Design Analysis

Ginna Station

EVALUATION OF GINNA RCS COOLANT TEMPERATURE TO SUPPORT LTOPS REQUIREMENTS

Rochester Gas and Electric Corporation
89 East Avenue
Rochester, New York 14649

DA-ME-97-031

Revision 0

April 14, 1997

Prepared by: [signature] 4/15/97
Responsible Engineer — Date

Reviewed by: [signature] 4/23/97
Independent Reviewer or Group Leader — Date

TECHNICAL INPUT FORM				
EIN	RRC01			
KEYWORDS	Brittle Fracture, 10CFR50 Appendix G			
CROSS REF	LTOPS			
PSSL 01	EWR/ OTHER	PROPRIETARY	YES	NO X
COMMENT				
SUPERSEDES				

Revision Status Sheet

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All	0				

Revision Status Sheet

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All	0				

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1.0 OBJECTIVE

This evaluation will calculate the RCS coolant temperature such that corresponding metal temperature at a distance one-fourth of the RV section thickness from the inside surface will not be less that RTndt + 50 F. This is needed to protect the reactor vessel from being exposed to conditions of fast propagating brittle fracture per requirements of 10CFR50 Appendix G.

2.0 CONCLUSIONS

This analysis showed that for a vessel beltline weld material RTndt of 232 F, an instrumentation uncertainty of 21.1 F, and consideration of conservative heat transfer parameters, the temperature difference between coolant and 1/4 thickness is 3.2 F and corresponding RCS coolant temperature is 306.3 F.

3.0 DESIGN INPUT

3.1 10 CFR Part 50 Appendix G

3.2 ASME Code Case N-514, "Low Temperature Overpressure Protection", Section XI, Division 1

3.3 WCAP-14864, "R. E. Ginna Heatup and Cooldown Limit Curves For Normal Operation", June 1996.

3.4 USNRC RG 1.99, Rev. 2, "Radiation Embrittlement of Reactor Vessel Material", May 1988

4.0 REFERENCES

4.1 RG&E Analysis, DA-EE-93-154, "Uncertainty Of Cold Leg Temperature Recording", EWR 10106

4.2 CEO, P. Bamford to A. Rochino, "RV Annulus Temperatures", 4/2/97.

4.3 Marks' Standard Handbook For Mechanical Engineers, 9th Edition, by E. A. Avallone, and T. Baumeister

4.4 V. M. Faires, "Thermodynamics", 4th Edition

4.5 Westinghouse Dwg No. 117804E, Rev. 7, "Material List Reactor Vessel"

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4.4 V. M. Faires, "Thermodynamics", 4th Edition

4.5 Westinghouse Dwg No. 117804E, Rev. 7, "Material List Reactor Vessel"

4.6 Westinghouse Dwg No. 117849E, Rev. 2, "General Outline Of Reactor Vessel"

4.7 TRANSCO, Inc. Dwg No. TP 3609-1, "Elev. of Reactor Vessel (Typical Panel Sections).

5.0 ASSUMPTIONS

5.1 Assumptions, if used, to simplify analysis and/or provide conservative results are fully documented in the body of this design analysis and do not require verification at a later date.

5.2 Since the results of this calculation will be utilized to justify Ginna LTOP Enable Temperature, conservative values of heat transfer parameters will be used in the calculation so as to give a higher RCS coolant temperature.

6.0 COMPUTER CODES

6.1 None

7.0 ANALYSIS

The temperature of the RCS coolant will be determined based on a known temperature at a point 1/4 of the RV section thickness from the inside surface of the vessel. Steady state heat transfer methodology is then employed since the air annulus temperature outside of vessel is also known. The film coefficients at the inside and outside surfaces are conservatively taken to represent typical conditions as listed in heat transfer textbooks.

7.1 Heat Transfer From 1/4 Thickness To Outside

By definition, resistance to heat transfer in cylindrical solid walls is given by the equation, (Reference 4.4)

$$Rw = - DT/Q = Ln(Do/Di)/2\pi ZK \qquad (1)$$

Where: DT = Temperature difference between the wall surfaces, deg F

Q = Heat Transfer, Btu/hr

Do = Outside surface diameter, ft

Di = Inside surface diameter, ft

Z = Length of cylinder, ft

K = thermal conductivity of cylindrical wall, Btu ft/hr-sq ft-F

Resistance of films at surfaces of the cylindrical walls is expressed by the relation,

$$Ri = 1/AiHi \quad \text{or} \quad Ro = 1/AoHo \qquad (2)$$

Where: Ri = Resistance of film inside cylinders, (deg F-hr)/Btu

Ro = Resistance of film outside cylinders, (deg F-hr)/Btu

Ai = Inside surface area, sq ft

Ao = Outside surface area, sq ft

Ho = Outside film coefficient, Btu/(hr sq ft F)

Hi = Inside film coefficient, Btu/(hr sq ft F)

The heat transfer path from the 1/4 thickness section to the outside is made up of composite cylinders representing the remaining part of the reactor vessel and the insulation, each cylinder having its own resistance. This is shown in Figure 1 below. In addition, there will be a film resistance at the outside surface.

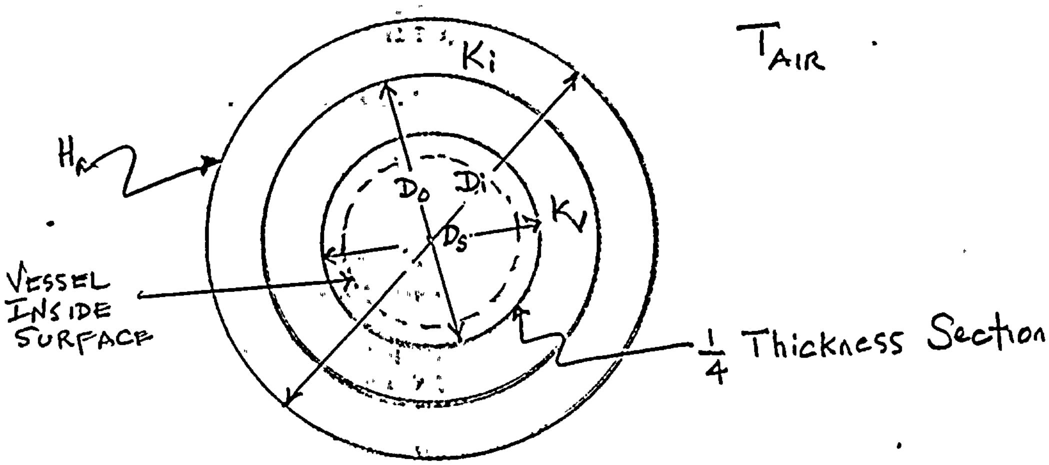


Figure 1.
Composite Cylinders From 1/4Thickness To Outside

The heat transfer through the series of resistances is expressed as follows:

$$Q = DT/(\text{Sum of Resistances in Path}) \quad (3)$$

Where DT is the temperature difference between 1/4 thickness section and the outside annulus temperature. The resistances in series consist of the remaining vessel thickness, the insulation, and the outside film. Details of Equation 3 is shown below.

$$Q = \frac{(Ts - Tair)}{\frac{Ln(Do/Ds)}{2\pi ZKv} + \frac{Ln(Di/Do)}{2\pi ZKi} + \frac{1}{AiHa}} \quad (4)$$

Where:

Ts = Temperature at 1/4 thickness section
= 282 F (Design Input 3.3)

Tair = Annulus temperature surrounding the vessel, 50F (Reference 4.2).

Do = Outside diameter of the vessel
= 145" or 12.0833' (Reference 4.6)

Ds = Diameter of 1/4 thickness section
= 135.25" or 11.2708' (Reference 4.6)

Di = Outside diameter of insulation, 3" thick per Reference 4.7
= 151" or 12.5833'

Ai = πZDi = Insulation Surface area, sq ft
= 12.5833πZ sq ft

Kv = Thermal conductivity of vessel material which is ASTM A508 (Ref. 4.5) Btu ft/hr-sq ft-F;
From Table 4.4.1 of Reference 4.3, conductivity of steel is given as 26.2 Btu ft/hr-sq ft-F

Ki = Thermal conductivity of vessel insulation, which is Kaowool (Ref.4.7)
= 0.059 Btu ft/hr-sq ft-F from Table 4.4.3 of Reference 4.3.

Ha = film coefficient at the surface of the insulation with the annulus room. From Table 4.4.9 of Reference 4.3 a typical value for air outside of tubes is given as 7.5 Btu/hr-sq ft-F. This This will be increased to 10 Btu/hr-sq ft-F for conservative value.
= 10 Btu/hr-sq ft-F

Z = Length of Cylinder, which will be assumed equal to 1 ft.

Substituting the above values into Equation 4, we have:

$$Q = \frac{(282 - 50)}{\dfrac{\ln(12.0833/11.2708)}{2\pi(1)(26.2)} + \dfrac{\ln(12.5833/12.0833)}{2\pi(1)(0.059)} + \dfrac{1}{\pi(12.5833)(10)}}$$

$$= \frac{232}{0.000422848 + 0.1093822 + 0.0025296}$$

$$= 232/0.1123347$$

$= 2065.2573$ Btu/hr for 1 ft vessel length (5)

7.2 Heat Transfer From 1/4 Thickness To RCS Coolant

The heat transfer path from the 1/4 thickness section to the inside part of the vessel, containing the RCS coolant is also made up of composite cylinders representing the cladding, and the 1/4 section of the vessel. In addition, there is also a film resistance at the inside surface. This is shown in Figure 2, which is depicted in the next page.

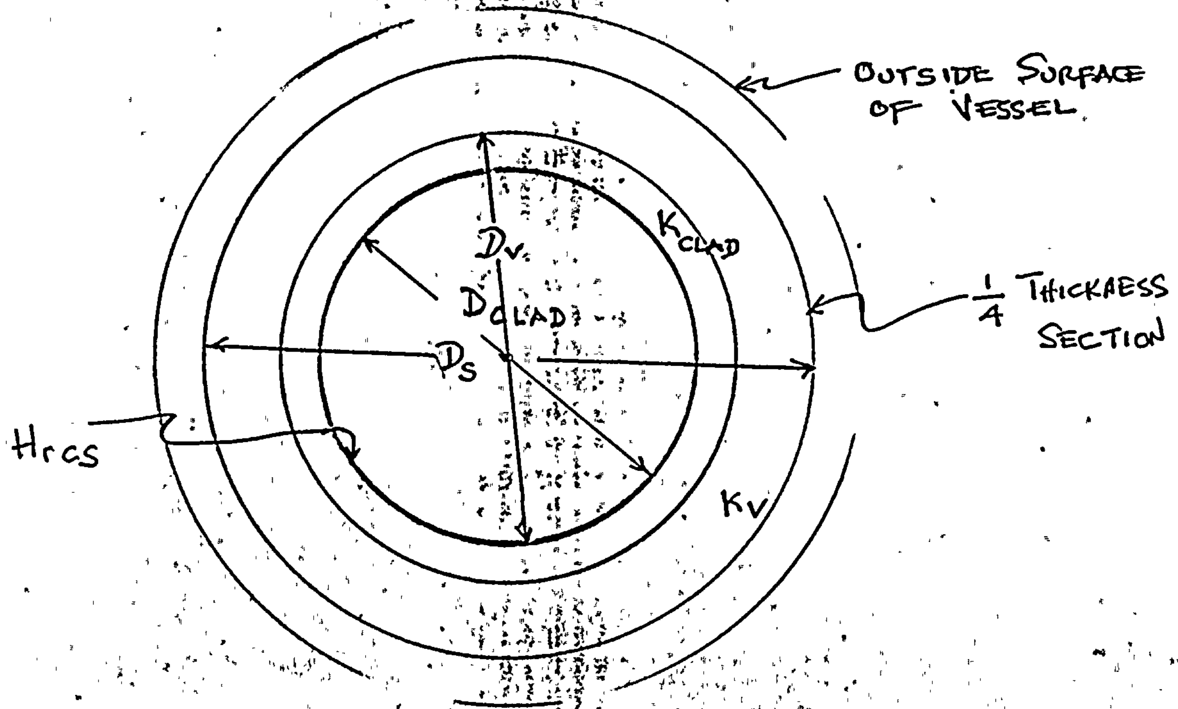


Figure 2
Composite Cylinders From 1/4Thickness To Inside

The heat transfer through the series of resistances in Figure 2 is expressed below.

$$Q = DT/(\text{Sum of Resistances in Path}) \qquad (3)$$

Where DT is the temperature difference between coolant temperature, Trcs and the metal temperature at 1/4 thickness, Ts which is equal to 282 F (Design Input 3.3). Considering the resistance formulations in Equations (1) and (2), the heat transfer equation in (3) becomes,

$$Q = \frac{(Trcs - Ts)}{\dfrac{Ln(Ds/Dv)}{2\pi ZKv} + \dfrac{Ln(Dv/Dclad)}{2\pi ZKclad} + \dfrac{1}{Aclad\ Hrcs}} \qquad (6)$$

Where: Ts = Temperature at 1/4 thickness section
= 282 F (Design Input 3.3)

Trcs = Temperature of coolant inside the vessel, F. This will be calculated.

Ds = Diameter of 1/4 thickness section
= 135.25" or 11.2708'

Dv = Inside diameter of the vessel
= 132" or 11.0'

Kv = Thermal conductivity of vessel material which is ASTM A508 (Ref. 4.5), Btu ft/hr-sq ft-F.
From Table 4.4.1 of Reference 4.3, conductivity of steel is given as 26.2 Btu ft/hr-sq ft-F.

Kclad = Thermal conductivity of cladding material which is Type 304 SS, Btu ft/hr-sq ft-F. From Table 4.4.1 of Ref. 4.3, conductivity of stainless steel is also equal to 26.2 Btu ft/hr-sq ft-F.

Dclad = Inside diameter of cladding
= 131.688" or 10.974'

Aclad = π ZDclad = Surface area inside clad
= 10.974 π Z sq ft

hclad = Film coefficient at the inside surface of the vessel clad. From Table 4.4.9 of Reference 4.3, a typical value for water inside pipe is 1260 Btu /hr-sq ft-F. For conservative results, we will use a film coefficient value of 1000 Btu/hr-sq ft-F.

Z = Length of vessel, which will be assumed equal to 1 ft.

Substituting the above values into Equation (6), we obtain,

$$Q = \frac{(Trcs - 282)}{\frac{Ln(11.2708/11.0)}{2\pi(1)(26.2)} + \frac{Ln(11.0/10.974)}{2\pi(1)(26.2)} + \frac{1}{\pi 10.974\ (1000)}}$$

$$Q = \frac{Trcs - 282}{0.000147735 + 0.000014375 + 0.000029006} \qquad (7)$$

$$Q = \frac{Trcs - 282}{0.000191116} \qquad (7')$$

The heat flow in Equation 7' is equal to that in Equation 5. Consequently, we have

Q = 2065.2573(0.00019116) = Trcs -282

Solving for Trcs,

Trcs = 282 + 0.395 = 282.395 F

A conservative assumption will be now be considered where the vessel insulation resistance decreases by an order of magnitude, i.e., by a factor of 10. In Equation (4) this will increase the heat flow to,

Q = 232/(0.000422848 + 0.01093822 + 0.0025296)

= 232/0.013890668

= 16701.86 Btu/hr per ft length of vessel

Substituting this value into Equation (7'), we can solve for the coolant temperature,

Trcs = 282 + 16701.86(0.00019116) = 285.2 F (8)

8.0 SUMMARY OF RESULTS

For a vessel beltline weld material RTndt of 232 F, and a corresponding metal temperature at a distance one-fourth of the vessel thickness from the inside surface of 282 F, and an instrumentation uncertainty of 21.1 F (Reference 4.1), this calculation has shown the following results:

Temperature Difference Between Coolant and 1/4 Thickness = 3.2 F

RCS Coolant Temperature = 285.2 + 21.1

= 306.3 F

Design Analysis

Ginna Station

Uncertainty of RCS Cold Leg Temperature Recording

Rochester Gas and Electric Corporation
89 East Avenue
Rochester, New York 14649

DA-EE-93-154

Revision 0

EWR 10106

Prepared by:	John R. Bitter Responsible Engineer	11-22-93 Date
Reviewed by:	Richard A. Baker Discipline Reviewer	11-22-93 Date
Reviewed by:	N/A JRB RAB Nuclear Safety & Licensing "When Required Otherwise "N/A" and Initials"	Date
Approved by:	Charles A. ... Jr. Discipline Manager	11-24-93 Date

Document Control Sheet

NUCLEAR SAFETY & LICENSING
INQUIRY DATA BLOCK

Changed or New Equipment/System Information Requires copy to Ginna if any box is checked below.	Safety Class From GMEDB	Review by NS&L
Requires Copy to Ginna.(Check applicable box)	See #1	(Y/N)
☐ Setpoints (Instrument, Relief Valve, Time Delay, Other)	______	______ See (#2)
☐ Operating Parameters (Flow, Pressure, Temperature, Volume, Other)	______	______ See (#2)
☐ Operational Restrictions	______	______ See (#3)
☐ UFSAR changes are required Section(s) ______ ______ ______	______	______ See (#4)

NOTES:
(#1) If any box is checked, consult the GMEDB records to determine the component safety class, then enter "SR" if Safety Related, or "SS" if Safety Significant or "NSR" if Non-Safety Related.
(#2) If Safety Class is "SR" or "SS" review by NS&L is required.
(#3) If box is checked, review by NS&L is required.
(#4) Responsible NES Engineer shall complete the UFSAR section. If UFSAR changes are required, review by NS&L is required.

DOCUMENT CONTROL DATA FORM

PLANT SYSTEMS AND STRUCTURES LIST
(Ref. 2.3; PSSL Numeric Identifiers)

KEY WORDS:
RCS Cold Leg

CROSS REFERENCED TO:
N/A

SUPERSEDED REFERENCE DATA:
N/A

EIN DESIGNATORS(S):
RK-3

Page	Latest Revision	Page	Latest Revision	Page	Latest Revision
i	0				
ii	0				
iii	0				
1	0				
2	0				
Attach. A	0				
Attach. B	0				

DESIGN ANALYSIS

1.0 **Objective**

Determine the uncertainty of RCS A&B cold leg temperature indication on RK-3 as a result of this modification. Then perform a comparison of the new uncertainty to the existing uncertainty of RCS A&B cold leg temperature currently indicated on RK-3 and show that the new uncertainty is less than or equal to that which currently exists.

2.0 **Conclusion**

The resultant loop uncertainty of the proposed modification is less than that of the existing configuration, therefore, the new configuration does not impact existing setpoints or operational requirements.

3.0 **Design Inputs**

3.1 Design Criteria, "RCS Cold Leg Temperature Recorder," EWR 10106, Rev. 0, October 14, 1993.

3.2 Safety Evaluation, SEV 1006, "RCS Cold Leg Temperature Recorder," EWR 10106, Rev. 0.

4.0 **Referenced Documents**

4.1 "Ginna Instrument Channel Uncertainty Report," RCS Temperature (Cold Leg Recorder), Channel TR-450A, Volian Enterprises, July 89.

4.2 RG&E Drawing 33013-2662

4.3 Calibration Procedure CP-I-RVLMS-INSTR-15.1, "Calibration of Reactor Vessel Level Monitoring System Train A Instrumentation," Rev. 3.

4.4 Westinghouse Specification IM 4D2B1-01EW for UR100 Micro Recorder

4.5 Foxboro Specification MI 2AO-130, "Voltage to Current Converter," dated May 1978

4.6 Foxboro Specification TI 2AI-180, August 1977.

01409.036

5.0 **Assumptions**

None

6.0 **Computer Codes**

RCST409B (Refer to Attachment B)

7.0 **Analysis**

The basis uncertainty of the existing RCS A&B cold leg temperature indication on MCB chart recorder RK-3 is ± 21.1 °F (Ref. 4.1). The instrument uncertainty for the proposed modification as calculated in Attachment A to this analysis is ± 20.25 °F which is less than the existing design basis uncertainty.

8.0 **Results**

A comparison of the existing basis uncertainty to the uncertainty of the proposed modification shows that the proposed modification uncertainty is less than the that of the existing basis. Therefore, there is no impact on existing setpoints or operational requirements as a result of this modification.

9108080137

Proposed Modification Instrument Uncertainty Impact

Description:

The proposed instrument modification is shown diagramatically in Figure 1.

Existing Instrument Basis Uncertainty:

± 21.1 °F

The basis for the existing cold leg recorder uncertainty is the "Ginna Instrument Channel Uncertainty Report", RCS Temperature (Cold Leg Recorder), Channel TR-450A, Volian Enterprises, July 89. The existing loop is not qualified for accident environments.

Proposed Instrument Modification Uncertainty:

± 2.893527 % span

The instrument span used in the proposed modification is 700 °F. This yields a temperature uncertainty of,

± 20.25469 °F

Since the total loop uncertainty for the proposed modification is less than the basis uncertainy of the existing configuration there is no impact on existing setpoints, or operating requirements.

01209.938

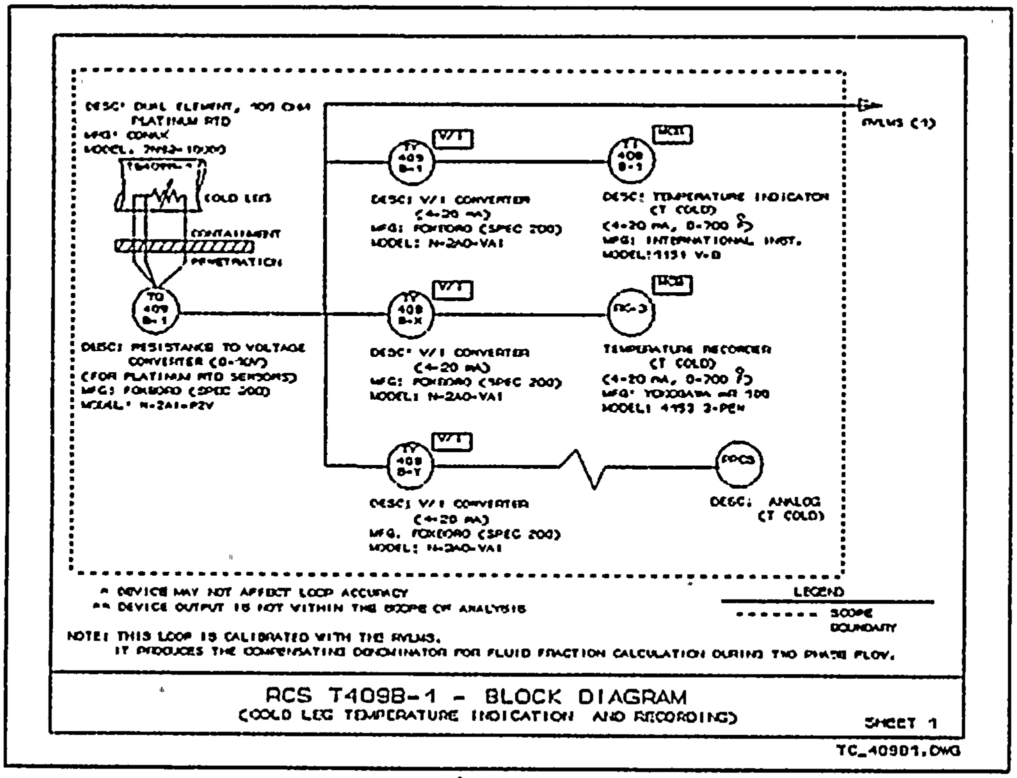


Figure 1

01209.939

LOOP T409B-1

	PMU	SU	R•U	DU	M&TEU	TU	AEU	CLU+AB	SU
TE409B-1	0.1	0	0	0	0	0	0	0	0
TQ409B-1	0	0.75	0	0	0.1414214	1	0	0	0
TY409B-1	0	0	0.6	0	0.2	1	0	0	0
RK_3	0	0	0.6	1	0.1414214	2	0	0	0
RESULTA	0.01	0.5625	0.72	1	0.08	6	0	0	0

TEMPERATURE(DEG F 700 COUNTER N/A

RND ERR 2.8935273 BIAS 0

SUOU N/A +/- N/A

TLU 0 +/- 2.8935273

LOOP	T406B-1	MFG	CONAX
MODULE	TE406B-1	MODEL	7N#2-10000
PRESSURE	N/A		

EFFECT	PROCESS		SENSOR (NORMAL)							
	Pma	Pea	Sa	Sspe	Ste	Spse	Sme	Sd	St	Sce
E1		0.1								
E2										
E3										
E4										
E5										
RESULTAN	0	0.1	0	0	0	0	0	0	0	0

EFFECT	RACK A AND PANEL MOUNTED						
	Rea	Rte	Rpse	Rme	Red	Ret	Rce
E1							
E2							
E3							
E4							
E5							
RESULTAN	0	0	0	0	0	0	0

EFFECT	ACCIDENT RELATED										SEISMIC
	Cee	Re	Te	Pe	S/Ce	AB	CI	SI	PI	TBI	CSI	Se
E1	0						0					
E2												
E3												
E4												
E5												
RESULTAN	0	0	0	0	0	0	0	0	0	0	0	0

GROUP	PMU	SU	ReU	DU	M&TEU	TU	AEU	AB+CLU	SU
	0.1	0	0	0	0	0	0	0	0

MODULE ERROR		
0	+/-	0.1

01209.941

LOOP	T409B-1	MFG	FOXBORO
MODULE	TQ409B-1	MODEL	N-2AI-P2V
PRESSURE	N/A		

	PROCESS		SENSOR (NORMAL)							
EFFECT	Pma	Pea	Sa	Sdpe	Ste	Spse	Sme	Sd	St	Sce
E1			0.75		0	0		0	1	0.1
E2			0							0.1
E3										
E4										
E5										
RESULTAN	0	0	0.75	0	0	0	0	0	1	0.14142136

	RACK A AND PANEL MOUNTED						
EFFECT	Rea	Rte	Rpse	Rme	Red	Ret	Rce
E1							
E2							
E3							
E4							
E5							
RESULTAN	0	0	0	0	0	0	0

	ACCIDENT RELATED											SEISMIC
EFFECT	Cre	Re	Te	Pe	S/Ce	AB	CI	SI	PI	TBI	CSI	Se
E1												0
E2												
E3												
E4												
E5												
RESULTAN	0	0	0	0	0	0	0	0	0	0	0	0

GROUP	PMU	SU	ReU	DU	M&TEU	TU	AEU	AB+CLU	SU
	0	0.75	0	0	0.14142136	1	0	0	0

MODULE ERROR		
0	+/-	1.25797456

01209.942

LOOP	T402B-1	MFG	FOXBORO
MODULE	TY40vB-1	MODEL	N-2AO-VAI

PRESSURE N/A

EFFECT	PROCESS		SENSOR (NORMAL)							
	Pma	Pea	Sa	Sspe	Ste	Spse	Sme	Sd	St	Sce
E1										
E2										
E3										
E4										
E5										
RESULTAN	0	0	0	0	0	0	0	0	0	0

EFFECT	RACK A AND PANEL MOUNTED						
	Rea	Rte	Rpse	Rme	Rerl	Ret	Rce
E1	0.6				0	1	0.2
E2							
E3							
E4							
E5							
RESULTAN	0.6	0	0	0	0	1	0.2

EFFECT	ACCIDENT RELATED											SEISMIC
	Crae	Re	Te	Pe	S/Ce	AB	CI	SI	PI	TBI	CSI	Se
E1												0
E2												
E3												
E4												
E5												
RESULTAN	0	0	0	0	0	0	0	0	0	0	0	0

GROUP	PMU	SU	ReU	DU	M&TEU	TU	AEU	AB+CLU	SU
	0	0	0.6	0	0.2	1	0	0	0

MODULE ERROR		
0	+/-	1.18321596

LOOP: T4023-1 | MFG: YOKOGAWA
MODULE: RK-3 | MODEL: mR 100 4153 3 PEN
PRESSURE: N/A

EFFECT	PROCESS Pme	Pse	SENSOR (NORMAL) Se	Sspe	Ste	Spse	Sme	Sd	St	Sce
E1										
E2										
E3										
E4										
E5										
RESULTAN	0	0	0	0	0	0	0	0	0	0

EFFECT	RACK A AND PANEL MOUNTED Rea	Rte	Rpse	Rme	Red	Ret	Rce
E1	0.6			0	1	2	0.1
E2							0.1
E3							
E4							
E5							
RESULTAN	0.6	0	0	0	1	2	0.14142136

EFFECT	ACCIDENT RELATED Cree	Re	Te	Pe	S/Ce	AB	CI	SI	PI	TBI	CSI	SEISMIC Se
E1												0
E2												
E3												
E4												
E5												
RESULTAN	0	0	0	0	0	0	0	0	0	0	0	0

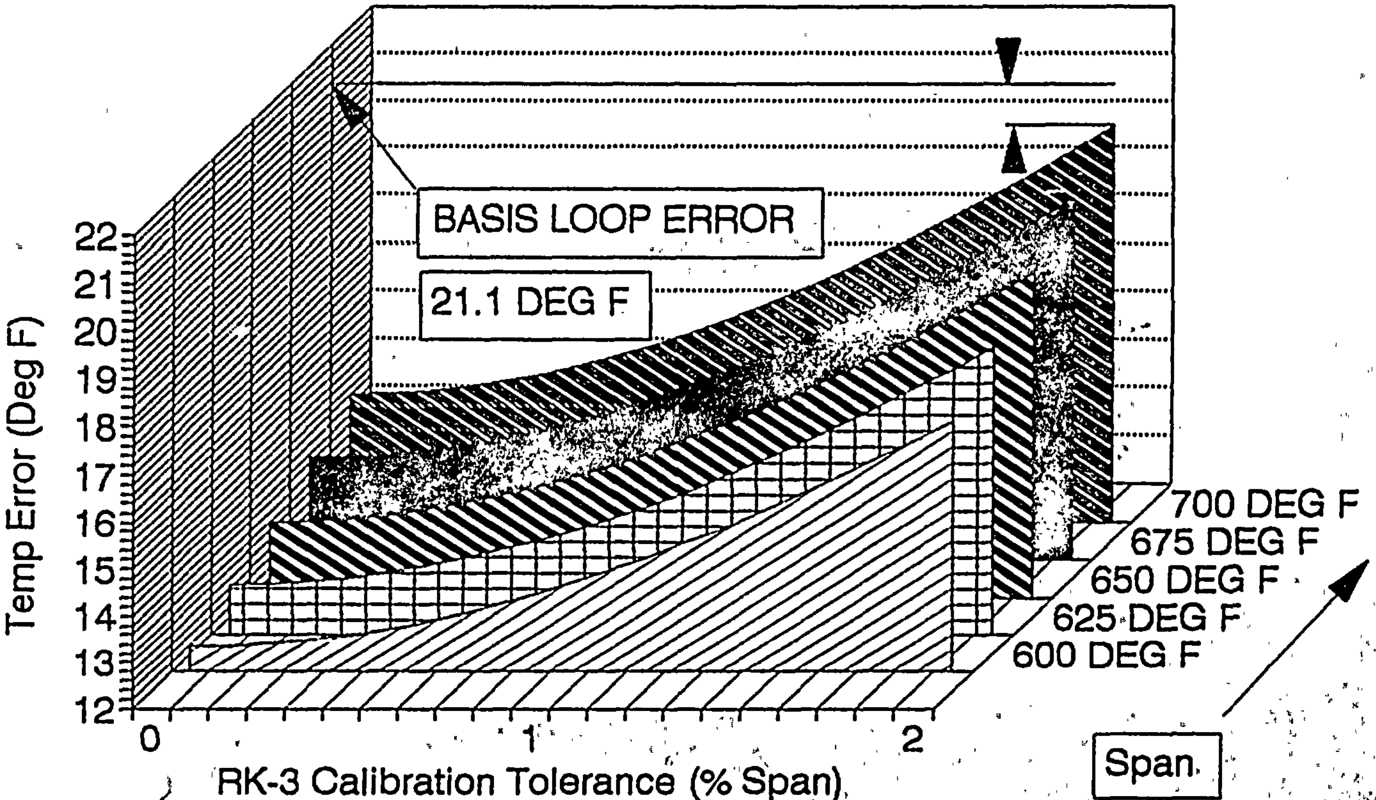
GROUP	PMU	SU	RaU	DU	M&TEU	TU	AEU	AB+CLU	SU
	0	0	0.6	1	0.14142136	2	0	0	0

MODULE ERROR: 0 +/- 2.3194827

	ERROR (?F)					
SPAN(?F)	600	625	650	675	700	RK-3 CAL TOL (% SPAN)
	12.54631	13.06908	13.59184	14.1146	14.63737	0
	12.56065	13.08401	13.60737	14.13073	14.65409	0.1
	12.60357	13.12872	13.65387	14.17902	14.70417	0.2
	12.67478	13.20289	13.73101	14.25913	14.78724	0.3
	12.7738	13.30604	13.83828	14.37053	14.90277	0.4
	12.9	13.4375	13.975	14.5125	15.05	0.5
	13.05259	13.59644	14.1403	14.68416	15.22802	0.6
	13.23065	13.78192	14.3332	14.88448	15.43575	0.7
	13.43317	13.99288	14.5526	15.11231	15.67203	0.8
	13.65906	14.22819	14.79732	15.36645	15.93557	0.9
	13.90719	14.48666	15.06613	15.64559	16.22506	1
	14.17639	14.76707	15.35775	15.94844	16.53912	1.1
	14.46548	15.0682	15.67093	16.27366	16.87639	1.2
	14.77329	15.38884	16.00439	16.61995	17.2355	1.3
	15.09868	15.72779	16.3569	16.98601	17.61512	1.4
	15.44053	16.08389	16.72724	17.3706	18.01395	1.5
	15.79778	16.45603	17.11427	17.77251	18.43075	1.6
	16.16942	16.84314	17.51687	18.19059	18.86432	1.7
	16.55446	17.24422	17.93399	18.62376	19.31353	1.8
	16.95199	17.65832	18.36466	19.07099	19.77732	1.9
	17.36116	18.08455	18.80793	19.53131	20.25469	2

Temperature Error (Deg F)

vs RK-3 Calibration Tolerance (% Span)



Computer Software Documentation

The computer programs utilized in this analysis are classified as type 4 in accordance with Appendix B of QE 330, Rev. 0.

Type 4: Computer Software Package Documentation Summary

1. Title of Report or Analysis RCS-T409B-1, DA-EE-93-154
2. Author George Daniels, et al
3. Verification of Program
   - (a) (1) Name of Program: RCST409B
     - (2) Description (include source code location)

       The principal program consists of linked spreadsheet files written using QUATTRO PRO 3.0 (Borland International, Inc.) Cell algorithms and code are attached.
     - (3) Algorithm Bases
       - ☐ Found in text, page N/A
       - ☐ Reference N/A
     - (4) Numerical Methods Used
       - (i) Description N\A
       - (ii) Reference N\A
       - (iii) Other N/A

Instrument Uncertainty Data Processing System

In order to accommodate instrument uncertainties with significant variability related to process state parameters, a computer program using an advanced spreadsheet environment (QUATTRO PRO) is utilized. A typical file structure is shown in Figure 1 below.

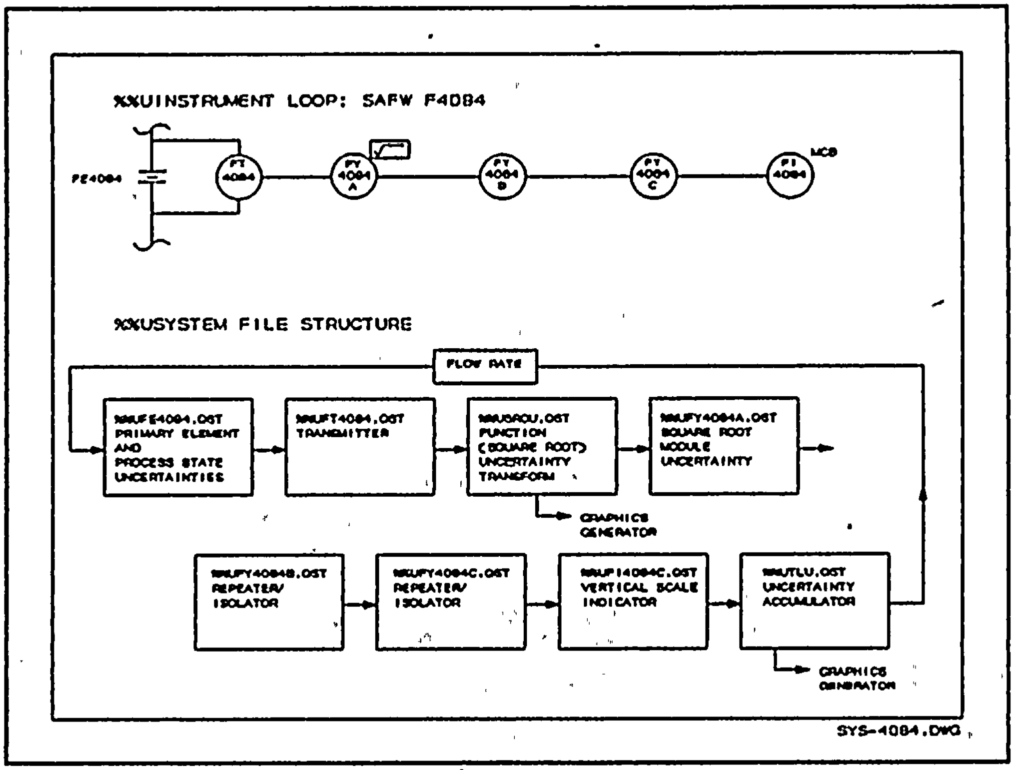


Figure 1

A complete listing of files used for this analysis is provided in the following pages.

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Graphics Generation

The graphics documented in the Analysis text are intended to provide sufficient insight into complex parametric uncertainty effects to verify conformity with performance requirements. However the software system provides the capability for generating additional graphics, either to check existing calculations, or for providing additional data related to instrument performance during normal or emergency conditions.

Each uncertainty accumulator file uses cells C30-I30 as the graphics variable block. The macro "GRAPHMAC" is used to generate text files for the selected parameter set. GRAPHMAC is located in the LIB.QST file. It must be configured for the limits, range, and desired granularity of the parameters being graphed. Text files produced by GRAPHMAC are then imported to a QUATTRO PRO spreadsheet for use by the graphics utility. An example of this capability is shown in Figure 2 below.

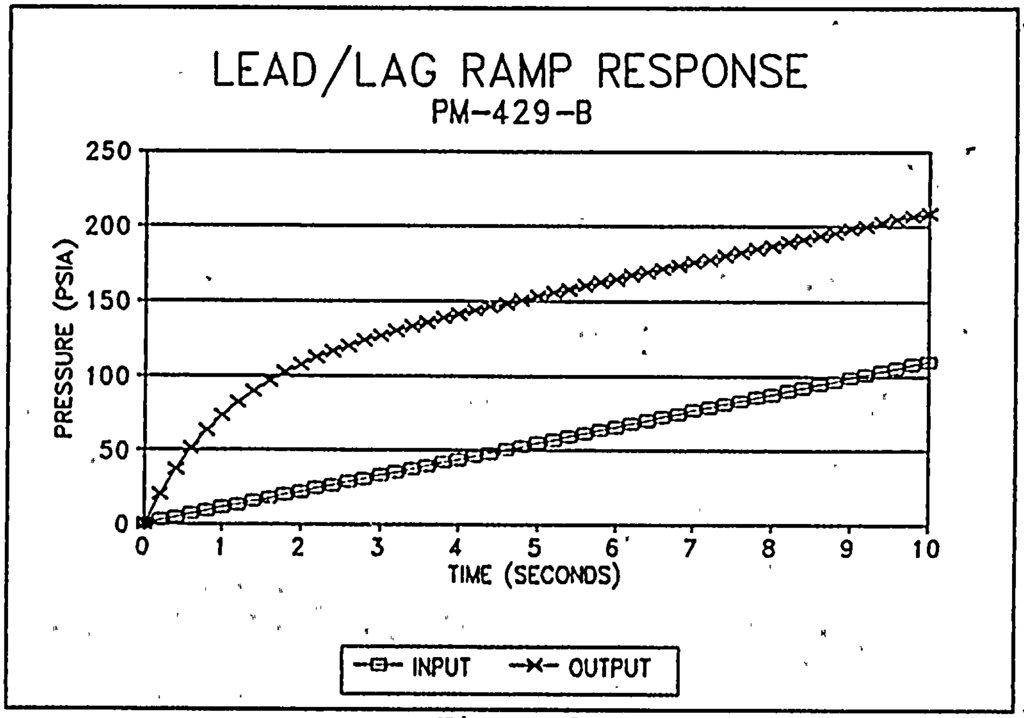

Figure 2

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COLD LEG TEMPERATURE - INDICATOR LOOP

01209.950

LIB.QST

```
B3: 20
F3: 1
J3: 5
N3: 1
R3: 20
B4: 980
F4: 100
J4: 200
N4: 100
R4: 1000
B5: 20
F5: 1
J5: 5
N5: 1
R5: 20
B8: '{FOR E10,B3,B4,B5,B10}
F8: '{FOR E10,F3,F4,F5,F10}
J8: '{FOR E10,J3,J4,J5,J10}
N8: '{FOR E10,N3,N4,N5,N10}
R8: '{FOR E10,R3,R4,R5,R10}
B10: '{/ Print;Block}C20..E20~
E10: 1020
F10: '{/ Print;Block}C22..E22~
J10: '{/ Print;Block}C24..E24~
N10: '{/ Print;Block}C26..E26~
R10: '{/ Print;Block}C30..G30~
B11: '{/ Print;Go}
F11: '{/ Print;Go}
J11: '{/ Print;Go}
N11: '{/ Print;Go}
R11: '{/ Print;Go}
```

TE409B_1.QST

```
A1:  'LOOP
B1:  'T409B-1
D1:  'MFG
E1:  'CONAX
A2:  'MODULE
B2:  'TE409B-1
D2:  'MODEL
E2:  '7N92-10000
A4:  'PRESSURE (PERCENT)
B4:  'N/A
C5:  '     PROCESS
I5:  'SENSOR (NORMAL)
A6:  '
B6:  'EFFECT
C6:  '  Pma
D6:  '   Pea
E6:  '   Sa
F6:  '   Sspe
G6:  '   Ste
H6:  '   Spse
I6:  '   Sme
J6:  '   Sd
K6:  '   St
L6:  '   Sce
A7:  '
B7:  'E1
C7:  '
D7:  0.1
E7:  '
G7:  '
H7:  '
J7:  '
K7:  '
L7:  '
A8:  '
B8:  'E2
C8:  '
E8:  '
A9:  '
B9:  'E3
A10:  '
B10:  'E4
A11:  '
B11:  'E5
A12:  '
B12:  'RESULTANT
C12:  @SQRT(C7^2+C8^2+C9^2+C10^2+C11^2)
D12:  @SQRT(D7^2+D8^2+D9^2+D10^2+D11^2)
```

```
E12: @SQRT(E7^2+E8^2+E9^2+E10^2+E11^2)
F12: @SQRT(F7^2+F8^2+F9^2+F10^2+F11^2)
G12: @SQRT(G7^2+G8^2+G9^2+G10^2+G11^2)
H12: @SQRT(H7^2+H8^2+H9^2+H10^2+H11^2)
I12: @SQRT(I7^2+I8^2+I9^2+I10^2+I11^2)
J12: @SQRT(J7^2+J8^2+J9^2+J10^2+J11^2)
K12: @SQRT(K7^2+K8^2+K9^2+K10^2+K11^2)
L12: @SQRT(L7^2+L8^2+L9^2+L10^2+L11^2)
```

```
D14: '    RACK AND PANEL
E14: 'AND PANEL
F14: ' MOUNTED
B15: 'EFFECT
C15: '   Rea
D15: '   Rte
E15: '   Rpse
F15: '   Rme
G15: '   Red
H15: '   Ret
I15: '   Rce
B16: 'E1
B17: 'E2
B18: 'E3
B19: 'E4
B20: 'E5
B21: 'RESULTANT
C21: @SQRT(C16^2+C17^2+C18^2+C19^2+C20^2)
D21: @SQRT(D16^2+D17^2+D18^2+D19^2+D20^2)
E21: @SQRT(E16^2+E17^2+E18^2+E19^2+E20^2)
F21: @SQRT(F16^2+F17^2+F18^2+F19^2+F20^2)
G21: @SQRT(G16^2+G17^2+G18^2+G19^2+G20^2)
H21: @SQRT(H16^2+H17^2+H18^2+H19^2+H20^2)
I21: @SQRT(I16^2+I17^2+I18^2+I19^2+I20^2)
F23: 'ACCIDENT RELATED
N23: 'SEISMIC
B24: 'EFFECT
C24: '   Crae
D24: '   Re
E24: '   Te
F24: '   Pe
G24: '   S/Ce
H24: '   AB
```

```
I24: '   Cl
J24: '   Sl
K24: '   Pl
L24: '   TBl
M24: '   CSl
N24: '   Se
B25: 'E1
C25: 0
I25: 0
B26: 'E2
B27: 'E3
B28: 'E4
B29: 'E5
B30: 'RESULTANT
C30: @SQRT(C25^2+C26^2+C27^2+C28^2+C29^2)
D30: @SQRT(D25^2+D26^2+D27^2+D28^2+D29^2)
E30: @SQRT(E25^2+E26^2+E27^2+E28^2+E29^2)
F30: @SQRT(F25^2+F26^2+F27^2+F28^2+F29^2)
G30: @SQRT(G25^2+G26^2+G27^2+G28^2+G29^2)
H30: @SUM(H25..H29)
I30: @SUM(I25..I29)
J30: @SUM(J25..J29)
K30: @SUM(K25..K29)
```

```
L30: @SUM(L25..L29)
M30: @SUM(M25..M29)
N30: @SQRT(N25^2+N26^2+N27^2+N28^2+N29^2)
B34: 'GROUP
C34: '   PMU
D34: '   SU
E34: '   ReU
F34: '   DU
G34: '  M&TEU
H34: '   TU
I34: '   AEU
J34: '  AB+CLU
K34: '   SU
C35: @SQRT(C12^2+D12^2)
D35: @SQRT(E12^2+F12^2+G12^2+H12^2+I12^2)
E35: @SQRT(C21^2+D21^2+E21^2+F21^2)
F35: @SQRT(J12^2+G21^2)
G35: @SQRT(L12^2+I21^2)
```

```
.H35: @SQRT(K12^2+H21^2)
 I35: @SQRT(C30^2+D30^2+E30^2+F30^2+G30^2)
 J35: @SUM(H30..M30)
 K35: @SQRT(N30^2)
```

TI409B_1.QST

```
A1: 'LOOP
B1: 'T409B-1
D1: 'MFG
E1: 'INTL INST
A2: 'MODULE
B2: 'TI409B-1
D2: 'MODEL
E2: '1151 V-B
A4: 'PRESSURE (PERCENT)
B4: 'N/A
C5: '    PROCESS
I5: 'SENSOR (NORMAL)
A6: '
B6: 'EFFECT
C6: '  Pma
D6: '   Pea
E6: '   Sa
F6: '   Sspe
G6: '   Ste
H6: '   Spse
I6: '   Sme
J6: '   Sd
K6: '   St
L6: '   Sce
A7: '
B7: 'E1
C7: '
E7: '
G7: '
H7: '
J7: '
K7: '
L7: '
A8: '
B8: 'E2
C8: '
E8: '
A9: '
B9: 'E3
A10: '
B10: 'E4
A11: '
B11: 'E5
A12: '
B12: 'RESULTANT
C12: @SQRT(C7^2+C8^2+C9^2+C10^2+C11^2)
D12: @SQRT(D7^2+D8^2+D9^2+D10^2+D11^2)
E12: @SQRT(E7^2+E8^2+E9^2+E10^2+E11^2)
```


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```
F12: @SQRT(F7^2+F8^2+F9^2+F10^2+F11^2)
G12: @SQRT(G7^2+G8^2+G9^2+G10^2+G11^2)
H12: @SQRT(H7^2+H8^2+H9^2+H10^2+H11^2)
I12: @SQRT(I7^2+I8^2+I9^2+I10^2+I11^2)
J12: @SQRT(J7^2+J8^2+J9^2+J10^2+J11^2)
K12: @SQRT(K7^2+K8^2+K9^2+K10^2+K11^2)
L12: @SQRT(L7^2+L8^2+L9^2+L10^2+L11^2)
D14: '    RACK AND PANEL
```

```
E14: 'AND PANEL
F14: ' MOUNTED
B15: 'EFFECT
C15: '   Rea
D15: '   Rte
E15: '   Rpse
F15: '   Rme
G15: '   Red
H15: '   Ret
I15: '   Rce
B16: 'E1
C16: 1.5
F16: 0.7
G16: 1
H16: 1
I16: 0.1
B17: 'E2
B18: 'E3
B19: 'E4
B20: 'E5
B21: 'RESULTANT
C21: @SQRT(C16^2+C17^2+C18^2+C19^2+C20^2)
D21: @SQRT(D16^2+D17^2+D18^2+D19^2+D20^2)
E21: @SQRT(E16^2+E17^2+E18^2+E19^2+E20^2)
F21: @SQRT(F16^2+F17^2+F18^2+F19^2+F20^2)
G21: @SQRT(G16^2+G17^2+G18^2+G19^2+G20^2)
H21: @SQRT(H16^2+H17^2+H18^2+H19^2+H20^2)
I21: @SQRT(I16^2+I17^2+I18^2+I19^2+I20^2)
F23: 'ACCIDENT RELATED
N23: 'SEISMIC
B24: 'EFFECT
C24: '   Crae
D24: '   Re
```


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```
E24: '    Te
F24: '    Pe
G24: '    S/Ce
H24: '    AB
I24: '    Cl
J24: '    Sl
K24: '    Pl
L24: '    TBl
M24: '    CSl
N24: '    Se
B25: 'E1
N25: 0
B26: 'E2
B27: 'E3
B28: 'E4
B29: 'E5
B30: 'RESULTANT
C30: @SQRT(C25^2+C26^2+C27^2+C28^2+C29^2)
D30: @SQRT(D25^2+D26^2+D27^2+D28^2+D29^2)
E30: @SQRT(E25^2+E26^2+E27^2+E28^2+E29^2)
F30: @SQRT(F25^2+F26^2+F27^2+F28^2+F29^2)
G30: @SQRT(G25^2+G26^2+G27^2+G28^2+G29^2)
H30: @SUM(H25..H29)
```

```
I30: @SUM(I25..I29)
J30: @SUM(J25..J29)
K30: @SUM(K25..K29)
L30: @SUM(L25..L29)
M30: @SUM(M25..M29)
N30: @SQRT(N25^2+N26^2+N27^2+N28^2+N29^2)
B34: 'GROUP
C34: '    PMU
D34: '    SU
E34: '    ReU
F34: '    DU
G34: '   M&TEU
H34: '    TU
I34: '    AEU
J34: '   AB+CLU
K34: '    SU
C35: @SQRT(C12^2+D12^2)
D35: @SQRT(E12^2+F12^2+G12^2+H12^2+I12^2)
```

```
E35: @SQRT(C21^2+D21^2+E21^2+F21^2)
F35: @SQRT(J12^2+G21^2)
G35: @SQRT(L12^2+I21^2)
H35: @SQRT(K12^2+H21^2)
I35: @SQRT(C30^2+D30^2+E30^2+F30^2+G30^2)
J35: @SUM(H30..M30)
K35: @SQRT(N30^2)
```

TLU.QST

```
A1:  'LOOP
B1:  'T409B-1
A3:  '
C3:  'PMU
D3:  'SU
E3:  'ReU
F3:  'DU
G3:  'M&TEU
H3:  'TU
I3:  'AEU
J3:  'CLU+AB
K3:  'SU
B4:  'TE409B-1
C4:  +[TE409B_1]C35
D4:  +[TE409B_1]D35
E4:  +[TE409B_1]E35
F4:  +[TE409B_1]F35
G4:  +[TE409B_1]G35
H4:  +[TE409B_1]H35
I4:  +[TE409B_1]I35
J4:  +[TE409B_1]J35
K4:  +[TE409B_1]K35
B5:  'TQ409B-1
C5:  +[TQ409B_1]C35
D5:  +[TQ409B_1]D35
E5:  +[TQ409B_1]E35
F5:  +[TQ409B_1]F35
G5:  +[TQ409B_1]G35
H5:  +[TQ409B_1]H35
I5:  +[TQ409B_1]I35
J5:  +[TQ409B_1]J35
K5:  +[TQ409B_1]K35
B6:  'TY409B-1
C6:  +[TY409B_1]C35
D6:  +[TY409B_1]D35
E6:  +[TY409B_1]E35
F6:  +[TY409B_1]F35
G6:  +[TY409B_1]G35
H6:  +[TY409B_1]H35
I6:  +[TY409B_1]I35
J6:  +[TY409B_1]J35
K6:  +[TY409B_1]K35
B7:  'TI409B-1
C7:  +[TI409B_1]C35
D7:  +[TI409B_1]D35
E7:  +[TI409B_1]E35
F7:  +[TI409B_1]F35
G7:  +[TI409B_1]G35
```


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```
H7: +[TI409B_1]H35
I7: +[TI409B_1]I35
J7: +[TI409B_1]J35
K7: +[TI409B_1]K35
A8: '
B8: 'RESULTANT
C8: @IF(ROC=1,0,+C4^2+C6^2+C7^2+C5^2)
D8: +D4^2+D6^2+D7^2+D5^2
```

```
E8: +E4^2+E6^2+E7^2+E5^2
F8: @IF(ROC=1,0,+F4^2+F6^2+F7^2+F5^2)
G8: @IF(ROC=1,0,+G4^2+G6^2+G7^2+G5^2)
H8: @IF(ROC=1,0,+H4^2+H6^2+H7^2+H5^2)
I8: +I4^2+I6^2+I7^2+I5^2
J8: +J4+J6+J7+J5
K8: +K4^2+K6^2+K7^2+K5^2
E9: '
A10: 'PRESSURE (PERCENT)
C10: '   N/A
D10: ' COUNTER
E10: '   N/A
G10: 'RATE OF CHANGE
I10: 1
O10: '
N11: 1
A12: '
B12: 'RND ERR
C12: @SQRT(@SUM(C8..I8)+K8)
D12: '   BIAS
E12: +J8
N12: 100
K13: '
N13: 1
A14: '
B14: 'SUOU
C14: '   N/A
D14: '   +/-
E14: '   N/A
B15: '
G15: +BIAS+RANDOM
A16: '
B16: 'TLU
```

```
C16: +E12
D16: '   +/-
E16: @SQRT(C12^2)
G17: +BIAS-RANDOM
B18: 'SYSTEM STATE SPECIFICATION BLOCK
N18: '
B19: 'NORM OPS
D19: 1
E19: '
F19: +NORM#AND#(#NOT#ACCHI)#AND#(#NOT#ACCLO)
N19: '{FOR E10,N11,N12,N13,N21}
D20: '
E20: '
L20: '
N20: '
B21: 'ACC HI
C21: '
D21: 0
E21: '
F21: +ACCHI#AND#(#NOT#NORM)#AND#(#NOT#ACCLO)
K21: '
N21: '{/ Print;Block}E14..E14~
A22: '
```

```
D22: '
E22: '
N22: '{/ Print;Go}
B23: 'ACC LO
D23: 0
F23: +ACCLO#AND#(#NOT#NORM)#AND#(#NOT#ACCHI)
                                    B       2       4       :
@IF((#NOT#ACCHI)#AND#(#NOT#ACCLO)#AND#(#NOT#NORM)=1,"SYSTEM STATE
SPECIFICATION ERROR"," ")
                                    B       2       5       :
@IF((NORM#AND#ACCHI)#OR#(ACCHI#AND#ACCLO)#OR#(ACCLO#AND#NORM),"SY
STEM STATE SPECIFICATION ERROR",B24)
```


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TQ409B_1.QST

```
A1: 'LOOP
B1: 'T409B-1
D1: 'MFG
E1: 'FOXBORO
A2: 'MODULE
B2: 'TQ409B-1
D2: 'MODEL
E2: 'N-2AI-P2V
A4: 'PRESSURE (PERCENT)
B4: 'N/A
C5: '     PROCESS
I5: 'SENSOR (NORMAL)
A6: '
B6: 'EFFECT
C6: '   Pma
D6: '    Pea
E6: '    Sa
F6: '    Sspe
G6: '    Ste
H6: '    Spse
I6: '    Sme
J6: '    Sd
K6: '    St
L6: '    Sce
A7: '
B7: 'E1
C7: '
E7: 0.75
G7: 0
H7: 0
J7: 0
K7: 1
L7: 0.1
A8: '
B8: 'E2
C8: '
E8: 0
L8: 0.1
A9: '
B9: 'E3
A10: '
B10: 'E4
A11: '
B11: 'E5
A12: '
B12: 'RESULTANT
C12: @SQRT(C7^2+C8^2+C9^2+C10^2+C11^2)
D12: @SQRT(D7^2+D8^2+D9^2+D10^2+D11^2)
```

```
E12: @SQRT(E7^2+E8^2+E9^2+E10^2+E11^2)
F12: @SQRT(F7^2+F8^2+F9^2+F10^2+F11^2)
G12: @SQRT(G7^2+G8^2+G9^2+G10^2+G11^2)
H12: @SQRT(H7^2+H8^2+H9^2+H10^2+H11^2)
I12: @SQRT(I7^2+I8^2+I9^2+I10^2+I11^2)
J12: @SQRT(J7^2+J8^2+J9^2+J10^2+J11^2)
K12: @SQRT(K7^2+K8^2+K9^2+K10^2+K11^2)
L12: @SQRT(L7^2+L8^2+L9^2+L10^2+L11^2)
```

```
D14: '     RACK AND PANEL
E14: 'AND PANEL
F14: ' MOUNTED
B15: 'EFFECT
C15: '    Rea
D15: '    Rte
E15: '    Rpse
F15: '    Rme
G15: '    Red
H15: '    Ret
I15: '    Rce
B16: 'E1
B17: 'E2
B18: 'E3
B19: 'E4
B20: 'E5
B21: 'RESULTANT
C21: @SQRT(C16^2+C17^2+C18^2+C19^2+C20^2)
D21: @SQRT(D16^2+D17^2+D18^2+D19^2+D20^2)
E21: @SQRT(E16^2+E17^2+E18^2+E19^2+E20^2)
F21: @SQRT(F16^2+F17^2+F18^2+F19^2+F20^2)
G21: @SQRT(G16^2+G17^2+G18^2+G19^2+G20^2)
H21: @SQRT(H16^2+H17^2+H18^2+H19^2+H20^2)
I21: @SQRT(I16^2+I17^2+I18^2+I19^2+I20^2)
F23: 'ACCIDENT RELATED
N23: 'SEISMIC
B24: 'EFFECT
C24: '    Crae
D24: '    Re
E24: '    Te
F24: '    Pe
G24: '    S/Ce
H24: '    AB
```

```
I24: '    Cl
J24: '    Sl
K24: '    Pl
L24: '    TBl
M24: '    CSl
N24: '    Se
B25: 'E1
C25: @IF([TLU]NORM=0,0.56,0)
I25: @IF([TLU]ACCLO=1,-0.43,0)
N25: 0
B26: 'E2
B27: 'E3
B28: 'E4
B29: 'E5
B30: 'RESULTANT
C30: @SQRT(C25^2+C26^2+C27^2+C28^2+C29^2)
D30: @SQRT(D25^2+D26^2+D27^2+D28^2+D29^2)
E30: @SQRT(E25^2+E26^2+E27^2+E28^2+E29^2)
F30: @SQRT(F25^2+F26^2+F27^2+F28^2+F29^2)
G30: @SQRT(G25^2+G26^2+G27^2+G28^2+G29^2)
H30: @SUM(H25..H29)
I30: @SUM(I25..I29)
J30: @SUM(J25..J29)
```

```
K30: @SUM(K25..K29)
L30: @SUM(L25..L29)
M30: @SUM(M25..M29)
N30: @SQRT(N25^2+N26^2+N27^2+N28^2+N29^2)
B34: 'GROUP
C34: '    PMU
D34: '    SU
E34: '    ReU
F34: '    DU
G34: '   M&TEU
H34: '    TU
I34: '    AEU
J34: '   AB+CLU
K34: '    SU
C35: @SQRT(C12^2+D12^2)
D35: @SQRT(E12^2+F12^2+G12^2+H12^2+I12^2)
E35: @SQRT(C21^2+D21^2+E21^2+F21^2)
F35: @SQRT(J12^2+G21^2)
```

```
G35: @SQRT(L12^2+I21^2)
H35: @SQRT(K12^2+H21^2)
I35: @SQRT(C30^2+D30^2+E30^2+F30^2+G30^2)
J35: @SUM(H30..M30)
K35: @SQRT(N30^2)
```

TY409B_1.QST

```
A1:  'LOOP
B1:  'T409B-1
D1:  'MFG
E1:  'FOXBORO
A2:  'MODULE
B2:  'TY409B-1
D2:  'MODEL
E2:  'N-2AO-VAI
A4:  'PRESSURE (PERCENT)
B4:  'N/A
C5:  '    PROCESS
I5:  'SENSOR (NORMAL)
A6:  '
B6:  'EFFECT
C6:  '  Pma
D6:  '   Pea
E6:  '   Sa
F6:  '   Sspe
G6:  '   Ste
H6:  '   Spse
I6:  '   Sme
J6:  '   Sd
K6:  '   St
L6:  '   Sce
A7:  '
B7:  'E1
C7:  '
E7:  '
G7:  '
H7:  '
J7:  '
K7:  '
L7:  '
A8:  '
B8:  'E2
C8:  '
E8:  '
A9:  '
B9:  'E3
A10: '
B10: 'E4
A11: '
B11: 'E5
A12: '
B12: 'RESULTANT
C12: @SQRT(C7^2+C8^2+C9^2+C10^2+C11^2)
D12: @SQRT(D7^2+D8^2+D9^2+D10^2+D11^2)
E12: @SQRT(E7^2+E8^2+E9^2+E10^2+E11^2)
```

```
F12: @SQRT(F7^2+F8^2+F9^2+F10^2+F11^2)
G12: @SQRT(G7^2+G8^2+G9^2+G10^2+G11^2)
H12: @SQRT(H7^2+H8^2+H9^2+H10^2+H11^2)
I12: @SQRT(I7^2+I8^2+I9^2+I10^2+I11^2)
J12: @SQRT(J7^2+J8^2+J9^2+J10^2+J11^2)
K12: @SQRT(K7^2+K8^2+K9^2+K10^2+K11^2)
L12: @SQRT(L7^2+L8^2+L9^2+L10^2+L11^2)
D14: '    RACK AND PANEL
```

```
E14: 'AND PANEL
F14: ' MOUNTED
B15: 'EFFECT
C15: '    Rea
D15: '    Rte
E15: '    Rpse
F15: '    Rme
G15: '    Red
H15: '    Ret
I15: '    Rce
B16: 'E1
C16: 0.6
G16: 0
H16: 1
I16: 0.2
B17: 'E2
B18: 'E3
B19: 'E4
B20: 'E5
B21: 'RESULTANT
C21: @SQRT(C16^2+C17^2+C18^2+C19^2+C20^2)
D21: @SQRT(D16^2+D17^2+D18^2+D19^2+D20^2)
E21: @SQRT(E16^2+E17^2+E18^2+E19^2+E20^2)
F21: @SQRT(F16^2+F17^2+F18^2+F19^2+F20^2)
G21: @SQRT(G16^2+G17^2+G18^2+G19^2+G20^2)
H21: @SQRT(H16^2+H17^2+H18^2+H19^2+H20^2)
I21: @SQRT(I16^2+I17^2+I18^2+I19^2+I20^2)
F23: 'ACCIDENT RELATED
N23: 'SEISMIC
B24: 'EFFECT
C24: '    Crae
D24: '    Re
E24: '    Te
```


01209.967

```
F24: '    Pe
G24: '    S/Ce
H24: '    AB
I24: '    Cl
J24: '    Sl
K24: '    Pl
L24: '    TBl
M24: '    CSl
N24: '    Se
B25: 'E1
N25: 0
B26: 'E2
B27: 'E3
B28: 'E4
B29: 'E5
B30: 'RESULTANT
C30: @SQRT(C25^2+C26^2+C27^2+C28^2+C29^2)
D30: @SQRT(D25^2+D26^2+D27^2+D28^2+D29^2)
E30: @SQRT(E25^2+E26^2+E27^2+E28^2+E29^2)
F30: @SQRT(F25^2+F26^2+F27^2+F28^2+F29^2)
G30: @SQRT(G25^2+G26^2+G27^2+G28^2+G29^2)
H30: @SUM(H25..H29)
I30: @SUM(I25..I29)
```

```
J30: @SUM(J25..J29)
K30: @SUM(K25..K29)
L30: @SUM(L25..L29)
M30: @SUM(M25..M29)
N30: @SQRT(N25^2+N26^2+N27^2+N28^2+N29^2)
B34: 'GROUP
C34: '    PMU
D34: '    SU
E34: '    ReU
F34: '    DU
G34: '  M&TEU
H34: '    TU
I34: '    AEU
J34: '  AB+CLU
K34: '    SU
C35: @SQRT(C12^2+D12^2)
D35: @SQRT(E12^2+F12^2+G12^2+H12^2+I12^2)
E35: @SQRT(C21^2+D21^2+E21^2+F21^2)
```

01209.969

```
F35: @SQRT(J12^2+G21^2)
G35: @SQRT(L12^2+I21^2)
H35: @SQRT(K12^2+H21^2)
I35: @SQRT(C30^2+D30^2+E30^2+F30^2+G30^2)
J35: @SUM(H30..M30)
K35: @SQRT(N30^2)
```

Attachment VIII

WCAP-14684

(First use of P/T limit methodology. No change from that provided in September 13, 1996 RG&E letter to NRC.)