CALCULATION COVER SHEET

Calc No.: 91-EQ-2002-02 Unit: 2 Category: Q

Calc Title: Loop Error, Setpoint, and Time Response Analysis for Narrow Range Containment Building Pressure ESFAS and RPS Trip Functions

System(s): ESFAS, RPS

Topic(s): INUN, SETC

Calc Type: IC

Component No(s).: 2PT-5601-1, 2PT-5602-2, 2PT-5603-3, 2PT-5604-4

Plt Area: Bldg. ______ Elev ______
Room ______
Coordinates: ______

Abstract (Include Purpose/Results): To calculate the errors, setpoints, allowable values and time response of the ANO-2 Narrow Range Containment Building Pressure ESFAS and RPS instrumentation loops. The results are shown in the Summary section of this calculation.

Rev. No.: 0 Verification Method: Design Review: X
Alternate Calculation: ____ Qualification Testing: ____

Pages Revised and/or Added: All

Purpose of Revision: Original Issue.

Initiating Documents	Resulting document(s)	Reference Calcs
DCP 91-2013		

Amends Calc(s): 85-EQ-0004-18

Supersedes Calc(s):

Computer Software (Ver. 1): Allways (2.2) / Lotus Symphony (2.2) / Freelance Plus (3.01) / WordPerfect (5.1)
(Filenames 91200202.ALL / 91200202.WR1 / 91200202.DA, 91200202.DB, 91200202.DC, 91200202.DD / 91200202.WP)

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Check if additional revisions ______

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1.0 PURPOSE/SCOPE

1.1 PURPOSE

The purpose of this calculation is to determine the uncertainties, setpoints, allowable values, and time responses of the ANO-2 Narrow Range Containment Building Pressure ESFAS and RPS Trip instrumentation loops. This calculation supercedes the Containment Pressure portions of all previous ABB/CE setpoint calculations.

1.2 SCOPE

This calculation is applicable to the following instrument loops:

Unit	Instrument Loop No.	Service
2	2PT-5601-1	Containment Pressure
2	2PT-5602-2	Containment Pressure
2	2PT-5603-3	Containment Pressure
2	2PT-5604-4	Containment Pressure

Instrument loop uncertainties are calculated for the Reference Condition, Abnormal Condition and Accident Condition.

2.0 INTRODUCTION

The statistical method of the Square Root of the Sum of Squares (SRSS) is used to determine the random error on a component level and for the loop. Non-random errors are combined algebraically with the random error term to establish total error.

This calculation is done in accordance with the guidelines set forth in the Instrument Loop Error Analysis and Setpoint Methodology Manual (Reference 6.2).

All percentages are expressed in terms of span unless otherwise noted.

All terms are considered random error terms unless noted by a lowercase "b" suffix to indicate a bias error term, or "t" suffix to indicate the total of the bias and random error terms.

3.0 ASSUMPTIONS AND GIVEN CONDITIONS

3.1 Calibration and Testing Environment

The uncertainties provided are based on calibrating and testing the equipment under the following environmental conditions:

A. Control Room
The calibration temperature for PPS Equipment in the control room is assumed to be 75 deg F and the maximum operating temperature for PPS Equipment in the control room is assumed to be 84 deg F. All other conditions "normal" for a control room environment, per Reference 6.2.

B. Containment
The calibration temperature of the PPS Equipment inside containment is assumed to be 60 deg F and the maximum operating temperature of PPS Equipment inside containment is assumed to be 120 deg F. All other conditions "normal" for a containment environment, per Reference 6.2.

C. Outside Containment

The calibration temperature is assumed to be 60°F. This is a conservative temperature to envelope the expected ambient at the time of calibration. See Reference 6.2.

3.2 Calibration and Testing Equipment

The measurement and test equipment (M&TE) used to calibrate and test the PPS Equipment will have an accuracy twice as good as the accuracy of the device or loop being tested. For example: if a transmitter has a reference accuracy of +/- 1.0 % span, it's assumed M&TE uncertainty will be +/- 0.5 % of span. This assumed M&TE accuracy applies to all PPS Equipment unless otherwise specified. See Reference 6.2.

3.3 Calibration and Testing Interval

A. The PPS Cabinet (Bistable) will be calibrated and tested on an interval that does not exceed 39 days.

B. The process instrumentation will be calibrated on an interval that does not exceed 22.5 months.

ANO-2 Technical Specifications, Section 4.0.2, permits a 25% extension of the monthly (31 days) and refueling (18 months) calibration intervals.

3.4 Power Supply Variation

Unless specifically stated otherwise, the variation of the instrument power system is 120 ± 10 VAC and the maximum power supply variation is ± 10% of the nominal power supply. See Section 3.9.7 of Reference 6.2.

3.5 Deleted.

3.6 Seismic and Post-Seismic Errors

Seismic and post-seismic errors are not considered with any design basis events because ANO-2 will, after each seismic event, determine that the post-seismic error are negligible or will recalibrate all effected PPS equipment, per Reference 6.28.

3.7 Signal Converter Drift

Unless otherwise stated, the drift for the signal converters is assumed to be no worse than its reference accuracy per Reference 6.27. The line voltage effect is assumed to be +/- 0.1% span, for a 10% change in line voltage since no vendor information is available per Reference 6.2.

3.8 Transmitter Background Radiation Effect

Unless otherwise stated, the background radiation effect for the transmitters is assumed negligible because the effect of background radiation is calibrated out each refueling, per Reference 6.2.

3.9 That combination of instrument uncertainties from various sources by the root-sum-square method is realistic and conservative enough when these uncertainties are random and independent of each other.

3.10 That combination of instrument uncertainties from various sources by algebraic summation is the most conservative method whenever the errors are non-random.

3.11 The calibration uncertainties for process instrumentation assumes that there are separate calibration devices on the input and output of the instrument being calibrated, per Reference 6.2.

3.12 Error terms that are less than 0.05% of SPAN are considered negligible and are not included in the calculation per Reference 6.2.

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4.0 PPS FUNCTIONS

The PPS functions included in this calculation, per agreement with ANO-2, are the Containment Pressure - HIGH and HIGH-HIGH functions. The functional requirements of these PPS trips are given below.

4.1 CONTAINMENT PRESSURE

4.1.1 Functional Description

The containment pressure function of the Plant Protection System (PPS) provides a reactor trip, a containment isolation actuation signal (CIAS), a containment cooling actuation signal (CCAS) and a safety injection actuation signal (SIAS) on a High Containment Pressure trip. Also, the containment pressure function provides a containment spray actuation signal (CSAS) on a High-High Containment Pressure trip. The reactor trip, the CIAS and SIAS, and the CSAS are initiated by separate bistables. See Figures 4.1 - 4.4. The CSAS cannot be initiated without a concurrent CIAS or SIAS.

The containment pressure transmitter is calibrated from 0 to 27 psia and outputs at 4 to 20 mA signal. A 250 ohm droppi[illegible] resistor provides a 1 to 5 volt signal to the bistables. It should be noted that the signal represents absolute pressure and not gage pressure.

4.1.2 Design Basis and Requirements

The purpose of the containment pressure function is to protect the containment vessel integrity and minimize the radioactive release during a postulated accident.

The reactor trip function is not credited as the primary trip for any Chapter 15 event. It is however considered the back-up trip for many of the events. The reactor trip can be credited with limiting the temperature and pressure which the containment will reach prior to reactor trip. This function is often used to reduce the accident temperature errors prior to reactor trip for all PPS equipment which serve the same function as the high containment pressure.

The containment isolation function is credited in the SAR Chapter 6.0 Analysis. The Chapter 6.0 Analysis determines the peak containment pressures and temperatures following a primary or secondary pipe break. Therefore, the CIAS analysis setpoint cannot be changed without determining the effect of this change on the Chapter 6.0 Analysis. The CIAS setpoint must be sufficiently larger than the ambient pressure to prevent initiation due only to instrument errors and normal pressure variations.

The safety injection and containment cooling functions are credited in the SAR Chapter 15.0 LOCA analyses with limiting the consequences of the LOCA events.

The containment spray function is credited with reducing the temperature, pressure and radioactivity level of the containment environment following a primary or secondary pipe break. The containment spray contains chemicals to reduce the radioactivity level inside the containment and therefore reduce the amount of radioactivity released to the environment. The effect of the chemicals and the consequences of the clean up of the additional water in the containment are such that the HIGH-HIGH Containment Pressure trip setpoint should be sufficiently greater than ambient pressure to ensure that spray is initiated only during actual pipe breaks. The CSAS analysis setpoint is determined by the SAR Chapter 6.0 Containment Analysis. Therefore, the analysis setpoint cannot be changed without determining the effect of this change on the Chapter 6.0 Analysis.

FIGURE 4.1

CONTAINMENT PRESSURE BLOCK DIAGRAM

CHANNEL A

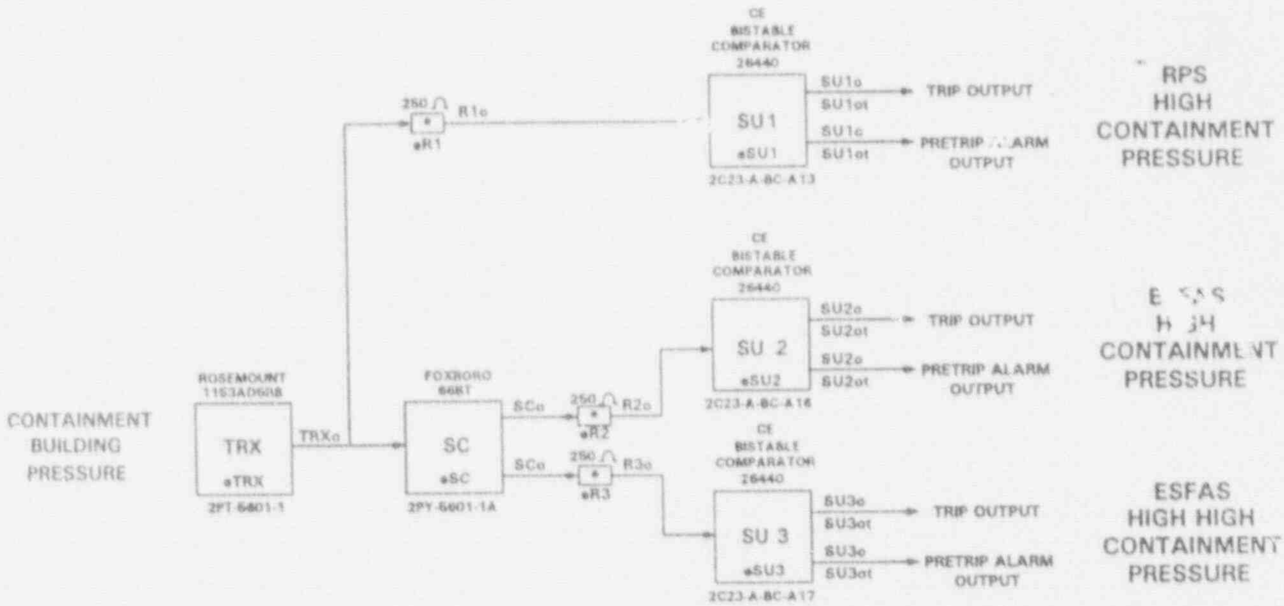

FIGURE 4.2

CONTAINMENT PRESSURE BLOCK DIAGRAM

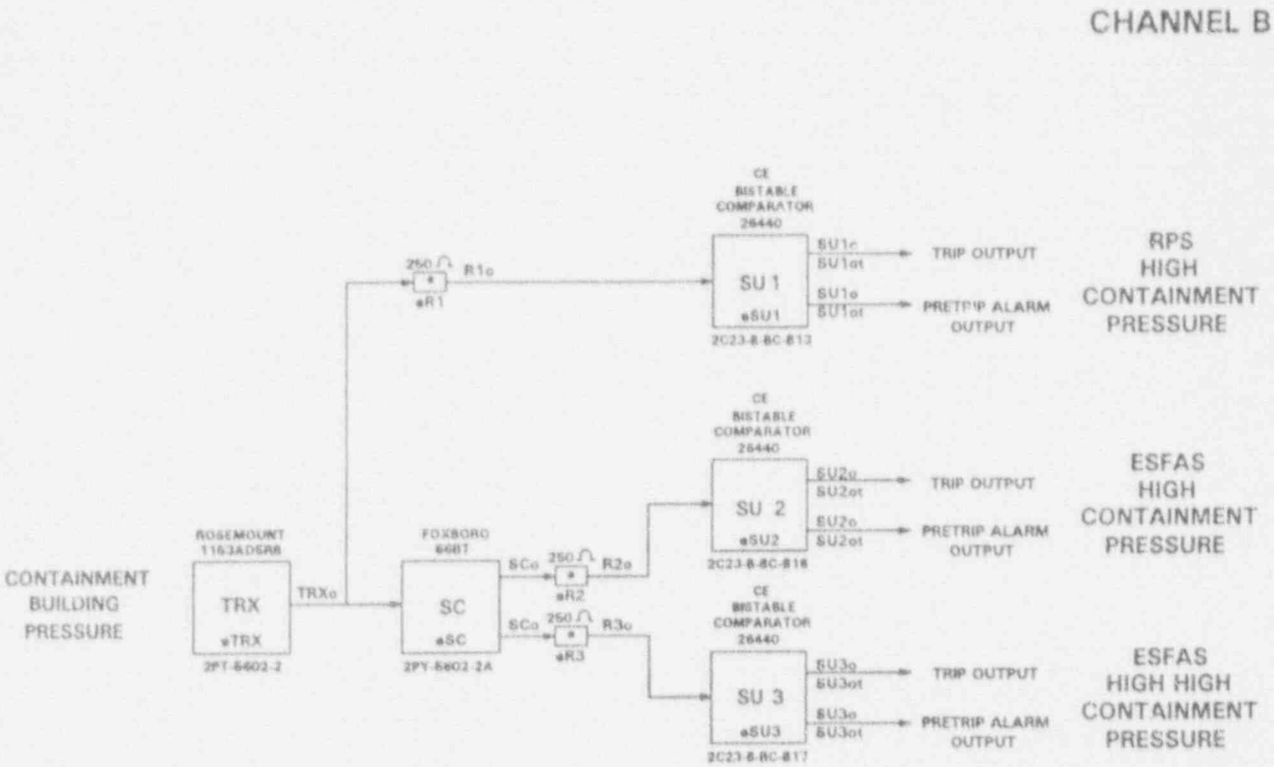

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FIGURE 4.3

CONTAINMLNT PRESSURE BLOCK DIAGRAM

CHANNEL C

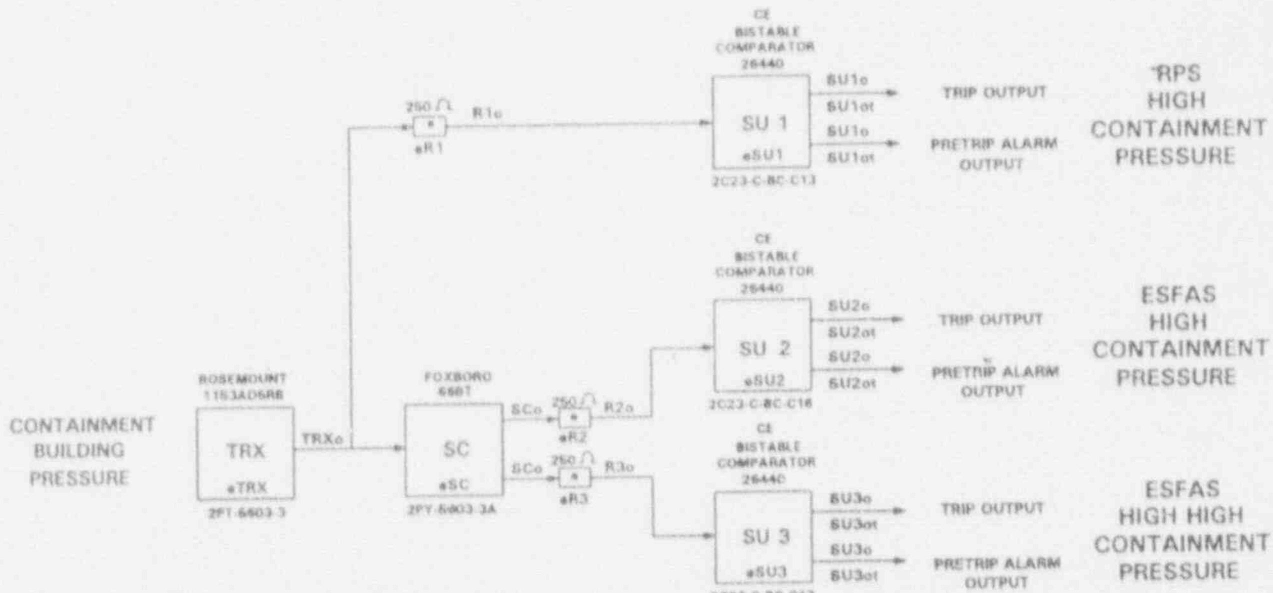

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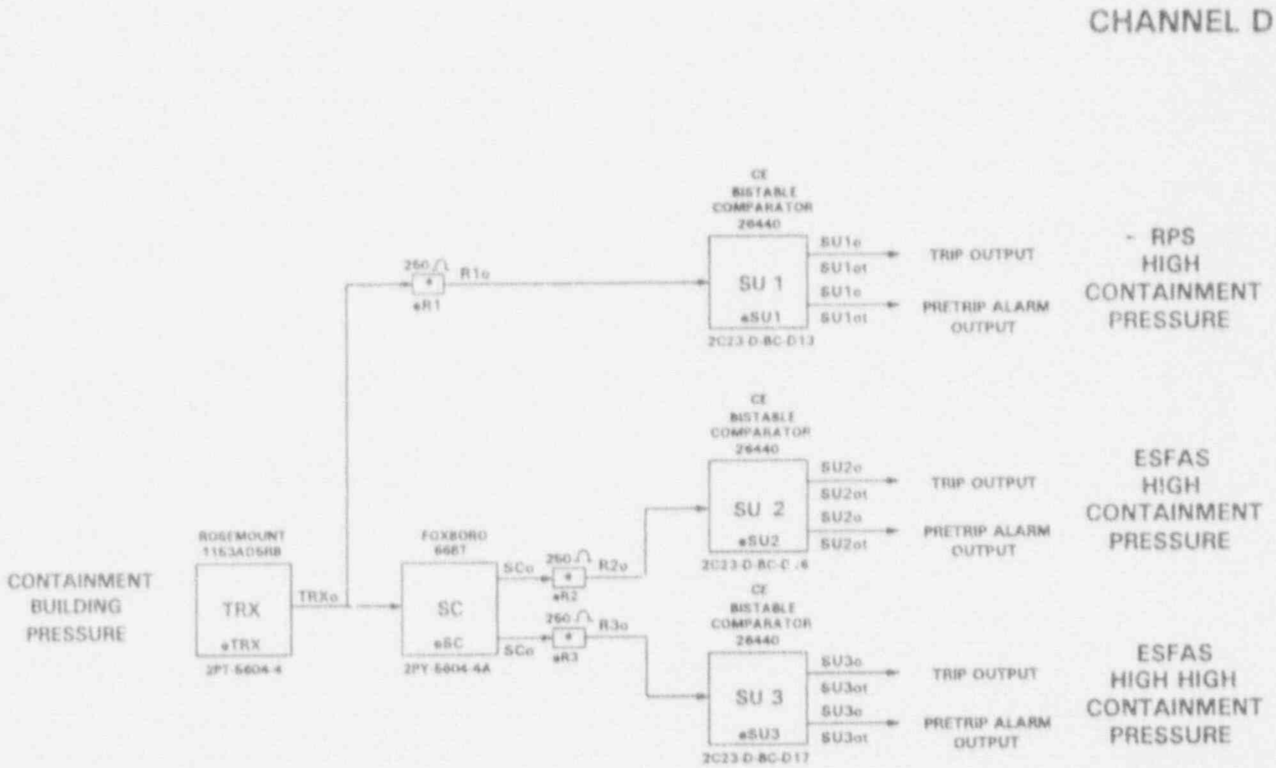
FIGURE 4.4

CONTAINMENT PRESSURE BLOCK DIAGRAM



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4.1.3 Containment Pressure Loop Error Calculation

4.1.3.1

COMPONENT ID

					Source
Containment Pressure Transmitter					
Tag Number:	2PT-5601-1,2PT-5602-2,2PT-5603-3,2PT-5604-4				(6.22,6.1.b,6.1.g)
Model:	Rosemount 1153AD5RB				(6.22,6.1.f)
Range Limits:	0	to	27.0975 PSIA	(0-750 inches of water, URL = 27.0975)	(6.3)
Calibrated Range:	0	to	27 PSIA		(6.22)
Calibrated Span:			27 PSI		(6.22)
Time Response:		0.2 sec			(6.3)

PROCESS/ENVIRONMENTAL CONDITIONS

Amb Cal Temp (AMB):		60	degF	(3.1.b)
Abn Amb Temp (ABN):		120	degF	(3.1.b)
Acc Amb Temp (ACC):		288	degF	(6.25)
DT (ABN-AMB):		60	degF	
Power Supply Voltage:		24	VDC	(6.7)
Power Supply Variance:	±	10.0%		(3.4)
(DV) :	±	2.4	VDC	
Max Voltage :		26.4	VDC	
Calibration Interval :		22.5	MONTHS (18 months + 25% marigin)	(3.3)
Acc Radiation :		3.3E+07	RAD	(6.25)

ERROR SUMMARY		ERROR % SPAN	ERROR PSIA	
a. ACCURACY (RA):	±(0.25% SPAN)	± 0.250%	± 0.068	(6.3)
b. CALIBRATION (CAL): ±(TIMES MORE ACCURATE THAN INSTRUMENT)	±[(0.5RA)^2+(0.5RA)^2]^0.5 % SPAN	± 0.177%	± 0.048	(3.2,3.11)
c. DRIFT (DR):	±(0.20% URL FOR 30 MONTHS)	± 0.201%	± 0.054	(6.4)
d. POWER SUPPLY EFFECT (PS):	(Less than 0.005% SPAN/volt) (NEGLIGIBLE)	± 0.000%	± 0.000	(6.3)

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								Source
						ERROR % SPAN	ERROR PSIA	
e. ABNORMAL TEMPERATURE EFFECT (TE):								
	±(0.75% URL +	0.50% SPAN) per	100	degF	±	0.752% ±	0.203	(6.3)
		calculated at	60	degF				
f. ACCIDENT TEMPERATURE EFFECT (ATE):		TESTED AT	420	degF				(6.3)
	±(4.50% URL +	3.50% SPAN)			±	8.016% ±	2.164	
g. ACCIDENT RADIATION EFFECT (ARE):		TESTED AT	5.50E+07	rads TID				
	±(1.50% URL +	1.00% SPAN)			±	2.505% ±	0 676	(6.3)

The transmitter error (eTRX) for Reference (REF), Abnormal (ABN) and Accident (ACC) conditions is given as follows: (3.6)

REF eTRX =	± (RA + CAL)	±	0.427% ±	0.115
ABN eT	± ((RA + CAL)^2 + DR^2 + TE^2)^0.5	±	0.887% ±	0.240
ACC (LOCA) eTRX =	± ((RA + CAL)^2 + DR^2 + ATE^2 + ARE^2)0.5	±	8.412% ±	2.271
ACC (SLB) eTRX =	± ((RA + CAL)^2 + DR^2 + ATE^2)^0.5	±	8.030% ±	2.168

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The transmitter output error (TRXo) for Reference (REF), Abnormal (ABN) and Accident (ACC) conditions is given as follows:

			ERROR % SPAN	ERROR PSIA	Source
REF TRXo =	± REF eTRX	±	0.427% ±	0.115	
ABN TRXo =	± ABN eTRX	±	0.887% ±	0.240	
ACC (LOCA) TRXo =	± ACC (LOCA) eTRX	±	8.412% ±	2.271	
ACC (SLB) TRXo =	± ACC (SLB) eTRX	±	8.030% ±	2.168	

4.1.3.2 Insulation Resistance

The transmitter is located within the containment building, and as such the effects of harsh enviroment on the loop signal cabling must be considered. The accident environment effects are considered for cabling from the transmitter through the containment electrical penetrations.

			ERROR % SPAN	ERROR PSIA	Source
Cable Length:	200 Ft				(6.14)
Power Supply Voltage:	24 VDC				(6.7)
IRb:	+ 0.99% SPAN	+	0.990% +	0.267	(6.11)

The error attributed by the insulation resistance (IRb) for LOCA and SLB Accident (ACC) condition.

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4.1.3.3

COMPONENT ID

				Source
Containment Pressure Signal Converter				(6.22,6.1.b,6.1.g)
Tag Number:	2PY-5601-1A,2PY-5602-2A,2PY-5603-3A,2PY-5604-4A			(6.22,6.1.f)
Model:	Foxboro 66BT			(6.8,6.7)
Input Range:	4	to	20 mA	(6.8,6.7)
Output Range:	4	to	20 mA	(6.6)
Time Response:	<	0.3 sec		

PROCESS/ENVIRONMENTAL CONDITIONS

Amb Cal Temp (AMB):		60 degF	(3.1.c)
Abn Amb Temp (ABN):		105 degF	(6.24)
Acc Amb Temp (ACC):		105 degF	(6.24)
DT (ABN-AMB):		45 degF	
Line Voltage:		120 VAC	(3.4)
Line Volt. Variance:	±	10 VAC	(3.4)
(DV) :	±	8.3%	

ERROR SUMMARY

				ERROR % SPAN		ERROR PSIA	Source
a. Spec. Reference Accurancy:	± 0.50% SPAN		±	0.500%	±	0.135	(6.6)
b. Repeatability: (Better than	± 0.05% SPAN)		±	0.050%	±	0.014	(6.6)
c. ACCURACY (RA):	± (Spec. RA + Repeatablity)	% SPAN	±	0.550%	±	0.149	(6.2)
d. CALIBRATION (CAL): ±(2 TIMES MORE ACCURATE THAN INSTRUMENT) ±[(0.5 spec. RA)^2+(0.5 spec. RA)^2]^0.5		% SPAN	±	0.354%	±	0.095	(3.11,3.2)
e. DRIFT (DR):	± (ACCURACY)		±	0.550%	±	0.149	(3.7)
f. LINE VOLTAGE EFFECT (LV):	±(0.10% SPAN) per	10.00%	±	0.083%	±	0.022	(3.7)
g. ABNORMAL TEMP. EFFECT (TE): Less than	±(1.00% SPAN) per	50 degF	±	0.900%	±	0.243	(6.6)

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The converter error (eSC) is as follows:

			ERROR % SPAN		ERROR PSIA	Source
REF eSC =	± (RA + CAL)	±	0.904%	±	0.244	
ABN eSC =	± ((RA + CAL)^2 + DR^2 + TE^2 + LV^2)^0.5	±	1.391%	±	0.376	
ACC eSC =	± ((RA + CAL)^2 + DR^2 + TE^2 + LV^2)^0.5	±	1.391%	±	0.376	

The output error term for the signal converter (SC) is given as follows:

REF SCo =	± (TRXo^2 + eSC^2)^0.5	±	0.999%	±	0.270	
ABN SCo =	± (TRXo^2 + eSC^2)^0.5	±	1.650%	±	0.446	
ACC (LOCA) SCo =	± (TRXo(LOCA)^2 + eSC^2)^0.5	±	8.526%	±	2.302	
ACC (LOCA) SCob =	± IRb	+	0.990%	+	0.267	
ACC (LOCA) SCot =	+ SCo + SCob	+	9.516%	+	2.569	
	− SCo	−	8.526%	−	2.302	
ACC (SLB) SCo =	± (TRXo(SLB)^2 + eSC^2)^0.5	±	8.150%	±	2.200	
ACC (SLB) SCob =	± IRb	+	0.990%	+	0.267	
ACC (SLB) SCot =	+ SCo + SCob	+	9.140%	+	2.468	
	− SCo	−	8.150%	−	2.200	

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4.1.3.4

COMPONENT ID

					Source
Containment Pressure Resistors					(6.22, 6.1.b)
Type:	250 ohm Resistors				(6.7)
Input Range:	4	to	20 mA		(6.7)
Ouput Range:	1	to	5 vdc		

PROCESS/ENVIRONMENTAL CONDITIONS

				Source
Amb Cal Temp (AMB):	60 degF	=	15.6 degC	(3.1.c)
Abn Amb Temp (ABN):	105 degF	=	40.6 degC	(6.24)
Acc Amb Temp (ACC):	105 degF	=	40.6 degC	(6.24)
DT (ABN-AMB):	45 degF		25.0 degC	

ERROR SUMMARY

				ERROR % SPAN		ERROR PSIA	
a. Accurancy (RA):	±	0.10%	±	0.100%	±	0.027	(6.13)
b. Temp. Coeff. (TE):	±	3 ppm/degC (Negligible)	±	0.009%	±	0.003	(6.23)
c. Stability (DR): (22.5 months)	±	35 ppm/year (Negligible)	±	0.008%	±	0.002	(6.23)

The resistor error (eR) is as follows:

REF eR =	±	(RA)	±	0.100%	±	0.027
ABN eR =	±	(RA)	±	0.100%	±	0.027
ACC eR =	±	(RA)	±	0.100%	±	0.027

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The output error term for the resistor (R1) after the transmitter is given as follows:

			ERROR % SPAN		ERROR PSIA
REF R1o =	± (TRXo^2 + eR^2)^0.5	±	0.438%	±	0.118
ABN R1o =	± (TRXo^2 + eR^2)^0.5	±	0.893	±	0.241
ACC (LOCA) R1o =	± (TRXo(LOCA)^2 + eR^2)^0.5	±	8.412%	±	2.271
ACC (LOCA) R1ob =	+ IRb	+	0.990%	+	0.267
ACC (LOCA) R1ot =	+ R1o + R1ob	+	9.402%	+	2.539
	– R1o	–	8.412%	–	2.271
ACC (SLB) R1o =	± (TRXo(SLB)^2 + eR^2)^0.5	±	8.030%	±	2.168
ACC (SLB) R1ob =	+ IRb	+	0.990%	+	0.267
ACC (SLB) R1ot =	+ R1o + R1ob	+	9.020%	+	2.435
	– R1o	–	8.030%	–	2.168

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The output error term for the resistor (R2) after the signal converter is given as follows:

			ERROR % SPAN	ERROR PSIA
REF R2o =	± (SCo^2 + eR^2)^0.5	±	1.004% ±	0.271
ABN R2o =	± (SCo^2 + eR^2)^0.5	±	1.653% ±	0.446
ACC (LOCA) R2o =	± (SCo(LOCA)^2 + eR^2)^0.5	±	8.527% ±	2.302
ACC (LOCA) R2ob =	+ SCob	+	0.990% +	0.267
ACC (LOCA) R2ot =	+ R2o + R2ob	+	9.517% +	2.570
	− R2o	−	8.527% −	2.302
ACC (SLB) R2o =	± (SCo(SLB)^2 + eR^2)^0.5	±	8.150% ±	2.201
ACC (SLB) R2ob =	+ SCob	+	0.990% +	0.267
ACC (SLB) R2ot =	+ R2o + R2ob	+	9.140% +	2.468
	− R2o	−	8.150% −	2.201

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The output error term for the resistor (R3) after the signal converter is given as follows:

			ERROR % SPAN		ERROR PSIA
REF R3o =	± (SCo^2 + eR^2)^0.5	±	1.004%	±	0.271
ABN R3o =	± (SCo^2 + eR^2)^0.5	±	1.653%	±	0.446
ACC (LOCA) R3o =	± (SCo(LOCA)^2 + eR^2)^0.5	±	8.527%	±	2.302
ACC (LOCA) R3ob =	+ SCob	+	0.990%	+	0.267
ACC (LOCA) R3ot =	+ R3o + R3ob	+	9.517%	+	2.570
	– R3o	–	8.527%	–	2.302
ACC (SLB) R3o =	± (SCo(SLB)^2 + eR^2)^0.5	±	8.150%	±	2.201
ACC (SLB) R3ob =	+ SCob	+	0.990%	+	0.267
ACC (SLB) R3ot =	+ R3o + R3ob	+	9.140%	+	2.468
	– R3o	–	8.150%	–	2.201

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4.1.3.5

COMPONENT ID

					Source
Containment Pressure Trip Bistable					(6.22,6.1.f,6.7)
Tag Numbers:	2C23 A-BC-A13, 2C23 A-BC-A16, 2C23 A-BC-A17				
	2C23 B-BC-B13, 2C23 B-BC-B16, 2C23 B-BC-B17				
	2C23 C-BC-C13, 2C23 C-BC-C16, 2C23 C-BC-C17				
	2C23 D-BC-D13, 2C23 D-BC-D16, 2C23 D-BC-D17				(6.22,6.1.f)
Model:	CE Bistable Comparator Card 26440				(6.22)
Instrument Range:	0	to	27	PSIA	
Instrument Span:			27	PSI	(6.7)
Operating Range:	1	to	5	VDC	(6.16)
Full Range:	0	to	10	VDC	
Conversion Factor:		6.75	psi/volt		(6.16)
Time Response:		150	msec		

ERROR SUMMARY

				ERROR % SPAN	ERROR PSIA	
a. ACCURACY (RA) (includes repeatability and resolution)	±	25 mV	±	0.625% ±	0.169	(6.16)
b. CALIBRATION (CAL)	±	12.50 mV	±	0.313% ±	0.084	(3.2)
c. DRIFT (DR): (39 days)	±	9.0 mV	±	0.225% ±	0.061	(6.18)

d. WORST CASE NORMAL TEMPERATURE EFFECT (±TE + TEb):
(for a temperature shift of 20 degC)

TE	: ±	5.07 mV	±	0.127% ±	0.034	(6.18)
TEb	: +	1.52 mV	+	0.038% ±	0.01	(6.18)

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The Bistable Comparator Card error (eSU) is as follows:

				ERROR % SPAN		ERROR PSIA
REF (eSU) =	±	(RA + CAL)	±	0.938%	±	0.253
ABN (eSU) =	±	((RA + CAL)^2 + DR^2 + TE^2)^0.5	±	0.972%	±	0.263
ABN (eSUb) =		(TEb)	+	0.038%	+	0.010
ACC (eSU) =	±	((RA + CAL)^2 + DR^2 + TE^2)^0.5	±	0.972%	±	0.263
ACC (eSUb) =		(TEb)	+	0.038%	+	0.010
PERIODIC TEST ERROR =	±	(RA^2 + CAL^2 + DR^2)^0.5	±	0.734%	±	0.198

Preparer: MEA Date: 5/8/92 Checker: [signature] Date: 5/8/92

The output error term for the bistable card (SU1) after the transmitter and resistor is given as follows:

			ERROR % SPAN	ERROR PSIA
REF SU1o =	± (R1o^2 + eSU^2)^0.5	±	1.035% ±	0.279
ABN SU1o =	± (R1o^2 + eSU^2)^0.5	±	1.320% ±	0.356
ABN SU1ob =	eSUb	+	0.038% +	0.010
ABN SU1ot =	+ SU1o + SU1ob	+	1.358% +	0.367
	− SU1o	−	1.320% −	0.356
ACC (LOCA) SU1o =	± (R1o(LOCA)^2 + eSU^2)^0.5	±	8.468% ±	2.286
ACC (LOCA) SU1ob =	eSUb + R1ob	+	1.028% +	0.278
ACC (LOCA) SU1ot =	+ SU1o + SU1ob	+	9.496% +	2.564
	− SU1o	−	8.468% −	2.286
ACC (SLB) SU1o =	± (R1o(SLB)^2 + eSU^2)^0.5	±	8.089% ±	2.184
ACC (SLB) SU1ob =	eSUb + R1ob	+	1.028% +	0.278
ACC (SLB) SU1ot =	+ SU1o + SU1ob	+	9.117% +	2.462
	− SU1o	−	8.089% −	2.184

Preparer: MEA Date: 5/8/92 Checker: HB Date: 5/8/92

The output error term for the Bistable Card (SU2) after the signal converter and resistor is given as follows:

			ERROR % SPAN		ERROR PSIA
REF SU2o =	± (R2o^2 + eSU^2)^0.5	±	1.374%	±	0.371
ABN SU2o =	± (R2o^2 + eSU^2)^0.5	±	1.918%	±	0.518
ABN SU2ob =	eSUb	+	0.038%	+	0.010
ABN SU2ot =	+ SU2o + SU2ob	+	1.956%	+	0.528
	− SU2o	−	1.918%	−	0.518
ACC (LOCA) SU2o =	± (R2o(LOCA)^2 + eSU^2)^0.5	±	8.582%	±	2.317
ACC (LOCA) SU2ob =	R2ob + eSUb	+	1.028%	+	0.278
ACC (LOCA) SU2ot =	+ SU2o + SU2ob	+	9.610%	+	2.595
	− SU2o	−	8.582%	−	2.317
ACC (SLB) SU2o =	± (R2o(SLB)^2 + eSU^2)^0.5	±	8.208%	±	2.216
ACC (SLB) SU2ob =	R2ob + eSUb	+	1.028%	+	0.278
ACC (SLB) SU2ot =	+ SU2o + SU2ob	+	9.236%	+	2.494
	− SU2o	−	8.208%	−	2.216

Preparer: MEA Date: 5/8/92 Checker: HB. Date: 5/8/92

The output error term for the Bistable Card (SU3) after the signal converter and resistor is given as follows:

			ERROR % SPAN	ERROR PSIA
REF SU3o =	± (R3o^2 + eSU^2)^0.5	±	1.374% ±	0.371
ABN SU3o =	± (R3o^2 + eSU^2)^0.5	±	1.918% ±	0.518
ABN SU3ob =	eSUb	+	0.038% +	0.010
ABN SU3ot =	+ SU3o + SU3ob	+	1.956% +	0.528
	- SU3o	-	1.918% -	0.518
ACC (LOCA) SU3o =	± (R3o(LOCA)^2 + eSU^2)^0.5	±	8.582% ±	2.317
ACC (LOCA) SU3ob =	R3ob + eSUb	+	1.028% +	0.278
ACC (LOCA) SU3ot =	+ SU3o + SU3ob		9.610% +	2.595
	- SU3o	-	3.582% -	2.317
ACC (SLB) SU3o =	± (R3o(SLB)^2 + eSU^2)^0.5	±	8.208% ±	2.216
ACC (SLB) SU3ob =	R3ob + eSUb	+	1.028% +	0.278
ACC (SLB) SU3ot =	+ SU3o + SU3ob	+	9.236% +	2.494
	- SU3o	-	8.208% -	2.216

Preparer: MEQ Date: 5/8/92 Checker: HFS Date: 5/8/92

4.1.4 Calculated Trip Setpoints and Allowable Values

The limiting safety analysis setpoints for the High Containment Pressure are : a reactor trip at 6.0 psig for the Steam Line Break event; containment isolation, containment cooling and safety injection actuation at 6.0 psig for Loss of Coolant Accident. The limiting safety analysis setpoint for the High-High Containment Pressure is containment spray actuatuion at 11.0 psig for the Loss of Coolant Accident. These setpoints are taken from Refrense 6.19.

The limiting setpoints used in the Containment Analysis are the same as those given above. The Containment Analysis setpoints are taken from the current Chapter 6.0 Safety Analysis Report (SAR).

4.1.4.1 Trip/Actuation Setpoints

SU1 (Hi) Trip Setpoint	=	RPS Analysis Setpoint + Atmospheric Pressure - ACC(SLB) SU1ot		
	=	6.0 psig +	14.7 psia	-2.2 psi
	=	18.5 psia		
SU2 (Hi) Actuation Setpoint	=	SIAS/CCAS/CIAS Analysis Setpoint + Atmospheric Pressure - ACC(LOCA) SU2ot		
	=	6.0 psig +	14.7 psia	-2.4 psi
	=	18.3 psia		
SU3 (Hi-Hi) Actuation Setpoint	=	CSAS Analysis Setpoint + Atmospheric Pressure - ACC(LOCA) SU3ot		
	=	11.0 psig +	14.7 psia	-2.4 psi
	=	23.3 psia		
RPS Trip Setpoint	=	MIN[SU1 Trip Setpoint, SU2 Actuation Setpoint]		
	=	18.3 psia		
SIAS Setpoint	=	MAX[RPS Trip Setpoint , SU2 Actuation Setpoint]		
	=	18.3 psia		

Preparer: W. L. Greene Date: 5-8-92 Checker: H.B. Date: 5/8/92

To ensure that the reactor is tripped concurrently with to SIAS:

SU1 (Hi) Trip Setpoint	=	RPS Trip Setpoint
	=	18.3 psia
SU2 (Hi) Actuation Setpoint	=	SIAS/CIAS Setpoint
	=	18.3 psia

Therefore, the setpoints are established as follows:

SU1 (Hi) Trip Setpoint	=	RPS Trip Setpoint
	=	18.3 psia
SU2 (Hi) Actuation Setpoint	=	SIAS/CIAS Setpoint
	=	18.3 psia
SU3 (Hi–Hi) Actuation Setpoint	=	CSAS Setpoint
	=	23.3 psia

4.1.4.2 Allowable Values

SU1 Allowable Value	=	SU1 Setpoint + SU1 PTE	
	=	18.3 psia +	0.19 psi
	=	18.49 psia	
SU2 Allowable Value	=	SU2 Setpoint + SU2 PTE	
	=	18.3 psia +	0.19 psi
	=	18.49 psia	
SU3 Allowable Value	=	SU3 Setpoint + SU3 PTE	
	=	23.3 psia +	0.19 psi
	=	23.49 psia	

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4.1.4.3 Alarm Setpoints

There are no safety analysis requirements for the pretrip (alarm) setpoints, therefore the following values may be changed as required.

SU1 Alarm Setpoint	=	SU1 Trip Setpoint - ABN SU1ot	
	=	18.3 psia	-0.4 psi
	=	17.9 psia	
SU2 Alarm Setpoint	=	SU2 Actuation Setpoint - ABN SU2ot	
	=	18.3 psia	-0.6 psi
	=	17.7 psia	
SU3 Alarm Setpoint	=	SU3 Actuation Setpoint - ABN SU3ot	
	=	23.3 psia	-0.6 psi
	=	22.7 psia	

The current pretrip (alarm) setpoints from refrence 6.26, are still conservative and will be retained:

SU1 Alarm Setpoint	=	17.0 psia
SU2 Alarm Setpoint	=	17.0 psia
SU3 Alarm Setpoint	=	20.0 psia

4.1.4.4 Bypass Setpoints

The Containment Pressure function is not required for any Bypass or Bypass Removal Setpoint , therefore, no Bypass Setpoints are calculated.

Preparer: W.L. Greene Date: 5-8-92 Checker: [illegible] Date: 5/8/92

4.1.5 Voltage Equivalents for Setpoints and Allowable Values

The PPS Cabinet input ranges from 1 to 5 volts.
This is equivalent to a process range of 0 to 27 PSIA.
Based on these endpoints the following equation be derived:

$$V = (P / 6.750) + 1.00$$

		Value	Voltage
Setpoints			
	SU1	18.3 PSIA	3.711 volts
	SU2	18.3 PSIA	3.711 volts
	SU3	23.3 PSIA	4.451 volts
Allowable Values			
	SU1	18.49 PSIA	3.739 volts
	SU2	18.49 PSIA	3.739 volts
	SU3	23.49 PSIA	4.480 volts
Pretrip Setpoints			
	SU1	17.0 PSIA	3.518 volts
	SU2	17.0 PSIA	3.516 volts
	SU3	20.0 PSIA	3.962 volts
Bypass Setpoints		N/A	

Preparer: W.L. Greene Date: 5-8-92 Checker: HFS. Date: 5/8/92

4.1.6 Measurement Channel Response Times

Source

The RPS Channel Delay Time is the time interval from when the monitored parameter exceeds the trip setpoint value at the input to the channel sensor until electrical power is interrupted to the CEA Drive Mechanism. The ESF Channel Delay Time is the time interval from when the monitored parameter exceeds the trip setpoint value at the input to the channel sensor until the output of the actuation relays in the ESF cabinet changes state. The ESF response time provided does not include the actuated components (e.g. pumps, valves, etc.). See ANO-2 Technical Specification Tables 3.3-2 and 3.3-5.

	SU1	SU2	SU3	Source
Rosemount Transmitter:	0.20 sec.	0.20 sec.	0.20 sec.	
Foxboro I/I Converter:	n/a sec.	0.30 sec.	0.30 sec.	
PPS Cabinet (Bistable):	0.15 sec.	0.15 sec.	0.15 sec.	
Reactor Trip Switch Gear :	0.10 sec.	n/a sec.	n/a sec.	(6.29)
ESFAS Relay Cabinet Delay Time :	n/a sec.	0.02 sec.	0.02 sec.	(6.29)
Total Channel Response Time:	0.45 sec.	0.67 sec.	0.67 sec.	

The expected RPS Channel Delay Time for SU1 is less than the 1.59 second response time of ANO-2 Technical Specification Table 3.3-2.

The expected SIAS/CCAS/CIAS Channel Delay Time for SU2 is not significant compared to the 28.1 second response time (including sequence loading delays) of ANO-2 Technical Specification Table 3.3-5.

The expected CSAS Channel Delay Time for SU3 is not significant compared to the 27.1 second response time (including sequence loading delays) of ANO-2 Technical Specification Table 3.3-5.

Preparer: W.L. Greene Date: 5-8-92 Checker: [illegible] Date: 5/8/92

5.0 CONCLUSIONS

The loop errors for instrument loop numbers 2PT-5601-1, 2PT-5602-2, 2PT-5603-3 and PT-5604-4 are:

		% SPAN		psia
REF SU1o =	±	1.035%	±	0.279
ABN SU1ot =	+	1.358%	+	0.367
	-	1.320%	-	0.356
ACC (LOCA) SU1ot =	+	9.496%	+	2.564
	-	8.468%	-	2.286
ACC (SLB) SU1ot =	+	9.117%	+	2.462
	-	8.089%	-	2.184
REF SU2o =	±	1.374%	±	0.371
ABN SU2ot =	+	1.956%	+	0.528
	-	1.918%	-	0.518
ACC (LOCA) SU2ot =	+	9.610%	+	2.595
	-	8.582%	-	2.317
ACC (SLB) SU2ot =	+	9.236%	+	2.494
	-	8.208%	-	2.216
REF SU3o =	±	1.374%	±	0.371
ABN SU3ot =	+	1.956%	+	0.528
	-	1.918%	-	0.518
ACC (LOCA) SU3ot =	+	9.610%	+	2.595
	-	8.582%	-	2.317
ACC (SLB) SU3ot =	+	9.236%	+	2.494
	-	8.208%	-	2.216

Preparer: W L Greene Date: 5-8-92 Checker: JHS Date: 5/8/92

The setpoints for these instrument loops are:

	psia	volts
SU1	18.3	3.711
SU2	18.3	3.711
SU3	23.3	4.451

The allowable values for these instrument loops are:

	psia	volts
SU1	18.49	3.518
SU2	18.49	3.518
SU3	23.49	3.962

The pretrip setpoints for these instrument loops are:

	psia	volts
SU1	17.0	3.518
SU2	17.0	3.518
SU3	20.0	3.962

The response times for these instrument loops are:

SU1	0.45 sec
SU2	0.67 sec
SU3	0.67 sec

6.0 REFERENCES

6.1 Letter to P. Collette from A. J. Wrape III (ENTERGY), ANO-91-2-00919, November 12, 1991.

a) Schematic Block Diagrams E-2205 Sh. 2, Rev. 3
b) Schematic E-2753 Sh. 22 Rev. 10, E-2753 Sh. 29, Rev. 10
c) Internal Connection 2C15: 6600-2-M2001-M1-48, Rev. 13
6600-2-M2001-M1-50, Rev. 16
6600-2-M2001-M1-52, Rev. 12
6600-2-M2001-M1-54, Rev. 13
6600-2-M2001-M1-55, Rev. 12
6600-2-M2001-M1-56, Rev. 12
6600-2-M2001-M1-58, Rev. 13
6600-2-M2001-M1-59, Rev. 12
d) External Connections: E-2951 Sh. 1, Rev. 13
E-2951 Sh. 4, Rev. 13
E-2951 Sh. 7, Rev. 9
E-2951 Sh. 9, Rev. 10
E-2693 Sh. 9, Rev. 2
E-2693 Sh. 10, Rev. 2
E-2693 Sh. 11, Rev. 2
E-2693 Sh. 12, Rev. 2
e) Fig. 8-1 Sh. 2 (CE PPS Vol. II TM C490.0850 Vol. 2 of 3)
f) SIMS Component List
g) P&ID M-2236 Sh 2, Rev. 9
h) Instrument Data sheets M-2516 Sh. 5, Rev. 4

6.2 Instrument Loop Error Analysis and Setpoint Methodology Manual, Design Guide IDG-001-0.

6.3 Rosemount Product Data Sheet 2388, Model 1153, Series D Alphaline Pressure Transmitter for Nuclear Service, Revised 11/87.

(Vendor Manual TM R370.0010, TD R370.0150 Rev. 2; "Installation Manual for Nuclear Service Model 1153 Series D Alphaline".)

6.4 Rosemount Report D8900126, Rev A, "30 Month Stability Specification for Rosemount Model 1152, 1153 and 1154 Pressure Transmitters."

(Vendor EQ File V43 Item 134)

6.5 Rosemount Qualification Report D8300040,"1153 Series D Rosemount Pressure Transmitters For Nuclear Service." (Vendor EQ File V43 Item 90 (Rev. A), Item 131 (Rev. C))

6.6 Foxboro General Specification GS2A-2D1A, Dec 1968.

(Vendor Manual TM F18.0970, TD F180.4.9.30 Rev. 0; "Instruction Book 2008 for Foxboro Current Repeater Model 66B")

6.7 I&C Periodic Test Procedure 2304.041, Rev. 13, Plant Protection System Channel A Field Calibration.

I&C Periodic Test Procedure 2304.042, Rev. 13, Plant Protection System Channel B Field Calibration.

I&C Periodic Test Procedure 2304.043, Rev. 14, Plant Protection System Channel C Field Calibration.

I&C Periodic Test Procedure 2304.044, Rev. 14, Plant Protection System Channel D Field Calibration.

6.8 Foxboro Diagram 660-M2204A-153, Rev.4.

6.9 Rangedown Effect on Model 1153 Series B and D transmitters, RMT Report 108221, Rev. A.

6.10 Type Test Report for Pressure Transmitter Rosemount Models 1153 Series B and D Output Code "R", RMT Report D8300131, Rev. A.

(Vendor EQ File V43, Item 57)

6.11 Calculation No. 86EQ-0001-05, Rev. 01; Generic IR Errors

6.12 Control of Calculations, Procedure 5010.015, Rev. 6.

6.13 Telecon from D. McQuade (ABB/CE) to W. Cottingham (ENTERGY) 11/27/91, 3:00PM "PPS Loop Uncertainty/Setpoint Calculations" TIC-92-299.

6.14 Telecon from D. McQuade (ABB/CE) to M. Zuber (ENTERGY) 12/3/91, 2:20PM "PPS Loop Uncertainty/Setpoint Calculations-Incontainment Cable Lengths", TIC-91-1795.

6.15 Letter to C. H. Neuschaefer from R. Baker, 3/17/77, ID-77-125, "PPS Equipment Uncertainty Errors and Time Delays for AP&L, LP&L, SCE 2, 3."

6.16 "General Engineering Specification for a Plant Protection System", Specification No. 0000-ICE-3001, Rev. 03, May 13, 1976.

6.17 Telecon from Pete Hung to W. Cottingham, 3/6/92, 10:15, "ANO-2 PPS Loop Uncertainty/Setpoint Calculation", TIC-92-053.

6.18 "ANO-2 Miscellaneous PPS Uncertainty Information", TIC-92-068, April 6, 1992.

6.19 R. C. Thomas, "Data Transmittal for ANO-2 (511920)", Memo A-PSA-067, to P. P. Slowik, dated 5/19/77.

6.20 Rosemount Product Data Sheet 2631, Model 1154 Series H Alphaline Nuclear Pressure Transmitters, Revised 4/89.

(Vendor Manual TM R370.0010, TD R370.0300 Rev. 1; "Instruction Manual for Rosemount Alphaline Pressure Transmitter Model 1154 Series H")

6.21 Fischer & Porter Specification 50EK1000, File: Section 49.

6.22 Letter to P. Collette (ABB/CE) from A. J. Wrape (ANO) dated 2/13/92, ANO-92-00370.

6.23 General Resistance, Inc. "Econistor Types 8E16/8E24" 1982.

6.24 NP#71, Rev. 4, Environmental Qualification Program Manual.

6.25 System Component Evaluation Worksheet #2A074 - 2A077, Rev. 1.

6.26 I&C Periodic Test Procedure 2304.089 Rev. 0; Plant Protection System Channel A Calibration.

I&C Periodic Test Procedure 2304.090 Rev. 0; Plant Protection System Channel B Calibration.

I&C Periodic Test Procedure 2304.091 Rev. 0; Plant Protection System Channel C Calibration.

I&C Periodic Test Procedure 2304.092 Rev. 0; Plant Protection System Channel D Calibration.

6.27 Letter to P. Collette (ABB/CE) from A. J. Wrape (ANO) dated 11/20/91, ANO-91-2-00930.

6.28 ANO-2 Plant Protection System Methodology Review, 92-12-2614-01, Rev. 0.

6.29 J. C. Winslow, "Response Times of the ESFAS Auxiliary Relay Cabinets and Reactor Trip Switch Gear", Memo ID-77-260, to P. P. Slowik, dated 6/16/77.

Attachment 3

Loop Error, Setpoint, and Time Response Analysis for
Low Pressurizer Wide Range Pressure ESFAS and RPS Trip Functions

Since our submittal requesting the increase in allowable pressurizer pressure range and lowering the low pressurizer pressure setpoint for reactor trip, safety injection, and containment cooling (letter 2CAN079202 dated July 22, 1992) the calculation for the pressurizer pressure instrumentation has been revised twic Neither revision has affected our requested values in our Technical Specifications change submittal.

Rev 0(1)

The main purpose for revision 0(1) was to change the Variable Setpoint Step Increment from 400 PSI, which was established per the original calculation revision 0 in anticipation of a Technical Specification change revising the step increment value, back to the existing value of 200 PSI as it was decided to pursue this particular change at a later date. A secondary purpose was to add a note clarifying the insulation resistance (IR) error value selection as related to differences between values calculated for each channel.

Rev 0(2)

The main purpose of revision 0(2) was to increase the error allowance for component number 2PY-4624-2C, 2PY-4624-1A, 2PY-4624-2A, 2PY-4624-3A, and 2PY-4624-4A drift (DR) based on a review of past as-found/as-left calibration history. Also, excess conservatisms were removed from the IR error calculation.