NORTHEAST UTILITIES
THE CONNECTICUT LIGHT AND POWER COMPANY
WESTERN MASSACHUSETTS ELECTRIC COMPANY
HOLYOKE WATER POWER COMPANY
NORTHEAST UTILITIES SERVICE COMPANY
NORTHEAST NUCLEAR ENERGY COMPANY

General Offices • Selden Street, Berlin, Connecticut

P.O. BOX 270
HARTFORD, CONNECTICUT 06141-0270
(203) 666-6911

February 22, 1983
Docket No. 50-336
B10698

Director of Nuclear Reactor Regulation
Attn: Mr. Robert A. Clark, Chief
Operating Reactors Branch #3
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

References: (1) W. G. Counsil letter to R. A. Clark dated, November 4, 1982.

(2) R. A. Clark letter to W. G. Counsil dated, August 19, 1982.

(3) W. G. Counsil letter to R. A. Clark dated, January 4, 1983.

(4) W. G. Counsil letter to R. A. Clark dated, March 4, 1982.

Gentlemen:

Millstone Nuclear Power Station, Unit No. 2
Request for Additional Information, Measurement Uncertainties
Response to Question 4

In Reference (1), Northeast Nuclear Energy Company (NNECO) provided a partial response to the Staff's Reference (2) request for additional information concerning measurement uncertainties utilized in the Millstone Unit No. 2 safety analysis. Additional time was necessary to complete our responses to Questions 4 and 6 of Reference (2) and a mutually agreed upon schedule for providing these responses was documented in Reference (2) and updated in Reference (3). As per our Reference (3) agreement, NNECO hereby provides the response to Question 4 of Reference (2).

During the 1981-1982 (Cycle 4/5) refueling outage, NNECO installed new process equipment for several of the measurement channels addressed in the uncertainty analyses of References (1) and (4). Modifications included changes to the safety pressurizer pressure and steam generator pressure channels. Additionally, NNECO plans modifications to the feedwater differential pressure (delta-P) measurement channels as well as changes to hot and cold leg Reactor Coolant System temperature measurement channels. Details concerning the modifications are attached.

In providing justification of drift allowances assumed for the measurement channels under review, NNECO provided plant historical drift data obtained from a number of previous calibration cycles. NNECO also included drift allowances for process equipment installed during the Cycle 4/5 refueling outage. Since this

A001
1/40

equipment was installed, the operating characteristics of the modified channels have been excellent with minimal drift experienced. In addition, available historical data obtained from existing and replaced hardware, where applicable, has been used to justify drift allowances for new process equipment installed during the Cycle 4/5 outage and hardware to be installed in the upcoming Cycle 5/6 refueling outage. In this way, all drift assumptions were verified to be conservative relative to a 95% probability criteria based on the evaluation of additional plant calibration data.

The process equipment modifications and revised drift allowances necessitated the reanalysis of the measurement uncertainties provided in Reference (4). As such, the response to Question 4 also provides the results of the measurement uncertainty reanalysis of primary pressure, primary temperature, core power (LCO), primary flow, axial shape index (ASI) and core power (LSSS). The calculated uncertainties are based on conservative calibration allowances and drift assumptions as discussed above. A comparison of the revised uncertainty analyses results with the measurement uncertainty assumptions utilized in the Millstone Unit No. 2 reload analysis demonstrates the additional conservation inherent in the reload analysis assumptions.

Our response to question 4 is complete and attached. This information continues to support the measurement uncertainties utilized in the Millstone Unit No. 2 safety analysis. The conclusions presented herein have not as yet been QA-verified. This verification is expected to be completed shortly and you will be notified promptly when this process is done.

Concerning Reference (1), NNECO indicated that an evaluation of the feedwater measurement system was underway. The intent of this evaluation program is to identify possible areas of improvement in order to provide a more accurate indication of feedwater temperature and thus a smaller core power uncertainty. At present this evaluation is nearly complete and NNECO plans to submit results of the program along with our response to Question 6 of Reference (2) in April, 1983.

We trust you will find this information responsive to the Reference (2) requests.

Very truly yours,

NORTHEAST NUCLEAR ENERGY COMPANY

W. G. Counsil

W. G. Counsil
Senior Vice President

C. Frederick Sears

By: C. F. Sears
Vice President Nuclear and
Environmental Engineering

REQUEST FOR ADDITIONAL INFORMATION
NORTHEAST NUCLEAR ENERGY COMPANY
MILLSTONE NUCLEAR POWER STATION, UNIT NO. 2
DOCKET 50-336

QUESTION 4

Information is supplied in Appendix A to define instrument span drifts between calibrations. The data supplied are too few to support the assumption of 2σ limit. Provide further historical data to confirm the 2σ assumption.

1. Background

Question 1 of Reference 1 provided the results of a measurement uncertainty analysis for primary pressure, primary temperature, core power (LCO), primary flow, axial shape index (ASI), and core power (LSSS). Reference 2 provided the results of a reanalysis of the core power (LCO) and primary flow uncertainties to determine the effects of certain dependent error contributions. These uncertainty analyses were done to justify the uncertainties assumed in the Millstone Point Unit 2 Reload Analyses.

This question requests additional information to justify the drift uncertainties assumed in the above referenced analyses. Recently, Northeast Nuclear Energy Company installed new process equipment for some of the measurement channels under review. Additional process equipment replacements are scheduled to be made during the Cycle 5/6 refueling outage. These process equipment changes necessitated a reanalysis of the above mentioned uncertainties.

Section 2 of this response will provide the results of the measurement uncertainty analysis including the effects of the process equipment change outs. Section 3 will justify the drift values assumed in this analysis. Justification is based on a review of plant historical drift data obtained from a number of previous calibration cycles. To date, operating characteristics of channel modifications performed during the Cycle 4/5 refueling outage have been excellent with minimal drift experienced. It is expected that further process equipment replacements will exhibit similiar operating characteristics meeting and in most cases exceeding the performance of the replaced equipment. Therefore, the historical drift data used to justify drift allowances for new equipment is conservatively bounding.

2. Measurement Uncertainties

This section provides the results of the measurement uncertainty reanalysis of primary pressure, primary tempe. ature, core power (LCO), primary flow, axial shape index (ASI), and core power (LSSS). Figures 1-7 provide the block diagrams for those measurement channels under investigation. A listing of the equipment as well as the calibration accuracy, drift, range and span are specified on the block diagrams. Tables 1-11 summarize the

calculations of the individual measurement channel uncertainties as well as the overall uncertainties in core power (LCO), primary flow, ASI, and neutron power calibration. Table 13 provides a comparison of the uncertainties calculated in this analysis and the uncertainties utilized in the Millstone Unit 2 Reload Analyses.

The attached figures and tables are similar to those previously provided in References 1 and 2. Figures 2, 3, 4, 5, and 7 provide the block diagrams for those measurement channels whose process equipment has been or will be changed during the Cycle 5/6 refueling outage scheduled for late-May, 1983. As noted on these figures, the Foxboro E11GM pressure transmitters are replaced with LOCA qualified Foxboro NE11GM transmitters. The main feedwater ΔP transmitters will be replaced with redundant Foxboro 823 ΔP transmitters for each of the two main feedwater flow measurement channels. For each train, either ΔP transmitter may be selected for input to the computer calorimetric core power calculation. The redundant ΔP transmitters have been provided to increase the reliability of the main feedwater flow measurement. Foxboro SPEC 200 process equipment is provided to process the pressure and ΔP transmitter current output. This equipment consists of current to voltage (I/V) and voltage to current (V/I) converter rack modules. The processed current signal is converted to a voltage signal across a precision 250 ohm resistor which is then provided to either the computer or RPS.

Figures 3 and 4 provide the block diagrams for the new primary temperature measurement channels. The primary sensor is a platinum RTD provided by the Weed Instrument Co. The Foxboro SPEC 200 process equipment consists of platinum resistance to voltage (R/V), and V/I converter rack modules. The processed current signal is converted to a voltage signal across a precision 250 ohm resistor which is then provided to either the RPS or to the computer for the primary flow calculation.

Figures 1 and 6 provide the block diagrams for the measurement channels that are unaffected by the process equipment changeouts. The pressurizer pressure channel shown in Figure 1 is used in the computer calculation of primary flow. The main feedwater temperature channel shown in Figure 6 is used in the computer calculation of calorimetric core power.

The RTD accuracies utilized in this analysis include the calibration accuracy as well as the small errors resulting from joule heating, friction heating, and stem conduction. The 100 ohm resistor error and computer uncertainties were previously discussed in Reference 1. It must be noted that the Reference 1 and 2 analyses assumed an overly conservative calibration accuracy of $\pm.4\%$ ($\pm 2.4^{o}F$) for the main feedwater temperature RTD sensor. As shown on Figure 6, the appropriate calibration accuracy for this type of RTD is $\pm 1.6^{o}F$ which corresponds to $\pm.27\%$ of span. This results in a slightly decreased overall channel uncertainty compared with the channel uncertainty utilized in the Reference 1 and 2 analyses.

The transmitter calibration and temperature effects uncertainties as well as the feedwater venturi calibration uncertainties were previously

discussed in Reference 1. The pressurizer pressure (safety channels), steam pressure and feedwater ΔP transmitter replacements do not effect these uncertainties.

The calibration accuracies for the Foxboro SPEC 200 rack modules are shown on the block diagrams for those channels utilizing Foxboro process equipment. It should be noted that for those channels which have more than one rack module mounted in series a reference calibration signal is input at the front end of the channel and all modules are "tuned" to the reference signal. For this type of calibration, the rack module and precision resistor uncertainties need not be considered individually. The Foxboro SPEC 200 rack calibration uncertainties utilized in this analysis bound any uncertainties associated with the "as left" setting tolerance as well as the small uncertainties associated with calibration equipment.

All drift uncertainties utilized in this analysis are justified in Section 3 of this response.

Tables 1-11 summarize the results of the calculation of the overall uncertainties for the parameters under investigation. The calculational methodology is the same as that provided in References 1 and 2. It must be noted that the calculation of the primary flow uncertainty summarized on Table 9 utilized slightly modified sensitivity factors to relate primary temperature and pressure uncertainties to flow uncertainties. The temperature measurement uncertainties result in enthalpy uncertainties equivalent to the following reactor coolant flow uncertainties:

$\pm$ 2.2% nominal flow/^{o}F (THOT)

$\pm$ 1.95% nominal flow/^{o}F (TCOLD)

The $\pm$ .33^{o}F uncertainty in THOT and TCOLD results in the following reactor coolant flow uncertainties:

$\pm$ .73% nominal flow (THOT)

$\pm$ .65% nominal flow (TCOLD)

As discussed in Reference 1, an additional uncertainty of $\pm$ .5^{o}F is assumed to account for hot leg temperature gradient effects which results in a $\pm$ 1.1% flow uncertainty.

The pressurizer pressure uncertainty results in enthalpy uncertainties equivalent to the following reactor coolant flow uncertainties:

+ .0067% nominal flow/psi (h_h)

- .0022% nominal flow/psi (h_c)

A +19 psi uncertainty in the primary pressure measurement results in the following reactor coolant flow uncertainties:

+ .13% nominal flow (h_h)

-.042% nominal flow (h_c)

Since the pressure errors are dependent, they are added to give an overall uncertainty of ± .088% nominal flow. The overall pressure uncertainty can be combined statistically with the temperature and core power error contributions using the RMS method since the overall pressure uncertainty is independent with respect to these errors. As noted on Table 9, the reactor coolant flow uncertainty is ± 2.38% of nominal flow.

Recent primary flow calculations performed at Millstone Unit 2 indicated a nominal measured flow of 118.5% of the design flow of 324800 GPM. The Reference 1 and 2 analyses were based on an earlier measured nominal flow of 123.6% of design. The reduction in the nominal measured flow is attributed to a number of steam generator tube plugging operations performed at Millstone Unit 2 which slightly increased the overall primary coolant loop resistance. The decrease in loop flow resulted in a slight variation in primary temperatures which resulted in the slight modifications to the above mentioned sensitivity factors.

It is preferable to express the reactor coolant flow uncertainty as a percent of the design volume flowrate. Multiplying the nominal flow uncertainty by 1.185 gives a reactor coolant flow uncertainty of ± 2.82% of design flow.

Tables 10 and 11 summarize the calculation of overall error in ASI calibration and neutron power calibration. Reference 1 provided a description of the methodology to determine the overall errors. The only difference between the Reference 1 analysis and this response is the value of core power uncertainty and the ASI and neutron power drift allowances. Table 9 provides the overall calorimetric core power uncertainty. All drift allowances utilized in this analysis are justified in the following section.

3. Justification of Drift Allowances

In order to justify the drift allowances assumed in this analysis, a statistical evaluation was performed on the calibration data for those measurement channels under investigation. Drift is determined from the difference between "as found" and "as left" checks between calibration cycles.

Data for the Foxboro E11GM pressurizer (safety and control) and steam generator (safety) pressure transmitters were lumped together. These transmitters are recalibrated during refueling outages. The drift value obtained from this data is applied to those pressure channels which incorporate the new Foxboro NE11GM transmitters since these transmitters are expected to exhibit less drift than the Foxboro E11GM. Drift data obtained from the GE MAC 555 feedwater Δ P transmitter calibration checks is used to estimate the drift for the new Foxboro 823 Δ P transmitters. These transmitters are calibrated quarterly. All historical

drift data was used to justify the feedwater temperature transmitter drift assumption.

The Foxboro SPEC 200 rack module drift assumption is justified from data obtained from the monthly calibration checks for the new pressurizer and steam generator pressure channels installed during the Cycle 4/5 refueling outage. This data is also used to justify the rack module drift associated with those channels to be installed during the Cycle 5/6 refueling outage.

The excore ASI measurement is calibrated to the incore value on a monthly basis while the neutron power measurement determined from the excore neutron flux detectors is calibrated to the calorimetric core power reference value on a daily basis.

A 95% probability criteria is used to justify the drift limits used in this analysis. A review of the calibration data obtained for the above mentioned channels indicates that a normal or Gaussian distribution provides the best prediction of the actual distribution of the drift data. For a normal distribution, the 95% probability limits are defined by 1.96 times the standard deviation of the data distribution.

Table 12 summarizes the results of the statistical evaluation of the drift data distributions. The standard deviation, S, is calculated from the drift data using a population parameter of "N-1", where N is the number of data points. The standard deviation for ASI and neutron power calibration is given in terms of ASI units and percent power, respectively. The standard deviation for the remaining channels is given in percent of span. In all cases the analysis assumptions are greater than the 95% probability limits defined by the data.

4. Conclusion

Table 13 provides a comparison of the uncertainties calculated in this analysis and the uncertainties utilized in the Millstone Unit 2 Reload Analysis. The calculated uncertainties are based on conservative calibration allowances and drift assumptions. All drift assumptions were verified to be conservative relative to a 95% probability criteria based on an evaluation of additional plant calibration data.

Axial Shape Index and LSSS Power uncertainties are made up of a number of components which include measurement uncertainties as well as calculational allowances. This analysis only addressed the calibration/drift error component. The ASI calibration/drift allowance is ±.01 asiu. The LSSS Power calibration/drift allowance is ±2% power. The results shown on Tables 10 and 11 justify these allowances.

The results of the comparison shown on Table 13, therefore, justify the applicability and conservatism of the measurement uncertainties utilized in the Millstone Unit 2 Reload Analysis.

5. References

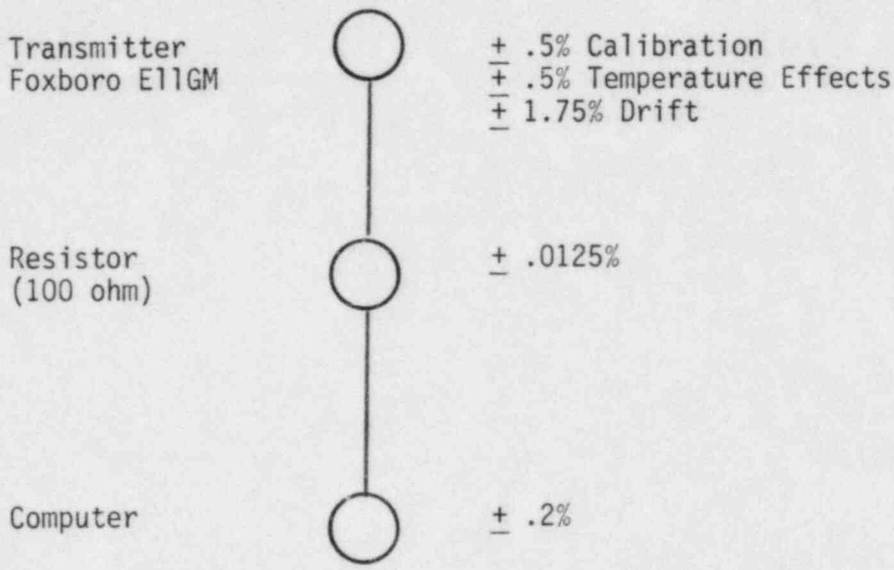
1. W. G. Counsil to R. A. Clark, "Millstone Unit 2 Measurement Uncertainties," March 4, 1982.

2. W. G. Counsil to R. A. Clark, "Millstone Unit 2 - Additional Information, Measurement Uncertainties," November 4, 1982.

<u>FIGURE 1</u>

<u>Pressurizer Pressure</u>
(Control Channels)

Span 1000 psi
Range 1500-2500 psia

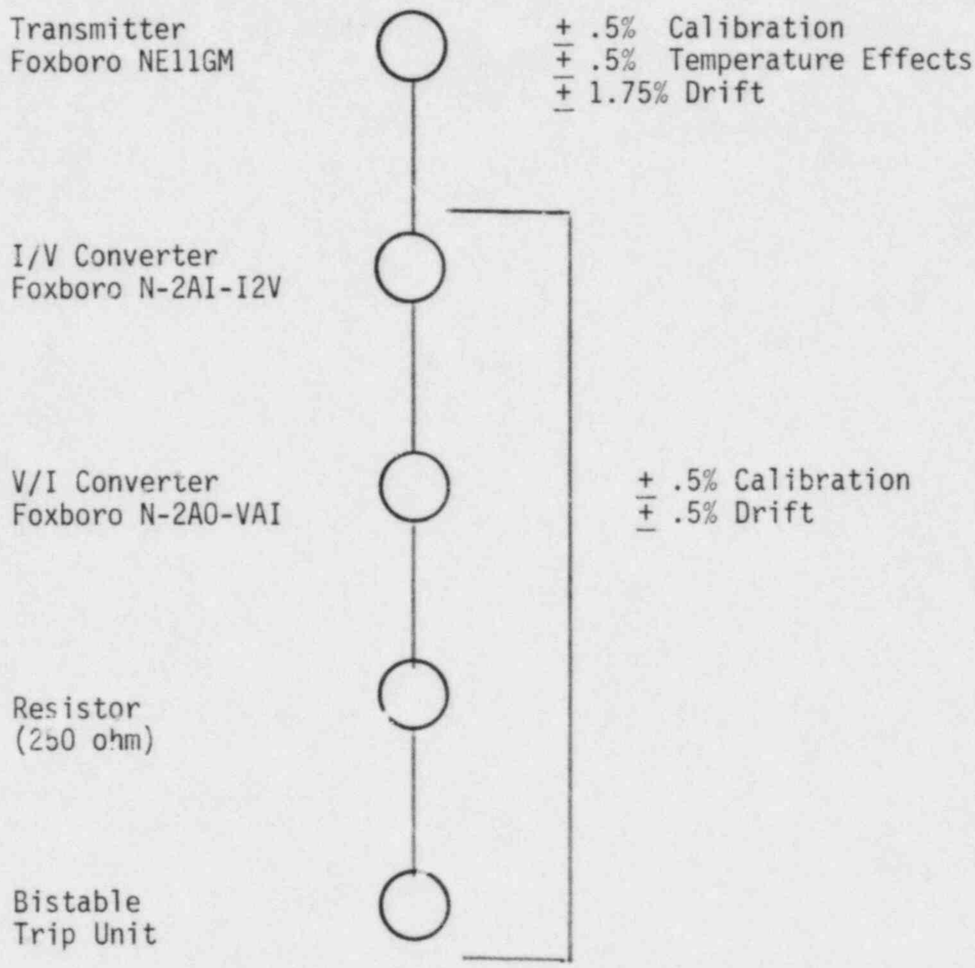


Errors in percent of span

FIGURE 2

Pressurizer Pressure
(Safety Channels)

Span 1000 psi
Range 1500-2500 psia

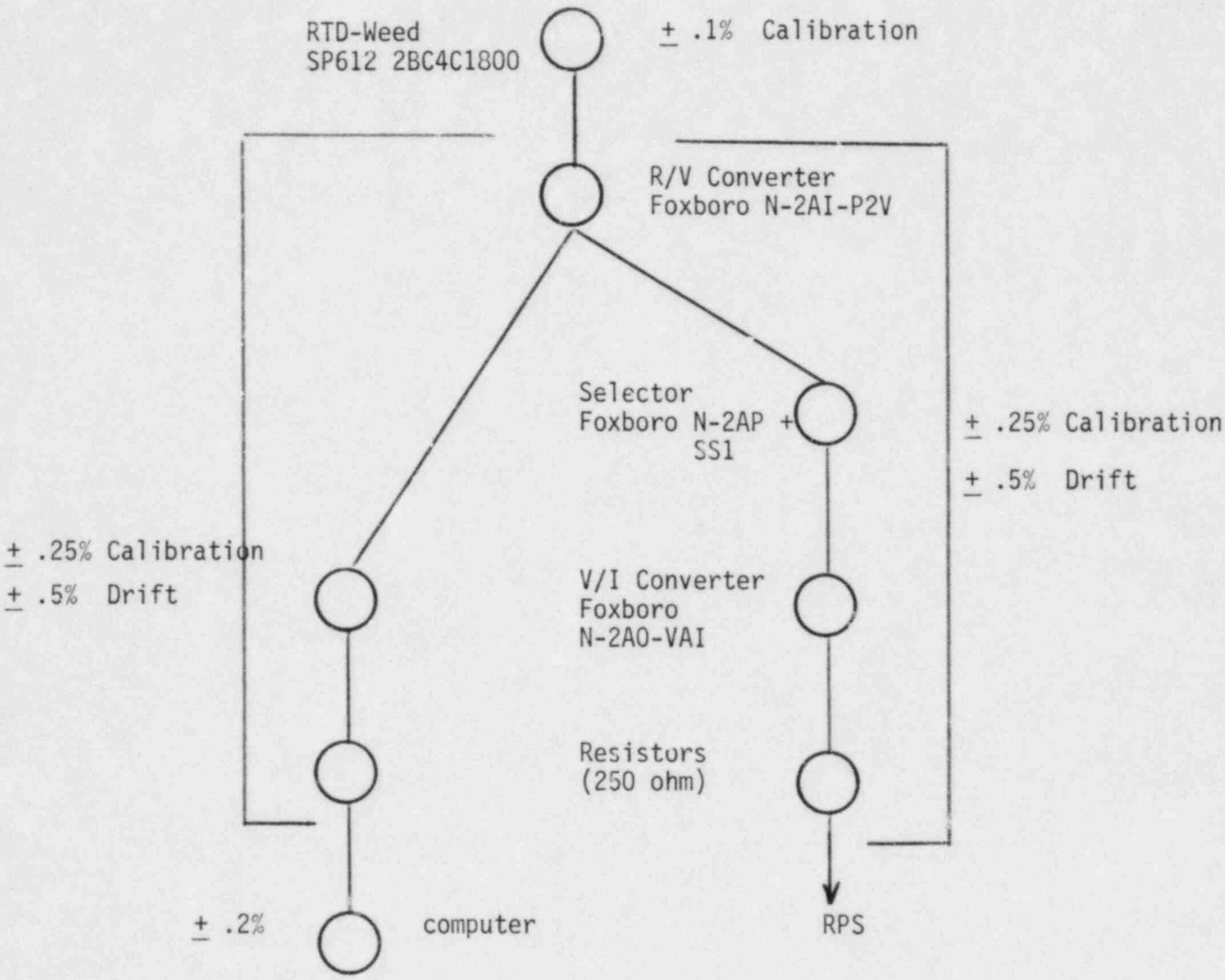


Errors in percent span

FIGURE 3

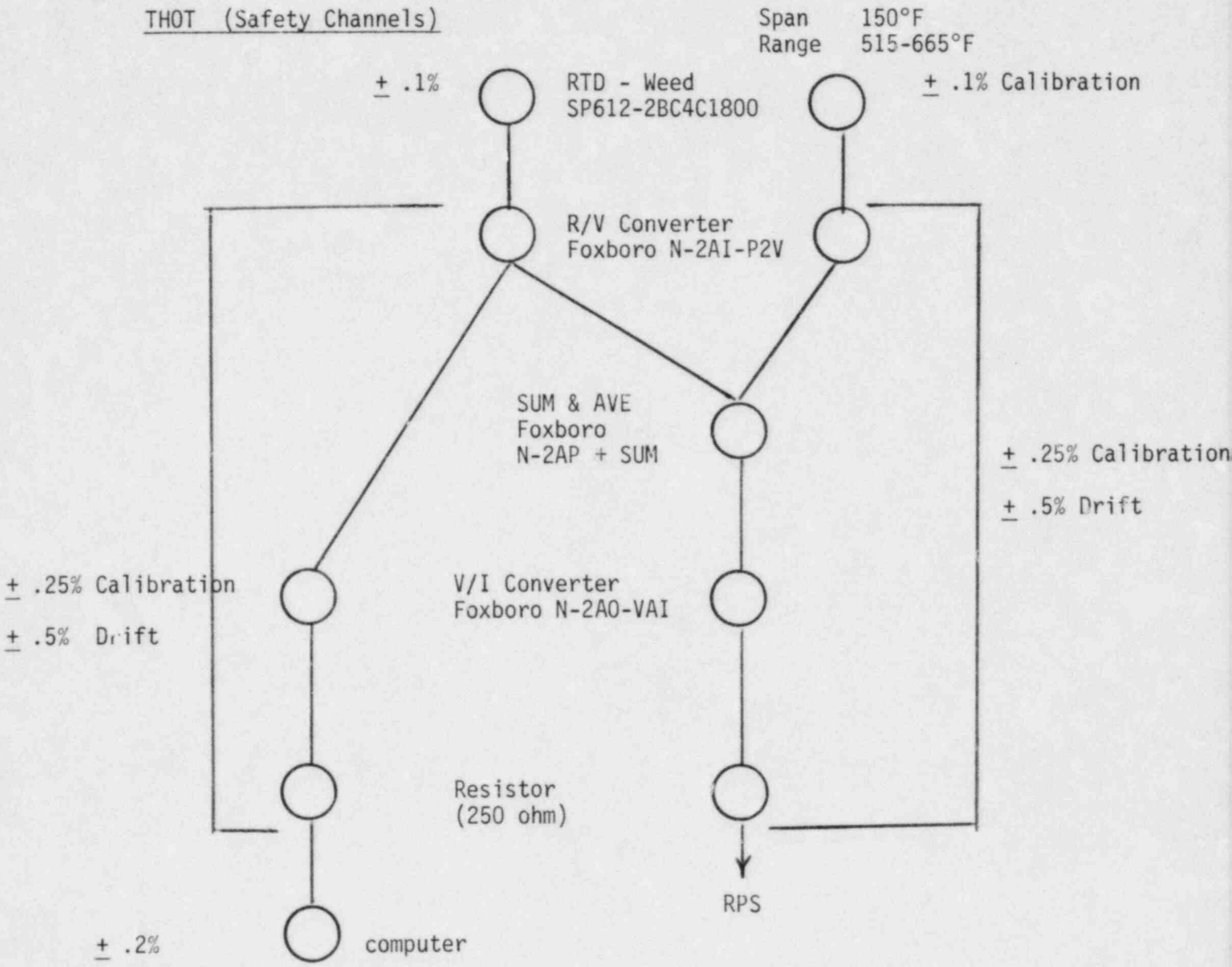
TCOLD (Safety Channels)

Span 150°F
Range 465-615°F



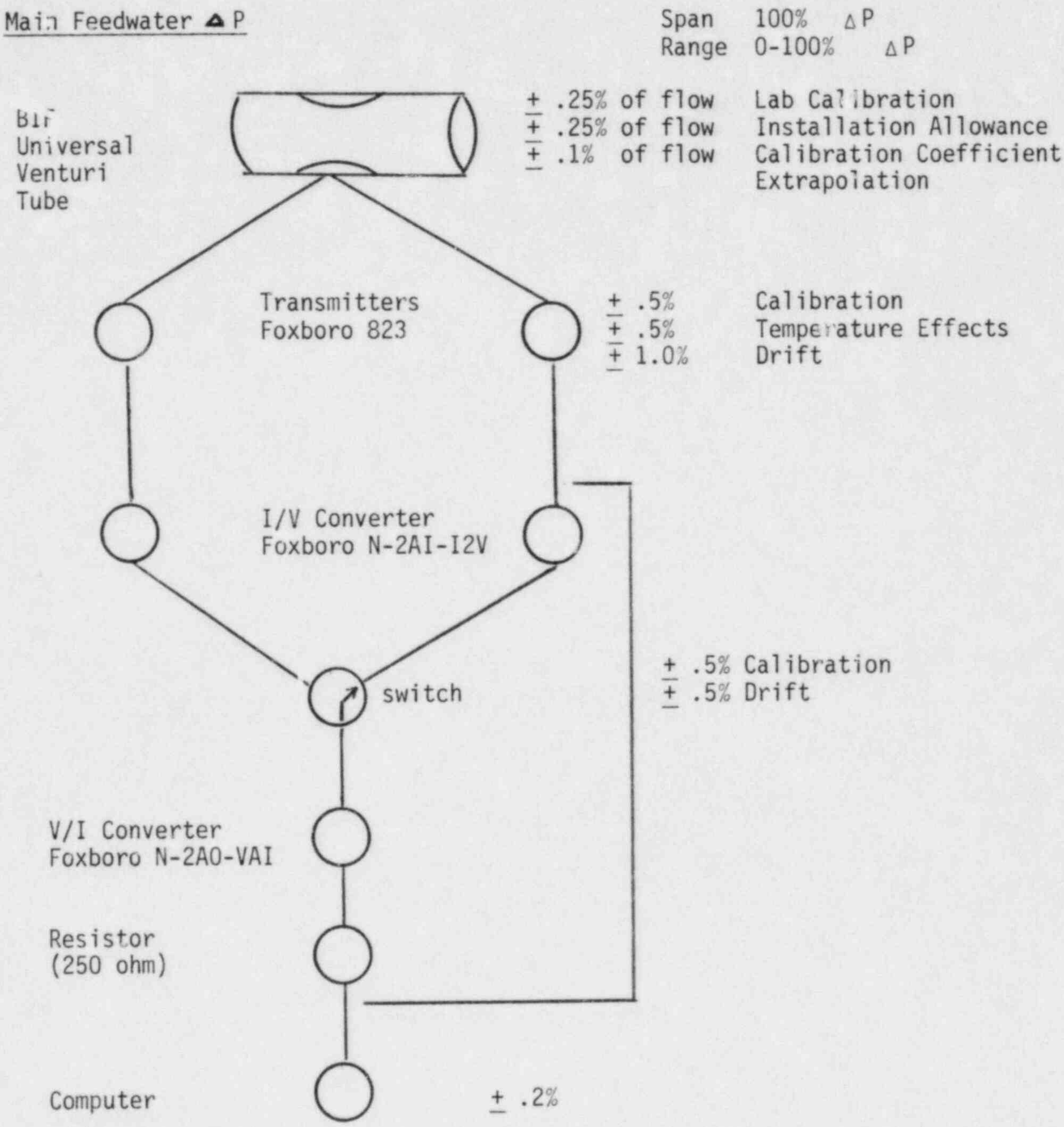
Errors in percent span

FIGURE 4



Errors in percent span

FIGURE 5

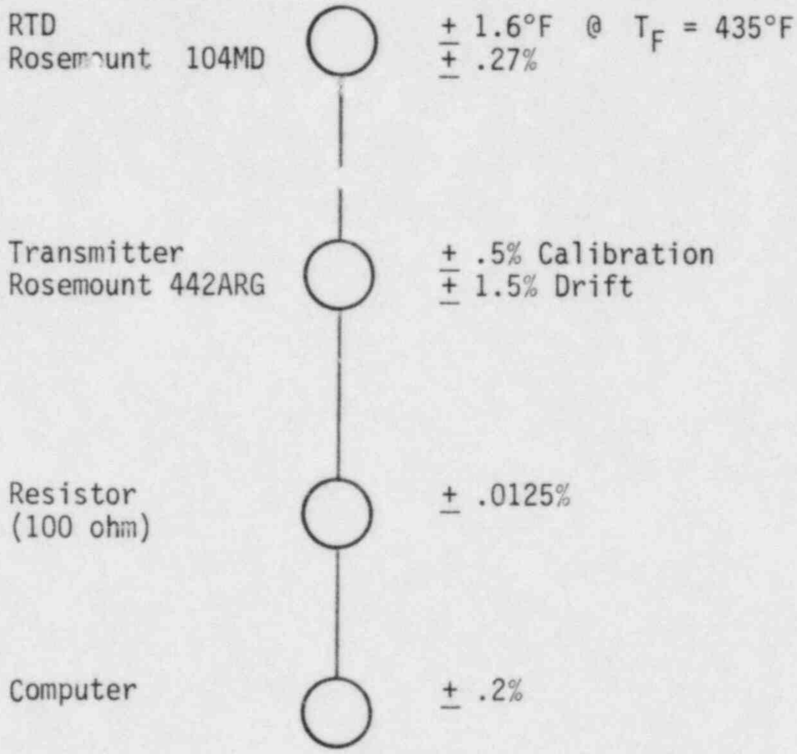


Note: All errors in percent of ΔP span unless specified otherwise

FIGURE 6

Feedwater Temperature

Span 600°F
Range 0-600°F

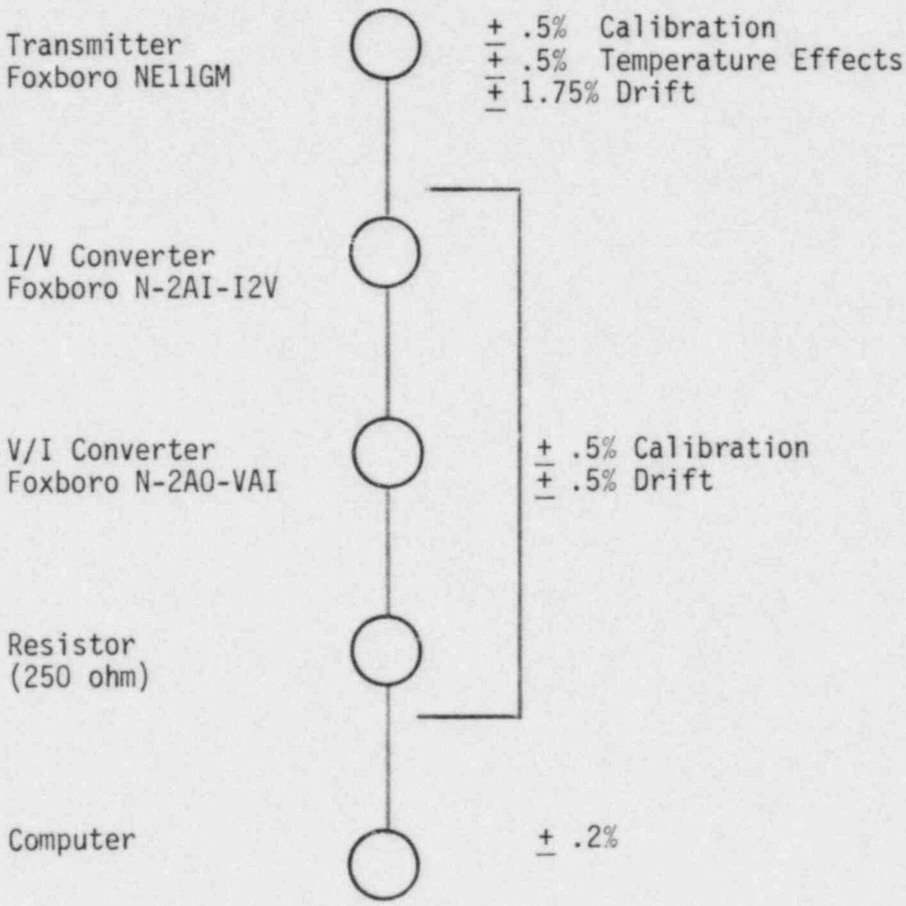


Errors in percent span

FIGURE 7

Steam Pressure

Span 1000 psi
Range 0-1000 psia



Errors in percent span

TABLE 1

Errors in Pressurizer Pressure (Control Channels) P-100 X, Y

Span 1000 psi

Range 1500-2500 psia

1. Transmitter (Foxboro E11GM)	
Calibration Accuracy	$\pm$ .5%
Temperature Effects	$\pm$ .5%
Drift	$\pm$ 1.75%
2. Precision Resistor (100 ohm)	$\pm$ .0125%
3. Computer Accuracy	$\pm$ .2%

$$\text{Total Error} = [\ .5^2 + .5^2 + 1.75^2 + .0125^2 + .2^2\ ]^{\frac{1}{2}}$$

$$= \pm\ 1.9\%\ \text{of span}$$

$$= \pm\ 19\ \text{psi}$$

Errors in percent span

TABLE 2

Errors in Pressurizer Pressure (Safety Channels) — P-102 A,B,C,D

Span 1000 psi
Range 1500-2500 psi

1. Transmitter (Foxboro NE11GM)

Calibration Accuracy	± .5%
Temperature Effects	± .5%
Drift	± 1.75%

2. Foxboro SPEC 200 Rack Modules (Including Bistable Trip Unit)

Calibration	± .5%
Drift	± .5%

Total Error $= [\ .5^2 + .5^2 + 1.75^2 + .5^2 + .5^2\ ]^{\frac{1}{2}}$

$= \pm\ 2.02\%$ of span

$= \pm\ 20.2$ psi

Errors in percent span

TABLE 3

Errors in TCOLD (Safety Channels)		
	T-112C	A,B,C,D
	T-122C	A,B,C,D
	Span	150°F
	Range	465-615°F

1. RTD (Weed SP612 2BC4C1800) Calibration ± .1%
2. Foxboro SPEC 200 Rack Modules

   Calibration ± .25%

   Drift ± .5%
3. Computer ± .2%

Error (to RPS) = $[\ .1^2 + .25^2 + .5^2\ ]^{\frac{1}{2}}$ = ± .57% span

= ± .86°F

Error in TCOLD Associated with RV Flow Determination:

Error (to computer) = $[\ .1^2 + .25^2 + .5^2 + .2^2\ ]^{\frac{1}{2}}$ = ± .61% span

= ± .92°F

Error (Average of 8 TCOLD measurements) = $\frac{\pm .61\%}{\sqrt{8}}$

= ± .22%

= ± .33°F

Errors in percent span

TABLE 4

Errors in THOT (Safety Channels)

T-112H A,B,C,D
T-122H A,B,C,D

Span 150°F
Range 515-665°F

1. RTD (Weed SP612 2BC4C1800) Calibration ± .1%

2. Foxboro SPEC 200 Rack Modules

   Calibration ± .25%

   Drift ± .5%

3. Computer ± .2%

Error (to RPS) = $[\,.1^2 + .25^2 + .5^2\,]^{\frac{1}{2}}$ = ± .57% span

= ± .86°F

Error in THOT associated with RV flow determination:

Error (to computer) = $[\,.1^2 + .25^2 + .5^2 + .2^2\,]^{\frac{1}{2}}$ = ± .61% span

= ± .92°F

Error (Average of 8 THOT measurements) = $\pm \frac{.61\%}{\sqrt{8}}$

= ± .22%

= ± .33°F

Errors in percent span

TABLE 5

Errors in Main Feedwater ΔP	F-5268, F-5269
	Span 100% ΔP Range 0-100% ΔP
1. BIF Universal Venturi Tube	
Laboratory Calibration	± .25% of nominal flow
Installation Allowance	± .25% of nominal flow
Calibration Coefficient Extrapolation Allowance	± .1% of nominal flow
2. ΔP Transmitter (Foxboro 823)	
Calibration Accuracy	± .5%
Temperature Effects	± .5%
Drift	± 1.0%
3. Foxboro SPEC 200 Rack Modules	
Calibration	± .5%
Drift	± .5%
4. Computer	± .2%

Errors in Venturi calibration coefficient (K) $= [\,.25^2 + .25^2 + .1^2\,]^{\frac{1}{2}}$

$= .37\%$ of nominal flow

Errors in Venturi ΔP measurement $= [\,.5^2 + .5^2 + 1^2 + .5^2 + .5^2 + .2^2]^{\frac{1}{2}}$

$= \pm\ 1.43\%$ of ΔP span

The ΔP measurement error is converted to percent of nominal measured feedwater flow at 100% power conditions by multiplying by a factor of .567.

ΔP measurement error $= .567 \times (\pm\ 1.43\%\ \Delta P$ span)
$= .81\%$ of nominal flow

NOTE: Individual component errors are in percent of ΔP span unless specified otherwise

TABLE 6

Errors in Feedwater Temperature	T-5262
	Span 600°F Range 0-600°F
1. RTD (Rosemount 104MD) Calibration	± 1.6°F @ T_F = 435°
	± .27%
2. Transmitter (Rosemount 442 ARG)	
Calibration Accuracy	± .5%
Drift	± 1.5%
3. Precision Resistor (100 ohm)	± .0125%
4. Computer Accuracy	± .2%

$$\text{Total Error} = [\ .27^2 + .5^2 + 1.5^2 + .0125^2 + .2^2\ ]^{\frac{1}{2}}$$

$$= \pm\ 1.62\% \text{ of span}$$

$$= \pm\ 9.72°F$$

Errors in percent span

TABLE 7

Errors in Steam Generator Pressure — P-1013 A, P-1023 A

Span	1000 psi
Range	0-1000 psia

1. Transmitter (Foxboro NE11GM)	
Calibration Accuracy	± .5%
Temperature Effects	± .5%
Drift	± 1.75%
2. Foxboro SPEC 200 Rack Modules	
Calibration	± .5%
Drift	± .5%
3. Computer	± .2%

$$\text{Error} = [\,.5^2 + .5^2 + 1.75^2 + .5^2 + .5^2 + .2^2\,]^{\frac{1}{2}}$$

$$= \pm\ 2.03\%\ \text{span}$$

$$= \pm\ 20.3\ \text{psi}$$

Errors in percent span

TABLE 8

Errors in Steam Generator Thermal Output and Core Thermal Power

Errors in Steam Generator Thermal Output

Error Component	Error (% SG Thermal Output)
1. Independent Errors	
- Due to venturi calibration coefficient (K)	± .37%
- Due to venturi area expansion factor (F_a) (linear thermal expansion coefficient uncertainty)	± .034%
- Due to ΔP measurement	± .81%
Subtotal of Independent Errors (RMS)	± .9%
2. Errors due to steam Pressure (P_s)	
- Error in steam enthalpy (h_s)	- .091%
- Error in feedwater enthalpy (h_f)	- .002%
- Error in feedwater density (ρ_f)	+ .008%
Total of P_s Errors	± .085%
3. Errors Due to Feedwater Temperature (T_f)	
- Error in feedwater enthalpy (h_f)	- 1.37%
- Error in feedwater density (ρ_f)	- .41%
- Error in F_a	+ .02%
Total of T_f Errors	± 1.76%

$$\% \text{ Core Thermal Power Uncertainty} = \left[2\left(\frac{.9}{2}\right)^2 + 2\left(\frac{.085}{2}\right)^2 + \left(\frac{1.76}{2} + \frac{1.76}{2}\right)^2\right]^{\frac{1}{2}}$$

$$= \pm 1.87\%$$

The ± 1.87% uncertainty is the error in core thermal power expressed as a percent of the nominal measured core thermal power of 2700 MW.

TABLE 9

Errors in Reactor Coolant Flow Determination

	Error Component	Error (% Nominal Flow)
1.	Core Thermal Power Uncertainty (± 1.87%)	± 1.87%
2.	Error Due to Average THOT	
	Error in hot leg enthalpy (h_h)	± .73%
3.	Error Due to Temperature Gradient Effect	
	Error in hot leg enthalpy (h_h)	± 1.1%
4.	Error Due to Average TCOLD	
	Error in cold leg enthalpy (h_c)	± .65%
5.	Error Due to Pressurizer Pressure (P_p)	
	Error in hot leg enthalpy (h_h)	+ .13%
	Error in cold leg enthalpy (h_c)	- .042%
	Total of P_p errors	± .088%
	TOTAL ERROR (RMS)	± 2.38%

Typical measured flow is 118.5% of the design flow of 324800 GPM, therefore:

% Reactor Coolant Flow Uncertainty = 1.185 x 2.38%

= ± 2.82 % of design flow

TABLE 10

Error in Axial Shape Index Due to Calibration of Excore Detector Voltage Signals

	Error Contribution	Error (asiu)
1.	Error in upper detector voltage (U) calibration	± .00096
2.	Error in lower detector voltage (L) calibration	± .0008
3.	Axial Shape Index drift allowance	± .00891
4.	Total Error (RSS)	± .009

TABLE 11

Error in Nuclear Power and ΔT Power Calibration to Calorimetric Power

	Error Contribution	Error (% Power)
1.	Calorimetric Power Uncertainty	± 1.87
2.	RPS Digital Panel Meter (Newport Series 2000-3)	± .06
3.	Calibration Setting Tolerance	± .1
4.	Drift Allowance	± .5
5.	Total Error (RSS)	± 1.94

TABLE 12

JUSTIFICATION OF DRIFT ASSUMPTIONS

EQUIPMENT	# DRIFT DATA POINTS	STANDARD DEVIATION (S)	95% PROBABILITY LIMITS (1.96S)	ANALYSIS ASSUMPTION
Pressure Transmitters	39	.88%	± 1.73%	± 1.75%
Feedwater Δ P Transmitters	8	.36%	± .71%	± 1.0%
Feedwater Temperature Transmitter	10	.61%	± 1.196%	± 1.5%
Foxboro SPEC 200 Rack Modules	84	.18%	± .353%	± .5%
ASI Calibration	140	.0042 asiu	± .0083 asiu	± .00891 asiu
Neutron Power Calibration	57	.132%	± .26%	± .5%

TABLE 13

Comparison of Uncertainties

Parameter	Calculated Uncertainties	Uncertainties Utilized in Reload Analyses
Pressure	± 20.2 psi	± 22 psi
Temperature	± .86°F	± 2°F
Power (LCO)	± 1.87%	± 2%
Primary Flow	± 2.82%	± 4%
Axial Shape Index	< ± .06 asiu	± .06 asiu
Power (LSSS)	< ± 5%	± 5%