.232''WC$$

(Calibration error terms are calculated in Section 6.2.2.6)

$$ALT_2 = 0.232"WC \times \frac{16mA}{69.8"WC}$$
$$ALT_2 = \pm 0.053mA$$

An ALT of ±0.05 mA is conservative and will be used.

$$ALT_2 = \pm 0.05mA \times \frac{69.8"WC}{16mA}$$
$$ALT_2 = \pm 0.22"WC$$

6.2.2.6 Device Calibration Error:

Since the output of the trip unit is measured by an LED on/off indication, no uncertainty is associated with the output MTE for the trip unit.

Term	Value	Sigma (n)	Reference
C_2:	0.044" WC	3	Note 1
C_{2ASTD}:	0.005" WC	3	Note 2
C_{2BSTD}:	0.088" WC	3	Note 3
ALT_2:	0.22" WC	2	6.2.2.5

Note 1: From Input 4.25, the vendor accuracy of XDV-9076 is 0.01 mA.

$$C_2 = \pm 0.01\,mA \times \frac{69.8"\,WC}{16\,mA} = 0.044"\,WC$$

Note 2: From Reference 10.14 and Input 4.6, the output calibration devices are calibrated with a Fluke Model 8505A voltmeter. The voltmeter has a rated accuracy of 0.001% of reading plus 8 counts or 0.0001 Vdc at 2 Vdc (Input 4.22).

$$C_{2ASTD} = \pm 0.0001\,Vdc \times \frac{20\,mA}{2Vdc} \times \frac{69.8"\,WC}{16\,mA} = 0.005"\,WC$$

Note 3: From Reference 10.14, the output of XDV-9076 is read by the voltmeter using a 100 ohm 0.1% resistor.

$$C_{2BSTD} = \pm 0.001 \times 20\ mA \times \frac{69.8"\ WC}{16\ mA} = 0.088"\ WC$$

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

C_2 = Device 2 Calibration Error

$$C_2 = \frac{2}{3}\sqrt{C_2{}^2 + C_{2ASTD}{}^2 + C_{2BSTD}{}^2 + ALT_2{}^2}$$

$$C_2 = \frac{2}{3}\sqrt{0.044^2 + 0.005^2 + 0.088^2 + 0.22^2}$$

$$C_2 = 0.16"\ WC$$

6.3 Determination of Loop/Channel Values

6.3.1 Determination of Loop Accuracy:

A_{LN} = Channel Instrument Accuracy (Normal)

$$A_{LN} = \sqrt{A_{1N}{}^2 + A_{2N}{}^2}$$

$$A_{LN} = \sqrt{0.37^2 + 0.16^2}$$

$$A_{LN} = 0.40"\ WC$$

A_{LT} = Channel Instrument Accuracy (Trip)

$$A_{LT} = \sqrt{A_{1T}{}^2 + A_{2T}{}^2}$$

$$A_{LT} = \sqrt{0.37^2 + 0.16^2}$$

$$A_{LT} = 0.40"\ WC$$

6.3.2 Determination of Loop Calibration Error:

Calibration tools used to calibrate instruments in the loop are listed in Sections 6.2.1.6 and 6.2.2.6. Since the items are calibrated separately, all instruments need to be included in the loop calibration error. The SRSS of C_1 and C_2 is equal to the SRSS of the individual calibration error terms.

$C_L = Channel\ Calibration\ Error$

$C_L = \sqrt{C_1^2 + C_2^2}$

$C_L = \sqrt{0.24^2 + 0.16^2}$

$C_L = 0.29"\ WC$

6.3.3 Determination of Loop Drift:

$D_L = Channel\ Instrument\ Drift$

$D_L = \sqrt{D_1^2 + D_2^2} + bias\ term$

$D_L = \sqrt{0.37^2 + 0.12^2} + 0$

$D_L = 0.39"\ WC$

6.4 Determination of Primary Element Accuracy (PEA) and Process Measurement Accuracy (PMA)

PEA = Primary Element Accuracy = ±0.5" WC (Reference 10.1) due to uncertainty in elevation of condensing chamber in construction and thermal growth.

PMA = Process Measurement Accuracy = ±0.6" WC (Input 4.10) resulting from water level density variation.

The RPV reference legs are routed outside the drywell at MNGP. Operating Experience Assesment for SIL 299 (Input 4.17) calculated the effect of high drywell temperature on level setpoints. When RPV level is at -50" assuming no flashing, this effect is small and in the conservative direction. Refer to SIL 299 supplement 2 "High Drywell Temperature Effect on RPV Water Level Instrumentation" assessment (Input 4.17) for more detail. The effects of flashing will not be considered in this calculation because in the event of a LOCA, the Low level trip will occur before the RPV depressurizes to the reference leg saturation pressure (approx 50 psi).

From Input 4.26, an additional PMA bias of 7.03 inches was evaluated to account for the Bernoulli error due to steam flow past the reference leg tap. A conservative PMA bias of 7.1 inches will be used.

PEA = ±0.5" WC
PMA = ±0.6" WC + 7.1"

6.5 Determination of Other Error Terms

Term	Value
Indicator Readability/Operator Reading Error (ORE)	0
Resistors, Multiplexers, etc.	0
Software Errors	0
Degradation of Insulation Resistance (IRE)	0
Other - Backfill Effect	0

IRE effect considered negligible since instrument operates in the first 10 minutes during the accident and does not experience harsh environmental conditions (Input 4.8).

Backfill Effect: The effect of backfill has been determined to be less than 0.1" indicated bias in the conservative direction at the normal flow rate of 2.5 to 3.5 lb/hr (Input 4.9). No credit will be taken for this bias in this calculation.

CA-03-032 (Input 4.10) determined that a maximum bias of -1" (indicated level) exists due to the effect of feedwater subcooling below the feedwater spargers. This bias would cause the low water level trip to occur at a higher level (away from the Technical Specification limit, and therefore, the conservative direction) and it will not be considered in this calculation.

6.6 Calculation of Allowable Value and Operating Setpoint

6.6.1 Allowable Value (AV):

Analytical Limit (AL): -2.5" Input 4.4

Monticello EPU OPL-3 form (Input 4.4) uses a Level 3 water level of 475" AVZ. Per Input 4.5, the vessel instrument zero is located at 477.5" AVZ. Therefore, -2.5" from instrument zero (475" - 477.5") is used as the Analytical Limit.

AL $\geq$ -2.5"

Term	Value (" WC)	Sigma	Reference
A_{LT}	0.40	2	Section 6.3.1
C_L	0.29	2	Section 6.3.2
PMA	0.6	2	Section 6.4
PMA Bias	7.1 **IWL**	N/A	Section 6.4
PEA	0.5	2	Section 6.4
IRE	0	NA	Section 6.5
ORE	0	NA	Section 6.5
Other	0	NA	Section 6.5

The Allowable value is calculated using the SRSS of random terms added to the Analytical Limit and bias terms.

$$AV \geq AL + \left(\sqrt{A_{LT}{}^2 + C_L{}^2 + PMA^2 + PEA^2 + ORE^2 + IRE^2}\right) + \text{bias terms}$$

$$AV \geq -2.5 + \left(\left(\sqrt{0.40^2 + 0.29^2 + 0.6^2 + 0.5^2 + 0^2 + 0^2}\right) \times \frac{100\text{" Indicated}}{69.8\text{" WC}}\right) + 7.1$$

$$AV \geq +6.0\text{"}$$

Since this value is lower (less conservative) than the Technical Specification value (Input 4.3), the Technical Specification value will be used as the AV. This results in an extra margin of 1" to be included in the determination of $NTSP_1$.

$$AV \geq +7\text{"}$$

6.6.2 Nominal Trip Setpoint ($NTSP_1$):

Term	Value (" WC)	Sigma	Reference
A_{LT}	0.40	2	Section 6.3.1
C_L	0.29	2	Section 6.3.2
D_L	0.39	2	Section 6.3.3
PMA	0.6	2	Section 6.4
PMA Bias	7.1 IWL	N/A	Section 6.4
PEA	0.5	2	Section 6.4
IRE	0	NA	Section 6.5
ORE	0	NA	Section 6.5
Other	0	NA	Section 6.5
Margin	1.0	N/A	Section 6.6.1

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

$$NTSP_1 = -2.5 + \left(\left(\sqrt{0.40^2 + 0.29^2 + 0.39^2 + 0.6^2 + 0.5^2 + 0^2 + 0^2}\right) \times \frac{100\text{"Indicated}}{69.8\text{"WC}}\right) + 7.1 + 1.0$$

$$NTSP_1 = +7.1\text{"}$$

6.6.3 Licensee Event Report (LER) Avoidance Evaluation:

The purpose of the LER Avoidance Evaluation is to ensure there is sufficient margin provided between the AV and the NTSP to reasonably avoid violations of the AV. For an instrument, which is part of a multiple channel logic system, a Z value of greater than 0.81 provides sufficient margin between the NTSP and the AV. Therefore, $NTSP_2$ is calculated to provide a lower bound for the NTSP based on LER avoidance criteria.

$$Sigma(LER) = \left(\frac{1}{2}\right)\left(\sqrt{A_{LN}{}^2 + C_L{}^2 + D_L{}^2}\right) \times \frac{100}{69.8}$$

$$Sigma(LER) = \left(\frac{1}{2}\right)\left(\sqrt{0.40^2 + 0.29^2 + 0.39^2}\right) \times \frac{100}{69.8}$$

$$Sigma(LER) = 0.45$$

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

$$NTSP_2 = +7 + (0.81 \times 0.45)$$

$$NTSP_2 = +7.37''$$

Therefore, an $NTSP_2 \geq +7.37''$ will result in a Z greater than 0.81 and provide sufficient margin between the NTSP and the AV.

6.6.4 Selection of Operating Setpoint:

Combining the ALT for the items in the loop:

$$ALT_L = \sqrt{ALT_1^2 + ALT_2^2} \times \frac{100''\ Indicated}{16\ mA}$$

$$ALT_L = \sqrt{0.05^2 + 0.05^2} \times \frac{100''\ Indicated}{16\ mA}$$

$$ALT_L = 0.44''$$

$NTSP_2$ will be used as a lower bound for the setpoint. The actual NTSP is separated from $NTSP_2$ by an amount greater or equal to the ALT_L.

$$NTSP \geq NSTP_2 + ALT_L$$

$$NTSP \geq +7.37 + 0.44$$

$$NTSP \geq 7.81$$

The existing trip setpoint of +9" above instrument zero is conservative and will be used.

NTSP = +9"

6.6.5 Leave Alone Zone:

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

6.6.6 Establishing As-Found Tolerance (AFT):

An As-Found tolerance is calculated to provide suggested limits for use during the surveillance testing:

Transmitter:

$$AFT_1 = \sqrt{ALT_1^{\,2} + D_1^{\,2}} \times \frac{16\ mA}{69.8"\ WC}$$

$$AFT_1 = \sqrt{0.22^2 + 0.37^2} \times \frac{16\ mA}{69.8"\ WC}$$

$$AFT_1 = 0.09\ mA$$

Trip unit:

$$AFT_2 = \sqrt{ALT_2^{\,2} + D_2^{\,2}} \times \frac{16\ mA}{69.8"\ WC}$$

$$AFT_2 = \sqrt{0.22^2 + 0.12^2} \times \frac{16\ mA}{69.8"\ WC}$$

$$AFT_2 = 0.06\ mA$$

6.6.7 Required Limits Evaluation:

The purpose of a Required Limits Evaluation is to ensure that the combination of errors present during calibration of each device in the channel is accounted for while allowing for the possibility that the devices may not be recalibrated. Since Leave Alone Zones are not used at MNGP, the devices are always verified or recalibrated to be within the As Left Zone. Therefore, a Required Limits Evaluation as discussed in the GE methodology is not applicable.

To ensure that the combination of individual device AFTs will not cause the channel Allowable Value to be exceeded, the AFTs of the devices are combined using the SRSS method:

$$Loop\ As-Found = \pm\sqrt{AFT_1^2 + AFT_2^2} \times \frac{100"}{16\ mA}$$

$$Loop\ As-Found = \pm\sqrt{0.09^2 + 0.06^2} \times \frac{100"}{16\ mA}$$

$$Loop\ As-Found = \pm 0.68"$$

Per Section 6.6.1, the Allowable Value is +7". Per Section 6.6.4, the Operating Setpoint is +9". Therefore, 2" margin exists between these two values, which exceeds the Loop As-Found tolerance. Therefore, no further adjustments to the As Found Tolerances are required as a result of this calculation.

6.6.8 Spurious Trip Avoidance Evaluation:

A spurious trip avoidance evaluation is performed to ensure that there is a reasonable probability that spurious trips will not occur using the selected setpoint. Per Input 4.15, Operational Limits were evaluated, showing that operational transients did not cause drops of more than 3 inches in indicated level from the starting point. Per Input 4.29, this operational transient applies to EPU. Per Input 4.5, the normal water level is shown as +35 inches indicated which would result in a +32 inches indicated water level during the maximum operational transient level drop. This is above the 9" setpoint and would not cause a spurious trip.

During a normal plant shutdown, the manual scram should not cause a vessel level low enough to trip the automatic scram. Plant process computer information shows that the vessel level decreased to approximately 16 inches during the shutdown for refueling outage 23. EPU has no impact on the water level during a normal plant shutdown (Input 4.29). Since the change in vessel level following a manual scram depends on a number of variables, a conservative value of +15 inches will be used in determining the Operational Limit.

The indicated vessel level is provided by transmitters LT-2-3-85A and LT-2-3-85B which are calibrated to the same ranges as the level transmitters in this calculation (Input 4.10). From Input 4.6, these transmitters have an As Left Tolerance of ± 0.16 mA or 1 inch indicated level. Therefore an Operation Limit of 14 inches indicated will be used.

$$Operational\ Limit = +14"\ indicated$$

Any Z value greater than 1.65 provides sufficient margin between the NTSP and the Operational Limit to reasonably avoid spurious trip conditions. Per Section 5.6.8 of Input 4.1, the following equations are used to compute Z_{STA}.

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

$$Sigma(STA) = \left(\frac{1}{2}\right)\left(\sqrt{0.4^2 + 0.29^2 + 0.39^2 + 0.5^2 + 0.6^2}\right)\left(\frac{100"}{69.8"\ WC}\right)$$

$$Sigma(STA) = 0.72$$

$$Z_{STA} = \frac{|Adjusted\ NTSP - Operational\ Limit|}{Sigma(STA)}$$

$$Z_{STA} = \frac{|(9.0 + 0.44) - 14|}{0.72}$$

$$Z_{STA} = 6.33$$

Therefore, the NTSP = 9" results in a Z_{STA} much greater than 1.65 and provides sufficient margin between the NTSP and the Operational Limit.

6.6.9 Elevation Correction:

Not applicable.

6.6.10 Instrument Scaling:

The loop values are calculated based on indicated level. The following equation is used to convert the indicated level to mA for the trip unit settings:

$$mA = 4 + \left((50 + L) \times \frac{16}{100}\right)$$

This results in the following values (see Attachment 3 for a graphical representation):

Loop Values	Indicated Level (L) (inches)	Signal (mA)
Instrument Range Upper Limit	+50	20.00
Setpoint (NTSP):	+9	13.44
Loop As-Found Range:	+8.32 to +9.68	13.33 to 13.55
Loop As-Left Range:	+8.56 to +9.44	13.37 to 13.51
$NTSP_2$	≥ +7.37	13.18
Technical Specifications Allowable Value (AV)	≥ +7.0	13.12

$NTSP_1$	≥ +7.1	13.14
AL	≥ -2.5	11.60
Instrument Range Lower Limit	-50	4.00

6.7 Channel Error Calculation

Channel error calculation is not applicable for this trip channel.

7. CONCLUSIONS

The results of the calculations are as follows:

Term	Value	Section
A_{LN}	±0.40" WC	6.3.1
A_{LT}	±0.40" WC	6.3.1
A_{LP}	NA	NA
D_L	±0.39" WC	6.3.3
C_L	±0.29" WC	6.3.2
PEA	±0.5" WC	6.4
PMA	±0.6" WC + 7.1" Water Level	6.4
ORE	0	6.5
IRE	0	6.5
AL	≥ -2.5" Water Level	6.6.1
AV	≥ +7.0" Water Level	6.6.1
$NTSP_1$	≥ +7.1" Water Level	6.6.2
$NTSP_2$	≥ +7.37" Water Level	6.6.3
NTSP	+9" Water Level	6.6.4
ALT_1 (transmitters)	±0.05 mA	6.2.1.5
ALT_2 (trip units)	±0.05 mA	6.2.2.5
AFT_1 (transmitters)	±0.09 mA	6.6.6
AFT_2 (trip units)	±0.06 mA	6.6.6

This calculation has shown that the existing setpoints for the Reactor Low Water Level SCRAM instruments are acceptable.

8. FUTURE NEEDS

8.1 The ALT and AFT have changed for the transmitters and trip units. The CML database and calibration procedures need to be updated to reflect these changes.

9. ATTACHMENTS

1. Drift Analysis
2. Drift Analysis Spreadsheets
3. Setpoint Relationships
4. DRF-0000-0065-8910, Monticello Bernoulli Error for EPU

10. REFERENCES

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

10.2 EPRI TR-103335-R1, Guidelines for Instrument Calibration Extension/Reduction - Revision 1, October 1998.

10.3 NH-36242. Revision AY, P&ID Vessel Instrumentation, Nuclear Boiler System.

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

10.5 Procedure 0004, Revision 23, Reactor Water Low Level SCRAM & Lo-Lo Level Isolation Trip Unit Test and Calibration Procedure.

10.6 Procedure 0021-01, Revision 6, Reactor Low Level SCRAM & Low-Low Level Isolation Transmitter Calibration Procedure.

10.7 NF-100338, Revision F, RPS Channel A1 Analog Trip Cabinet C-304A Elementary Diagram E81EA01.

10.8 NF-100339, Revision E, RPS Channel B1 Analog Trip Cabinet C-304B Elementary Diagram E81EA01.

10.9 NF-100340, Revision E, RPS Channel A2 Analog Trip Cabinet C-304C Elementary Diagram E81EA01.

10.10 NF-100341, Revision E, RPS Channel B2 Analog Trip Cabinet C-304D Elementary Diagram E81EA01.

10.11 IMP-1019, Revision 3, Pneumatic Calibrator Performance Test and Calibration Procedure.

10.12 IMP-1001, Revision 2, Fluke Model 8062A Digital Multimeter Performance Test.

10.13 IMP-1026, Revision 0, Fluke Model 189 Digital Multimeter Performance Test.

10.14 IMP-1008, Revision 1, Rosemount Model 510DU Readout Assembly Performance Test and Calibration.

10.15 NX-7823-4-4, Revision 76, Primary Containment Isolation System.

10.16 NX-7823-4-5, Revision 76, Primary Containment Isolation System.

10.17 GE 10 CFR Part 21 Communication, SC04-14, October 11, 2004. Narrow Range Water Level Instrument L3 Trip Final Report.

10.18 FP-E-CAL-01, Revision 2, February 7, 2006. Fleet Guidance on Calculations.

A1.1 Data Grouping

The following Rosemount model 00710-0002 trip units are included in this analysis:

Equipment ID	Range	Setpoint (desired)
LIS-2-3-657A	4 - 20 mA (-50 to +50 inches)	13.44 mA
LIS-2-3-657B	4 - 20 mA (-50 to +50 inches)	13.44 mA
LIS-2-3-658A	4 - 20 mA (-50 to +50 inches)	13.44 mA
LIS-2-3-658B	4 - 20 mA (-50 to +50 inches)	13.44 mA

As shown in section 6.2.2.2, 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 (Input 12).

A1.2 Populating the Spreadsheet

Calibration data for the trip units 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 Attachment 2.

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.

Only one initial data value for LIS-2-3-658A was eliminated from the analysis (see note on page 6 of Attachment 2). The data point was eliminated due to a malfunctioning trip unit which needed to be repaired. Since the erroneous data was caused by a malfunction, the As-Found data would not accurately represent the drift of this device. Therefore, the As-Found data for that particular calibration data was removed from the data set prior to any statistical analysis.

It is noted that for all trip units analyzed, no calibration adjustments were made for the entire study period, with the exception of the repair to LIS-2-3-658A mentioned in the preceding paragraph.

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

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

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 9 of Attachment 2 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:

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

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 Input 12.

The t-Test is shown on pages 10 through 15 of Attachment 2. Based on a sample size of 252, the critical value utilized in the t-Test is 4.0. 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 Input 12 require that the data set be tested for normality. It is recommended that for samples of over 50 data points, the D' Test be utilized.

D' (D-Prime) Test
The D' Test calculates a test statistic value for the sample population and compares the calculated value to the values for the D' percentage points of the distribution, which are tabulated in Table 9.7 of ESM-03.02-APP-III. The D' Test is two-sided, which means that the two-sided percentage limits at the stated level of significance must bound the calculated D' value. For the given sample size, the calculated value of D' must lie with the two values provided in Table 9.7 in order to accept the hypothesis for normality.

To perform a D' 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 linear combination (T) of the sample group:

$$t_i = \left(i - \frac{n+1}{2}\right) \times x_i$$

$$T = \sum t_i$$

where T = linear combination of the sample
t_i = individual component of T
i = number of sample point
n = total number of data points
x_i = individual sample data point

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

$$D' = \frac{T}{S}$$

Determine the critical D' values based on the sample size using Table 9.7 in Input 12. If the exact sample size is not listed in Table 9.7, interpolate the values to obtain an estimate of the critical D' values.

See pages 16 through 21 of Attachment 2 to see the D' Test for the drift data. For a sample size of 252, the critical D' values are 1107.6 and 1141. The calculated D' value was 1077.53. Based on this results, the assumption of normality is rejected.

Coverage Analysis
Since the assumption of normality was rejected by the D' Test, a coverage analysis was performed per section 4.7.5.E of ESM-03.02-APP-III. A coverage analysis is discussed for cases in which the hypothesis tests reject the assumption of normality, but the assumption of normality may still be a conservative representation of the data. The coverage analysis involves the use of a histogram of the data set, overlaid with the equivalent probability distribution curve for the normal distribution, based on the data sample's mean and standard deviation. Visual examination of the plot is used, and the kurtosis is analyzed to determine if the distribution of the data is near normal. If the data is near normal, then a normal distribution model which adequately covers the set of drift data as observed is derived. This normal distribution will be used as the model for the drift of the device.

Sample counting is used to determine an acceptable normal distribution. The standard deviation of the group is computed. The number of times the samples are within 2 standard deviations of the mean is computed. The count is divided by the total number of samples in the group to determine a percentage. If the percentage of data within 2 standard deviations of the mean is greater than 95.45%, the existing standard deviation is acceptable to be used for the encompassing normal distribution model. In case the percentage is less than required, the standard deviation should be enlarged. The required multiplier for the standard deviation in order to provide this coverage is termed the Normality Adjustment Factor (NAF). If no adjustment is required, the NAF is equal to one.

The coverage analysis is presented on page 22 of Attachment 2. Visual inspection shows a high kurtosis, as most of the data points are found within 1.5 standard deviations of the mean. Calculations using the table on page 22 of Attachment 2 show that 98.1% of the data is encompassed by 2 standard deviations of the mean. Therefore, it is concluded that a normal distribution is a conservative representation of the data, and thus NAF is equal to 1.

A1.6 Selection of Final Data Set

Since the instruments encompassed by this drift analysis are all calibrated to the same point (13.44 mA), no further analysis is required in determining the final data set.

A1.7 Time-Dependency Analysis

Standard statistical analyses do no consider time-dependency. The following tests attempt to uncover any time-related performance and the impact of any time-dependency on the analysis.

Drift Interval Plot
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 23 of Attachment 2 shows the drift interval plot for this data set. The plot shows a scatter of drift values, both positive and negative around the 3 month calibration interval. As this was the most common interval, most of the data points are found near this time period. Based on the equation of the regression line, there may be a slight time-dependency present. The drift interval plot includes the tolerance interval (TI). This tolerance interval is equal to the random drift term calculated in section A1.9.

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 Input 12, 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 (Attachment 2, pages 24-29) shows that only 1 valid bin exists. Therefore, per the criteria in Input 12, the data will be established as moderately time dependent for the purposes of extrapolation of the drift value.

Due to the fact that multiple valid bins did not exist in the binning analysis, no further time-dependency testing is available.

A1.8 Drift Bias Determination

The absolute value of the average calculated drift for the trip units is 0.000 mA. Similarly, the absolute value of the average calculated drift is less than 0.1% of the calibrated span. Therefore, it is concluded that the instrument drift does not have a bias.

A1.9 Analyzed Drift Value

Bias Term
Based on the 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 value of TIF is obtained from Table 9.1 of ESM-03.02-APP-III. Based on a sample size of 252, TIF is equal to 2.121. From the coverage analysis, NAF was determined to be 1. From page 9 of Attachment 2, the standard deviation of the sample is 0.0105. Thus the random term is equal to 0.0223 mA.

3.75-Month 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 0.0223 mA. The extended calibration interval is equal to the surveillance calibration interval (92 days or 3 months) plus an additional 25% (0.75 months). Therefore, CI_E is equal to 3.75 months. CI_O is determined from a valid bin of data with the longest calibration interval.

There was only one valid bin, with a calibration interval range of 1.25 to 3.75 months. The average calibration interval within this bin is equal to 2.9 months. These values produce a 3.75-month predicted drift term of 0.0254 mA.

Per the criteria in step 5.10.4.B, a check was made to ensure that the calculated 30-month predicted drift uncertainty is greater than the uncertainty calculated with the 99%/95% tolerance factor. The uncertainty calculated using the 99%/95% TIF of 2.191 is 0.023 mA. Therefore, the 3.75-month predicted drift uncertainty is 0.0254 mA.

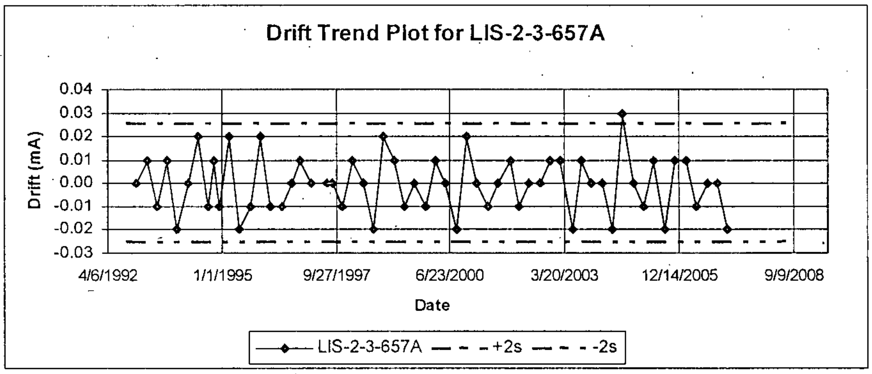
Drift Data for LIS-2-3-657A

Calibration		AF (mA)	AL (mA)	Drift (mA)	Drift (%)
Date	Interval (CI) (Months)				
5/21/2008	3.1	13.46	13.46	-0.01	-0.06
2/15/2008	3.0	13.47	13.47	0.01	0.06
11/16/2007	3.0	13.46	13.46	0.01	0.06
8/17/2007	3.0	13.45	13.45	-0.01	-0.06
5/16/2007	3.0	13.46	13.46	0.03	0.19
2/13/2007	3.0	13.43	13.43	-0.02	-0.12
11/15/2006	3.0	13.45	13.45	0.00	0.00
8/16/2006	3.0	13.45	13.45	0.00	0.00
5/17/2006	3.0	13.45	13.45	-0.01	-0.06
2/15/2006	3.2	13.46	13.46	0.01	0.06
11/10/2005	3.0	13.45	13.45	0.01	0.06
8/10/2005	3.0	13.44	13.44	-0.02	-0.13
5/11/2005	3.0	13.46	13.46	0.01	0.06
2/10/2005	2.9	13.45	13.45	-0.01	-0.06
11/15/2004	3.1	13.46	13.46	0.00	0.00
8/11/2004	3.0	13.46	13.46	0.03	0.19
5/12/2004	3.0	13.43	13.43	-0.02	-0.12
2/11/2004	3.0	13.45	13.45	0.00	0.00
11/12/2003	3.0	13.45	13.45	0.00	0.00
8/13/2003	2.5	13.45	13.45	0.01	0.06
5/28/2003	3.4	13.44	13.44	-0.02	-0.13
2/12/2003	3.0	13.46	13.46	0.01	0.06
11/14/2002	3.0	13.45	13.45	0.01	0.06
8/15/2002	3.0	13.44	13.44	0.00	0.00
5/16/2002	3.0	13.44	13.44	0.00	0.00
2/13/2002	2.2	13.44	13.44	-0.01	-0.06
12/8/2001	3.8	13.45	13.45	0.01	0.06
8/15/2001	3.0	13.44	13.44	0.00	0.00
5/16/2001	3.0	13.44	13.44	-0.01	-0.06
2/13/2001	3.0	13.45	13.45	0.00	0.00
11/15/2000	3.0	13.45	13.45	0.02	0.12
8/17/2000	3.0	13.43	13.43	-0.02	-0.12
5/17/2000	2.8	13.45	13.45	0.00	0.00
2/21/2000	3.1	13.45	13.45	0.01	0.06
11/18/1999	3.0	13.44	13.44	-0.01	-0.06
8/19/1999	3.0	13.45	13.45	0.00	0.00
5/19/1999	3.0	13.45	13.45	-0.01	-0.06
2/17/1999	3.0	13.46	13.46	0.01	0.06
11/18/1998	3.0	13.45	13.45	0.02	0.12
8/19/1998	3.0	13.43	13.43	-0.02	-0.12
5/20/1998	3.0	13.45	13.45	0.00	0.00

2/18/1998	3.0	13.45	13.45	0.01	0.06
11/17/1997	2.9	13.44	13.44	-0.01	-0.06
8/20/1997	1.4	13.45	13.45	0.00	0.00
7/8/1997	4.6	13.45	13.45	0.00	0.00
2/18/1997	3.0	13.45	13.45	0.00	0.00
11/20/1996	2.6	13.45	13.45	0.01	0.06
9/3/1996	3.0	13.44	13.44	0.00	0.00
6/3/1996	3.0	13.44	13.44	-0.01	-0.06
3/5/1996	3.0	13.45	13.45	-0.01	-0.06
12/4/1995	3.0	13.46	13.46	0.02	0.13
9/5/1995	3.0	13.44	13.44	-0.01	-0.06
6/5/1995	3.0	13.45	13.45	-0.02	-0.13
3/7/1995	3.0	13.47	13.47	0.02	0.13
12/5/1994	1.5	13.45	13.45	-0.01	-0.06
10/21/1994	1.5	13.46	13.46	0.01	0.06
9/6/1994	2.8	13.45	13.45	-0.01	-0.06
6/13/1994	3.2	13.46	13.46	0.02	0.13
3/7/1994	3.0	13.44	13.44	0.00	0.00
12/6/1993	3.0	13.44	13.44	-0.02	-0.13
9/7/1993	3.0	13.46	13.46	0.01	0.06
6/8/1993	2.7	13.45	13.45	-0.01	-0.06
3/18/1993	3.2	13.46	13.46	0.01	0.06
12/10/1992	3.0	13.45	13.45	0.00	0.00
9/11/1992		13.45	13.45		

Basic Statistics for LIS-2-3-657A

Average	$\bar{x}$	(mA)	0.00
Standard Deviation	s	(mA)	0.0127
Variance	s^2	(mA)	0.0002
Largest Positive Drift		(mA)	0.03
Largest Negative Drift		(mA)	-0.02
Number of Samples	n		64
Average	$\bar{x}$	(%)	0.00
Standard Deviation	s	(%)	0.0791
Largest Positive Drift		(%)	0.19
Largest Negative Drift		(%)	-0.13



Drift Data for LIS-2-3-657B

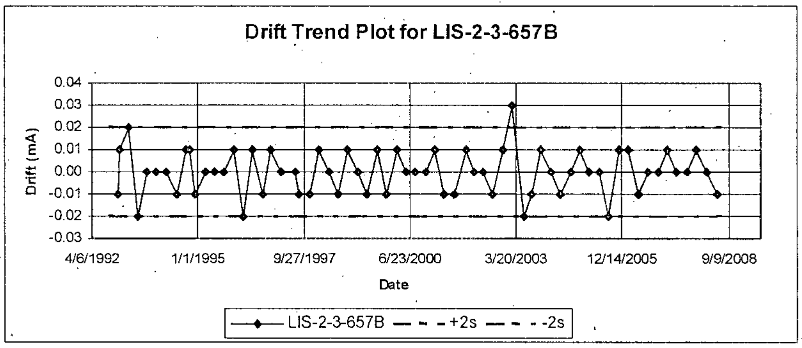
Calibration		AF (mA)	AL (mA)	Drift (mA)	Drift (%)
Date	Interval (CI) (Months)				
5/21/2008	3.1	13.45	13.45	-0.01	-0.06
2/15/2008	3.0	13.46	13.46	0.00	0.00
11/16/2007	3.0	13.46	13.46	0.01	0.06
8/17/2007	3.0	13.45	13.45	0.00	0.00
5/16/2007	3.0	13.45	13.45	0.00	0.00
2/13/2007	3.0	13.45	13.45	0.01	0.06
11/15/2006	3.0	13.44	13.44	0.00	0.00
8/16/2006	3.0	13.44	13.44	0.00	0.00
5/17/2006	3.0	13.44	13.44	-0.01	-0.06
2/15/2006	3.2	13.45	13.45	0.01	0.06
11/10/2005	3.0	13.44	13.44	0.01	0.06
8/10/2005	3.0	13.43	13.43	-0.02	-0.12
5/11/2005	3.0	13.45	13.45	0.00	0.00
2/10/2005	2.9	13.45	13.45	0.00	0.00
11/15/2004	3.1	13.45	13.45	0.01	0.06
8/11/2004	3.0	13.44	13.44	0.00	0.00
5/12/2004	3.0	13.44	13.44	-0.01	-0.06
2/11/2004	3.0	13.45	13.45	0.00	0.00
11/12/2003	3.0	13.45	13.45	0.01	0.06
8/13/2003	2.5	13.44	13.44	-0.01	-0.06
5/28/2003	3.4	13.45	13.45	-0.02	-0.13
2/12/2003	3.0	13.47	13.47	0.03	0.19
11/14/2002	3.0	13.44	13.44	0.01	0.06
8/15/2002	3.0	13.43	13.43	-0.01	-0.06
5/16/2002	3.0	13.44	13.44	0.00	0.00
2/13/2002	2.2	13.44	13.44	0.00	0.00
12/8/2001	3.8	13.44	13.44	0.01	0.06
8/15/2001	3.0	13.43	13.43	-0.01	-0.06

5/16/2001	3.0	13.44	13.44	-0.01	-0.06
2/13/2001	3.0	13.45	13.45	0.01	0.06
11/15/2000	3.0	13.44	13.44	0.00	0.00
8/17/2000	3.0	13.44	13.44	0.00	0.00
5/17/2000	2.8	13.44	13.44	0.00	0.00
2/21/2000	3.1	13.44	13.44	0.01	0.06
11/18/1999	3.0	13.43	13.43	-0.01	-0.06
8/19/1999	3.0	13.44	13.44	0.01	0.06
5/19/1999	3.0	13.43	13.43	-0.01	-0.06
2/17/1999	3.0	13.44	13.44	0.00	0.00
11/18/1998	3.0	13.44	13.44	0.01	0.06
8/19/1998	3.0	13.43	13.43	-0.01	-0.06
5/20/1998	3.0	13.44	13.44	0.00	0.00
2/18/1998	3.0	13.44	13.44	0.01	0.06
11/17/1997	2.9	13.43	13.43	-0.01	-0.06
8/20/1997	1.4	13.44	13.44	-0.01	-0.06
7/8/1997	4.6	13.45	13.45	0.00	0.00
2/18/1997	3.0	13.45	13.45	0.00	0.00
11/20/1996	2.6	13.45	13.45	0.01	0.06
9/3/1996	3.0	13.44	13.44	-0.01	-0.06
6/3/1996	3.0	13.45	13.45	0.01	0.06
3/5/1996	3.0	13.44	13.44	-0.02	-0.13
12/4/1995	3.0	13.46	13.46	0.01	0.06
9/5/1995	3.0	13.45	13.45	0.00	0.00
6/5/1995	3.0	13.45	13.45	0.00	0.00
3/7/1995	3.0	13.45	13.45	0.00	0.00
12/5/1994	1.5	13.45	13.45	-0.01	-0.06
10/21/1994	1.5	13.46	13.46	0.01	0.06
9/6/1994	2.8	13.45	13.45	0.01	0.06
6/13/1994	3.2	13.44	13.44	-0.01	-0.06
3/7/1994	3.0	13.45	13.45	0.00	0.00
12/6/1993	3.0	13.45	13.45	0.00	0.00
9/7/1993	3.0	13.45	13.45	0.00	0.00
6/8/1993	2.7	13.45	13.45	-0.02	-0.13
3/18/1993	3.0	13.47	13.47	0.02	0.13
12/17/1992	0.2	13.45	13.45	0.01	0.06
12/10/1992	3.0	13.44	13.44	-0.01	-0.06
9/11/1992		13.45	13.45		

Basic Statistics for LIS-2-3-657B

Average	$\overline{x}$	(mA)	0.00
Standard Deviation	s	(mA)	0.0100
Variance	s^2	(mA)	0.0001
Largest Positive Drift		(mA)	0.03
Largest Negative Drift		(mA)	-0.02

Number of Samples	n		65
Average	$\overline{x}$	(%)	0.00
Standard Deviation	s	(%)	0.0625
Largest Positive Drift		(%)	0.19
Largest Negative Drift		(%)	-0.13



Drift Data for LIS-2-3-658A

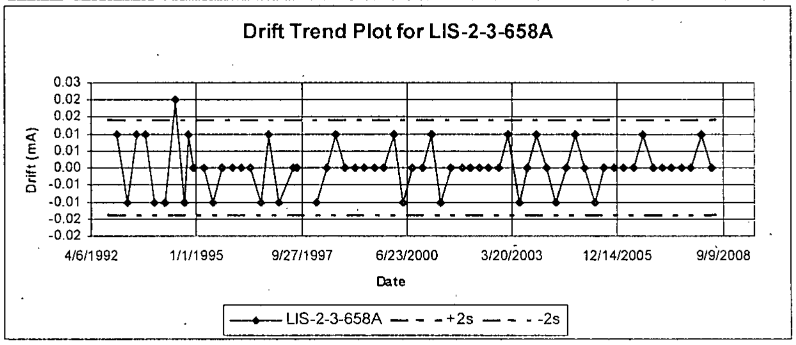
Calibration Date	Calibration Interval (CI) (Months)	AF (mA)	AL (mA)	Drift (mA)	Drift (%)
5/21/2008	3.1	13.47	13.47	0.00	0.00
2/15/2008	3.0	13.47	13.47	0.01	0.06
11/16/2007	3.0	13.46	13.46	0.00	0.00
8/17/2007	3.0	13.46	13.46	0.00	0.00
5/16/2007	3.0	13.46	13.46	0.00	0.00
2/13/2007	3.0	13.46	13.46	0.00	0.00
11/15/2006	3.0	13.46	13.46	0.00	0.00
8/16/2006	3.0	13.46	13.46	0.01	0.06
5/17/2006	3.0	13.45	13.45	0.00	0.00
2/15/2006	3.2	13.45	13.45	0.00	0.00
11/10/2005	3.0	13.45	13.45	0.00	0.00
8/10/2005	3.0	13.45	13.45	0.00	0.00
5/11/2005	3.0	13.45	13.45	-0.01	-0.06
2/10/2005	2.9	13.46	13.46	0.00	0.00
11/15/2004	3.1	13.46	13.46	0.01	0.06
8/11/2004	3.0	13.45	13.45	0.00	0.00
5/12/2004	3.0	13.45	13.45	-0.01	-0.06
2/11/2004	3.0	13.46	13.46	0.00	0.00
11/12/2003	3.0	13.46	13.46	0.01	0.06
8/13/2003	2.5	13.45	13.45	0.00	0.00
5/28/2003	3.4	13.45	13.45	-0.01	-0.06
2/12/2003	3.0	13.46	13.46	0.01	0.06

11/14/2002	3.0	13.45	13.45	0.00	0.00
8/15/2002	3.0	13.45	13.45	0.00	0.00
5/16/2002	3.0	13.45	13.45	0.00	0.00
2/13/2002	2.2	13.45	13.45	0.00	0.00
12/8/2001	3.8	13.45	13.45	0.00	0.00
8/15/2001	3.0	13.45	13.45	0.00	0.00
5/16/2001	3.0	13.45	13.45	-0.01	-0.06
2/13/2001	3.0	13.46	13.46	0.01	0.06
11/15/2000	3.0	13.45	13.45	0.00	0.00
8/17/2000	3.0	13.45	13.45	0.00	0.00
5/17/2000	2.8	13.45	13.45	-0.01	-0.06
2/21/2000	3.1	13.46	13.46	0.01	0.06
11/18/1999	3.0	13.45	13.45	0.00	0.00
8/19/1999	3.0	13.45	13.45	0.00	0.00
5/19/1999	3.0	13.45	13.45	0.00	0.00
2/17/1999	3.0	13.45	13.45	0.00	0.00
11/18/1998	3.0	13.45	13.45	0.00	0.00
8/19/1998	3.0	13.45	13.45	0.01	0.06
5/20/1998	3.0	13.44	13.44	0.00	0.00
2/18/1998	3.0	13.44	13.44	-0.01	-0.06
11/17/1997	2.9	13.38	13.45		
8/20/1997	1.4	13.43	13.43	0.00	0.00
7/8/1997	4.6	13.43	13.43	0.00	0.00
2/18/1997	3.0	13.43	13.43	-0.01	-0.06
11/20/1996	2.6	13.44	13.44	0.01	0.06
9/3/1996	3.0	13.43	13.43	-0.01	-0.06
6/3/1996	3.0	13.44	13.44	0.00	0.00
3/5/1996	3.0	13.44	13.44	0.00	0.00
12/4/1995	3.0	13.44	13.44	0.00	0.00
9/5/1995	3.0	13.44	13.44	0.00	0.00
6/5/1995	3.0	13.44	13.44	-0.01	-0.06
3/7/1995	3.0	13.45	13.45	0.00	0.00
12/5/1994	1.5	13.45	13.45	0.00	0.00
10/21/1994	1.5	13.45	13.45	0.01	0.06
9/6/1994	2.8	13.44	13.44	-0.01	-0.06
6/13/1994	3.2	13.45	13.45	0.02	0.12
3/7/1994	3.0	13.43	13.43	-0.01	-0.06
12/6/1993	3.0	13.44	13.44	-0.01	-0.06
9/7/1993	3.0	13.45	13.45	0.01	0.06
6/8/1993	2.7	13.44	13.44	0.01	0.06
3/18/1993	3.2	13.43	13.43	-0.01	-0.06
12/10/1992	3.0	13.44	13.44	0.01	0.06
9/11/1992		13.43	13.43		0.00

NOTE: During the calibration on 11/17/97, it was found that the trip unit was malfunctioning and needed to be repaired. Since this is not indicative of drift, this data point was not included in the analysis.

Basic Statistics for LIS-2-3-658A

Average	$\bar{x}$	(mA)	0.00
Standard Deviation	s	(mA)	0.0069
Variance	s²	(mA)	0.0000
Largest Positive Drift		(mA)	0.02
Largest Negative Drift		(mA)	-0.01
Number of Samples	n		63
Average	$\bar{x}$	(%)	0.00
Standard Deviation	s	(%)	0.0434
Largest Positive Drift		(%)	0.12
Largest Negative Drift		(%)	-0.06



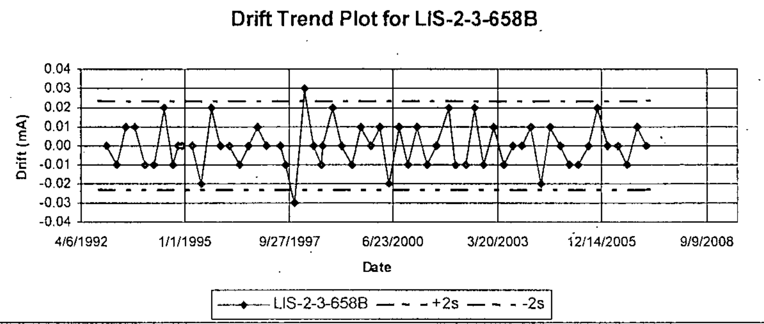
Drift Data for LIS-2-3-658B

Calibration		AF (mA)	AL (mA)	Drift (mA)	Drift (%)
Date	Interval (CI) (Months)				
2/13/2007	3.0	13.44	13.44	0.00	0.00
11/15/2006	3.0	13.44	13.44	0.01	0.06
8/16/2006	3.0	13.43	13.43	-0.01	-0.06
5/17/2006	3.0	13.44	13.44	0.00	0.00
2/15/2006	3.2	13.44	13.44	0.00	0.00
11/10/2005	3.0	13.44	13.44	0.02	0.12
8/10/2005	3.0	13.42	13.42	0.00	0.00
5/11/2005	3.0	13.42	13.42	-0.01	-0.06
2/10/2005	2.9	13.43	13.43	-0.01	-0.06
11/15/2004	3.1	13.44	13.44	0.00	0.00
8/11/2004	3.0	13.44	13.44	0.01	0.06
5/12/2004	3.0	13.43	13.43	-0.02	-0.12
2/11/2004	3.0	13.45	13.45	0.01	0.06
11/12/2003	3.0	13.44	13.44	0.00	0.00
8/13/2003	2.5	13.44	13.44	0.00	0.00
5/28/2003	3.4	13.44	13.44	-0.01	-0.06

2/12/2003	3.0	13.45	13.45	0.01	0.06
11/14/2002	3.0	13.44	13.44	-0.01	-0.06
8/15/2002	3.0	13.45	13.45	0.02	0.12
5/16/2002	3.0	13.43	13.43	-0.01	-0.06
2/13/2002	2.2	13.44	13.44	-0.01	-0.06
12/8/2001	3.8	13.45	13.45	0.02	0.12
8/15/2001	3.0	13.43	13.43	0.00	0.00
5/16/2001	3.0	13.43	13.43	-0.01	-0.06
2/13/2001	3.0	13.44	13.44	0.01	0.06
11/15/2000	3.0	13.43	13.43	-0.01	-0.06
8/17/2000	3.0	13.44	13.44	0.01	0.06
5/17/2000	2.8	13.43	13.43	-0.02	-0.12
2/21/2000	3.1	13.45	13.45	0.01	0.06
11/18/1999	3.0	13.44	13.44	0.00	0.00
8/19/1999	3.0	13.44	13.44	0.01	0.06
5/19/1999	3.0	13.43	13.43	-0.01	-0.06
2/17/1999	3.0	13.44	13.44	0.00	0.00
11/18/1998	3.0	13.44	13.44	0.02	0.12
8/19/1998	0.7	13.42	13.42	0.00	0.00
7/29/1998	2.3	13.42	13.42	-0.01	-0.06
5/20/1998	3.0	13.43	13.43	0.00	0.00
2/18/1998	3.0	13.43	13.43	0.03	0.19
11/17/1997	2.9	13.40	13.40	-0.03	-0.19
8/20/1997	1.4	13.43	13.43	-0.01	-0.06
7/8/1997	4.6	13.44	13.44	0.00	0.00
2/18/1997	3.0	13.44	13.44	0.00	0.00
11/20/1996	2.6	13.44	13.44	0.01	0.06
9/3/1996	3.0	13.43	13.43	0.00	0.00
6/3/1996	3.0	13.43	13.43	-0.01	-0.06
3/5/1996	3.0	13.44	13.44	0.00	0.00
12/4/1995	3.0	13.44	13.44	0.00	0.00
9/5/1995	3.0	13.44	13.44	0.02	0.12
6/5/1995	3.0	13.42	13.42	-0.02	-0.12
3/7/1995	3.0	13.44	13.44	0.00	0.00
12/5/1994	1.5	13.44	13.44	0.00	0.00
10/21/1994	1.5	13.44	13.44	0.00	0.00
9/6/1994	2.8	13.44	13.44	-0.01	-0.06
6/13/1994	3.2	13.45	13.45	0.02	0.12
3/7/1994	3.0	13.43	13.43	-0.01	-0.06
12/6/1993	3.0	13.44	13.44	-0.01	-0.06
9/7/1993	3.0	13.45	13.45	0.01	0.06
6/8/1993	2.7	13.44	13.44	0.01	0.06
3/18/1993	3.2	13.43	13.43	-0.01	-0.06
12/10/1992	3.0	13.44	13.44	0.00	0.00
9/11/1992		13.44	13.44		

Basic Statistics for LIS-2-3-658B

Average	$\bar{x}$	(mA)	0.00
Standard Deviation	s	(mA)	0.0118
Variance	s²	(mA)	0.0001
Largest Positive Drift		(mA)	0.03
Largest Negative Drift		(mA)	-0.03
Number of Samples	n		60
Average	$\bar{x}$	(%)	0.00
Standard Deviation	s	(%)	0.0737
Largest Positive Drift		(%)	0.19
Largest Negative Drift		(%)	-0.19



Basic Statistics for Combined Drift Data

Average	mean	(mA)	0.00
Standard Deviation	s	(mA)	0.0105
Variance	s²	(mA)	0.0001
Largest Positive Drift		(mA)	0.03
Largest Negative Drift		(mA)	-0.03
Number of Samples	n		252
Average	mean	(%)	0.00
Standard Deviation	s	(%)	0.0657
Largest Positive Drift		(%)	0.19
Largest Negative Drift		(%)	-0.19

Outlier Test (t-Test) for Combined Data Set

Equipment ID	CI (Months)	Drift Value (mA)	T	Outlier? YES/NO
LIS-2-3-657A	3.1	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	3.0	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.03	2.84	NO
	3.0	-0.02	1.92	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.2	0.01	0.94	NO
	3.0	0.01	0.94	NO
	3.0	-0.02	1.92	NO
	3.0	0.01	0.94	NO
	2.9	-0.01	0.96	NO
	3.1	0.00	0.01	NO
	3.0	0.03	2.84	NO
	3.0	-0.02	1.92	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	2.5	0.01	0.94	NO
	3.4	-0.02	1.92	NO
	3.0	0.01	0.94	NO
	3.0	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	2.2	-0.01	0.96	NO
	3.8	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	0.02	1.89	NO
	3.0	-0.02	1.92	NO
	2.8	0.00	0.01	NO
	3.1	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	3.0	0.02	1.89	NO
	3.0	-0.02	1.92	NO
	3.0	0.00	0.01	NO

	3.0	0.01	0.94	NO
	2.9	-0.01	0.96	NO
	1.4	0.00	0.01	NO
	4.6	0.00	0.01	NO
	3.0	0.00	0.01	NO
	2.6	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.0	-0.01	0.96	NO
	3.0	0.02	1.89	NO
	3.0	-0.01	0.96	NO
	3.0	-0.02	1.92	NO
	3.0	0.02	1.89	NO
	1.5	-0.01	0.96	NO
	1.5	0.01	0.94	NO
	2.8	-0.01	0.96	NO
	3.2	0.02	1.89	NO
	3.0	0.00	0.01	NO
	3.0	-0.02	1.92	NO
	3.0	0.01	0.94	NO
	2.7	-0.01	0.96	NO
	3.2	0.01	0.94	NO
	3.0	0.00	0.01	NO
LIS-2-3-657B	3.1	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.2	0.01	0.94	NO
	3.0	0.01	0.94	NO
	3.0	-0.02	1.92	NO
	3.0	0.00	0.01	NO
	2.9	0.00	0.01	NO
	3.1	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	0.01	0.94	NO
	2.5	-0.01	0.96	NO
	3.4	-0.02	1.92	NO
	3.0	0.03	2.84	NO

	3.0	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	2.2	0.00	0.01	NO
	3.8	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	2.8	0.00	0.01	NO
	3.1	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	0.01	0.94	NO
	2.9	-0.01	0.96	NO
	1.4	-0.01	0.96	NO
	4.6	0.00	0.01	NO
	3.0	0.00	0.01	NO
	2.6	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	3.0	-0.02	1.92	NO
	3.0	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	1.5	-0.01	0.96	NO
	1.5	0.01	0.94	NO
	2.8	0.01	0.94	NO
	3.2	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	2.7	-0.02	1.92	NO
	3.0	0.02	1.89	NO
	0.2	0.01	0.94	NO
	3.0	-0.01	0.96	NO
LIS-2-3-658A	3.1	0.00	0.01	NO
	3.0	0.01	0.94	NO

	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.2	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	2.9	0.00	0.01	NO
	3.1	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	0.01	0.94	NO
	2.5	0.00	0.01	NO
	3.4	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	2.2	0.00	0.01	NO
	3.8	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	2.8	-0.01	0.96	NO
	3.1	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	1.4	0.00	0.01	NO
	4.6	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	2.6	0.01	0.94	NO
	3.0	-0.01	0.96	NO

	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	1.5	0.00	0.01	NO
	1.5	0.01	0.94	NO
	2.8	-0.01	0.96	NO
	3.2	0.02	1.89	NO
	3.0	-0.01	0.96	NO
	3.0	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	2.7	0.01	0.94	NO
	3.2	-0.01	0.96	NO
	3.0	0.01	0.94	NO
LIS-2-3-658B	3.0	0.00	0.01	NO
	3.0	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.2	0.00	0.01	NO
	3.0	0.02	1.89	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	2.9	-0.01	0.96	NO
	3.1	0.00	0.01	NO
	3.0	0.01	0.94	NO
	3.0	-0.02	1.92	NO
	3.0	0.01	0.94	NO
	3.0	0.00	0.01	NO
	2.5	0.00	0.01	NO
	3.4	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.02	1.89	NO
	3.0	-0.01	0.96	NO
	2.2	-0.01	0.96	NO
	3.8	0.02	1.89	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	2.8	-0.02	1.92	NO
	3.1	0.01	0.94	NO

	3.0	0.00	0.01	NO
	3.0	0.01	0.94	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	0.02	1.89	NO
	0.7	0.00	0.01	NO
	2.3	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	0.03	2.84	NO
	2.9	-0.03	2.87	NO
	1.4	-0.01	0.96	NO
	4.6	0.00	0.01	NO
	3.0	0.00	0.01	NO
	2.6	0.01	0.94	NO
	3.0	0.00	0.01	NO
	3.0	-0.01	0.96	NO
	3.0	0.00	0.01	NO
	3.0	0.00	0.01	NO
	3.0	0.02	1.89	NO
	3.0	-0.02	1.92	NO
	3.0	0.00	0.01	NO
	1.5	0.00	0.01	NO
	1.5	0.00	0.01	NO
	2.8	-0.01	0.96	NO
	3.2	0.02	1.89	NO
	3.0	-0.01	0.96	NO
	3.0	-0.01	0.96	NO
	3.0	0.01	0.94	NO
	2.7	0.01	0.94	NO
	3.2	-0.01	0.96	NO
	3.0	0.00	0.01	NO

The outlier test shows that none of the individual T-statistics exceed the critical value of 4.0. The critical value was obtained from Table 9.2 of ESM-03.02-APP-III. Therefore, the data set contains no outliers.

Normality Test – D' Test

Data # (i)	Drift (mA)	Ti
1	-0.03	3.76
2	-0.02	2.49
3	-0.02	2.47
4	-0.02	2.45
5	-0.02	2.43
6	-0.02	2.41
7	-0.02	2.39
8	-0.02	2.37
9	-0.02	2.35
10	-0.02	2.33
11	-0.02	2.31
12	-0.02	2.29
13	-0.02	2.27
14	-0.02	2.25
15	-0.02	2.23
16	-0.02	2.21
17	-0.01	1.10
18	-0.01	1.09
19	-0.01	1.08
20	-0.01	1.07
21	-0.01	1.06
22	-0.01	1.05
23	-0.01	1.04
24	-0.01	1.03
25	-0.01	1.02
26	-0.01	1.01
27	-0.01	1.00
28	-0.01	0.99
29	-0.01	0.98
30	-0.01	0.97
31	-0.01	0.96
32	-0.01	0.94
33	-0.01	0.93
34	-0.01	0.92
35	-0.01	0.91
36	-0.01	0.90
37	-0.01	0.89
38	-0.01	0.88
39	-0.01	0.87
40	-0.01	0.86
41	-0.01	0.85

42	-0.01	0.84
43	-0.01	0.83
44	-0.01	0.82
45	-0.01	0.81
46	-0.01	0.80
47	-0.01	0.79
48	-0.01	0.78
49	-0.01	0.77
50	-0.01	0.76
51	-0.01	0.75
52	-0.01	0.74
53	-0.01	0.73
54	-0.01	0.72
55	-0.01	0.71
56	-0.01	0.70
57	-0.01	0.69
58	-0.01	0.68
59	-0.01	0.67
60	-0.01	0.66
61	-0.01	0.65
62	-0.01	0.64
63	-0.01	0.63
64	-0.01	0.62
65	-0.01	0.61
66	-0.01	0.60
67	-0.01	0.59
68	-0.01	0.58
69	-0.01	0.57
70	-0.01	0.56
71	-0.01	0.55
72	-0.01	0.54
73	-0.01	0.53
74	-0.01	0.52
75	-0.01	0.51
76	-0.01	0.50
77	-0.01	0.49
78	0.00	0.00
79	0.00	0.00
80	0.00	0.00
81	0.00	0.00
82	0.00	0.00
83	0.00	0.00
84	0.00	0.00
85	0.00	0.00
86	0.00	0.00

87	0.00	0.00
88	0.00	0.00
89	0.00	0.00
90	0.00	0.00
91	0.00	0.00
92	0.00	0.00
93	0.00	0.00
94	0.00	0.00
95	0.00	0.00
96	0.00	0.00
97	0.00	0.00
98	0.00	0.00
99	0.00	0.00
100	0.00	0.00
101	0.00	0.00
102	0.00	0.00
103	0.00	0.00
104	0.00	0.00
105	0.00	0.00
106	0.00	0.00
107	0.00	0.00
108	0.00	0.00
109	0.00	0.00
110	0.00	0.00
111	0.00	0.00
112	0.00	0.00
113	0.00	0.00
114	0.00	0.00
115	0.00	0.00
116	0.00	0.00
117	0.00	0.00
118	0.00	0.00
119	0.00	0.00
120	0.00	0.00
121	0.00	0.00
122	0.00	0.00
123	0.00	0.00
124	0.00	0.00
125	0.00	0.00
126	0.00	0.00
127	0.00	0.00
128	0.00	0.00
129	0.00	0.00
130	0.00	0.00
131	0.00	0.00

132	0.00	0.00
133	0.00	0.00
134	0.00	0.00
135	0.00	0.00
136	0.00	0.00
137	0.00	0.00
138	0.00	0.00
139	0.00	0.00
140	0.00	0.00
141	0.00	0.00
142	0.00	0.00
143	0.00	0.00
144	0.00	0.00
145	0.00	0.00
146	0.00	0.00
147	0.00	0.00
148	0.00	0.00
149	0.00	0.00
150	0.00	0.00
151	0.00	0.00
152	0.00	0.00
153	0.00	0.00
154	0.00	0.00
155	0.00	0.00
156	0.00	0.00
157	0.00	0.00
158	0.00	0.00
159	0.00	0.00
160	0.00	0.00
161	0.00	0.00
162	0.00	0.00
163	0.00	0.00
164	0.00	0.00
165	0.00	0.00
166	0.00	0.00
167	0.00	0.00
168	0.00	0.00
169	0.00	0.00
170	0.00	0.00
171	0.00	0.00
172	0.00	0.00
173	0.00	0.00
174	0.00	0.00
175	0.00	0.00
176	0.00	0.00

177	0.01	0.50
178	0.01	0.51
179	0.01	0.52
180	0.01	0.53
181	0.01	0.54
182	0.01	0.55
183	0.01	0.56
184	0.01	0.57
185	0.01	0.58
186	0.01	0.59
187	0.01	0.60
188	0.01	0.61
189	0.01	0.62
190	0.01	0.63
191	0.01	0.64
192	0.01	0.65
193	0.01	0.66
194	0.01	0.67
195	0.01	0.68
196	0.01	0.69
197	0.01	0.70
198	0.01	0.71
199	0.01	0.72
200	0.01	0.73
201	0.01	0.74
202	0.01	0.75
203	0.01	0.76
204	0.01	0.77
205	0.01	0.78
206	0.01	0.79
207	0.01	0.80
208	0.01	0.81
209	0.01	0.82
210	0.01	0.83
211	0.01	0.84
212	0.01	0.85
213	0.01	0.86
214	0.01	0.87
215	0.01	0.88
216	0.01	0.89
217	0.01	0.90
218	0.01	0.91
219	0.01	0.93
220	0.01	0.94
221	0.01	0.95

222	0.01	0.96
223	0.01	0.97
224	0.01	0.98
225	0.01	0.99
226	0.01	1.00
227	0.01	1.01
228	0.01	1.02
229	0.01	1.03
230	0.01	1.04
231	0.01	1.05
232	0.01	1.06
233	0.01	1.07
234	0.01	1.08
235	0.01	1.09
236	0.02	2.19
237	0.02	2.21
238	0.02	2.23
239	0.02	2.25
240	0.02	2.27
241	0.02	2.29
242	0.02	2.31
243	0.02	2.33
244	0.02	2.35
245	0.02	2.37
246	0.02	2.39
247	0.02	2.41
248	0.02	2.43
249	0.03	3.67
250	0.03	3.71
251	0.03	3.74
252	0.03	3.77

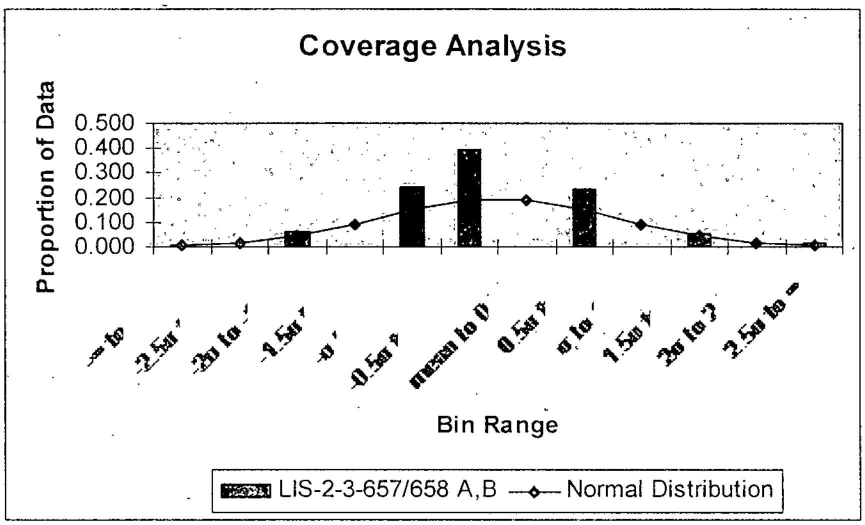
D' Test Analysis

S^2	0.0277	
Total (n)	252	
T	179.33	
95% Significance Limits	1107.6	1141
D'	1077.53	

Since the result of the D' test show the calculated value of D' is outside the 95% significance interval, the assumption of normality is rejected. According to this statistical test, the data set does not fall under the criteria of a normal distribution.

Normality Test – Coverage Analysis

Bin #	Bin Range	# Per Bin	Proportion Per Bin	Normal Distribution
1	-∞ to -2.5σ	1	0.004	0.0062
2	-2.5σ to -2σ	0	0.000	0.0166
3	-2σ to -1.5σ	15	0.060	0.0440
4	-1.5σ to -σ	0	0.000	0.0919
5	-σ to -0.5σ	61	0.242	0.1498
6	-0.5σ to mean	99	0.393	0.1915
7	mean to 0.5σ	0	0.000	0.1915
8	0.5σ to σ	59	0.234	0.1498
9	σ to 1.5σ	0	0.000	0.0919
10	1.5σ to 2σ	13	0.052	0.0440
11	2σ to 2.5σ	0	0.000	0.0166
12	2.5σ to ∞	4	0.016	0.0062



Drift Tolerance Interval (TI)

TI = s * TIF * NAF	
s =	0.0105
TIF =	2.121
NAF =	1
TI =	**0.0223**

MONTICELLO NUCLEAR GENERATING PLANT		CA-95-073
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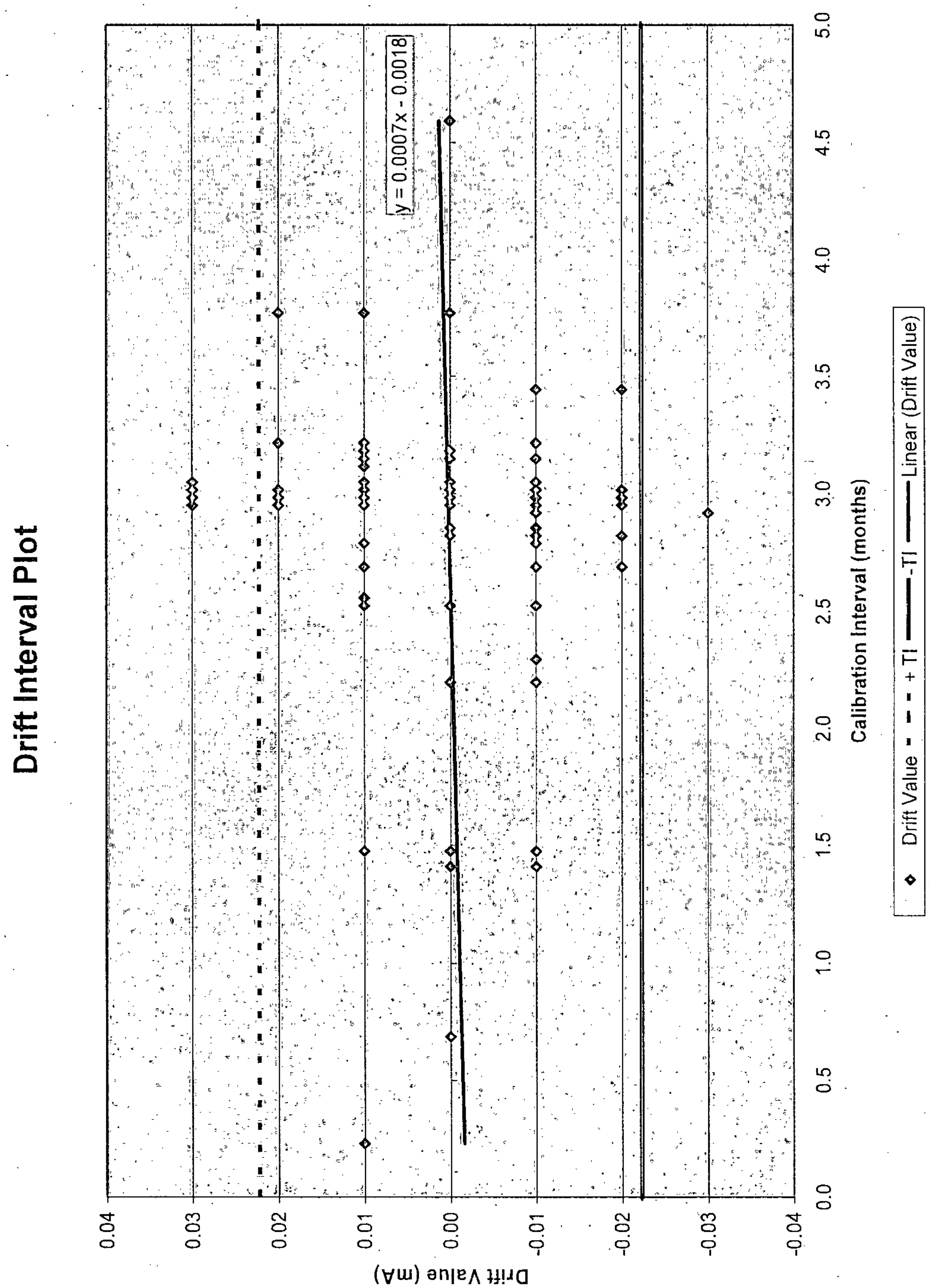
Time Dependency Testing – Drift Interval plot



Time Dependency Testing – Binning Analysis

Bin Ranges (months)		
0 to 1.25	**> 1.25 to 3.75**	**> 3.75 to 7.5**
0.01	-0.01	0.01
0.00	0.01	0.00
	0.01	0.01
	-0.01	0.00
	0.03	0.00
	-0.02	0.00
	0.00	0.02
	0.00	0.00
	-0.01	
	0.01	
	0.01	
	-0.02	
	0.01	
	-0.01	
	0.00	
	0.03	
	-0.02	
	0.00	
	0.00	
	0.01	
	-0.02	
	0.01	
	0.01	
	0.00	
	0.00	
	-0.01	
	0.00	
	-0.01	
	0.00	
	0.02	
	-0.02	
	0.00	
	0.01	
	-0.01	
	0.00	
	-0.01	
	0.01	
	0.02	
	-0.02	
	0.00	
	0.01	

	-0.01	
	0.00	
	0.00	
	0.01	
	0.00	
	-0.01	
	-0.01	
	0.02	
	-0.01	
	-0.02	
	0.02	
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	0.00	
	0.00	
	0.01	
	0.00	
	0.00	
	-0.01	
	0.01	
	0.01	
	-0.02	
	0.00	
	0.00	
	0.01	
	0.00	
	-0.01	
	0.00	
	0.01	
	-0.01	
	-0.02	
	0.03	
	0.01	
	-0.01	

	0.00	
	0.00	
	-0.01	
	-0.01	
	0.01	
	0.00	
	0.00	
	0.00	
	0.01	
	-0.01	
	0.01	
	-0.01	
	0.00	
	0.01	
	-0.01	
	0.00	
	0.01	
	-0.01	
	-0.01	
	0.00	
	0.01	
	-0.01	
	0.01	
	-0.02	
	0.01	
	0.00	
	0.00	
	0.00	
	-0.01	
	0.01	
	0.01	
	-0.01	
	0.00	
	0.00	
	0.00	
	-0.02	
	0.02	
	-0.01	
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	0.01	
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	0.01	
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	0.00	
	-0.01	
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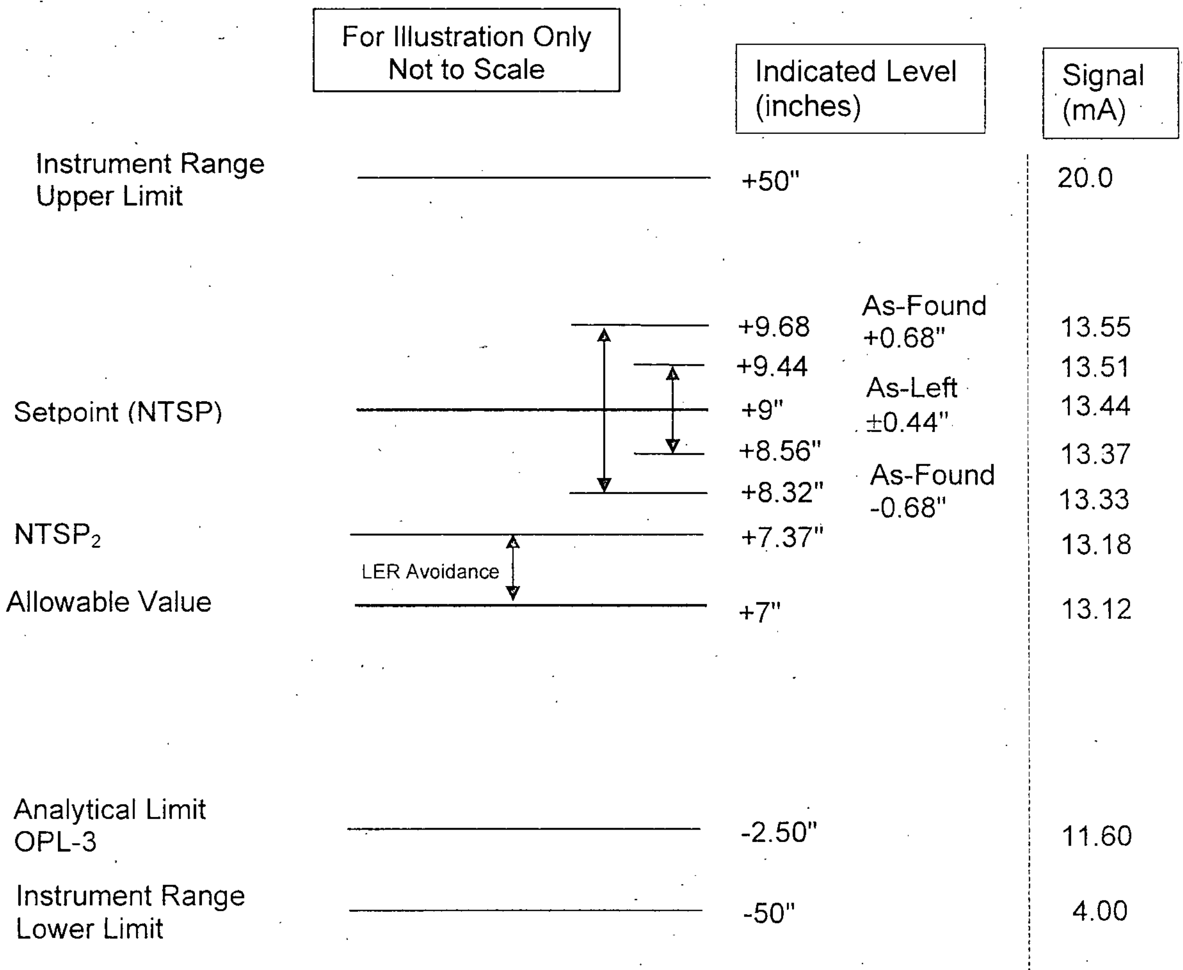
	0.00	
	-0.01	
	0.00	
	0.00	

	0.01	
	-0.01	
	0.02	
	-0.01	
	-0.01	
	0.01	
	0.01	
	-0.01	
	0.01	
	0.00	
	0.01	
	-0.01	
	0.00	
	0.00	
	0.02	
	0.00	
	-0.01	
	-0.01	
	0.00	
	0.01	
	-0.02	
	0.01	
	0.00	
	0.00	
	-0.01	
	0.01	
	-0.01	
	0.02	
	-0.01	
	-0.01	
	0.00	
	-0.01	
	0.01	
	-0.01	
	0.01	
	-0.02	
	0.01	
	0.00	
	0.01	
	-0.01	
	0.00	
	0.02	
	-0.01	
	0.00	
	0.03	

	-0.03	
	-0.01	
	0.00	
	0.01	
	0.00	
	-0.01	
	0.00	
	0.00	
	0.02	
	-0.02	
	0.00	
	0.00	
	0.00	
	-0.01	
	0.02	
	-0.01	
	-0.01	
	0.01	
	0.01	
	-0.01	
	0.00	
0 to 1.25 **(Total Data Points)**	**> 1.25 to 3.75** **(Total Data Points)**	**> 3.75 to 7.5** **(Total Data Points)**
2	242	8

ESM-03.02-APP-III sets forth criteria to perform the binning analysis. One of the requirements is that there are multiple valid bins. A bin is considered valid if it contains at least 5 data points and 10% of the total data. Only the middle bin (> 1.25 to 3.75) meets the criteria. Therefore, the complete binning analysis cannot be performed on this data. Per the instruction in ESM-03.02-APP-III, the data is considered **moderately time dependent**.

MONTICELLO NUCLEAR GENERATING PLANT		CA-95-073
TITLE:	**Reactor Low Water Level SCRAM Setpoint Setpoint Relationships**	Revision 4
		Attachment 3 Page 1 of 1



$$Loop\ As-Left = \pm\sqrt{ALT_1^{\,2} + ALT_2^{\,2}} \times \frac{100''}{16\ mA}$$

$$Loop\ As-Left = \pm\sqrt{0.05^2 + 0.05^2} \times \frac{100''}{16\ mA}$$

$$Loop\ As-Left = \pm 0.44''$$

$$Loop\ As-Found = \pm\sqrt{AFT_1^{\,2} + AFT_2^{\,2}} \times \frac{100''}{16\ mA}$$

$$Loop\ As-Found = \pm\sqrt{0.09^2 + 0.06^2} \times \frac{100''}{16\ mA}$$

$$Loop\ As-Found = \pm 0.68''$$

Title: Monticello Bernoulli Error for EPU		
GE Proprietary Information File Name: Monticello Bernoulli Error for EPU2.doc	Originator: Y. Dayal	Date: 3/11/08
DRF Number: 0000-0065-8910 Section Number: 0000-0078-5591 R2	GE Calculation Results	Sheet 1 of 1

Summary

GE has performed a Bernoulli error (also called Steam Flow Induced error, SFIE) calculation applicable to the L3 setpoint for Monticello operating at EPU conditions, using the revised L3 AL (Reference 3). The key inputs and results are shown below:

Plant	Vessel ID	Skirt Bottom	Variable Leg Nozzle	AL	AL - Skirt	AL - Var Leg	EPU Stm flow	Dryer dP		Bernoulli Error		Potential Impact		
								Nom Rated		Max	Applicable	Safety	Set point	Comment
	Inches	in AVZ	in AVZ	in AVZ	Inches	Inches	Mlbs/hr	psid	in IWL	in IWL	in IWL			
BWR - 3														
Monticello	205	478.08	422.00	475.00	-3.00	53.00	8.338	0.80	11.42	7.03	7.03	NO	YES	Note 1

in AVZ = Inches Above Vessel Zero
in IWL = Inches Indicated Water Level

Notes:

1. Impact on L3 setpoint is Maximum Bernoulli Error, since AL is below Dryer Skirt Bottom.
   No safety impact since AL - Variable Leg Nozzle distance is greater than the applicable Bernoulli Error.

The results show that for Monticello EPU where the steam flow was 8.338 Mlbs/hr corresponding to 100% EPU power (120% OLTP) and 105% Core Flow (Reference 1), the Bernoulli error is 7.03 Inches Indicated Water Level (IWL). This compares with 5.37 inches IWL reported in an earlier report (Reference 2) for pre-EPU operation at 106.3% OLTP. There is no safety impact because the margin between AL and variable leg tap is much greater than the applicable Bernoulli error.

Monticello currently has 5.5 inches IWL of extra margin available in their L3 setpoint calculation (Reference 2) for the pre-EPU AL of 477.5 inches. For EPU the AL has been lowered by 2.5 inches from its current pre-EPU value of 477.5 inches to an EPU value of 475.0 inches (Reference 3). Note that reducing the AL does not affect the SFIE of 7.03 inches because the pre-EPU AL was already below the skirt bottom, and further AL reduction does not change the SFIE. Assuming that none of the extra 2.5 inch margin is needed for other parts of the EPU setpoint calculation, the available extra margin is increased to 5.5+2.5 = 8 inches. This 8 inch extra margin is sufficient to absorb the SFIE error for EPU operation.

References

1. Derived from EPU Task 100, Draft Report B
2. GE-NE-0000-0066-0631-R0, March 2007
3. E-mail from R. Neulk (MNGP) to R. Willems (GEH) 10/19/07; in response to DIR-2 for BWROG project for SFIE evaluation.