Consumers Power Company

J W Reynolds
Executive Vice President

General Offices: 1945 West Parnall Road, Jackson, MI 49201 • (517) 788-1920

July 5, 1983

Harold R Denton, Director
Office of Nuclear Reactor Regulation
Division of Licensing
US Nuclear Regulatory Commission
Washington, DC 20555

MIDLAND ENERGY CENTER PROJECT
MIDLAND DOCKET NOS 50-329, 50-330
SER CONFIRMATORY ISSUE 15
SETPOINT METHODOLOGY DOCUMENTATION
FILE B16.0/B7.1 SERIAL 23238

REFERENCE: (1) NRC LETTER FROM ELINOR G ADENSAM TO J W COOK DATED MAY 31, 1983 ON SER CONFIRMATORY ISSUES 15, 18 and 19

(2) CP CO LETTER FROM J W COOK TO H R DENTON DATED MARCH 9, 1983 SERIAL 21566

ENCLOSURE: BECHTEL LETTER BLC-17305 DATED JULY 1, 1983 WITH SETPOINT CALCULATIONS J-6064(G) AND J-6065(G)

The referenced NRC letter requested additional information concerning the numerical data used in conjunction with setpoint methodology to calculate technical specification setpoints. Examples of these setpoint calculations for borated water storage tank low level and steam generator low pressure are forwarded with this letter and typify the numeral data requested. These calculations illustrate application of the setpoint methodology document which was previously submitted (Reference 2).

Each setpoint calculation is unique in that different types and styles of transmitters may be used. These transmitters may be located in different environments and the number and type of components in the instrument string may vary. Due to these unique characteristics, each setpoint is calculated individually. As described in our setpoint methodology document, the starting point for determining technical specification setpoints are the process limit or setpoint used in the safety analysis. FSAR Tables 15.0-2 and 7.3-2 list the trip setpoints assumed in the safety analysis for the Reactor Protection System (RPS) and the Engineered Safety Features Actuation System (ESFAS). Comparison of these safety analysis trip setpoints with equipment setpoints listed in FSAR Tables 16.2.2-1 and 16.3.3-4 shows the margin included to

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account for instrumentation inaccuracies and other factors. For example, Table 7.3-2 lists the trip setpoints for low steam generator pressure as 585 psig decreasing. The equipment trip setpoint listed in Table 16.3.3-4 is 670 psig which allows for an 85 psi margin between the safety analysis trip setpoint and the equipment setpoint. The factors evaluated in determining this margin are described in the attached calculation of the steam generator low pressure setpoint.

The attached calculations provide an example of how the setpoint methodology is utilized to numerically determine technical specification setpoint values. A review of the FSAR tables identified above summarizes the total margin included between the accident analysis and technical specification setpoints. This letter should provide the information necessary for the Staff to complete their review of Confirmatory Item (15) of the Midland Safety Evaluation Report.

JWR/RMH/fme

CC RJCook, Midland Resident Inspector
MAMiller, US NRC
JGKeppler, NRC, Region III

CONSUMERS POWER COMPANY
Midland Units 1 and 2
Docket No 50-329, 50-330

Letter Serial 23238 Dated July 5, 1983

At the request of the Commission and pursuant to the Atomic Energy Act of 1954, and the Energy Reorganization Act of 1974, as amended and the Commission's Rules and Regulations thereunder, Consumers Power Company submits information on the methodology for selecting Technical Specification setpoints for the Reactor Protection System and Engineered Safety Feature Actuation System.

CONSUMERS POWER COMPANY

By _____
J W Reynolds, Executive Vice President
Energy Supply

Sworn and subscribed before me this 5th day of July.

Helen L. Dempski
Notary Public
Jackson County, Michigan

My Commission Expires Dec 14, 1983

oc0783-1841a131

Bechtel Associates Professional Corporation

777 East Eisenhower Parkway
Ann Arbor, Michigan

Mail Address P.O. Box 1000, Ann Arbor, Michigan 48106

July 1, 1983

BLC-17305

Consumers Power Company
1945 West Parnall Road
Jackson, Michigan 49201

Attention: Mr. L.S. Gibson
Project Engineering Manager -
Electrical and Nuclear

Subject: Midland Plant Units 1 and 2
Consumers Power Company
Bechtel Job 7220
RELEASE OF TWO SETPOINT
CALCULATIONS TO CLIENT FOR
NRC USE

Reference: BLC-16061, 2/17/83 Com 105419

An urgent request from your D. Sommers to provide copies of two or three setpoint calculations for submittal to the Nuclear Regulatory Commission (NRC) by July 1, 1983, was received by our D.F. Lewis on June 24, 1983. The following two calculations were subsequently requested by your R. Hamm in a verbal conversation with our M. Gerding on June 24, 1983:

a. J-6064(Q), Rev 2, Steam Generator Low Pressure Trip Setpoint and MSLIS Bypass

b. J-6065(Q), Rev 2, BWST Low Level Trip Setpoint.

Consumers Power Company has agreed to provide these calculations to the NRC to fulfill commitments to close an SER open item regarding the Midland setpoint methodology.

In response to the request, the above calculations were reviewed jointly with your R. Hamm and our K. Davis on June 27, 1983, to ensure that the purpose, assumptions, and judgment were thoroughly understood. These calculations were then hand carried to your M. Rice on July 1, 1983, for review by the NRC. The methodology explaining the assumptions and limitations was provided to Consumers Power Company as an attachment to the referenced letter.

Bechtel has developed these calculations in connection with a specific set of design conditions and such calculations are not to be and should not be used in whole or in part by others under any circumstances. No warranties, express or implied, are made and no legal liability or responsibility is assumed for the accuracy, completeness or usefulness of the calculations or the information or conclusions contained therein or for any designs by others derived from these calculations.

The above limitations were reviewed and understood by your M. Rice on July 1, 1983, at our office.

If you have any questions, please contact J.M. Anderson at (313) 994-7102.

Very truly yours,

E.M. Hughes
Project Engineer

GS/UNS/hl
063001

cc: F.W. Buckman
D.B. Miller

Written Repsonse Requested: No

CALCULATION COVER SHEET

PROJECT Midland Units 1 & 2 JOB NO. 7220 DISCIPLINE Control Sys.

SUBJECT BWST Low Level Trip Setpoint FILE NO. _____

CALC NO. J-6065 (Q)

ORIGINATOR William J. Razgunas DATE 4-8-82

CHECKER K. M. Strickland DATE 4-26-82 NO. OF SHEETS 26 1.1

RECORD OF ISSUES

NO.	DESCRIPTION	BY	DATE	CHKD	DATE	APPRD	DATE	DATE FILMED
△								
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2	REVISED SHTS 4 & 3 AS SHOWN	JWR	6/27/83	[illegible]	6/27/83	[illegible]	6/27/83	
1	REVISED AS INDICATED	KB	12-20-82	[illegible]	12/21/82	[illegible]	2/18/83	MAY 11 1983
△	ACCEPTED BY MIDLAND PROJECT	—	—	—	—	ACCEPTED [illegible]	4/28/82	MAY 29 1982
0	Issued for Use	KJR	4/8/82	[illegible]	4-26-82	[illegible]	26APR82	

PRELIMINARY CALC ☐ COMMITTED PRELIMINARY DESIGN CALC ☐

SUPERSEDED CALC ☐ FINAL CALC ☒

COMPUTER PROGRAM

NUMBER N/A

ACRONYM _____

VERSION _____

VERIFIED Yes ☐ No ☐

If no, separate verification attached ☐

THIS CALCULATION HAS NO ATTACHMENTS

△1

CALCULATION SHEET

CALC. NO. J-6665(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/22/82

PROJECT MIDLAND UNITS 1 and 2 JOB NO. 7220

SUBJECT ESFAS Trip Setpoint-BWST Low Level SHEET NO. 2

I. List of Assumptions

A. Deleted

B. The level transmitter and instrument line temperature is maintained at or above the low temperature limit for the BWST contents (40°F).

C. The signal from the BWST transmitters to the redundant control room indication does not affect the accuracy of the signal from the same level transmitters to the ESFAS sensor channel trip bistable. See block diagram in section III.

D. Transmitter drift over 18 months will not exceed the published value of drift over 6 months claimed by Rosemount. See Ref. F.

E. Transmitter calibration occurs at the maximum outdoor temperature of 106°F and the BWST low level trip condition occurs at the BWST contents minimum temperature of 40°F. See sections IV. D. (3) and IV. D. (4). THIS IS DONE TO BE CONSERVATIVE.

F. THE DIFFERENCE BETWEEN THE SPECIFIC VOLUME OF WATER AND BORATED WATER IS NEGLIGBLE.

G. Bistable drift over the monthly calibration period is zero. See section V. C. (2).

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CALCULATION SHEET

CALC. NO. J-6065(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12-[illegible]

PROJECT JOB NO. 7220

SUBJECT SHEET NO. 3

I. List of Calculation Assumptions (Continued)

H. The monthly ESFAS channel functional test verifies the bistable setting, but excludes the transmitter input portion of the trip circuit. The 18-month (refueling) ESFAS channel calibration includes the entire trip string in a single test of the trip setting, from transmitter input to bistable input signal at which the trip occurs.

J. To conservatively calculate setpoint and allowable values, all transmitter errors are additive in the same (worst case) direction. See section III. D. ⑤

K. Deleted.

L. The BWST is level.

M. Standard (STD.) inches of water column is defined as the height of water at a temperature of 68°F

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CALCULATION SHEET

CALC. NO. J-6065(Q) REV. NO. 0 1 2

ORIGINATOR W. J. Rogers DATE 4-5-82 CHECKED [illegible] DATE [illegible]

PROJECT _____ JOB NO. 7220

SUBJECT _____ SHEET NO. 4

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References:

A. Bechtel Data Sheet J-1245-22, Rev 2 dated 4/16/79

B. Level Setting Diagram 7220-J-630, SHTS 1+2, REV. 3; SHTS 3+4, REV. 1

C. Bechtel Specification 7220-J-1564 Rev 5 dated 12/29/80

D. FSAR Section 9.2.8.3 "BWST Safety Evaluation One"

E. Rosemount Product Data Sheet 2235 (1976) for Model 1152 Alphaline Nuclear Pressure Transmitters.

F. Rosemount letter to K. Richards dated 12/23/81 (Com # 053687)

G. Babcock & Wilcox Manual, Serial 2016, Date 6-1-73, p. 4

H. Vender print 7220-J207-227-1 Midland ESFAS Technical Data.

J. Midland calculation number F-M-3725-10(Q) Rev. ~~1~~ 2 dated 9/2/82

K. Letter BLC-1281 dated 3/25/82 (Com # 063964)

L. DELETED

M. Bechtel Dwg., 7220-J405(Q) Rev. 4

N. BECHTEL DWG., 7220-M612(Q) SH. 7 Rev 9, SH. 8 Rev. 6
7220-M613(Q) SH. 7 Rev 9, SH. 8 Rev. 8

CALCULATION SHEET

CALC. NO. J-6066-A REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 1/24/83

PROJECT _____ JOB NO 7220

SUBJECT _____ SHEET NO 4a

References (cont'd)

O. DWG, F 7220-C18-181-4
P. DWG, 7220-C18-159-2
Q. DWG, 7220-C-128(Q), Rev 8

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CALCULATION SHEET

CALC. NO. J-601-5 (Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 1-[illegible]

PROJECT [illegible] JOB NO. 7220

SUBJECT BWST Low Level Trip Setpoint SHEET NO. 5

II. Purpose of Calculation

This calculation provides the basis for the Borated Water Storage Tank (BWST) Low Level Trip Setpoint RANGE and Allowable Values in the Midland ESFAS Setpoint Technical Specification 16.3/4.3.2, Table 16.3.3-4. IT IS ALSO USED TO CALCULATE TRANS. CAL. SPAN INDEPENDANT OF ELEVATIONS FOR USE IN PROJECT DESIGN DOCUMENTS (ie. level setting diagram, MRJ207 + dwgs. & data sheets) 1

III. Function of the Instrumentation

The instruments which generate a BWST Low Level Trip condition in the Midland ESFAS initiate the Recirculation Activation System (RAS) when an ECCAS signal is also present.

The above action occurs on a 2-out-of 4 coincident low level in the BWST. Low BWST level is indicative that the BWST's inventory has been depleted by the Emergency Core Cooling Systems (ECCS) in order to mitigate the consequences of a LOCA. Initiation of the RAS is intended to transfer the suction of the LPI and RB spray pumps from the BWST to the Reactor Building Sump.

The level instrumentation which initiates a Recirculation Activation System trip also provides redundant indication in the control room. This instrument setpoint calculation will only consider the instrument requirements and qualifications up to the point of accomplishing the low level trip function. A separate calculation will be necessary to determine the instrument string error for the level indicators.

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CALCULATION SHEET

CALC. NO. J-(0651(Q)) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 1-[illegible]

PROJECT _____ JOB NO. 7220

SUBJECT BWST Low Level Trip Setpoint SHEET NO. 6

III (Continued)

A block diagram of a typical BWST level instrumentation loop up to the trip device (bistable) is as follows:

The calculation which follows will consider the combined effects of transmitter and bistable module tolerances on the determination of the low level setpoint and allowable values.

IV BWST Level Transmitter Error

A. Instrument Tag Numbers

Unit 1	Unit 2
1LT-1218A	2LT-1318A
1LT-1218B	2LT-1318B
1LT-1218C	2LT-1318C
1LT-1218D	2LT-1318D

B. Transmitter Data (from Ref A)

Mfr: Rosemount
Model: 1152DP5
Range: 0-125/750 in H_2O
Calibrated Span: 0-344 STD IN. H_2O (Appendix A)
Output: 4-20 mA
Transmitter Elevation: 638' 3" (Unit 2) } with ±1½" tolerance
638' 3" (Unit 1) } Ref. 0

NOTE: THIS TRANSMITTER HAS NO REFERENCE LEG.

CALCULATION SHEET

CALC. NO. J-4065(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [signature] DATE 12/20/82

PROJECT JOB NO. 7220

SUBJECT LWST Low Level Trip Setpoint SHEET NO. 7

IV.C. Environmental Data (from Ref A. through D)

Location: Outdoors
Temperature: Minimum 40 F* (Ref. D)
Maximum 106 F
Pressure: Atmospheric
Rad dose: 42 Rads integrated over 40 years
71 Rads DBA and post DBA

* This temperature is based on the assumption that the the low temperature limit of the tank contents is the same as the low temperature limit of the transmitter and sensing line.

D. Sources of Transmitter Error

- Normal Inaccuracy (including hysteresis, linearity and repeatabili
- Stability (drift) over calibration period
- Temperature Effects on transmitter
- Temperature Effect on actual level in BWST
- Radiation Effect
- Seismic Effect

(1) Normal Inaccuracy (including hysteresis, linearity and repeatability,

From Reference E, Model 1152 transmitter inaccuracy is ±.25% of calibrated span. For a span of 0-344 STD inches water column, normal inaccuracy is:

.0025 × 344 "w.c. = ±0.86 STD. in. w.c.

Assumption M

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CALCULATION SHEET

CALC. NO. J-6065(N1) REV. NO. 2

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/20/82

PROJECT JOB NO. 7220

SUBJECT LWST Low Level Trip Setpoint SHEET NO. 8

IV. D. (Continued)

(2) Stability (drift) over the calibration period

From Ref. E, Model 1152 transmitter stability is ±.25% of upper range limit for a six month calibration interval. Although Rosemount does not state the stability for longer periods, they have stated in Ref F that the six month stability value is conservative, and could probably be extended to longer calibration intervals. Assuming that the stability value is valid for an 18-month calibration interval, stability is: ASSUMPTION D

.0025 x 750" w.c. = ±1.88 STD in. w.c.

(3) Temperature Effects on transmitter

Fro Ref. E, Model 1152 transmitter temperature effects are given for minimum and maximum span settings, as ±3.5% and ±1.0% of span per 100°F, respectively. For an intermediate span setting, the temperature effect equals the sum of the Fixed Zero error correction plus the span error correction.

ZERO ERROR: $\frac{\pm 0.5\%\ URL}{100°F} \times \frac{750\ STD.\ IN.\ W.C.}{344\ STD.\ IN.\ W.C.} = \pm 1.1\%\ CS/100°F$

+ SPAN ERROR: $= \pm .5\%\ CS/100°F$

TOTAL ERROR: $= \pm 1.6\%\ CS/100°F$

The variation in temperature per assumption E is:

$106°F - 40°F = 66°F$

The temperature effect corresponding to this ΔT is

$66°F \times \left[1.6\%/100°F \times 344\ in.w.c.\right] = \pm 3.63$ inches w.c. (STD)

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IV D. (Continued)

④ Temperature effect on actual level (volume) in BWST

The level transmitter is calibrated to read inches of water at 68°F (per Telecon with Bob Swanson of Rosemount on 12-8-82). Pure water at 68°F has a density of 0.998 (Ref. G) The actual level of borated water will be higher or lower than "level seen" by the transmitter depending on the boric acid concentration and water temperature since these will affect the liquid density. For a given condition of the liquid the readings at various levels will all be off by the same percentage but will be off by a greater number of inches (smaller gallons) at higher levels. A margin will need to be added to account for the affect this will have on injection volume.

Variation in actual top & bottom level of injection volume

Since a greater change in level will occur at the top level than the bottom level we are only concerned with conditions that will lower the actual level in the tank below that seen by the transmitter and therefore have the net affect of decreasing the injection volume. The maximum effect will occur when the density of the boric acid (assumed to be 1.3 wt % per Ref D) is at its highest. This will occur at the minimum tank temperature of 40°F.

CALCULATION SHEET

CALC. NO. J-6[illegible](Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/20/82

PROJECT 7220 JOB NO.

SUBJECT SHEET NO. 10

IV D 4 (Cont)

Specific Gravity of 1.3% Boric Acid at 40°F: 1.006 (Ref G)

The relation between pressure and height of liquid:

$P_1 = \rho g h_1$

ρ = density
g = acceleration of gravity
h = height of fluid
P pressure

If two liquids exert the same pressure:

$\rho_1 g h_1 = \rho_2 g h_2$

or $h_2 = h_1 \frac{\rho_1}{\rho_2}$

1 = H_2O at 60°F
2 = 1.3% Boric acid at 40°F

For top level of injection volume = 316.5 in. - 40in* = 276.5in (Ref J)

$$h_2 = 276.5 \times \frac{0.998}{1.006} = 274.3 \text{ in.}$$

For bottom level of injection volume = 86.2in - 40in* = 46.2in (Ref J)

$$h_2 = 46.2 \times \frac{0.998}{1.006} = 45.8 \text{ in.}$$

*Only the height of liquid above transmitter will contribute to the effect, so it is necessary to subtract height of liquid below transmitter

CALCULATION SHEET

CALC. NO. J-6065(Φ) REV. NO. 1

ORIGINATOR K. BOFFELARD DATE 12-20-82 CHECKED [illegible] DATE 12/21/82

PROJECT [illegible] JOB NO. 7[illegible]3

SUBJECT [illegible] SHEET NO. 10 OF [illegible]

$h_w = 276.5 - 46.2 = 230.3$ in. (19.2ft)

h_w = height of injection volume of H_2O at 68°F

$h_b = 274.3 - 45.8 = 228.5$ in. (19.0ft)

h_b = height of injection volume of 1.3% boric acid at 40°F

$\Delta h = h_w - h_b = 230.3 - 228.5 = 1.8$ in.

Δh = loss of injection volume height

Thus 1.8 in will be added to bottom of injection volume for determining upper limit of low level trip setpoint to allow for variation of injection volume due to density changes (refer to sheet 20).

CALCULATION SHEET

CALC. NO. I-6065(Q) REV. NO. 1

ORIGINATOR K. BORREGO DATE 12-20-82 CHECKED [illegible] DATE [illegible]

PROJECT _____ JOB NO. 7220

SUBJECT FWST Low Level Trip Setpoint SHEET NO. 11

IV. D. (Continued)

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⑤ Radiation Effects

The transmitters are located in a low radiation environment. Therefore, radiation has a negligible affect on transmitter accuracy.

⑥ Seismic Effects

From Ref. E, the Model 1152 seismic effect is .25% accuracy during and after the seismic event. The seismic effect is then:

$.0025 \times 750$ in w.c. $= \pm 1.88$ (STD.) inches w.c.

⑦ Overall Transmitter Error

Normal Inaccuracy	± 0.86 inches w.c.
Stability	± 1.88 " "
Temperature Effects - XMTR	± 3.63 " "
Radiation Effect	negligible " "
Seismic Effect	± 1.88 " "
Total	± 8.25 (STD.) inches w.c.

Worst Case Transmitter Error = ± 8.25 (STD.) inches w.c.

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CALCULATION SHEET

CALC. NO. T-6065(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/[illegible]

PROJECT [illegible] JOB NO. 722V

SUBJECT [illegible] SHEET NO. 12

The above number is a "worst case" transmitter error which assumes that all the transmitter errors are simultaneously additive in the same direction.

A negative error is defined as an error which will result in an indicated BWST level greater than the actual level. To correct for the error in transmitter readout to obtain the actual BWST level, the error amount would have to be subtracted from the transmitter readout.

A negative error will delay the trip to an actual level below the process limit, unless the trip set-point compensates for the error. A positive error, on the other hand, would cause an earlier-than-necessary trip on decreasing level. Positive errors will GIVE A READING LOWER THAN ACTUAL LEVEL, AND WOULD HAVE TO BE ADDED TO TRANS. READOUT TO OBTAIN THE ACTUAL LEVEL.

The sign convention for errors described above applies to the remainder of this calculation. Note that in order to compensate for negative errors, a positive amount will be added to the process limit value (see section VII) AND FOR POSITIVE ERRORS, THE AMOUNT WILL BE SUBTRACTED FROM THE PROCESS LIMIT VALUE.

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CALCULATION SHEET

CALC. NO. 7-6065(Q) REV. NO. 0

ORIGINATOR W. J. Rayguera DATE 4/8/82 CHECKED [illegible] DATE 4-26-82

PROJECT [blank] JOB NO. 7220

SUBJECT 1st Low Level Trip Setpoint SHEET NO. 13

V Trip Bistable Error

A. Bistable Data

Mfr: Vitro Laboratories
Model: 2717-1076
Input Signal: 1-5 vdc (corresponds to transmitter 4-20 ma signal)
Output: Logic Output, changes state on a bistable trip
Deadband: Adjustable between 0-5% of input
Setpoint: Adjustable over full range of input signal

B. Environmental Data

Location: ESFAS Cabinets 1/2C43 in Safety Related Equipment Room, Auxiliary Building, Elev 659'
Temperature: 65-85°F
Pressure: Atmospheric
Humidity: 20-80% RH.
Rad dose: 40 Rad/40 years

C. Sources of Bistable Error
- Normal Inaccuracy
- Stability (drift) over calibration period.
- Repeatability
- Temperature correction

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AAO-520 6/76

CALCULATION SHEET

CALC. NO. TI-6065(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/20/82

PROJECT JOB NO. 7220

SUBJECT BWST Low Level Trip Setpoint SHEET NO. 14

V.C (Continued)

① Normal Inaccuracy

From Ref. H, bistable inaccuracy is ±0.2% of full scale. Full scale for the BWST Low Level trip bistable is the 4-20 ma input from the associated transmitter, which corresponds to the transmitter span of 0 - 344 in. w.c. from App. A. ⚠1 The inaccuracy of the bistable is.

±.002 x 344 in w.c. = ± 0.69 STD in W.C.

② Stability (drift) over the calibration interval

From Ref. H, Vitro has not determined bistable setpoint drift. Vitro suggested using bistable drift data from the Big Rock Point RDS, which uses nearly identical Vitro bistable modules. Ray Brezinski (CPCo Midland plant staff) contacted Big Rock and was told that bistable drift in the RDS has been zero since system startup. Based on this information, no error contribution due to drift will be included in the bistable error calculation.

③ Repeatability

From Ref H, bistable repeatability is ± .1% of full scale. The repeatability is

±.001 x 344 in w.c. = ±.34 STD in W.C. ⚠1

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CALCULATION SHEET

CALC. NO. J-CC65(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE [illegible]

PROJECT JOB NO. 7220

SUBJECT BWST Low Level Trip Setpoint SHEET NO. 15

V. C (Continued)

④ Temperature Correction

From Ref. H, bistable temperature correction is ±.1% of full scale for the range of 0-60°C (32-140°F). The control room envelope has a temperature variation of only 20°F. The corresponding temperature correction for a 20°F variation is

$$\pm 0.001 \times \frac{20°F}{(140-32°F)} = \pm 0.0002 \quad [\pm .02\%]$$

$\pm .0002 \times 344$ "w.c. = ±0.07 STD. in w.c.

⑤ Overall Bistable Error

Normal Inaccuracy	±.69 inches w.c.
Stability	Zero
Repeatability	±.34 inches w.c.
Temperature Correction	±.07 " "

Overall Bistable Error ±1.10 STD in w.c.

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CALCULATION SHEET

CALC. NO. I 0050 REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/20/82

PROJECT _____ JOB NO. _____

SUBJECT BWST Low Level Trip Setpoint SHEET NO. 46

VI BWST RAS ESFAS LOW LEVEL SETPOINT AND ALLOWABLE VALUE

A. THE ACCIDENT ANALYSIS process Limit upon which the BWST LOW RAS Level trip setpoint is concerned is the actual water level allowing for sufficient volume for:

1) Vortex protection
2) closure time of BWST isolation VALVE By RAS

these ARE 1.0' AND 0.52' respectively, Ref. J. THE MIN. TANK LEVEL THAT CAN BE MEASURED IS 40", Appendix A. THUS THIS VALUE IS the RAS Low process limit. the levels mentioned ABOVE fall well within this, so by using 40" we are CONSERVATIVE. ANY DENSITY CHANGE ERROR DUE to temperature changes will als. fall within this VALUE. REFERENCING THIS TO THE TRANSMITTER,

$$40" - 40" = 0" = \text{process Limit}$$

THE TRANSMITTER HEIGHT ABOVE THE BOTTOM OF THE TANK IS USED AS A ZERO REFERENCE.

CALCULATION SHEET

CALC. NO. J-6067(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/20/82

PROJECT _____ JOB NO. 7220

SUBJECT _____ SHEET NO 17

NOTE;

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CALCULATION SHEET

CALC. NO. J-6065(1)-1 REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/[illegible]/82

PROJECT JOB NO. 7220

SUBJECT BWST Low Level Trip Setpoint SHEET NO. 18

VI Continued

C. Using the process limit in part B on the previous page, the Allowable Values for the BWST RAS low level trip are determined as follows: 1

1. The 18 month Allowable Value is the process limit plus all instrument errors except drift.

Process limit	.0 STD. in W.C. 1
Instrument error	
a. Transmitter (without drift)	6.37" (8.25" - 1.88" See ch. 11)
b. Bistable	1.10"
	7.47" STD in. W.C.

18 month Allowable value is

∴ Round up to 7.5" STD. in W.C. 1

2. The 30 day Allowable value is the 18 month Allowable value plus transmitter drift and transmitter calibration error. Per agreement with CPCo as documented in Reference K, the calibration error is assumed to be equal to the accuracy of the instrument being calibrated. The 30 day allowable value is then

18 month Allowable Value	7.5" STD in W.C.
Transmitter drift	1.88 inches
Transmitter calibration error	.86 inches
30 day Allowable Value	10.24" STD. in. W.C. 1

∴ Round off to 10.2" STD. in W.C.

8009040904

AAO-520 6/76

CALCULATION SHEET

CALC. NO. F-C0651(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 1-[illegible]

PROJECT JOB NO. 7220

SUBJECT BWST Low Level Trip Setpoint SHEET NO. 19

VI Continued

D. The Technical Specification Trip Setpoint is the 30 day Allowable Value plus bistable drift and bistable calibration error.

30 day Allowable Value	10.2" STD. in. W.C.
Bistable drift	zero
Bistable calibration error	0.69 inches
Tech Spec Trip Setpoint	10.89" STD. in. W.C

∴ Round up to 10.9" STD in. W.C.

TNC

E. The table on pg. 22 summarizes the contributors to the BWST tech spec trip setpoint. 1

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CALCULATION SHEET

CALC. NO. T-6065(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/20/82

PROJECT _____ JOB NO. 7220

SUBJECT BWST LOW LEVEL TRIP SETPOINT SHEET NO. 20

VII BWST RAS ESFAS UPPER SETPOINT LIMIT AND ALLOWABLE VALUE

A. THE BOTTOM OF THE INJECTION VOLUME PER REFERENCE 7 IS 86.2". A MARGIN IS SUBTRACTED FROM THIS VALUE TO ACCOUNT FOR DENSITY CHANGES (SH. 9-10A)

$$86.2" - 1.8" = 84.4"$$

CONVERTING TO TRANSMITTER READINGS

$$84.4 - 40" = 44.4"$$

1

B. USING THE INJECTION VOLUME BOTTOM ABOVE, THE ALLOWABLE VALUES FOR THE BWST RAS upper setpoint TRIP ARE DETERMINED AS FOLLOWS:

1. THE 18 MONTH ALLOWABLE VALUE IS THE PROCESS LIMIT MINUS ALL INSTR. ERRORS EXCEPT DRIFT.

INJECTION VOLUME BOTTOM (WITH MARGIN) 44.4 STD in.

INSTRUMENT ERROR:

a. - TRANS. (WITHOUT DRIFT) 6.37" (8.25 - 1.88" see SH. 11)

b. - BISTABLE 1.1" see SH 15

18 MONTH ALLOWABLE VALUE is 36.93" STD. in W.C.

∴ ROUND UP TO 37" STD. IN. W.C.

2. THE 30 DAY ALLOWABLE VALUE IS THE 18 MONTH ALLOWABLE VALUE MINUS TRANSMITTER DRIFT AND TRANSMITTER CALIBRATION ERROR. THIS METHOD IS IN AGREEMENT

CALCULATION SHEET

CALC. NO. J-600-[illegible] REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE [illegible]

PROJECT _____ JOB NO. 7220

SUBJECT _____ SHEET NO. 21

WITH CPC. AS DOCUMENTED IN REFERENCE K, THE CALIBRATION ERROR IS ASSUMED TO BE EQUAL TO THE ACCURACY OF THE INSTRUMENT BEING CALIBRATED. THE 30 DAY ALLOWABLE VALUE IS

18 MONTH ALLOWABLE VALUE	37.0 S W
-TRANSMITTER DRIFT	1.9"
-TRANSMITTER CAL. ERROR	0.9"
30 DAY ALLOWABLE VALUE	34.2 ST W.C.

1

C. THE TECHNICAL SPECIFICATION TRIP SETPOINT IS THE 30 DAY ALLOWABLE VALUE MINUS BISTABLE DRIFT AND BISTABLE CALIBRATION ERROR.

30 DAY ALLOWABLE VALUE	34.2 STD in W.C.
BISTABLE DRIFT	ZERO
BISTABLE CAL. ERROR	0.7 in
TECH. SPEC TRIP SETPOINT	33.5 STD in W.C.

THE TABLE ON PAGE 22 SUMMARIZES THIS INFO.

CALCULATION SHEET

CALC. NO. J-6065(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/20/82

PROJECT JOB NO. 7220

SUBJECT SHEET NO. 22

SUMMARY OF CONTRIBUTORS TO BWST LOW LEVEL SETPOINT

Level From Bottom of tank	HEIGHT ABOVE TRANSMITTER	
86.2	46.2"	ACCIDENT ANALYSIS BOTTOM OF INJECTION VOLUME
77.0	37.0"	18 MONTH ALLOWABLE LEVEL, UPPER LIM
74.2	34.2"	30 DAY .. ALLOWABLE LEVEL FOR UPPER LIMIT
73.5"	33.5"	RAS UPPER LIMIT FOR LOW LEVEL SETPOINT
50.9"	10.9"	RAS LOW LEVEL setpoint (MIN.)
50.2"	10.2"	30 DAY ALLOWABLE Level for Low Level SETPOINT
47.5"	7.5"	18 MONTH ALLOWABLE LEVEL FOR LOW LEVEL SETPOINT
40"	0	REFERENCE (LEVEL XMTR ELEVATION) (see Appendix A) ACCIDENT ANALYSIS LOW LEVEL Process Limit
9"		BWST LEVEL XMTR TAP ELEVATION (see Ref. P)
0"		BWST TANK BOTTOM

THESE ARE ALL IN STD. IN OF WATER AT 68 °F

AAO-820 6/76

CALCULATION SHEET

CALC. NO. J-6069-51 REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [signature] DATE 12/20/82

PROJECT JOB NO. 7220

SUBJECT SHEET NO. 23

1

APPENDIX A

THE HEIGHT OF THE LEVEL TRANSMITTER ABOVE THE BWST TANK BOTTOM:

THE HEIGHT OF THE TRANSMITTER IS DETERMINED BY KNOWING THAT THE TRANSMITTER IS LOCATED AT THE CENTER OF THE INSTRUMENT PAD MOUNTED TO THE TANK, REF. M. THERE IS A ± 1½" TOLERANCE ON THE PAD CENTER LINE ELEVATION OF 638' 3", REF. O. ALTHOUGH THE ACTUAL ELEVATIONS OF THE TANK DIFFER FROM THE ELEVATIONS ON REF. O USED BY THE VENDOR, THE DISTANCE BETWEEN THE TRANSMITTER AND THE TOP OF CONCRETE ELEVATION WILL BE A CONSTANT. THE VENDOR DOES NOT SUPPLY AN ELEVATION FOR THE TANK BOTTOM. THE TOP OF CONCRETE ELEVATIONS ARE 635' ½" AND 635' 1½" FOR UNITS 1 & 2 RESPECTIVELY, REF. O.

BECAUSE THE TRANSMITTER IS LOCATED ABOVE THE TAP IN THIS CASE, THE TRANSMITTER ELEVATION LIMITS THE MEASURABLE RANGE, ie (NO READING CAN OCCUR BELOW THE TRANSMITTER). TO BE CONSERVATIVE THE LARGEST DISTANCE BETWEEN TRANSMITTER AND TANK BOTTOM NEEDS TO BE CALCULATED TO DETERMINE THE LIMITING TRANSMITTER RANGE. FOR THIS REASON + 1½" PAD tolerance IS USED AND THE LOWEST TOP OF CONCRETE ELEVATION IS USED (635' ½"). THUS, THE MAX. DISTANCE BETWEEN TRANSMITTER CENTERLINE AND TOP OF CONC. IS:

$$(638'\ 3" + 1\tfrac{1}{2}") - (635'\ \tfrac{1}{2}") = 40"$$

TO DETERMINE THE DISTANCE BETWEEN THE

(cont'd)

NOTE: THIS TRANSMITTER HAS NO REFERENCE LEG.

CALCULATION SHEET

CALC. NO. J-6065(Q) REV. NO. 1

ORIGINATOR K. BORREGARD DATE 12-20-82 CHECKED [illegible] DATE 12/21/82

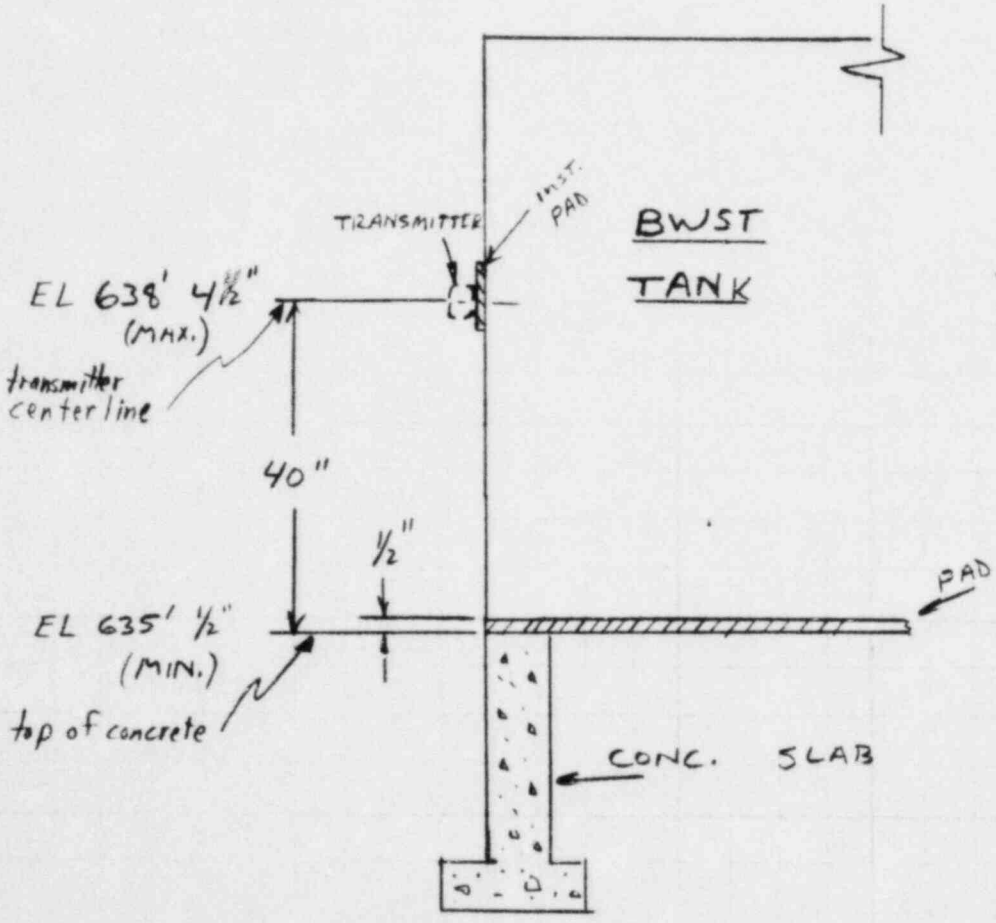
PROJECT JOB NO. 7220

SUBJECT SHEET NO. 24

TRANSMITTER AND BWST BOTTOM, 1/2" IS SUBTRACTED TO ACCOUNT FOR THE PAD THAT IS BETWEEN THE TANK AND TOP OF CONCRETE SLAB, Ref. Q. THUS,

$40" - 1/2" = 39\ 1/2"$ (ROUND UP TO 40")

This is the worst case transmitter center line distance above the bottom of the tank.



It is assumed that the BWST is level. - Assumption L

USING INFO. ABOVE THE SPAN OF THE TRANSMITTER IS CALCULATED BY SUBTRACTING THE HEIGHT OF THE TRANSMITTER FROM THE HEIGHT OF THE TANK (384"). THIS TURNS OUT TO BE 384" - 40" = 344". THIS SHALL BE USED FOR THE TRANSMITTER CALIBRATED RANGE.

MIDLAND UNITS 1 AND 2

CHANGE NOTICE LOG

CALC NO. ______________

				CUMULATIVE EFFECT ASSESSED		
CHANGE NOTICE NO.	SUPPORTING CALC NO.	EFFECT ON CALC	INCOR-PORATED	ENGR	CHKR	GRP SUPV

7220-477 3/83

CALCULATION COVER SHEET

PROJECT Midland Units 1 and 2 JOB NO. 7220 DISCIPLINE C S.

SUBJECT ESFAS Trip Setpoint and Allowable Values – Steam Generator Low Pressure & MSLIS Bypass FILE NO.

CALC NO. J-6064 (Q)

ORIGINATOR K.M. Strickland DATE 4-1-82

CHECKER W. J. Razzuk DATE 4/19/82 NO. OF SHEETS 21

RECORD OF ISSUES

NO.	DESCRIPTION	BY	DATE	CHKD	DATE	APPRD	DATE	DATE FILMED
△								
△								
2	REVISED AS INDICATED	DGP	6/3/83	[illegible]	6/3/83	[illegible]	6/3/83	
1	ASSUMPTION D REVISED & ADDED REFM	KB	9-21-82	GLW	9/27/82	[illegible]	12/22/82	FEB 10 1983
△	~~ACCEPTED BY MIDLAND PROJECT~~					ACCEPTED [illegible]	4/27/82	MAY 29 1987
0	ISSUED FOR PROJECT USE	KMS	4/1/82	[illegible]	4/19/82	[illegible]	26APR82	

PRELIMINARY CALC ☐
SUPERSEDED CALC ☐

COMMITTED PRELIMINARY DESIGN CALC ☐
FINAL CALC ☒

COMPUTER PROGRAM

NUMBER N/A

ACRONYM

VERSION

VERIFIED Yes ☐ No ☐

If no, separate verification attached ☐

COMPUTER PROGRAM

NUMBER N/A

ACRONYM

VERSION

VERIFIED Yes ☐ No ☐

If no, separate verification attached ☐

TABLE OF CONTENTS PAGE

ATTACHMENT: CHANGE NOTICE LOG FORM PAGE 1 OF 1

0 1 0 2 0 3 0 0 5 1

CALCULATION SHEET

BECHTEL

ORIGINATOR	Dennis H. Hoxt / Nandu R. Gurude	DATE	6/3/83
CALC. NO.	J-6064 (Q)	REV. NO.	2
CHECKED	[illegible]	DATE	6/3/83
PROJECT	Midland Plant Units 1 and 2	JOB NO.	7220
SUBJECT	Steam Generator Pressure Trip Setpoints	SHEET NO.	2

References:

A. Bechtel Data Sheets J-1245-51, Rev. 2 and J-1245-52, Rev. 1

B. Location Dwgs J-3126, Rev. 6 and J-3150, sht 2, Rev 3

C. Instrument Installation Summary 7220-J-705, Rev. 13

D. Specification 7220-J-1564, Rev 5 dated 12/29/80

E. Rosemount Product Data Sheet 2302 (1978) for Model 1153 Series B Alphaline Nuclear Pressure Transmitters

F. Rosemount letter to K. Richards dated 12/23/81.

G. Rosemount letter to K. Borregard dated 1/29/82 (Com # 057506

H. Vendor Print 7220-J-207-233-1, Midland ESFAS Technical Data

I. FSAR Table 15.0-2.

J. Letter BLC-12831 dated 3/25/82 (Com # 063964)

K. FSAR Subsection 7.3.3.2.5

L. Rosemount telex to R. Moon dated 6/24/81 (Com # 034214)

M. Letter, B&W to Bechtel, dated 7-21-82, (Com #078351) | ⚠1

N. LETTER, G. SINGH TO J. G. [illegible], DATED 5-6-83, COM 114303 | ⚠2

0102462

AAO-520 6/76

CALCULATION SHEET

ORIGINATOR Dennis H. Tom / Nandini P. Bunde DATE 6/3/83 CALC. NO. J-6664(Q) REV. NO. 2

CHECKED [signature] DATE 6/3/83

PROJECT JOB NO. 7220

SUBJECT SHEET NO. 3

I. LIST OF CALCULATION ASSUMPTIONS

A. Rosemount Model 1153 Series D transmitters have identical performance characteristics and error values to Model 1153 Series B transmitters. See discussion in Section IV.D.

B. Transmitter drift over 18 months will not exceed the published value of drift over 6 months claimed by Rosemount. See Section IV.D.②. This assumption should be verified during the first years of plant operation.

C. During a large steam line break inside containment, the steam generator pressure transmitters will detect a low pressure condition (~600psia) before the transmitter electronics will experience any temperature rise due to a steam environment inside containment. See Section IV.D.④

D. The steam generator low pressure trip function is not required to mitigate a main steam line break inside containment, because high reactor building pressure will trip MSLIS, AFWAS, and DGs start quicker than the low SG pressure condition per Reference M. Therefore, no accident environment temperature effects apply to the SG pressure transmitters. See section IV D ④ △1

E. Transmitter calibration occurs at 50°F Reactor Building temperature and the steam generator low pressure trip condition occurs at 120°F Reactor Building temperature. See Section IV.D.④

F. Low level radiation effects on the SG pressure transmitters will not exceed 1% of upper range limit. See Section IV.D.⑤

G. Bistable drift over the monthly calibration period is zero. See Section V C.②

H. TERMINAL BLOCK SIGNAL CURRENT LEAKAGE ERROR IS NEGLIGIBLE, [REF N] △2

0 1 2 4 1 0 0 0 3

CALCULATION SHEET

CALC. NO. J-6064(Q) REV. NO. C

ORIGINATOR K M. STECKLAND DATE 4-1-82 CHECKED [illegible] DATE 4/13/82

PROJECT MIDLAND PLANT UNITS 1 and 2 JOB NO. 7220

SUBJECT STEAM GENERATOR PRESSURE TRIP SETPOINTS SHEET NO. 4

8002420064

II. PURPOSE OF CALCULATION

This calculation provides the basis for the Steam Generator Pressure TRIP SETPOINTS AND Allowable Values in the Midland ESFAS Setpoint Technical Specification 16.2.3, Table 16.2.3-1, for the following conditions:

a. Steam Generator Low Pressure (either generator)
b. MSLIS Bypass Permissive (both generators)
c. MSLIS Bypass Reset (either generator)

III. FUNCTION OF THE INSTRUMENTATION

The instruments which generate the Steam Generator Low Pressure trip condition in the Midland ESFAS initiate the following protective actions:

a. Main Steam Line and Feedwater Line Isolation (via MSLIS)
b. Auxiliary Feedwater Flow
c. Diesel Generator Start
d. Control Room Isolation (via MSLIS)

The above actions occur on a 2-out-of-4 coincident low pressure in either steam generator. A low pressure in either steam generator is indicative of a steam or feedwater line break condition, as analyzed in FSAR Subsection 15.1.5. Initiation of the above actions is intended to mitigate the large steam line break accident.

The bistable which generates the MSLIS Bypass Permissive and Reset functions shares the same transmitter with the Low Pressure trip instruments discussed above. The MSLIS

CALCULATION SHEET

CALC. NO. J-6064 (Q) REV. NO. 0

ORIGINATOR K M. STRICKLAND DATE 4-1-82 CHECKED JJR DATE 4/12/82

PROJECT JOB NO. 7220

SUBJECT SHEET NO. 5

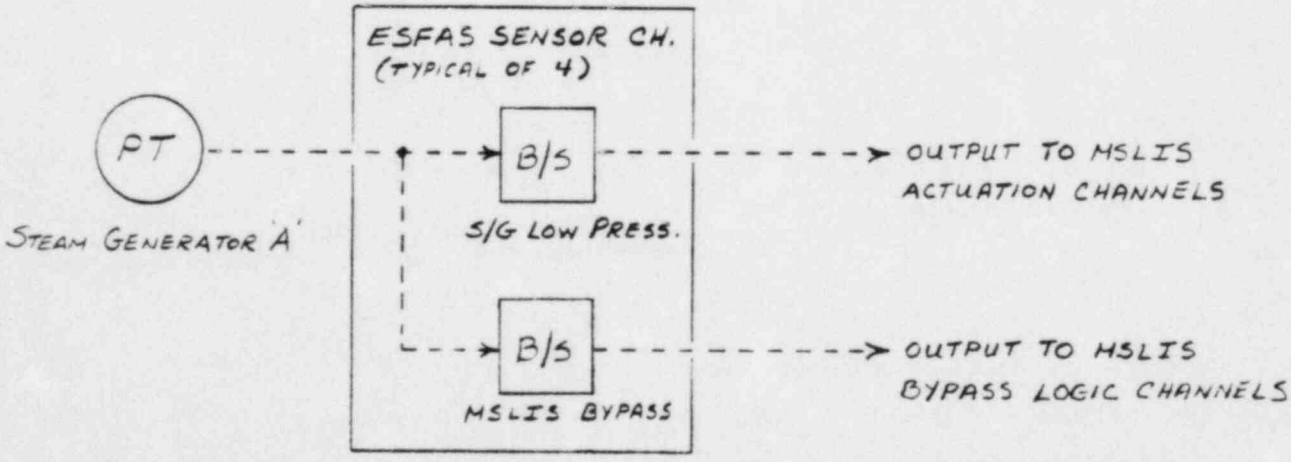
Bypass Permissive and Reset functions are needed to:

a. Permit manual bypass of the MSLIS trip function during normal shutdown/cooldown after S/G pressure decays to the MSLIS Bypass Permissive setpoint in both generators.

b. Automatically clear the MSLIS manual bypass during normal startup/heatup when S/G pressure increases to the MSLIS Bypass Reset value in either generator.

The MSLIS Bypass Permissive for each steam generator requires at least 2-out-of-4 coincident low pressure. Both steam generators must satisfy their respective 2-out-of-4 logic before MSLIS Bypass can be performed manually. Refer to logic diagram 7220-J-299, sheet 2, Rev. 8 for more detail.

A block diagram of a typical steam generator pressure instrumentation loop up to the Low Pressure and MSLIS Bypass Permissive trip bistables is as follows:



A block diagram of a typical steam generator 'B' loop would be identical to the above diagram.

CALCULATION SHEET

CALC. NO. J-6064 (Q) REV. NO. 0

ORIGINATOR K M STRICKLAND DATE 4-1-82 CHECKED [illegible] DATE 4/17/82

PROJECT _____ JOB NO. 7220

SUBJECT _____ SHEET NO. 6

IV. STEAM GENERATOR PRESSURE TRANSMITTER ERROR

A. Instrument Tag Numbers

	Unit 1	Unit 2
Generator A:	1PT-3134 A	2PT-3234 A
	B	B
	C	C
	D	D
Generator B:	1PT-3118 A	2PT-3218 A
	B	B
	C	C
	D	D

8000360
012441

B. Transmitter Data (from Ref. A)

Mfr: Rosemount
Model: 1153 GD9
Range: 0-500/3000 PSIG
Calibrated span: 0-1200 PSIG
Output: 4-20 mA
Transmitter Elevation: 605' and 644' (From Ref. B)
Tap Elevation: 690' to 691' (unit 1)
701'-6" to 706'-8" (UNIT 2) } (from Ref. C)

C. Environmental Data (from Ref D)

Location: Reactor Building
Temperature: Normal 50-120°F, Accident - up to 465°F
Pressure: Accident - 0 to 70 psig
Rad dose: 1.6×10^7 Rad integrated over 40 yr.
Accident - 1.5×10^8 Rad integrated over 30 days

D. Sources of Transmitter Error

- Normal Inaccuracy (including hysteresis, linearity, repeatability)
- Stability (drift) over calibration period
- Process Measurement Errors
- Temperature effects
- Radiation effects
- Seismic effects

The Rosemount Model 1153 D Transmitter is presently undergoing qualification testing. No formal product literature is available for transmitter performance data which affects output error. However, the Model 1153D has an identical electronics package to the Model 1153 B series transmitter, with the difference between models being the transmitter housing design and material. For this reason, this transmitter error calculation will assume that the Model 1153B error data (in Reference E) are also applicable to the Model 1153D transmitters. Rosemount has stated that this assumption is valid in Reference L.

① Normal Inaccuracy

From Ref. E, Model 1153B transmitter inaccuracy is ± 0.25 % of calibrated span. For a span of 0-1200 psig, normal inaccuracy is

$$\pm 0.0025 \times 1200 \text{ PSIG} = \pm 3 \text{ PSIG}$$

② Stability (drift) over calibration period

From Ref. E, Model 1153B transmitter stability is ± 0.25 % of upper range limit for a six month calibration interval. Although Rosemount does not state the stability for longer periods,

they have stated in Ref. F that the six month stability value is conservative, and could probably be extended to longer calibration intervals. Assuming that the stability value is valid for an 18-month calibration interval, stability is

$$\pm 0.0025 \times 3000 \text{ PSI} = \pm 7.5 \text{ PSI}$$

0 1 2 4 0 0 5 8

③ Process Measurement Errors

A. The Unit 2 steam generator pressure transmitters are located approximately 100 feet lower than the process taps on the main steam piping. The sensing lines for the transmitters will be water-filled, and this water will provide a static head on the transmitters which is additive to the actual generator internal pressure being sensed. Reference C indicates that different instrument taps have different elevations. The widest elevation difference occurs between four Unit 2 transmitters at elevation 605'-2" and their tap locations at elevation 706'-8". The static head produced by a water column of 101'-6" @ 20°C (68°F) is

$$101.5 \text{ ft} \times \frac{62.32 \text{ lbm}}{\text{ft}^3} \times \frac{1 \text{ ft}^2}{144 \text{ in}^2} = 43.9 \text{ psi}$$

This static head will be calibrated out of the transmitter output using the zero adjustment on the transmitter, and need not be considered in this calculation as a source of instrument error.

B. Because the steam generator pressure transmitters are gauge pressure transmitters inside containment, any positive containment pressure will shift the transmitter output in the negative (lower output) direction. For a large steam line break condition which creates a rapid increase in containment pressure, the effect of this higher pressure will be to lower the output of the pressure transmitter,

which will cause the low pressure trip setpoint to be reached sooner than if the containment was at atmospheric pressure. The overall effect, then, is a conservative trip of the low steam generator pressure trip function during a main steam line break accident. As such, this shift in transmitter output does not contribute to overall transmitter errors which must be considered in a low pressure trip setpoint calculation.

0 1 2 4 7 0 0 0 5 9

④ Temperature Effects

The low steam generator pressure trip is required to mitigate a large main steam line break accident. If the break occurs outside containment, the pressure transmitters will not experience any rise in ambient temperature. If the break occurs inside containment, the transmitters will be exposed to a steam environment immediately after the break. FSAR Figure 15.1-4 shows that the pressure in the ruptured generator will drop to 600 psia in less than 3 seconds after the break. For the purposes of this calculation, we assume that the transmitter electronics will not experience any temperature rise within the first 3 seconds of a large MSLB accident.

A small main steam line break accident may also result in a low steam generator pressure trip. However, there are diverse plant trip parameters which initiate MSLIS, AFWAS, and DG start under a small steam line break. For example, FSAR Table 15.1-9 indicates that reactor coolant low pressure will be the detecting parameter for a 2 ft^2 steam line break. RC low pressure will trip ECCAS, and, in turn, MSLIS, AFWAS and DG start. Although a spectrum of steam line breaks has not been analyzed in FSAR Chapter 15, it is assumed that small steam line break accidents are adequately sensed by diverse parameters such as low RC pressure to initiate ESFAS subsystems as or more rapidly than low steam generator pressure.

For the reasons given above, reactor building temperature increases due to steam line break accidents are not considered in steam generator pressure transmitter temperature effects. The only temperature effects which need to be calculated are for normal (non-accident) variations in reactor building temperature.

0 1 2 4 8 0 0 7 0

From Ref. E, Model 1153B transmitter temperature effects are given for minimum and maximum span settings, as ± 5.0% and ± 1.25% of span per 100°F, respectively. In each case, the effect consists of a zero error correction which is a fixed amount per 100°F which is independent of the span adjustment, and a span error correction which is 0.5% of calibrated span. For an intermediate span setting, the temperature effect equals the sum of the fixed zero error correction plus the span error correction (per each 100°F change in temperature). The overall temperature effect for a range code 9 transmitter (0-600/3000 psig span) with a 0-1200 psig span is ± 2.4% of span per 100°F. The variation in normal reactor building temperature is 120°F - 50°F = 70°F. The maximum temperature effect due to this temperature variation is

$$70°F \times (\pm 0.024 \times 1200 \text{ psig}/100°F) = \pm 20.2 \text{ psig}$$

(5) Radiation Effects

These transmitters are not required to function under a LOCA radiation environment. The large steam line break accident will not result in a radiation release prior to the SG low pressure trip occuring. Therefore, only the normal (non-accident) radiation

level in containment must be considered. The time over which the radiation dose will occur is the qualified life of the 1153[illegible] transmitters, presently estimated at 10 years in a 120°F environment. Although Rosemount has not tested their transmitters for low level radiation effects, they have stated that the error from low level radiation is expected to be less than 1% of upper range limit (Ref. G). On this basis, the radiation effect on steam generator pressure transmitters is estimated at ± 1% of upper range limit, or

$$\pm 0.01 \times 3000 \text{ psi} = \pm 30 \text{ psi}$$

0 1 0 2 0 4 9 7 1

⑥ Seismic Effect

From Ref. E, the Model 1153B seismic effect is ± 0.5% of upper range limit during and after the seismic event. The seismic effect is then:

$$\pm 0.005 \times 3000 \text{ psi} = \pm 15 \text{ psi}$$

⑦ Overall Transmitter Error

Normal Inaccuracy	± 3 psig
Stability	± 7.5 psi
Process Measurement Errors	zero
Temperature Effect	± 20.2 psig
Radiation Effect	± 30 psi
Seismic Effect	± 15 psi

Overall Transmitter Error = 75.7 psig

The above number is a "worst case" transmitter error which assumes that all the transmitter errors are simultaneously additive in the same direction

The direction of the worst case transmitter error is negative. A negative error is defined as an error which will result in an indicated steam generator pressure greater than the actual pressure. To correct for the error in transmitter readout to obtain the actual generater pressure, the error amount would have to be subtracted from the transmitter readout. Because the trip function of these transmitters is on a decreasing pressure signal, a negative error is of concern. A negative error will delay the trip to an actual pressure below the process limit, unless the trip setpoint compensates for the error. A positive error, on the other hand, would cause an earlier-than-necessary trip on decreasing pressure. Positive errors will therefore cause conservative trips and are not considered in this calculation.

The sign convention for errors described above applies to the remainder of this calculation. Note that in order to compensate for negative errors, a positive amount will be added to the process limit value (See Section VI).

V. Trip Bistable Error

This section of the calculation applies to both the steam generator low pressure trip bistable and the HSLIS Bypass Permissive trip bistable. Both bistables receive the same 1-5 VDC input signal generated by a voltage divider circuit for the SG pressure transmitter 4-20 mA output signal. The operation of each bistable is independent of the other.

A. Bistable Data

Mfr: Vitro Laboratories
Model: 2717-1076
Input Signal: 1-5 VDC (corresponds to 4-20 mA transmitter output)
Output: Logic output, changes state on bistable trip
Deadband: Adjustable between 0-5% of input span
Setpoint: Adjustable over full range of input signal

B. Environmental Data

Location: ESFAS Cabinets 1/2C43 in Safety-Related Equipment Room, Auxiliary Building, Elev. 659'
Temperature: 65-85 °F
Pressure: Atmospheric
Humidity: 20-80% RH
Rad dose: 40 Rad / 40 yr

C. Sources of Bistable Error

- Normal Inaccuracy
- Stability (drift) over calibration period
- Repeatability
- Temperature correction

① Normal Inaccuracy

From Ref. H, bistable inaccuracy is ±0.2% of full scale. Full scale for both bistables corresponds to the 4-20 mA output from the SG pressure transmitter, representing a range of 0-1200 psig. The inaccuracy of both bistables is

$$\pm 0.002 \times 1200 \text{ psig} = \pm 2.4 \text{ psig}$$

② Stability (drift) over calibration interval

From Ref. H, Vitro has not determined bistable setpoint drift. Vitro suggested using bistable drift data from the Big Rock plant RDS, which uses nearly identical Vitro bistable modules. Ray Brezinski (CPCo Midland plant staff) contacted Big Rock and was told that bistable drift in the RDS has been zero since system startup. Based on this information, the error contribution due to drift of the Midland bistable modules is also assumed to be zero over the monthly bistable calibration interval.

CALCULATION SHEET

CALC. NO. J-6064(Q) REV. NO. 0

ORIGINATOR K M. STRICKLAND DATE 4-1-82 CHECKED [illegible] DATE 4/7/82

PROJECT _____ JOB NO. 7220

SUBJECT _____ SHEET NO. 15

③ Repeatability

From Ref. H, bistable repeatability is ± 0.1% of full scale. The repeatability is

$$\pm 0.001 \times 1200 \text{ psig} = \pm 1.2 \text{ psig}$$

④ Temperature Correction

From Ref. H, bistable temperature correction is ± 0.1% of full scale for a span of 0-60°C (32-140°F). The control room envelope has a temperature variation of only 20°F. The corresponding temperature correction for a 20°F variation is

$$\pm 0.001 \times \frac{20°F}{(140-32°F)} = \pm 0.0002 \quad [0.02\%]$$

The temperature correction for a bistable input span of 0-1200 psig is

$$1200 \text{ psig} \times \pm 0.0002 = \pm 0.2 \text{ psig}$$

⑤ Overall Bistable Error

Normal Inaccuracy	± 2.4 psig
Stability	zero
Repeatability	± 1.2 psig
Temp. Correction	± 0.2 psig

Overall Bistable Error ± 3.8 psig

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VI. S/G LOW PRESSURE TRIP SETPOINT & ALLOWABLE VALUES

A. The accident analysis process limit upon which the S/G low pressure trip setpoint is based is an actual steam generator pressure of 585 psig (Ref. I) at the transmitter instrument tap.

Because the S/G pressure transmitters are located below the instrument tap, the weight of the sensing line water column calculated in section IV D (3) must be calibrated out of the transmitter output using the transmitter zero adjust. If this is done, the 585 psig process limit at the instrument tap also becomes the process limit at the transmitter itself.

B. Using the process limit at the transmitter in A above, the 18 month Allowable Value for the S/G low pressure trip is the process limit plus all instrument errors, except drift.

Process Limit	585 psig	
Instrument Error (except drift)		
a. Transmitter	68.2 psig	(75.7 - 7.5 psig from sht 11)
b. Bistable	3.8 psig	
18 month Allowable Value:	657 psig	

C. The 30 day Allowable Value is the 18 month Allowable Value plus transmitter drift and transmitter calibration error. Per Ref. J, the calibration error is assumed to be equal to the accuracy of the instrument being calibrated. The 30 day

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Allowable Value is then:

18 month Allowable Value	657 psig
Transmitter drift	7.5 psig
Transmitter calibration error	3 psig
30 day Allowable Value:	667.5 psig

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D. The Technical Specification Trip Setpoint for low S/G pressure is the 30 day Allowable Value plus bistable drift and bistable calibration error.

30 day Allowable Value	667.5 psig
Bistable drift	zero
Bistable calibration error	2.4 psig
Technical Spec. Trip Setpoint	669.9 psig

∴ ROUND UP TO 670 psig

E. The attached table summarizes the contributors to the steam generator low pressure tech. spec. trip setpoint.

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SUBJECT SHEET NO. 18

TABLE 1

SUMMARY OF CONTRIBUTORS TO S/G LOW PRESSURE SETPOINT

S/G PRESSURE (PSIG)

670	TECH. SPEC. TRIP SETPOINT ← ROUND UP
669.9	
	Bistable Calibration Error (no drift)
667.5	— 30 DAY ALLOWABLE VALUE
	Transmitter Drift plus Transmitter Calibration Error
657	— 18 mo. ALLOWABLE VALUE
	Bistable Error (excluding drift)
653.2	
	Transmitter Error (excluding drift)
585	TRANSMITTER TAP LOCATION PROCESS LIMIT
	Correction for sensing line water column (compensated by transmitter zero adjust)
585	SAFETY ANALYSIS PROCESS LIMIT (at instrument tap)

8 7 0 6 0 5 0 2 1

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SUBJECT SHEET NO. 19

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VII MSLIS BYPASS PERMISSIVE SETPOINT & ALLOWABLE VALUES

A. No accident analysis process limit exists for the MSLIS Bypass Permissive function. The MSLIS Bypass is an operational requirement, rather than a condition required for plant safety. The choice of a setpoint for the MSLIS Bypass Permissive must meet the following criteria:

1. The setpoint must be low enough to represent a sustained cooldown condition for the steam generators, such that inadvertent bypassing will not be possible during plant pressure transients.

2. The setpoint must be high enough to allow the operator time during cooldown to initiate the MSLIS bypass manually before the S/G low pressure trip setpoint is reached.

3. Because the MSLIS Bypass Reset is directly coupled to the MSLIS Bypass Permissive Setpoint (by the bistable deadband adjustment), the final value of permissive setpoint must give an MSLIS Bypass Reset value below operating plant pressure, even assuming positive instrument errors.

B. In Reference K, the MSLIS Bypass Permissive Setpoint is listed as 725 psig. This choice of a setpoint value will satisfy each of the above criteria. Therefore, the 725 psig setpoint listed in the FSAR can be retained.

C. The Allowable Values for the MSLIS Bypass Permissive

function can be calculated using identical margins calculated for the S/G low pressure trip setpoint, because the two functions share a common transmitter and use identical bistable modules.

Using the margins in Table 1 on sheet 18:

Tech. Spec. MSLIS Bypass Permissive Setpoint	725 psig
30 day Allowable Value	722.5 psig
18 month Allowable Value	712 psig

In the above case, the allowable values are calculated starting at the setpoint value and adding margins, rather than starting at a process limit value. This technique was necessary because no process limit exists for the MSLIS Bypass Permissive function.

VIII MSLIS Bypass Permissive Reset Value

The MSLIS Bypass Permissive Reset function automatically removes the MSLIS Bypass when steam generator pressure increases to the reset value of the MSLIS Bypass Permissive bistables. Removal of the MSLIS Bypass requires 3-out of 4 bistables to reset for either steam generator. The reset value is set by adjusting the deadband on the MSLIS Bypass Permissive bistable module.

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As discussed in Section II.A, the range of the bistable adjustable deadband is 0-5% of input span For the steam generator pressure transmitters, the deadband adjustment range corresponds to a process range of 0-60 psig. Selecting the deadband is arbitrary. The wider the deadband, the less likely the chance of removing the bypass inadvertently during cooldown due to a minor pressure increase immediately after reaching the MSLIS Bypass Permissive and operator action to enable the bypass.

The assumed value for the reset is chosen at 25 psig above the Tech Spec MSLIS Bypass Permissive Setpoint. This value will provide adequate margin to clear the MSLIS bypass prior to reaching operating S/G pressure of 900psig.

Table 2 below summarizes the values determined in this calculation.

Value (psig)	Function
900	Normal S/G operating pressure
750	MSLIS Bypass Permissive Reset
725	MSLIS Bypass Permissive Setpoint
670	S/G Low Pressure Trip Setpoint

Allowable Values and Process Limits corresponding to the setpoints above are given previously.

0-2506-31

Attachment to:

PAGE 1 of 1

MIDLAND UNITS 1 AND 2
CHANGE NOTICE LOG

CALC NO. J-6064(Q)

CHANGE NOTICE NO.	SUPPORTING CALC NO.	EFFECT ON CALC	INCOR-PORATED	CUMULATIVE EFFECT ASSESSED		
				ENGR	CHKR	GRP SUPV