FORM NC.DE-AP.ZZ-0002-1
CALCULATION COVER SHEET

CALC. NO.: SC-CN001-01 **REVISION:** 1IR1

CALC. TITLE: SALEM UNIT 1,2 STEAM GENERATOR LEVEL TRIP,ALARM, IND, & REC

 # SHTS. (CALC): 123 **ATTACHMENTS: #/TOTAL SHTS.:** 10/78 **TOTAL SHTS.:** 201

[X] INTERIM (Proposed Plant Change) [ ] VOID

[ ] FINAL (Supports Installed Condition)

DESCRIPTION OF CALCULATION REVISION (IF APPL.): See Revision 1IR1 History Sheet.

REASON FOR CALCULATION REVISION (IF APPL.): Interim Revision 1IR1 was intiated to provide engineering justification for lowering the Low Steam Generator Level setpoint.

HOPE CREEK [ ] Q [ ] Qs [ ] Qsh [ ] F [ ] R [X] N/A

Q-LIST (SALEM)? [X] YES [ ] NO

IMPORTANT TO SAFETY ? [X] YES [ ] NO

FUTURE CONFIRMATION REQUIRED ? [ ] YES [X] NO

OTHER DOCUMENTS AFFECTED? (CBDs, FSAR, etc.):

ORIGINATOR/COMPANY NAME: CYNTHIA M. MCNALL/PSE&G (signed: Cynthia McNall) 8/16/94 DATE

PEER REVIEWER/COMPANY NAME: LOUIS F. PYLE/PSE&G (signed) 8/16/94 DATE

VERIFIER/COMPANY NAME: Luis R. Gonzalez/PSE&G (signed) 8/19/94 DATE

REVIEWED: N/A N/A
Contractor Supervisor (as applicable) DATE

APPROVED: (signed) for LJR 8/30/94
PSE&G Supervisor (Req'd) DATE

If the calculation is either Q-List, Q, Qs, Qsh, F, R, or Important to Safety "YES", completion of the Certification for Design Verification (Form NC.DE-AP.ZZ-0010) is required.

FORM NC.DE-AP.ZZ-0002-1
CALCULATION COVER SHEET

CALC. NO.: SC-CN001-01 **REVISION:** 1 IRO

CALC. TITLE: SALEM UNIT 1,2 STEAM GENERATOR LEVEL TRIP,ALARM, IND, & REC

 # SHTS. (CALC): 102 **ATTACHMENTS: #/TOTAL SHTS.:** 11/101 **TOTAL SHTS.:** 203

☒ INTERIM (Proposed Plant Change) ☐ VOID

☐ FINAL (Supports Installed Condition)

DESCRIPTION OF CALCULATION REVISION (IF APPL.): This revision combines all the loops for the narrow range Steam Generator Level Instrumentation: high level override and alarm, low-low level trips, indication and recorder loops. This calculation supersedes SC-CN001-02 thru SC-CN001-05.

REASON FOR CALCULATION REVISION (IF APPL.): This calculation revision is required to include the evaluation of the replacement signal isolators being installed within DCP 2EC-~~3250~~. 899 3178 Pkg 2

HOPE CREEK ☐ Q ☐ Qs ☐ Qsh ☐ F ☐ R ☐ N/A

Q-LIST (SALEM)? ☒ YES ☐ NO

IMPORTANT TO SAFETY ? ☒ YES ☐ NO

FUTURE CONFIRMATION REQUIRED ? ☐ YES ☒ NO

OTHER DOCUMENTS AFFECTED? (CBDs, FSAR, etc.): 2EC-~~3250~~ 899 3178 Pkg 2

Cynthia M McNall /cmm

ORIGINATOR/COMPANY NAME: CYNTHIA M. MCNALL/PSE&G 12/13/93 DATE

cmm for Andrew F. Shaul (telecon)

PEER REVIEWER/COMPANY NAME: ANDREW F. SHAUL/PSE&G 12/28/93 DATE

S J Jannetty

VERIFIER/COMPANY NAME: SANDRA J. JANNETTY /PSE&G 1/11/94 DATE

REVIEWED: N/A N/A
Contractor Supervisor (as applicable) DATE

APPROVED: Furlan 2/23/94
PSE&G Supervisor (Req'd) DATE

If the calculation is either Q-List, Q, Qs, Qsh, F, R, or Important to Safety "YES", completion of the Certification for Design Verification (Form NC.DE-AP.ZZ-0001) is required.

A COMPUTER DISK EXISTS FOR THIS CALCULATION.
REVISIONS TO THIS CALCULATION REQUIRE DISK UPDATE !!!

PSE&G clear Department ulation Cover Sheet	Title SG NR LEVEL ID Number SC-CN001-01	REFERENCE		Cover Sheet 1 of 33
Calculation Revision	0 I R 1	0	1	
CP Number	SC-CN001-01	1EC-3099/I-5013 2EC-3078/I-701		
Revision History (Interim or Final) Interim = Proposed Plant Change Final = Supports Installed condition	INTERIM	FINAL	THIS PAGE NO LONGER UTILIZED, APPROVALS PER NC.DE-AP.ZZ-0002 (FORM 1)	
Future Confirmation Required:	YES	NO		
Originator (Initial & Date)	J.A. 01/03/92	RUDOLPH S. CHAN RJC 8/4/92		
Reviewer (Initial & Date)	1/3/92	SANDRA J JANNETTY 2-7-92		
Public Service Supervisor Approval (Inital & Date)	SJJ 2/14/92 John D. Carey Jr 2/14/92	John D. Carey Jr 8/10/92		
Cover Sheet ber Pages)	1	1		
culations (Number Pages) (Excluding Attachments)	32	32		
Attachments (Number/Total pages)	5 /25	5/25		
Total Pages	58	58		

~~THIS IS NOT AN OFFICIAL CALCULATION~~ RJC

~~THE INFORMATION IS NOT APPROVED~~

Important to Safety yes X no

If yes, design verification required per DE-AP-ZZ-0010(Q) (Design Verification, Ref. 8.3)

DE-AP.ZZ-0002(Q) Rev. 0 Exhibit 1 page 1 of 2

CALC. No.: SC-CN001-01		REFERENCE:			
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94	

REVISION HISTORY (1IR1)

This calculation is in Interim Revision 1IR1. Revision 1IR0 was initiated to support Design Change 2EC-3258, for modification to RG 1.97 isolation, and the finalization of the Emergency Response Guidelines Revision 1B. The results of 1IR0 indicated that the Low-Low Setpoint could change but made no recommendation for the Low Steam Generator Level setpoint. This Interim revision (1IR1) was initiated to provide engineering justification for the lowering of the Low Steam Generator trip coincident with the Steam Flow/Feed Flow Mismatch function from 25% to 10% based on the desire to change it at the same time the Low-Low Setpoint is changed. The proposed changes would increase operating margin relative to steam generator level. This would help preclude unnecessary reactor trips and AFW system actuations during plant evolutions involving steam generator water level changes (e.g., plant startup), while continuing to ensure the analytical limits in the safety analysis. Both setpoints will be changed within Design Change 1EC-3345 Pkg 2 and 2EC-3306 Pkg 2.

This calculation revision (1IR1) also addresses the following additions or changes:

The addition of a recommendation to change the Low Setpoint Allowable Value from 24% to 9%.

The addition of 1% additional PMA for the High-High trip function provided in Westinghouse Letter PSE-94-555, Subject: JPO (Justification for Past Operation) for Overpower Operation.

The addition of a recommendation to change EOP Indicated values affected by the addition of the 1% additional PMA.

Revisions to scaling corrected the "Recommended " Low-Low setpoint voltage table which erroneously showed the old setpoint (but did indicate the correct new voltage). An additional table was added for the new Low Setpoint. An error was also corrected in the High-High setpoint discussion where the setpoint was referenced as 65% instead of 67% as stated in the design inputs section.

Changes to the scaling tables based on a request from the plant to show "off scale" values in an alternate manner.

A change to Assumption 6.2 based on the replacement of the EQRR radiation maps with the new EDC PSBP 317079-01. This document also caused the Environmental table in Section 5.1.1 to be revised.

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET			SHEET: ii CONT'D ON SHEET:	
CALC. No.: SC-CN001-01		REFERENCE:			
ORIGINATOR, DATE	REV: CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE	AFS/SJJ 1/11/94		LFP 8/16/94		

A change to Assumption 6.1.4 based on interpretation changes for the Setpoint Technical Standard direction for adding Seismic uncertainties.

The change to include the EOP evaluation as part of the calculation and to finalize the data within that section based on the new revision to the EOPs and ERGs. The Attachments were renumbered based on the elimination of the EOP Attachment.

Various grooming improvements were made which did not affect the content of this document (i.e. spelling, font sizes, grammar). All significant changes are marked with a Revision Bar to denote the changes included in this interim revision.

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET	SHEET: iii CONT'D ON SHEET:

CALC. No.: SC-CN001-01				REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

LIST OF EFFECTIVE PAGES (MAIN BODY)

Page	Rev	Page	Rev	Page	Rev	Page	Rev	Page	Rev
Cover	1IR1	22	1IR1	49	1IR0	76	1IR0	103	1IR1
i	1IR1	23	1IR1	50	1IR0	77	1IR0	104	1IR1
ii	1IR1	24	1IR1	51	1IR0	78	1IR1	105	1IR1
iii	1IR1	25	1IR1	52	1IR0	79	1IR0	106	1IR1
iv	1IR1	26	1IR1	53	1IR0	80	1IR0	107	1IR1
v	1IR1	27	1IR1	54	1IR0	81	1IR0	108	1IR1
1	1IR1	28	1IR1	55	1IR0	82	1IR0	109	1IR1
2	1IR0	29	1IR1	56	1IR1	83	1IR0	110	1IR0
3	1IR0	30	1IR1	57	1IR0	84	1IR0	111	1IR1
4	1IR0	31	1IR1	58	1IR0	85	1IR0	112	1IR1
5	1IR0	32	1IR1	59	1IR0	86	1IR0	113	1IR1
6	1IR0	33	1IR1	60	1IR0	87	1IR0	114	1IR0
7	1IR0	34	1IR1	61	1IR0	88	1IR0	115	1IR0
8	1IR0	35	1IR1	62	1IR0	89	1IR0	116	1IR0
9	1IR0	36	1IR1	63	1IR0	90	1IR0	117	1IR1
10	1IR0	37	1IR1	64	1IR0	91	1IR0	118	1IR1
11	1IR0	38	1IR1	65	1IR0	92	1IR0	119	1IR1
12	1IR0	39	1IR1	66	1IR1	93	1IR0	120	1IR1
13	1IR0	40	1IR1	67	1IR1	94	1IR0	121	1IR1
14	1IR0	41	1IR1	68	1IR1	95	1IR0	122	1IR1
15	1IR1	42	1IR1	69	1IR1	96	1IR0	123	1IR1
16	1IR0	43	1IR0	70	1IR0	97	1IR0		
17	1IR1	44	1IR0	71	1IR1	98	1IR0		
18	1IR1	45	1IR1	72	1IR0	99	1IR1		
19	1IR1	46	1IR1	73	1IR0	100	1IR0		
20	1IR1	47	1IR1	74	1IR1	101	1IR1		
21	1IR1	48	1IR0	75	1IR0	102	1IR1		

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET	SHEET: iv CONT'D ON SHEET:

CALC. No.: SC-CN001-01					REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1		
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94			

LIST OF EFFECTIVE PAGES (ATTACHMENTS)

Attachment A

Page	i	1	2	3	4	5	6	7	8
Rev	1IR1	0	0	0	0	0	0	0	1IR0

Attachment B

Page	i	1	2	3	4	5	6	7	8
Rev	1IR1	0	0	0	0	0	0	0	1IR0

Attachment C

Page	i	1	2
Rev	1IR1	0	0

Attachment D

Page	i	1	2
Rev	1IR1	0	0

Attachment 10.1

Page	i	1	2	3	4	5	6	7	8	9	10	11	12	13
Rev	1IR1	1IR0	1IR0	1IR0	1IR0	1IR1	1IR1	1IR1	1IR1	1IR1	1IR0	1IR1	1IR1	1IR1

Attachment 10.2

Page	i	1	2	3	4
Rev	1IR1	1IR0	1IR0	1IR0	1IR0

Attachment 10.3

Page	i	1	2	3	4	5
Rev	1IR1	1IR0	1IR0	1IR0	1IR0	1IR0

Attachment 10.4

Page	i	1	2	3	4	5	6	7	8	9	10
Rev	1IR1	1IR0	1IR0	1IR0	1IR0	1IR0	1IR0	1IR0	1IR0	1IR0	1IR0

Attachment 10.5

Page	i	1	2	3	4	5	6	7	8
Rev	1IR1	1IR0	1IR0	1IR0	1IR0	1IR0	1IR0	1IR0	1IR0

Attachment 10.6

Page	i	1	2	3	4	5	6	7
Rev	1IR1	1IR1	1IR1	1IR1	1IR1	1IR1	1IR1	1IR1

TABLE OF CONTENTS

1.0 PURPOSE/SCOPE

1.1 Purpose

The purpose of this calculation is to establish the Total Channel Uncertainties for the Steam Generator Narrow Range Level Instrument loops for Low-Low Level Reactor Trip, the Low Level Steam Generator Water Level Trip, the High Level Override and Alarm setpoints, RG 1.97 Control Room Indication, Hot Shutdown Panel Indication, and Recorder. The uncertainties established in this calculation support Technical Specification Setpoints, and Surveillance Requirements.

This calculation establishes the Instrument Scaling, Calibration Tolerances and Acceptable/Allowable values to be used in Calibration or Surveillance Procedures.

Additionally, EOP Indicated Values using this instrumentation are evaluated with respect to their design basis, to determine that they are set conservatively away from applicable limits including the Total Channel Uncertainties (normal or adverse as applicable) established for the RG 1.97 Indication loops within this calculation. 1IR1

1.2 Scope

This calculation contains the following Instrument Loop Configurations: This calculation scope does not include an evaluation of the uncertainties for the computer points and therefore, they are not included below and are not shown on the Loop Diagram. See Section 4.0 for Loop Diagrams of the configurations shown below.

1.2.1 **Steam Generator 11 (21)**

1.2.1.1 Configuration A: Reactor Trip System Instrumentation : Trip Setpoint Steam Generator Level Low-Low Trip - Steam Generator Water Level Low-Low

Channel IV

1(2) LT-517	Level Transmitter
1(2) LC-517A-B/R	I/V
1(2) LC-517A-B	Signal Comparator (To BS-517B, SSPS Reactor Trip) Low-Low Level

Channel III

1(2) LT-518	Level Transmitter
1(2) LC-518A-B/R	I/V
1(2) LC-518A-B	Signal Comparator (To BS-518B, SSPS Reactor Trip) Low-Low Level

Channel II

1(2) LT-519	Level Transmitter
1(2) LC-519A-B/R	I/V
1(2) LC-519A-B	Signal Comparator (To BS-519B, SSPS Reactor Trip) Low-Low Level

1.2.1.2 Configuration B: Engineered Safety Feature Actuation System Instrumentation: Turbine Trip and Feedwater Isolation: Steam Generator Water Level High High.

Channel IV

1(2) LT-517	Level Transmitter
1(2) LC-517A-B/R	I/V
1(2) LC-517A-B	Signal Comparator (To BS-517A, SSPS Turbine Trip) High Level Override and Alarm

Channel III

1(2) LT-518	Level Transmitter
1(2) LC-518A-B/R	I/V
1(2) LC-518A-B	Signal Comparator (To BS-518A, SSPS Turbine Trip) High Level Override and Alarm

Channel II

1(2) LT-519	Level Transmitter
1(2) LC-519A-B/R	I/V
1(2) LC-519A-B	Signal Comparator (To BS-519A, SSPS Turbine Trip) High Level Override and Alarm

1.2.1.3 Configuration C: Reactor Trip System Instrumentation : Trip Setpoint Steam Generator Level Low

Channel IV

1(2) LT-517	Level Transmitter
1(2) LC-517A-C/R	I/V
1(2) LC-517C	Signal Comparator (To BS-517C, SSPS Reactor Trip) Low Level Mismatch Trip Interlock

Channel III

1(2) LT-518	Level Transmitter
1(2) LC-518A-C/R	I/V
1(2) LC-518C	Signal Comparator (To BS-518C, SSPS Reactor Trip) Low Level Mismatch Trip Interlock

1.2.1.4 Configuration D: Accident Monitoring Instrumentation: Steam Generator Water Level (Narrow Range) Control Room Indicator

Channel IV

1(2) LT-517	Level Transmitter
1(2) LM-517A/R	I/V
1(2) LM-517A	Signal Isolator
1(2) LI-517/R	I/V
1(2) LI-517	Indicator

Channel III

1(2) LT-518	Level Transmitter
1(2) LM-518/R	I/V
1(2) LM-518	Signal Isolator
1(2) LI-518/R	I/V
1(2) LI-518	Indicator

Channel II

1(2) LT-519	Level Transmitter
1(2) LM-519A/R	I/V
1(2) LM-519A	Signal Isolator
1(2) LI-519/R	I/V
1(2) LI-519	Indicator

1.2.1.5 Configuration E: Remote Shutdown Monitoring Instrumentation - Steam Generator Level Hot Shutdown Panel Indicator

Channel IV

1(2) LT-517	Level Transmitter
1(2) LM-517A/R	I/V
1(2) LM-517A	Signal Isolator
1(2) LI-517A	Hot Shutdown Panel Indicator

1.2.1.6 Configuration F: Accident Monitoring Instrumentation: Steam Generator Water Level (Narrow Range) Recorder

Channel II

1(2) LT-519	Level Transmitter
1(2) LC-519A-B/R	I/V
1(2) LM-519M	Signal Isolator
1(2) LM-500W/R	I/V
1(2) LM-519B	Signal Isolator
1(2) LA-5048	Recorder

1.2.2 Steam Generator 12 (22)

1.2.2.1 Configuration A: Reactor Trip System Instrumentation : Trip Setpoint Steam Generator Level Low-Low Trip - Steam Generator Water Level Low-Low

Channel IV

1(2) LT-527	Level Transmitter
1(2) LC-527A-B/R	I/V
1(2) LC-527A-B	Signal Comparator (To BS-527B, SSPS Reactor Trip) Low-Low Level

Channel III

1(2) LT-528	Level Transmitter
1(2) LC-528A-B/R	I/V
1(2) LC-528A-B	Signal Comparator (To BS-528B, SSPS Reactor Trip) Low-Low Level

Channel II
1(2) LT-529 Level Transmitter
1(2) LC-529A-B/R I/V
1(2) LC-529A-B Signal Comparator (To BS-529B, SSPS Reactor Trip) Low-Low Level

1.2.2.2 Configuration B: Engineered Safety Feature Actuation System Instrumentation: Turbine Trip and Feedwater Isolation: Steam Generator Water Level High High.

Channel IV
1(2) LT-527 Level Transmitter
1(2) LC-527A-B/R I/V
1(2) LC-527A-B Signal Comparator (To BS-527A, SSPS Turbine Trip) High Level Override and Alarm

Channel III
1(2) LT-528 Level Transmitter
1(2) LC-528A-B/R I/V
1(2) LC-528A-B Signal Comparator (To BS-528A, SSPS Turbine Trip) High Level Override and Alarm

Channel II
1(2) LT-529 Level Transmitter
1(2) LC-529A-B/R I/V
1(2) LC-529A-B Signal Comparator (To BS-529A, SSPS Turbine Trip) High Level Override and Alarm

1.2.2.3 Configuration C: Reactor Trip System Instrumentation: Trip Setpoint Steam Generator Level Low

Channel IV
1(2) LT-527 Level Transmitter
1(2) LC-527A-C/R I/V
1(2) LC-527C Signal Comparator (To BS-527C, SSPS Reactor Trip) Low Level Mismatch Trip Interlock

Channel III
1(2) LT-528 Level Transmitter
1(2) LC-528A-C/R I/V
1(2) LC-528C Signal Comparator (To BS-518C, SSPS Reactor Trip) Low Level Mismatch Trip Interlock

1.2.2.4 Configuration D: Accident Monitoring Instrumentation: Steam Generator Water Level (Narrow Range) Control Room Indicator

Channel IV

1(2) LT-527	Level Transmitter
1(2) LM-527A/R	I/V
1(2) LM-527A	Signal Isolator
1(2) LI-527/R	I/V
1(2) LI-527	Indicator

Channel III

1(2) LT-528	Level Transmitter
1(2) LM-528/R	I/V
1(2) LM-528	Signal Isolator
1(2) LI-528/R	I/V
1(2) LI-528	Indicator

Channel II

1(2) LT-529	Level Transmitter
1(2) LM-529A/R	I/V
1(2) LM-529A	Signal Isolator
1(2) LI-529/R	I/V
1(2) LI-529	Indicator

1.2.2.5 Configuration E: Remote Shutdown Monitoring Instrumentation - Steam Generator Level Hot Shutdown Panel Indicator

Channel IV

1(2) LT-527	Level Transmitter
1(2) LM-527A/R	I/V
1(2) LM-527A	Signal Isolator
1(2) LI-527A	Hot Shutdown Panel Indicator

1.2.2.6 Configuration F: Accident Monitoring Instrumentation: Steam Generator Water Level (Narrow Range) Recorder

Channel II

1(2) LT-529	Level Transmitter
1(2) LM-529A-I/R	I/V
1(2) LM-529M	Signal Isolator
1(2) LM-500X/R	I/V
1(2) LM-529B	Signal Isolator
1(2) LA-5049	Recorder

1.2.3 **Steam Generator 13 (23)**

1.2.3.1 Configuration A: Reactor Trip System Instrumentation : Trip Setpoint Steam Generator Level Low-Low Trip

Channel IV

1(2) LT-537	Level Transmitter
1(2) LC-537A-B/R	I/V
1(2) LC-537A-B	Signal Comparator (To BS-537B, SSPS Reactor Trip) Low-Low Level

Channel III

1(2) LT-538	Level Transmitter
1(2) LC-538A-B/R	I/V
1(2) LC-538A-B	Signal Comparator (To BS-538B, SSPS Reactor Trip) Low-Low Level

Channel II

1(2) LT-539	Level Transmitter
1(2) LC-539A-B/R	I/V
1(2) LC-539A-B	Signal Comparator (To BS-539B, SSPS Reactor Trip) Low-Low Level

1.2.3.2 Configuration B: Engineered Safety Feature Actuation System Instrumentation: Turbine Trip and Feedwater Isolation: Steam Generator Water Level High High.

Channel IV
- 1(2) LT-537 Level Transmitter
- 1(2) LC-537A-B/R I/V
- 1(2) LC-537A-B Signal Comparator (To BS-537A, SSPS Turbine Trip) High Level Override and Alarm

Channel III
- 1(2) LT-538 Level Transmitter
- 1(2) LC-538A-B/R I/V
- 1(2) LC-538A-B Signal Comparator (To BS-538A, SSPS Turbine Trip) High Level Override and Alarm

Channel II
- 1(2) LT-539 Level Transmitter
- 1(2) LC-539A-B/R I/V
- 1(2) LC-539A-B Signal Comparator (To BS-539A, SSPS Turbine Trip) High Level Override and Alarm

1.2.3.3 Configuration C: Reactor Trip System Instrumentation: Trip Setpoint Steam Generator Level Low

Channel IV
- 1(2) LT-537 Level Transmitter
- 1(2) LC-537A-C/R I/V
- 1(2) LC-537C Signal Comparator (To BS-537C, SSPS Reactor Trip) Low Level Mismatch Trip Interlock

Channel III
- 1(2) LT-538 Level Transmitter
- 1(2) LC-538A-C/R I/V
- 1(2) LC-538C Signal Comparator (To BS-538C, SSPS Reactor Trip) Low Level Mismatch Trip Interlock

1.2.3.4 Configuration D: Accident Monitoring Instrumentation: Steam Generator Water Level (Narrow Range) Control Room Indicator

Channel IV

1(2) LT-537	Level Transmitter
1(2) LM-537A/R	I/V
1(2) LM-537A	Signal Isolator
1(2) LI-537/R	I/V
1(2) LI-537	Indicator

Channel III

1(2) LT-538	Level Transmitter
1(2) LM-538/R	I/V
1(2) LM-538	Signal Isolator
1(2) LI-538/R	I/V
1(2) LI-538	Indicator

Channel II

1(2) LT-539	Level Transmitter
1(2) LM-539A/R	I/V
1(2) LM-539A	Signal Isolator
1(2) LI-539/R	I/V
1(2) LI-539	Indicator

1.2.3.5 Configuration E: Remote Shutdown Monitoring Instrumentation - Steam Generator Level Hot Shutdown Panel Indicator

Channel IV

1(2) LT-537	Level Transmitter
1(2) LM-537A/R	I/V
1(2) LM-537A	Signal Isolator
1(2) LI-537A	Hot Shutdown Panel Indicator

1.2.3.6 Configuration F: Accident Monitoring Instrumentation: Steam Generator Water Level (Narrow Range) Recorder

Channel II

1(2) LT-539	Level Transmitter
1(2) LM-539A/R	I/V
1(2) LM-539A	Signal Isolator
1(2) LM-500Y/R	I/V
1(2) LA-5050	Recorder

1.2.4 **Steam Generator 14 (24)**

1.2.4.1 Configuration A: Reactor Trip System Instrumentation : Trip Setpoint Steam Generator Level Low-Low Trip

Channel IV

1(2) LT-547	Level Transmitter
1(2) LC-547A-B/R	I/V
1(2) LC-547A-B	Signal Comparator (To BS-547B, SSPS Reactor Trip) Low-Low Level

Channel III

1(2) LT-548	Level Transmitter
1(2) LC-548A-B/R	I/V
1(2) LC-548A-B	Signal Comparator (To BS-548B, SSPS Reactor Trip) Low-Low Level

Channel II

1(2) LT-549	Level Transmitter
1(2) LC-549A-B/R	I/V
1(2) LC-549A-B	Signal Comparator (To BS-549B, SSPS Reactor Trip) Low-Low Level

1.2.4.2 Configuration B: Engineered Safety Feature Actuation System Instrumentation: Turbine Trip and Feedwater Isolation: Steam Generator Water Level High-High.

Channel IV

1(2) LT-547	Level Transmitter
1(2) LC-547A-B/R	I/V
1(2) LC-547A-B	Signal Comparator (To BS-547A, SSPS Turbine Trip) High Level Override and Alarm

Channel III

1(2) LT-548	Level Transmitter
1(2) LC-548A-B/R	I/V
1(2) LC-548A-B	Signal Comparator (To BS-548A, SSPS Turbine Trip) High Level Override and Alarm

Channel II

1(2) LT-549	Level Transmitter
1(2) LC-549A-B/R	I/V
1(2) LC-549A-B	Signal Comparator (To BS-549A, SSPS Turbine Trip) High Level Override and Alarm

1.2.4.3 Configuration C: Reactor Trip System Instrumentation : Trip Setpoint Steam Generator Level Low

Channel IV

1(2) LT-547	Level Transmitter
1(2) LC-547A-C/R	I/V
1(2) LC-547C	Signal Comparator (To BS-547C, SSPS Reactor Trip) Low Level Mismatch Trip Interlock

Channel III

1(2) LT-548	Level Transmitter
1(2) LC-548A-C/R	I/V
1(2) LC-548C	Signal Comparator (To BS-548C, SSPS Reactor Trip) Low Level Mismatch Trip Interlock

1.2.4.4 Configuration D: Accident Monitoring Instrumentation: Steam Generator Water Level (Narrow Range) Control Room Indicator

Channel IV

1(2) LT-547	Level Transmitter
1(2) LM-547A/R	I/V
1(2) LM-547A	Signal Isolator
1(2) LI-547/R	I/V
1(2) LI-547	Indicator

Channel III

1(2) LT-548	Level Transmitter
1(2) LM-548/R	I/V
1(2) LM-548	Signal Isolator
1(2) LI-548/R	I/V
1(2) LI-548	Indicator

Channel II

1(2) LT-549	Level Transmitter
1(2) LM-549A/R	I/V
1(2) LM-549A	Signal Isolator
1(2) LI-549/R	I/V
1(2) LI-549	Indicator

1.2.4.5 Configuration E: Accident Monitoring Instrumentation: Steam Generator Water Level Hot Shutdown Panel Indicator

Channel IV

1(2) LT-547	Level Transmitter
1(2) LM-547A/R	I/V
1(2) LM-547A	Signal Isolator
1(2) LI-547A	Hot Shutdown Panel Indicator

CALC. No.: SC-CN001-01					REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1		
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94			

1.2.4.6 Configuration F: Accident Monitoring Instrumentation: Steam Generator Water Level (Narrow Range) Recorder

Channel II

1(2) LT-549	Level Transmitter
1(2) LM-549A/R	I/V
1(2) LM-549A	Signal Isolator
1(2) LI-549Z/R	I/V
1(2) LI-5051	Recorder

2.0 FUNCTIONAL DESCRIPTION/DESIGN BASIS

2.1 Functional Description

(Ref. 3.1.3)

Reactor Protection- The Steam Generator Protection system prevents loss of secondary side heat transfer capability; i.e., loss of feedwater to the Steam Generators. Reactor Trip and Auxiliary Feedwater actuation occur on two out of three low-low level channels in any Steam Generator. The Low-Low Steam Generator Trip must be operable in Modes 1 and 2 when the reactor requires a heat sink. It is a primary trip function for Turbine Trip (EOL), Loss of AC Power (Station Blackout), Loss of Normal Feedwater and Feedwater System Pipe Break. It is a backup trip for Turbine Trip (BOL). Uncertainties for accident environment are included for the Low-Low trip function with the exception of reference leg heat up uncertainties. These effects are assumed to be minimized at the time of the trip since the reference legs are insulated.

The Steam Generator Water Level Low trip (used in coincidence with a Steam/Feedwater level trip) is not used in the transient analyses but is included in the Technical Specifications Table 2.2-1 to ensure the functional capability of the specified trip settings and thereby enhance the overall reliability of the Reactor Protection System. This trip is redundant to the Steam Generator Water Level Low-Low trip. The low trip value is set sufficiently away from normal operating values to preclude spurious trips but will initiate a reactor trip before the steam generators are dry. Therefore, the required capacity and starting time requirements of the auxiliary feedwater pumps are reduced and the resulting thermal transient on the Reactor coolant system and steam generators is minimized. Since this trip is redundant to the Low-Low Water Level trip function, the same accident uncertainties based on environmental and operating parameters will be considered in the calculation.

Engineered Safety Features Actuation - The Steam Generator Water Level High-High function is used to terminate Feedwater addition (via isolation) in order to protect the turbine from damage from steam with too high a moisture content. The capability of the upper regions of the steam generator to dry the steam is compromised when the water level in the steam generator gets too high. In addition, the steam piping supports are not designed to withstand the loading of piping plus water. Finally, the accuracy of the Steam Flow and Steamline Pressure Transmitters downstream in the steam piping would be decreased due to the addition of significant moisture in the steam. Since this function is not assumed to operate in adverse environmental conditions (no break in a pipe), instrument uncertainties are calculated for normal conditions only.

Main Control Room Indication is provided with all channels indicated and the channels used for control, recorded (FSAR Table 7.5-1). Both normal and accident uncertainties are calculated for use during normal and accident monitoring. A post accident uncertainty is calculated to demonstrate potential loop uncertainties for 120 days post accident conditions as specified in the transmitter environmental qualification.

Additionally, Remote Shutdown monitoring is provided at Hot Shutdown Panel 213. This calculation includes normal uncertainties only for this function since a Control Room Fire and Design Basis Event are not postulated to occur concurrently.

EOP Indicated Values are evaluated based on their function and requirements for inclusion of Instrument Uncertainties as provided in the footnotes of the Emergency Response Guidelines.

2.2 Design Basis Inputs

2.2.1 Analytical Limits

Low-Low Trip Safety Analysis Limit = 0% (Ref. 3.5.20)
High-High Trip Safety Analysis Limit = 75% (Ref. Attachment 10.5) | 1R1

2.2.2 Current Technical Specification Setpoints, Allowable Values

(Ref. 3.3.1.9), Table 2.2-1

Reactor Trip System Instrumentation Trip Setpoints

Functional Unit		Trip Setpoint	Allowable Value
13.	Steam Generator Water Level Low-Low	≥ 16% of NR Instr Span each Steam Generator	≥ 14.8% of NR Instr Span each Steam Generator
14.	Low Steam Generator Water level	≥ 25% of NR Inst Span each Steam Generator	≥ 24% of NR Instr Span each Steam Generator

2.2.3 Engineered Safety Feature Actuation System Instrumentation Trip Setpoints

(Ref. 3.3.1.5), Table 3.3-4

Functional Unit		Trip Setpoint	Allowable Value
5.	Turbine Trip and Feedwater Isolation	≤ 67% of NR span each Steam Generator	≤ 68% of NR span each Steam Generator

2.2.4 UFSAR Design Basis Requirements
Section 7.5 Safety Related Display Instrumentation

Main Control Room Indicators And/Or Recorders Available to the Operator
Table 7.5-1

Parameter	Channels	Range	Acc	Ind/Rec
Operational Occurrences				
7. SG water lvl (NR)	3/SG	+7 to -5 feet from full load wl	±4% span (hot)	All channels Indicated, control channels recorded
Accident Conditions				
3. SG water lvl (NR)	3/SG	+7 to -5 feet from full load wl	±10% span (hot)	All channels Indicated, control channels recorded

Main Control Room Indicators And/Or Recorders Available to the Operator to Monitor Significant Plant Parameters During Normal Operation
Table 7.5-2

Parameter	Channels	Range	Acc	Ind/Rec
Feedwater and Steam Systems				
2. Steam Generator level (NR)	3/SG	+7 to -5 Ft	±4%	All channels Indicated, control channels recorded

2.2.5 EOP Indicated Values (shown as Setpoint below)
(Ref. 3.3.3, 3.6.3)

EOP NUMBER AND TITLE: TRIP-1, REACTOR TRIP OR SAFETY INJECTION ERG NUMBER AND TITLE: E-0, REACTOR TRIP OR SAFETY INJECTION			
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
19	16	8	8% SG LEVEL
19	16	9	12% SG LEVEL
19	16	N/A	16-33% SG LEVEL
23	19	8	8% SG LEVEL
23	19	9	12% SG LEVEL
23	19	N/A	16-33% SG LEVEL
36	25	8	8% SG LEVEL
37	28	8	8% SG LEVEL
37	N/A	N/A	16-33% SG LEVEL
42	N/A	N/A	16% SG LEVEL
CAS	F.O.3	8	8% SG LEVEL
CAS	F.O.3	9	12% SG LEVEL

1IR1

2.2.5 EOP Indicated Values (shown as Setpoint below)
(Ref. 3.3.3, 3.6.3)

EOP NUMBER AND TITLE:	TRIP-1, REACTOR TRIP OR SAFETY INJECTION		
ERG NUMBER AND TITLE:	E-0, REACTOR TRIP OR SAFETY INJECTION		
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
19	16	8	8% SG LEVEL
19	16	9	12% SG LEVEL
19	16	N/A	16-33% SG LEVEL
23	19	8	8% SG LEVEL
23	19	9	12% SG LEVEL
23	19	N/A	16-33% SG LEVEL
36	25	8	8% SG LEVEL
37	28	8	8% SG LEVEL
37	N/A	N/A	16-33% SG LEVEL
42	N/A	N/A	16% SG LEVEL
CAS	F.O.3	8	8% SG LEVEL
CAS	F.O.3	9	12% SG LEVEL

1IR1

CALC. No.: SC-CN001-01				REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

EOP NUMBER AND TITLE: TRIP-2, REACTOR TRIP RESPONSE ERG NUMBER AND TITLE: ES-0.1, REACTOR TRIP RESPONSE			
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
4	1	3	8% SG LEVEL
4	5	N/A	12% SG LEVEL
13	6	3	8% SG LEVEL
13	6	N/A	16-33% SG LEVEL
16	N/A	3	16% SG LEVEL
24	12	N/A	16-33% SG LEVEL
30	12	N/A	16-33% SG LEVEL
EOP NUMBER AND TITLE: TRIP-3, REACTOR TRIP RESPONSE ERG NUMBER AND TITLE: ES-1.1, SI TERMINATION			
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
25	20	11	8% SG LEVEL
25	20	12	12% SG LEVEL
25	20	N/A	16-33% SG LEVEL
29	20	N/A	16-33% SG LEVEL
33	27	N/A	16-33% SG LEVEL

1IR1

EOP NUMBER AND TITLE: TRIP-4, NATURAL CIRCULATION COOLDOWN ERG NUMBER AND TITLE: ES-0.2, NATURAL CIRCULATION COOLDOWN			
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
7	N/A	N/A	8% SG LEVEL
7	N/A	N/A	12% SG LEVEL
7	N/A	N/A	16-33% SG LEVEL
12	6	N/A	16-33% SG LEVEL
EOP NUMBER AND TITLE: SGTR-1 STEAM GENERATOR TUBE RUPTURE ERG NUMBER AND TITLE: E-3, STEAM GENERATOR TUBE RUPTURE			
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
2	N/A	N/A	16% SG LEVEL
4	3	N/A	16% SG LEVEL
6	4	4	8% SG LEVEL
6	4	5	12% SG LEVEL
10	N/A	N/A	16% SG LEVEL
11	7	4	8% SG LEVEL
11	7	5	12% SG LEVEL
11	7	N/A	16-33% SG LEVEL
29	20	4	8% SG LEVEL
29	20	5	12% SG LEVEL
47	N/A	N/A	16-33% SG LEVEL

1IR1

EOP NUMBER AND TITLE: SGTR-2, POST SGTR COOLDOWN USING BACKFILL

ERG NUMBER AND TITLE: ES-3.1, POST SGTR COOLDOWN USING BACKFILL (ALSO ES-3.2)

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
4	3	N/A	16% SG LEVEL
8	4	6	8% SG LEVEL
8	4	7	12% SG LEVEL
8	4	N/A	16-33% SG LEVEL
13	6	22	16% SG LEVEL
13	6	9	62% SG LEVEL
13	6	10	53% SG LEVEL
41	4	6	8% SG LEVEL
41	4	7	12% SG LEVEL
41	4	N/A	16-33% SG LEVEL
47	8	23	16% SG LEVEL
47	8	24	62% SG LEVEL
47	8	25	53% SG LEVEL
55	N/A	N/A	8% SG LEVEL
55	N/A	N/A	12% SG LEVEL

1IR1

EOP NUMBER AND TITLE:		SGTR-3, SGTR WITH LOCA-SUBCOOLED RECOVERY	
ERG NUMBER AND TITLE:		ECA-3.1, SGTR WITH LOSS OF REACTOR COOLANT SUB-COOLED RECOVERY	
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
7	7	6	8% SG LEVEL
7	7	7	12% SG LEVEL
14	10	6	8% SG LEVEL
14	10	7	12% SG LEVEL
14	10	7	16-33% SG LEVEL
46	35	44	16% SG LEVEL
46	35	45	62% SG LEVEL
46	35	46	53% SG LEVEL

1IR1

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET			SHEET: 22 CONT'D ON SHEET:	
CALC. No.: SC-CN001-01		REFERENCE:			
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94	

EOP NUMBER AND TITLE: SGTR-4, SGTR WITH LOCA SATURATED RECOVERY

ERG NUMBER AND TITLE; ECA-3.2, SGTR WITH LOCA SATURATED RECOVERY DESIRED

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
4	3	5	8% SG LEVEL
4	3	6	12% SG LEVEL
8	N/A	N/A	8% SG LEVEL
8	N/A	N/A	12% SG LEVEL
11	5	5	8% SG LEVEL
11	5	6	12% SG LEVEL
11	N/A	N/A	16-33% SG LEVEL
32	N/A	N/A	16-33% SG LEVEL
49	29	41	16% SG LEVEL
49	29	42	62% SG LEVEL
49	29	43	53% SG LEVEL

1IR1

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET	SHEET: 23 CONT'D ON SHEET:

CALC. No.: SC-CN001-01					REFERENCE:	
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

EOP NUMBER AND TITLE: SGTR-5, SGTR WITHOUT PZR PRESSURE CONTROL

ERG NUMBER AND TITLE: ECA-3.3, SGTR WITHOUT PZR PRESSURE CONTROL

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
1	1	1	59% SG LEVEL
1	1	2	58% SG LEVEL
5	5	5	8% SG LEVEL
5	5	6	12% SG LEVEL
5	N/A	N/A	16-33% SG LEVEL
7	7	5	8% SG LEVEL
7	7	6	12% SG LEVEL
28	N/A	N/A	16% SG LEVEL
35	29	N/A	16% SG LEVEL
35	29	1	62% SG LEVEL
35	29	2	53% SG LEVEL

1IR1

EOP NUMBER AND TITLE: LOSC-2 MULTIPLE SG DEPRESSURIZATION

ERG NUMBER AND TITLE: ECA-2.1 UNCONTROLLED DEPRESSURIZATION OF ALL STEAM GENERATORS

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
6	CAUT 2	3	8% SG LEVEL
6	CAUT 2	4	12% SG LEVEL
7	2		33% SG LEVEL
25	24		33% SG LEVEL
35			16-33% SG LEVEL

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET	SHEET: 24 CONT'D ON SHEET:

CALC. No.: SC-CN001-01					REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1		
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94			

EOP NUMBER AND TITLE: LOPA-1, LOSS OF ALL AC POWER
ERG NUMBER AND TITLE: ECA-0.0, LOSS OF ALL AC POWER

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
25	N/A	N/A	16-33% SG LEVEL
25	13	5	8% SG LEVEL
25	13	4	12% SG LEVEL
28	N/A	N/A	16-33% SG LEVEL
32	N/A	N/A	16-33% SG LEVEL
50	13	4	8% SG LEVEL
50	13	5	12% SG LEVEL
50	N/A	N/A	16-33% SG LEVEL
54	N/A	N/A	8% SG LEVEL
54	N/A	N/A	12% SG LEVEL
55	N/A	N/A	8% SG LEVEL
55	N/A	N/A	12% SG LEVEL
57	16	4	8% SG LEVEL
57	16	5	12% SG LEVEL
65	N/A	N/A	16-33% SG LEVEL

1IR1

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
EOP NUMBER AND TITLE:	LOPA-2, LOSS OF ALL AC POWER/SI NOT REQUIRED		
ERG NUMBER AND TITLE:	ECA-0.1, LOSS OF ALL AC POWER RECOVERY WITHOUT SI REQUIRED		
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
10	7	9	8% SG LEVEL
10	7	10	12% SG LEVEL
11	N/A	N/A	16-33% SG LEVEL
25	N/A	N/A	16-33% SG LEVEL
EOP NUMBER AND TITLE:	LOPA-3, LOSS OF ALL AC POWER/SI REQUIRED		
ERG NUMBER AND TITLE:	ECA-0.2, LOSS OF ALL AC POWER RECOVERY WITH SI REQUIRED		
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
13	6	3	8% SG LEVEL
13	6	4	12% SG LEVEL
14	N/A	N/A	16-33% SG LEVEL

1IR1

EOP NUMBER AND TITLE:	LOCA-1, LOSS OF REACTOR COOLANT		
ERG NUMBER AND TITLE:	E-1, LOSS OF REACTOR OR SECONDARY COOLANT		
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
4	3	4	8% SG LEVEL
4	3	5	12% SG LEVEL
5	N/A	N/A	16-33% SG LEVEL
11	N/A	N/A	16% SG LEVEL
12	6	4	8% SG LEVEL
12	6	5	12% SG LEVEL
EOP NUMBER AND TITLE:	LOCA-2, LOSS OF REACTOR COOLANT		
ERG NUMBER AND TITLE:	ES-1.2, LOSS OF REACTOR OR SECONDARY COOLANT		
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
8	6	5	8% SG LEVEL
8	6	6	12% SG LEVEL
9	6	6	16-33% SG LEVEL
26	N/A		16-33% SG LEVEL

1IR1

EOP NUMBER AND TITLE: LOCA-5, LOSS OF EMERGENCY RECIRCULATION ERG NUMBER AND TITLE: ECA-1.1, LOSS OF EMERGENCY COOLANT RECIRCULATION			
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
5	5	33	8% SG LEVEL
5	5	34	12% SG LEVEL
5	5	33	16-33% SG LEVEL
EOP NUMBER AND TITLE: FRSM-1, RESPONSE TO NUCLEAR POWER GENERATION ERG NUMBER AND TITLE: FR-S.1, RESPONSE TO NUCLEAR POWER GENERATION-ATWS			
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
10	6	5	8% SG LEVEL
10	6	6	12% SG LEVEL

1IR1

CALC. No.: SC-CN001-01				REFERENCE:			
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1		
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94			

EOP NUMBER AND TITLE: FRCC-1, RESPONSE TO INADEQUATE CORE COOLING
ERG NUMBER AND TITLE: FR-C.1, RESPONSE TO INADEQUATE CORE COOLING

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
18	9	5	8% SG LEVEL
18	9	6	12% SG LEVEL
18	9	N/A	16-33% SG LEVEL
19	9	5	8% SG LEVEL
19	9	6	12% SG LEVEL
19	N/A	N/A	16-33% SG LEVEL
22	NOT 11	N/A	8% SG LEVEL
22	NOT 11	N/A	12% SG LEVEL

1IR1

EOP NUMBER AND TITLE: FRCC-2, RESPONSE TO DEGRADED CORE COOLING
ERG NUMBER AND TITLE: FR-C.2, RESPONSE TO DEGRADED CORE COOLING

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
20	9	11	8% SG LEVEL
20	9	12	12% SG LEVEL
21	9	N/A	16-33% SG LEVEL

CALC. No.: SC-CN001-01		REFERENCE:			
ORIGINATOR, DATE	REV: CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE	AFS/SJJ 1/11/94		LFP 8/16/94		

EOP NUMBER AND TITLE:	FRTS-1, RESPONSE TO IMMINENT PRESSURIZED THERMAL SHOCK		
ERG NUMBER AND TITLE:	FR-P.1, RESPONSE TO IMMINENT PRESSURIZED THERMAL SHOCK		
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
4	1	2	8% SG LEVEL
4	1	3	12% SG LEVEL
EOP NUMBER AND TITLE:	FRTS-2, RESPONSE TO ANTICIPATED PRESSURIZED THERMAL SHOCK		
ERG NUMBER AND TITLE:	FR-P.2, RESPONSE TO ANTICIPATED PRESSURIZED THERMAL SHOCK		
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
4	1	2	8% SG LEVEL
4	1	3	12% SG LEVEL

1IR1

EOP NUMBER AND TITLE: FRHS-1, RESPONSE TO LOSS OF SECONDARY HEAT SINK
ERG NUMBER AND TITLE: FR-H.1, RESPONSE TO LOSS OF SECONDARY HEAT SINK

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
18	8	6	8% SG LEVEL
18	8	7	12% SG LEVEL
19	8	N/A	8% SG LEVEL
19	8	N/A	12% SG LEVEL
34	20	6	8% SG LEVEL
34	20	7	12% SG LEVEL

EOP NUMBER AND TITLE: FRHS-2, RESPONSE TO SG OVERPRESSURE
ERG NUMBER AND TITLE: FR-H.2, RESPONSE TO SG OVERPRESSURE

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
4	3	2	92% SG LEVEL
4	3	3	91% SG LEVEL
5	CAUT 4	2	92% SG LEVEL
5	CAUT 4	3	91% SG LEVEL

1IR1

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
EOP NUMBER AND TITLE:	FRHS-3, RESPONSE TO SG HIGH LEVEL		
ERG NUMBER AND TITLE:	FR-H.3, RESPONSE TO SG HIGH LEVEL		
1	CAUT 1	1	91% SG LEVEL
1	CAUT 1	2	92% SG LEVEL
2	1	3	59% SG LEVEL
3	1	3	59% SG LEVEL
5	4	1	91% SG LEVEL
5	4	2	92% SG LEVEL
5	4	5	16-33% SG LEVEL
10	9	N/A	16% SG LEVEL
10	9	N/A	33% SG LEVEL
10	9	N/A	16-33% SG LEVEL
EOP NUMBER AND TITLE:	FRHS-4, RESPONSE TO LOSS OF SG ATMOSPHERIC AND CONDENSER DUMP VALVES		
ERG NUMBER AND TITLE:	FR-H.4, RESPONSE TO LOSS OF NORMAL STEAM RELEASE CAPABILITIES		
EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
2	1	2	92% SG LEVEL
2	1	3	91% SG LEVEL

1IR1

EOP NUMBER AND TITLE: FRHS-5, RESPONSE TO SG LOW LEVEL
ERG NUMBER AND TITLE: FR-H.5, RESPONSE TO SG LOW LEVEL

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
1	NOTE 1	1	8% SG LEVEL
1	NOTE 1	2	12% SG LEVEL
3	1	1	8% SG LEVEL
3	1	2	12% SG LEVEL
9	4	1	8% SG LEVEL
9	4	2	12% SG LEVEL
12	N/A	N/A	8% SG LEVEL
12	N/A	N/A	12% SG LEVEL
13	N/A	N/A	8% SG LEVEL
13	N/A	N/A	12% SG LEVEL

EOP NUMBER AND TITLE: APPX-4, POST SI RESTORATION
ERG NUMBER AND TITLE: N/A

EOP STEP	ERG STEP	FOOTNOTE	SETPOINT
4	N/A	N/A	16% SG LEVEL

1IR1

2.2.6 ERG Footnotes
(Ref. 3.3.3)

E-0, REACTOR TRIP OR SAFETY INJECTION (EOP TRIP-1)

(8) Enter plant specific value showing SG level just in the narrow range, including allowances for normal channel accuracy.

(9) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

ES-0.1, REACTOR TRIP RESPONSE (EOP TRIP-2)

(3) Enter plant specific value showing SG level just in the narrow range, including allowances for normal channel accuracy.

ES-0.2, NATURAL CIRCULATION COOLDOWN (EOP TRIP-4)

(3) Enter plant specific value corresponding to no-load SG level.

ECA-0.0, LOSS OF ALL AC POWER (EOP LOPA-1)

(4) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(5) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

ECA-0.1, LOSS OF ALL AC POWER RECOVERY WITHOUT SI REQUIRED (EOP LOPA-2)

(9) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(10) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

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ECA-0.2, LOSS OF ALL AC POWER RECOVERY WITH SI REQUIRED (EOP LOPA-3)

(3) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(4) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

E-1, LOSS OF REACTOR OR SECONDARY COOLANT (EOP LOCA-1)

(4) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(5) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

ES-1.1, SI TERMINATION (EOP TRIP-3)

(11) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(12) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

ES-1.2, POST LOCA COOLDOWN AND DEPRESSURIZATION (EOP LOCA-2)

(5) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(6) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

ECA-1.1, LOSS OF EMERGENCY COOLANT RECIRCULATION (EOP LOCA-5)

(33) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(34) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

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ECA-2.1, UNCONTROLLED DEPRESSURIZATION OF ALL STEAM GENERATORS (EOP LOSC-1)

(3) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(4) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

E-3, STEAM GENERATOR TUBE RUPTURE (EOP SGTR-1)

(4) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(5) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%. An upper limit of 50% is imposed to ensure some margin to SG overfill for control of feed flow.

ES-3.1, POST-SGTR COOLDOWN USING BACKFILL (EOP SGTR-2)

(6) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(7) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%. An upper limit of 50% is imposed to ensure some margin to SG overfill for control of feed flow.

(9) Plant specific value corresponding to high-high SG level setpoint. This value was selected to provide margin for filling the ruptured SG with cold feed flow while ensuring SG overfill does not occur.

(10) Plant specific value corresponding to high-high SG level setpoint including allowances for post accident transmitter errors and reference leg process errors not less than 50%. This value was selected to provide margin for filling the ruptured SG with cold feed flow to cool the metal in the upper regions while ensuring SG overfill does not occur. A lower limit of 50% is imposed to provide margin between uncovering the U tubes and terminating feed flow on high level.

(22) Enter plant specific value showing SG level greater than the AFW actuation setpoint

(23) Enter either the plant specific value showing SG level just in range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50% or the AFW actuation setpoint, whichever is greater.

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(24) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin.

(25) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin, including allowances for post accident transmitter errors and reference leg process errors, not less than 50%.

ES-3.2, POST-SGTR COOLDOWN USING BLOWDOWN (EOP SGTR-4)

(6) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(7) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%. An upper limit of 50% is imposed to ensure some margin to SG overfill for control of feed flow.

(22) Enter plant specific value showing SG level greater than the AFW actuation setpoint

(23) Enter either the plant specific value showing SG level just in range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50% or the AFW actuation setpoint, whichever is greater.

(24) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin.

(25) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin, including allowances for post accident transmitter errors and reference leg process errors, not less than 50%.

ES-3.3, POST-SGTR COOLDOWN USING STEAM DUMP (EOP SGTR-2)

(6) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(7) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%. An upper limit of 50% is imposed to ensure some margin to SG overfill for control of feed flow.

(27) Enter plant specific value showing SG level greater than the AFW actuation setpoint.

(28) Enter either the plant specific value showing SG level just in range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50% or the AFW actuation setpoint, whichever is greater.

(29) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin.

(30) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin, including allowances for post accident transmitter errors and reference leg process errors, not less than 50%.

ECA-3.1, SGTR WITH LOSS OF REACTOR COOLANT SUBCOOLED RECOVERY DESIRED (EOP SGTR-3)

(6) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(7) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%. An upper limit of 50% is imposed to ensure some margin to SG overfill for control of feed flow.

(43) Enter plant specific value showing SG level greater than the AFW actuation setpoint

(44) Enter either the plant specific value showing SG level just in range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50% or the AFW actuation setpoint, whichever is greater.

(45) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin.

(46) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin, including allowances for post accident transmitter errors and reference leg process errors, not less than 50%.

ECA-3.2, SGTR WITH LOSS OF REACTOR COOLANT-SATURATED RECOVERY DESIRED (EOP SGTR-4)

(5) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

(6) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%. An upper limit of 50% is imposed to ensure some margin to SG overfill for control of feed flow.

(40) Enter the plant specific value showing SG level greater than the AFW actuation setpoint.

(41) Enter either the plant specific value showing SG level just in range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50% or the AFW actuation setpoint, whichever is greater.

(42) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin.

CALC. No.: SC-CN001-01				REFERENCE:			
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1		
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94			

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(43) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin, including allowances for post accident transmitter errors and reference leg process errors, not less than 50%.

ECA-3.3, SGTR WITHOUT PRESSURIZER PRESSURE CONTROL (EOP SGTR-5)

(1) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin.
(2) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin, including allowances for post accident transmitter errors and reference leg process errors, not less than 50%.
(5) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.
(6) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%. An upper limit of 50% is imposed to ensure some margin to SG overfill for control of feed flow.
(33) Enter plant specific value showing SG level greater than the AFW actuation setpoint.
(34) Enter either the plant specific value showing SG level just in range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50% or the AFW actuation setpoint, whichever is greater.
(35) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin.
(36) Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin, including allowances for post accident transmitter errors and reference leg process errors, not less than 50%.

FR-C.1, RESPONSE TO INADEQUATE CORE COOLING (EOP FRCC-1)

(5) Enter plant specific value showing SG level just in the narrow range, including allowances for normal channel accuracy.
(6) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

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FR-C.2, RESPONSE TO DEGRADED CORE COOLING (EOP FRCC-2)

(11) Enter plant specific value showing SG level just in the narrow range, including allowances for normal channel accuracy.

(12) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

FR-H.1, RESPONSE TO LOSS OF SECONDARY HEAT SINK (EOP FRHS-1)

(6) Enter plant specific value showing SG level just in the narrow range, including allowances for normal channel accuracy.

(7) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

FR-H.2, RESPONSE TO SG OVERPRESSURE (EOP FRHS-2)

(2) Enter plant specific value corresponding to SG level at the upper tap, including allowances for normal channel accuracy.

(3) Enter plant specific value corresponding to SG level at the upper tap, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors.

FR-H.3, RESPONSE TO SG HIGH LEVEL (EOP FRHS-30

(1) Enter plant specific value corresponding to SG level at the upper tap, including allowances for normal channel accuracy.

(2) Enter plant specific value corresponding to SG level at the upper tap, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors.

(3) Enter plant specific value corresponding to SG high-high level feedwater isolation setpoint.

(4) Enter plant specific value showing SG level just in the narrow range, including allowances for normal channel accuracy.

(5) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

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FR-H.4, RESPONSE TO LOSS OF NORMAL STEAM RELEASE CAPABILITIES (EOP FRHS-4)

(2) Enter plant specific value corresponding to SG level at the upper tap, including allowances for normal channel accuracy.

(3) Enter plant specific value corresponding to SG level at the upper tap, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors.

FR-H.5, RESPONSE TO SG LOW LEVEL (EOP FRHS-5)

(1) Enter plant specific value showing SG level just in the narrow range, including allowances for normal channel accuracy.

(2) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

FR-P.1, RESPONSE TO IMMINENT PRESSURIZED THERMAL SHOCK (EOP FRTS-1)

(2) Enter plant specific value showing SG level just in the narrow range, including allowances for normal channel accuracy.

(3) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

FR-P.2, RESPONSE TO ANTICIPATED PRESSURIZED THERMAL SHOCK (EOP FRTS-2)

(2) Enter plant specific value showing SG level just in the narrow range, including allowances for normal channel accuracy.

(3) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

FR-S.1, RESPONSE TO NUCLEAR POWER GENERATION-ATWS (EOP FRSM-1)

(5) Enter plant specific value showing SG level just in the narrow range, including allowances for normal channel accuracy.

(6) Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

EOP Accident Terminology Clarification

When Emergency Response Guideline footnotes specify inclusion of normal, "post accident transmitter errors, and reference leg heat up " effects, this calculation applies the total channel uncertainties for "accident" conditions. This channel uncertainty includes all channel device uncertainties including environmental effects as well as non instrument related process uncertainties / bias terms. Bias terms are only used in this evaluation when they are applicable to the direction of interest being protected. Therefore, when an increasing value is established based on a high limit, the random Channel uncertainties and negative bias terms are applicable. When a decreasing value is established based on a low limit, the random Channel uncertainties and positive bias terms are applicable. Each ERG footnote is evaluated to determine whether normal or accident uncertainties are applicable.

Post Accident Indication uncertainties were calculated in the setpoint calculation. These values are based on the total channel uncertainty including worst case reference accuracy shifts applicable for "up to a year following a design basis event". The transmitter Post DBE effect used to develop this channel uncertainty assumes that accident temperature and radiation effects are no longer applicable. The post accident uncertainties were provided in the uncertainty calculation for information only and are not considered appropriate to the time duration that is applicable for the Emergency Operating Procedures.

1IR1

3.0 REFERENCES

3.1 Setpoint Procedures

3.1.1 SC.DE-TS.ZZ-1904(Q) Rev 0, Salem Unit 1 and 2 Technical Standard for Setpoints (1R1)
3.1.2 DE-TS.ZZ-1002(Q) Rev 2, Technical Standard Instrument Calibration Data Cards
3.1.3 S-C-RCP-CDC-0440 Rev 2, Westinghouse Setpoint Methodology for Protection Systems
3.1.4 VTD-304209 Rev 19, Salem Nuclear GS Units 1 & 2, Precautions Limitations and Setpoints

3.2 Updated Final Safety Analysis Report (UFSAR)

3.2.1 Section 7.2, Reactor Trip System, Table 7.2-7 SG Level Control and Protection System
3.2.2 Section 7.3, Engineered Safety Features Instrumentation, Table 7.3-1 Process Instrumentation for RPS and ESF Actuation
3.2.3 Section 7.4, Systems Required for Safe Shutdown, Section 7.4.2 Cold Shutdown Outside the Control Room
3.2.4 Section 7.5, Tables 7.5.1 "Main Control Room Indicators Available to the Operator."
3.2.5 Section 7.5, Table 7.5.2 "Main Control Room Indicators Available to the Operator to Monitor Significant Plant Parameters During Normal Operation."
3.2.6 Section 7.5, Table 7.5-3 Index Type "A" Variables
3.2.7 Section 7.5, Table 7.5-4 Summary of Instrumentation Compliance with RG 1.97
3.2.8 Section 15.1, Table 15.1.3 Trip Points and Time Delays to Trip Assumed in the Accident Analysis

3.3 Technical Specification /EOP Design Basis

3.3.1 Unit 1 and 2 Salem Technical Specifications
3.3.1.1 Section 3/4.3.2 Engineered Safety Feature Actuation System Instrumentation
3.3.1.2 Section 3/4.3.3 Subsection 3.3.3.7 Accident Monitoring Instrumentation, Limiting Condition for Operation
3.3.1.3 Subsection 4.3.3.7 Surveillance Requirements
3.3.1.4 Table 3.3-3 Engineered Safety Feature Actuation System Instrumentation
3.3.1.5 Table 3.3.4 Engineered Safety Feature Actuation Instrumentation Trip Setpoints
3.3.1.6 Table 3.3-11 Accident Monitoring Instrumentation
3.3.1.7 Table 4.3-11 Surveillance Requirements for Accident Monitoring Instrumentation
3.3.1.8 Table 4.3-2 Engineered Safety Feature Actuation System Instrumentation Surveillance Requirements
3.3.1.9 Section 2.2, Table 2.2.-1 Reactor Trip Instrumentation
3.3.2 SECL-92-049 Westinghouse Safety Evaluation
3.3.3 WOG-91-018 Westinghouse Owners Group Emergency Response Guidelines (Rev 1B) (1R1)
3.3.3.1 (ERG) FR-C.1, Response to Inadequate Core Cooling

3.3.3.2 (ERG) FR-C.2, Response to Degraded Core Cooling
3.3.3.3 (ERG) FR-H.1, Response to Loss of Secondary Heat Sink
3.3.3.4 (ERG) FR-H.2, Response to SG Overpressure
3.3.3.5 (ERG) FR-H.3, Response to SG High Level
3.3.3.6 (ERG) FR-H.4, Response to Loss of Normal Steam Release Capabilities
3.3.3.7 (ERG) FR-H.5, Response to SG Low Level
3.3.3.8 (ERG) FR-S.1, Response To Nuclear Power Generation -ATWS
3.3.3.9 (ERG) FR-P.1, Response to Imminent Pressurized Thermal Conditions
3.3.3.10 (ERG) FR-P.2, Response to Anticipated Pressurized Thermal Shock
3.3.3.11 (ERG) E-1, Loss of Reactor or Secondary Coolant
3.3.3.12 (ERG) ES-1.2, Post LOCA Cooldown and Depressurization
3.3.3.13 (ERG) ECA-1.1, Loss of Emergency Coolant Recirculation
3.3.3.14 (ERG) ECA-0.0, Loss of All AC Power
3.3.3.15 (ERG) ECA-0.1, Loss of All AC Power Recovery Without SI
3.3.3.16 (ERG) ECA-0.2, Loss of All AC Power Recovery With SI
3.3.3.17 (ERG) E-2, Faulted Seam Generator Isolation
3.3.3.18 (ERG) ECA-2.1, Uncontrolled Depressurization of all SGs
3.3.3.19 (ERG) E-3, Steam Generator Tube Rupture
3.3.3.20 (ERG) ES-3.1, Post SGTR Cooldown Using Backfill
3.3.3.21 (ERG) ES-3.2, Post SGTR Cooldown Using Blowdown
3.3.3.22 (ERG) ES-3.3, Post SGTR Cooldown Using Steam Dumps
3.3.3.23 (ERG) ECA-3.1, SGTR with Loss of Reactor Coolant - Subcooled Recovery
3.3.3.24 (ERG) ECA-3.2, SGTR with LOCA Saturated Recovery Desired
3.3.3.25 (ERG) ECA-3.3, SGTR without Pressurizer Pressure Control
3.3.3.26 (ERG) E-0, Reactor Trip or Safety Injection
3.3.3.27 (ERG) ES-0.1, Reactor Trip Response
3.3.3.28 (ERG) ES-1.1, SI Termination
3.3.3.29 (ERG) ES-0.2, Natural Circulation Cooldown

3.4 Drawings

3.4.1 205302 A 8762-46 Sheet 3 of 3, Steam Generator Feed and Condensate P&ID
3.4.2 220029 B 9537 Reactor Prot & Process Cont. Systems SG Interconnections, Wiring Diagram
3.4.3 220031 B 9537 Reactor Prot & Process Cont. System SG Interconnections, Wiring Diagram
3.4.4 220033 B 9537 Reactor Prot & Process Cont. System SG Interconnections, Wiring Diagram
3.4.5 220034 B 9537 -12 Reactor Prot & Process Control Systems SG Interconnections
3.4.6 220053 B 9537 -15 Reactor Prot & Process Control Systems SG Interconnections
3.4.7 220056 B 9537-14 Reactor Prot & Process Control Systems SG Interconnections
3.4.8 613101 No 1 Unit, Stm Gen Feed & Cond No. 11 SG Level 1LT518, Logic Diagram
3.4.9 613102 No 1 Unit, Stm Gen Feed & Cond No 12 SG Level 1LT528, Logic Diagram
3.4.10 613103 No 1 Unit, Stm Gen Feed & Cond No 13 SG Level 1LT538, Logic Diagram

3.4.11 613104 No 1 Unit, Stm Gen Feed & Cond No 14 SG Level 1LT548, Logic Diagram
3.4.12 613105 No 1 Unit, Stm Gen Feed & Cond No 11 SG Level 1LT517, Logic Diagram
3.4.13 613106 No 1 Unit, Stm Gen Feed & Cond No 12 SG Level 1LT527, Logic Diagram
3.4.14 613107 No 1 Unit, Stm Gen Feed & Cond No 13 SG Level 1LT537, Logic Diagram
3.4.15 613108 No 1 Unit, Stm Gen Feed & Cond No 14 SG Level 1LT547, Logic Diagram
3.4.16 613129 No 1 Unit, Stm Gen Feed & Cond No 11 SG Level 1LT519, Logic Diagram
3.4.17 613130 No 1 Unit, Stm Gen Feed & Cond No 12 SG Level 1LT529, Logic Diagram
3.4.18 613131 No 1 Unit, Stm Gen Feed & Cond No 13 SG Level 1LT539, Logic Diagram
3.4.19 613132 No 1 Unit, Stm Gen Feed & Cond No 14 SG Level 1LT549, Logic Diagram
3.4.20 613101 No 1 Unit, Stm Gen Feed & Cond No 11 SG Level 1LT518, Logic Diagram
3.4.21 613102 No 1 Unit, Stm Gen Feed & Cond No 12 SG Level 1LT528, Logic Diagram
3.4.22 613103 No 1 Unit, Stm Gen Feed & Cond No 13 SG Level 1LT538, Logic Diagram
3.4.23 613104 No 1 Unit, Stm Gen Feed & Cond No 14 SG Level 1LT548, Logic Diagram
3.4.24 623101 No 2 Unit, Stm Gen Feed & Cond No 21 SG Level 2LT518, Logic Diagram
3.4.25 623102 No 2 Unit, Stm Gen Feed & Cond No 22 SG Level 2LT528, Logic Diagram
3.4.26 623103 No 2 Unit, Stm Gen Feed & Cond No 23 SG Level 2LT538, Logic Diagram
3.4.27 623104 No 2 Unit, Stm Gen Feed & Cond No 24 SG Level 2LT548, Logic Diagram
3.4.28 623105 No 2 Unit, Stm Gen Feed & Cond No 21 SG Level 2LT517, Logic Diagram
3.4.29 623106 No 2 Unit, Stm Gen Feed & Cond No 22 SG Level 2LT527, Logic Diagram
3.4.30 623107 No 2 Unit, Stm Gen Feed & Cond No 23 SG Level 2LT537, Logic Diagram
3.4.31 623108 No 2 Unit, Stm Gen Feed & Cond No 24 SG Level 2LT547, Logic Diagram
3.4.32 623129 No 2 Unit, Stm Gen Feed & Cond No 21 SG Level 2LT519, Logic Diagram
3.4.33 623130 No 2 Unit, Stm Gen Feed & Cond No 22 SG Level 2LT529, Logic Diagram
3.4.34 623131 No 2 Unit, Stm Gen Feed & Cond No 23 SG Level 2LT539, Logic Diagram
3.4.35 623132 No 2 Unit, Stm Gen Feed & Cond No 24 SG Level 2LT549, Logic Diagram
3.4.36 218162 A 9783-35 No 1 Unit Control Room Annunciator Designations
3.4.37 211301 B 9508-11 No 1 Unit RC No 11 SG Level and Steam Flow Instrument Schematic
3.4.38 211302 B 9508-12 No 1 Unit, RC No 12 SG Level and Steam Flow Instrument Schematic
3.4.39 211303 B 9508-12 No 1 Unit RC No 13 SG Level and Steam Flow Instrument Schematic
3.4.40 211304 B 9508-11 No 1 Unit RC, No 14 SG Level and Steam Flow Instrument Schematic
3.4.41 240662 B 9656-10 No 2 Unit, RC No 21 SG Level and Steam Flow Instrument Schematic
3.4.42 240663 B 9656-10 No 2 Unit RC No 22 SG Level and Steam Flow Instrument Schematic
3.4.43 240664 B 9656-9 No 2 Unit, RC No 23 SG Level and Steam Flow Instrument Schematic
3.4.44 240665 B 9656-9 No 2 Unit, RC No 24 SG Level and Steam Flow Instrument Schematic
3.4.45 229928 A 1327-10 No 1 RC N-E & S-E Quadrants Ext.Tubing El 130'-0" Arrangement
3.4.46 229929 A 1327-13 No 1 RC N-W & S-W Quadrants Ext. Tubing El 130'-0" Arrangement
3.4.47 233026 A 1399-9 No 2 RC N-E & S-E Quadrants Ext. Tubing El 130'-0" Arrangement
3.4.48 233026 A 1399-9 No 2 RC N-W & S-W Quadrants Ext. Tubing El 130'-0" Arrangement
3.4.49 221056 B 9545-7 No 1 & 2 Units, Reactor Protection System, SG Trip Signals Loop Diagram
3.4.50 233609 B 9611-8 No 1 &2 Units, RC El 130' 11,12, 13, 14 SG Level Arrangement
3.4.51 203425 B 9790-7 No. 1 & 2 Units- Feedwater No. 11 SG Feedwater Flow Schematic

3.4.52 203426 B 9790-6 No. 1 & 2 Units- Feedwater No. 12 SG Feedwater Flow Schematic
3.4.53 203427 B 9790-6 No. 1 & 2 Units- Feedwater No. 13 SG Feedwater Flow Schematic
3.4.54 203428 B 9790-6 No. 1 & 2 Units- Feedwater No. 14 SG Feedwater Flow Schematic
3.4.55 205171 Rev 15, No. 1 Unit-Control Console Bezel
3.4.56 228476 Rev 12, No. 2 Unit-Control Console Bezel

3.5 Calculations and Support Documents

3.5.1 SC-MS-EQ49-001 Rev 5, Environmental Qualification for Rosemount Transmitters
3.5.2 S-C-ZZ-EEE-0625 Rev 0, Engineering Evaluation of M&TE
3.5.3 MMIS controlled database for Instrument Component Information
3.5.4 EQRR-0001 Rev 7, SGS Environmental Qualification Review Report
3.5.5 PSBP 138646 Rev 11, Westinghouse Rack Instruments
3.5.6 PSBP 312344, Dixon Edgewise Indicators
3.5.7 S-C-VAR-CEE-0811 Engineering Evaluation on the EPRI Drift Study
3.5.8 S-C-ZZ-CEE-0815 Engineering Evaluation for Acceptance Criteria for As Found Calibration Values for Salem Unit 1 & 2.
3.5.9 PSE&G VTD No 312351-03 Leeds and Northrup Recorder Specification, Speedomax 100 Series
3.5.10 DE-CB.CN-0015(Q) CBD for Steam Generator Feedwater & Condensate System
3.5.11 DE-CB.RCP/SEC/SSP/SPL-0032 (Q) CBD for Reactor Protection Systems
3.5.12 DE-CB.115-0017 (Q) CBD for Electrical Systems
3.5.13 PSBP 301669 SCT Transmitter, Moore Industries, Inc.
3.5.14 S-C-VAR-CEE-0807 Rev 0, Engineering Evaluation of Salem Generating Units 1&2 Insulation Resistance Effects
3.5.15 2EC-3178 Pkg 2, Design Change Package
3.5.16 PSE-92-106 Letter from Westinghouse to Mr. J. A Nichols, S/G Water Level PMA Term Inaccuracies Dated June 18, 1992
3.5.17 Rosemount Manual 4631, April 1989, 1154 Series H Alphaline Pressure Transmitters
3.5.18 Electrical Cable Database
3.5.19 ASME Steam Tables 5th Edition
3.5.20 PSE-92-043, Westinghouse Letter ET-NSL-OPL-II-92-088 Dated February 18, 1992, Safety Analysis Limits
3.5.21 PSE&G VTD No. 301129 Issue 6, Rosemount Manual, Model 1153 Series D Alphaline Pressure Transmitter and Acceptance Test Specification
3.5.22 PSE-94-532 Safety Evaluation for an Increase in SG High-High Level Setpoint Analysis
3.5.23 VTD 317079-01, Environmental Design Criteria (EDC)
3.5.24 PSE-94-555 Westinghouse Letter Dated March 24, 1994, Subject: JPO for Overpower Operation (Excerpt Attachment 10.6) 1IR1
3.5.25 PSBP 317093 Draft Seismic Safe Shutdown Equipment List (SSEL) Unit 1
3.5.26 PSBP 317095 Draft Seismic Safe Shutdown Equipment List (SSEL) Unit 2

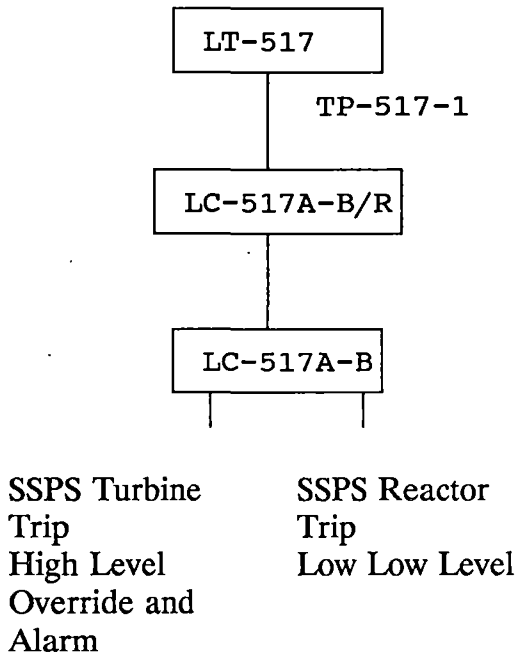
3.6 Procedures

3.6.1 Calibration Procedures
3.6.1.1 S1(2).IC-CC.RCP-0033(Q) 1(2)LT-517 Steam Generator Level Protection Channel IV
3.6.1.2 S1(2).IC-CC.RCP-0034(Q) 1(2)LT-518 Steam Generator Level Protection Channel III
3.6.1.3 S1(2).IC-CC.RCP-0035(Q) 1(2)LT-519 Steam Generator Level Protection Channel II
3.6.1.4 S1(2).IC-CC.RCP-0043(Q) 1(2)LT-527 Steam Generator Level Protection Channel IV
3.6.1.5 S1(2).IC-CC.RCP-0044(Q) 1(2)LT-528 Steam Generator Level Protection Channel III
3.6.1.6 S1(2).IC-CC.RCP-0045(Q) 1(2)LT-529 Steam Generator Level Protection Channel II
3.6.1.7 S1(2).IC-CC.RCP-0053(Q) 1(2)LT-537 Steam Generator Level Protection Channel IV
3.6.1.8 S1(2).IC-CC.RCP-0054(Q) 1(2)LT-538 Steam Generator Level Protection Channel III
3.6.1.9 S1(2).IC-CC.RCP-0055(Q) 1(2)LT-539 Steam Generator Level Protection Channel II
3.6.1.10 S1(2).IC-CC.RCP-0063(Q) 1(2)LT-547 Steam Generator Level Protection Channel IV
3.6.1.11 S1(2).IC-CC.RCP-0064(Q) 1(2)LT-548 Steam Generator Level Protection Channel III
3.6.1.12 S1(2).IC-CC.RCP-0065(Q) 1(2)LT-549 Steam Generator Level Protection Channel II
3.6.1.13 S1(2).IC-SC-RCP-0033(Q) 1(2)LT-517 Steam Generator Level Protection Channel IV
3.6.1.14 S1(2).IC-SC-RCP-0034(Q) 1(2)LT-518 Steam Generator Level Protection Channel III
3.6.1.15 S1(2).IC-SC.RCP-0035(Q) 1(2)LT-519 Steam Generator Level Protection Channel II
3.6.1.16 S1(2).IC-SC.RCP-0043(Q) 1(2)LT-527 Steam Generator Level Protection Channel IV
3.6.1.17 S1(2).IC-SC.RCP-0044(Q) 1(2)LT-528 Steam Generator Level Protection Channel III
3.6.1.18 S1(2).IC-SC.RCP-0045(Q) 1(2)LT-529 Steam Generator Level Protection Channel II
3.6.1.19 S1(2).IC-SC.RCP-0053(Q) 1(2)LT-537 Steam Generator Level Protection Channel IV
3.6.1.20 S1(2).IC-SC.RCP-0054(Q) 1(2)LT-538 Steam Generator Level Protection Channel III
3.6.1.21 S1(2).IC-SC.RCP-0055(Q) 1(2)LT-539 Steam Generator Level Protection Channel II
3.6.1.22 S1(2).IC-SC.RCP-0063(Q) 1(2)LT-547 Steam Generator Level Protection Channel IV
3.6.1.23 S1(2).IC-SC.RCP-0064(Q) 1(2)LT-548 Steam Generator Level Protection Channel III
3.6.1.24 S1(2).IC-SC.RCP-0065(Q) 1(2)LT-549 Steam Generator Level Protection Channel II
3.6.2 NC.DE-AP.ZZ-0007(Q) Specialty Reviews
3.6.3 Emergency Operating Procedures (Rev 10) 1R1
3.6.3.1 EOP-FRCC-1 Response to Inadequate Core Cooling
3.6.3.2 EOP-FRCC-2 Response to Degraded Core Cooling
3.6.3.3 EOP-FRHS-1 Response to Loss of Secondary Heat Sink
3.6.3.4 EOP-FRHS-2 Response to SG Overpressure
3.6.3.5 EOP-FRHS-3 Response to SG High Level
3.6.3.6 EOP-FRHS-4 Response to Loss of SG Atm and Condenser Dump Valves
3.6.3.7 EOP-FRHS-5 Response to SG Low Level
3.6.3.8 EOP-FRSM-1 Response to Nuclear Power Generation
3.6.3.9 EOP-FRTS-1 Response to Imminent Pressurized Thermal Conditions
3.6.3.10 EOP-FRTS-2 Response to Anticipated Pressurized Thermal Shock
3.6.3.11 EOP-LOCA-1 Loss of Reactor Coolant
3.6.3.12 EOP-LOCA-2 Post LOCA Cooldown and Depressurization

3.6.3.13 EOP-LOCA-5 Loss of Emergency Recirculation
3.6.3.14 EOP-LOPA-1 Loss of All AC Power
3.6.3.15 EOP-LOPA-2 Loss of All AC Power Recovery without SI (1R1)
3.6.3.16 EOP-LOPA-3 Loss of All AC Power Recovery with SI
3.6.3.17 EOP-LOSC-1 Loss of Secondary Coolant
3.6.3.18 EOP-LOSC-2 Multiple Steam Generator Depressurization
3.6.3.19 EOP-SGTR-1 Steam Generator Tube Rupture
3.6.3.20 EOP-SGTR-2 Post-SGTR Cooldown
3.6.3.21 EOP-SGTR-3 SGTR With LOCA, Subcooled Recovery
3.6.3.22 EOP-SGTR-4 SGTR with LOCA - Saturated Recovery
3.6.3.23 EOP-SGTR-5 SGTR without Pressurizer Pressure Control
3.6.3.24 EOP-TRIP-1 Reactor Trip or Safety Injection
3.6.3.25 EOP-TRIP-2 Reactor Trip Response
3.6.3.26 EOP-TRIP-3 Safety Injection Termination
3.6.3.27 EOP-TRIP-4 Natural Circulation Cooldown

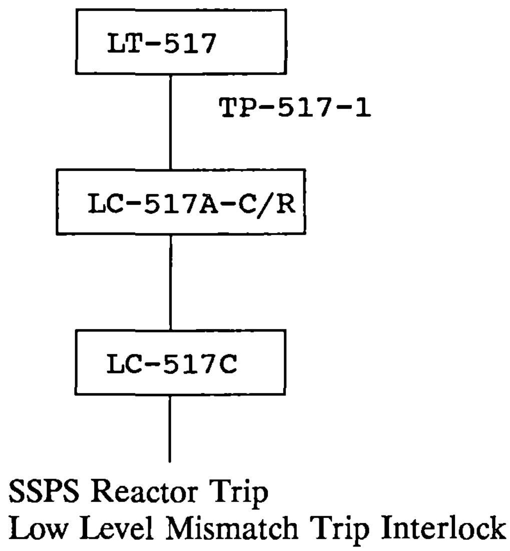
4.0 LOOP DIAGRAM

4.1 The Loop Diagram shown below is typical for the Comparator Setpoints, Configuration A and B. Refer to Calculation Section 1.2 for differences in Component IDs.

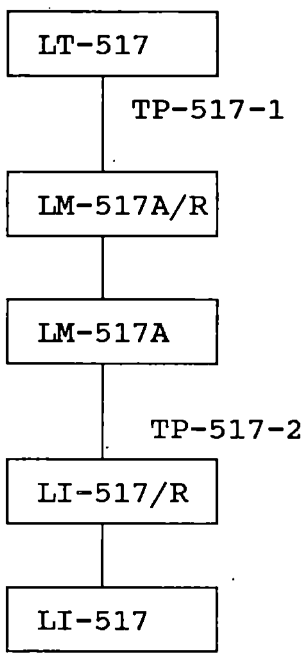


PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET				SHEET: 49 CONT'D ON SHEET:	
CALC. No.: SC-CN001-01			REFERENCE:			
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

4.2 The Loop Diagram shown below is typical for the Comparator Setpoints, Configuration C. Refer to Calculation Section 1.2 for differences in Component IDs.

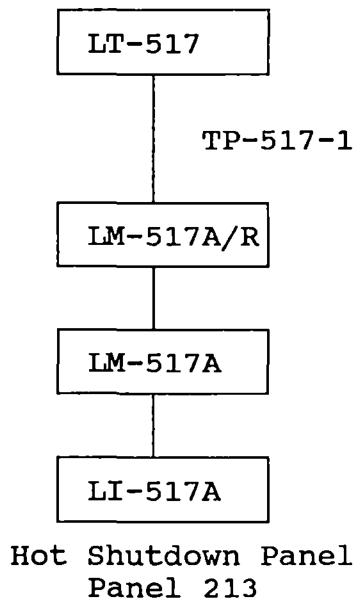


4.3 The Loop Diagram shown below is typical for the Control Room Indicator Loops, Configuration D. Refer to Calculation Section 1.2 for Component IDs.



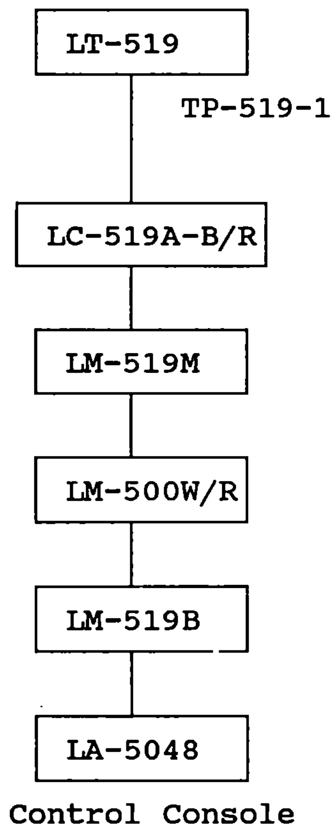
Control Console

4.4 The Loop Diagram shown below is typical for the Hot Shutdown Panel Indication, Configuration E. Refer to Calculation Section 1.2 for Component IDs.



CALC. No.: SC-CN001-01					REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1		
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94			

4.5 The Loop Diagram shown below is typical for the Recorder loops, Configuration F. Refer to Calculation Section 1.2 for Component IDs.



5.0 DESIGN INPUTS

5.1 General Design Inputs

5.1.1 Equipment Locations/ Environmental Parameters
(Ref. 3.5.3, 3.5.4)

Channel IV

Device	Description	Location
1(2)LT-517	Transmitter	Bldg 05, 15, Elev 130, Area 011, Panel 444-1(2)A
1(2)LT-527	Transmitter	Bldg 05, 15, Elev 130, Area 010, Panel 444-1(2)F
1(2)LT-537	Transmitter	Bldg 05, 15, Elev 130, Area 007, Panel 444-1(2)G
1(2)LT-547	Transmitter	Bldg 05, 15, Elev 130, Area 009, Panel 444-1(2)M
1(2)LM-517A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-527A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-537A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-547A/R	Conditioner	Bldg 01, 12, Elev 078, Area 005
1(2)LM-517A	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-527A	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-537A	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-547A	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-517A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-527A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-537A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-547A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-517	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-527	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-537	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-547	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-517A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-527A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-537A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-547A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-517C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-527C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-537C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-547C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-517A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-527A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-537A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-547A-B	Comparator	Bldg 01, 12, Elev 122, Area 002

1(2)LC-517C	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-527C	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-537C	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-547C	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-517A	Indicator	Bldg 01, 12, Elev 084, Area 015
1(2)LI-527A	Indicator	Bldg 01, 12, Elev 084, Area 015
1(2)LI-537A	Indicator	Bldg 01, 12, Elev 084, Area 015
1(2)LI-547A	Indicator	Bldg 01, 12, Elev 084, Area 015

Channel III

Device	Description	Location
1(2)LT-518	Transmitter	Bldg 05, 15, Elev 130, Area 011, Panel 444-1(2)B
1(2)LT-528	Transmitter	Bldg 05, 15, Elev 130, Area 011, Panel 444-1(2)E
1(2)LT-538	Transmitter	Bldg 05, 15, Elev 130, Area 007, Panel 444-1(2)H
1(2)LT-548	Transmitter	Bldg 05, 15, Elev 130, Area 009, Panel 444-1(2)L
1(2)LM-518A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-528A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-538A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-548A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-518	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-528	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-538	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-548	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-518A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-528A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-538A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-548A/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-518	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-528	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-538	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-548	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-518A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-528A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-538A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-548A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-518C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-528C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-538C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-548C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002

1(2)LC-518A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-528A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-538A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-548A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-518C	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-528C	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-538C	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-548C	Comparator	Bldg 01, 12, Elev 122, Area 002

Channel II

Device	Description	Location
1(2)LT-519	Transmitter	Bldg 05, 15, Elev 130, Area 011, Panel 444-1(2)C
1(2)LT-529	Transmitter	Bldg 05, 15, Elev 130, Area 010, Panel 444-1(2)D
1(2)LT-539	Transmitter	Bldg 05, 15, Elev 130, Area 007, Panel 444-1(2)J
1(2)LT-549	Transmitter	Bldg 05, 15, Elev 130, Area 009, Panel 444-1(2)K
1(2)LM-519A/R	Conditioner	Bldg 01, 12, Elev 122, Area 005
1(2)LM-529A/R	Conditioner	Bldg 01, 12, Elev 122, Area 005
1(2)LM-539A/R	Conditioner	Bldg 01, 12, Elev 122, Area 005
1(2)LM-549A/R	Conditioner	Bldg 01, 12, Elev 122, Area 005
1(2)LM-519A	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-529A	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-539A	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-549A	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-519/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-529/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-539/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-549/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LI-519	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-529	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-539	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LI-549	Indicator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-519A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-529A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-539A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-549A-B/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LC-519A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-529A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-539A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LC-549A-B	Comparator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-519A-C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002

1(2)LM-529A-C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-539A-C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-549A-C/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-519M	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-529M	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-539M	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-549M	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-500W/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-500X/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-500Y/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-500Z/R	Conditioner	Bldg 01, 12, Elev 122, Area 002
1(2)LM-519B	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-529B	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-539B	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LM-549B	Isolator	Bldg 01, 12, Elev 122, Area 002
1(2)LA-5048	Recorder	Bldg 01, 12, Elev 122, Area 002
1(2)LA-5049	Recorder	Bldg 01, 12, Elev 122, Area 002
1(2)LA-5050	Recorder	Bldg 01, 12, Elev 122, Area 002
1(2)LA-5051	Recorder	Bldg 01, 12, Elev 122, Area 002

AREA/ENVIRONMENTAL PARAMETERS					
AREA	TEMP	ACC TEMP	NORM/ ACC RH	NORM RADS	RADS
Containment 05, 15	60-120°F CAL; 70-90°F	351.3 °F	20-90% 100 % RH Steam	2.51E6*	2.93E7
Control Room 01, 12	55-85°F CAL; 70°F	N/A	20-90% RH	N/A	N/A

1R1

* EDC Value for 40 year TID normal is overly conservative for purposes of this calculation, see Normal Radiation Assumption 6.3.1.

1R1

5.1.2 Loop Power Supply
(Vac: Ref. 3.5.12)(Vdc: Ref. 3.5.5, 3.4.1-3.4.7)

120 Vac Vital Instrument Bus, regulated ±2%.

Rack Power Supplies
(Ref. 3.4.1-3.4.7)

Manufacturer	Westinghouse (Mfg Code H015)
Model	Model 121 (4111085-001)
Rating	46 Vdc ± 5% + 200 mV ripple

5.2 Process Design Inputs

Maximum Normal Operating Pressure is 756.52 psig (Unit 2, Attachment A) and 759.2 psig (Unit 1, Attachment B)
Calibrated Span is 107.673 inWC (Unit 2, Attachment A) 107.746 inWC (Unit 1, Attachment B)
Process Measurement Accuracy from Ref. 3.5.16 (Attachment 10.4)
Normal Operating High Level 44% (Ref 3.1.4)
Normal Operating Low Level 33% (Ref 3.1.4)
High High Analytical Limit 75% (Attachment 10.5)

5.3 Transmitter Design Inputs

Manufacturer and Model Numbers shown below are typical for all Transmitters listed in Section 1.2, unless otherwise noted.

5.3.1 Safety/Quality Designations
(Ref. 3.5.3)

SFTY RLTD/QAR: SR
CLASS/QGC: IE
EQ: H,
SEISMIC CAT: 1

Performance Specification - Transmitter
Range Code 4
(Ref. 3.5.17)

Manufacturer	Rosemount Inc.
Model No.	1154HH4RH
Output:	4-20 mA dc
Temperature Limits	+40°- 200°F
Humidity Limits	0-100% RH
Range	Range Code 4: 0-25 to 0-150 inH_2O
Over pressure Limits	3000 psig without damage
Accuracy:	±0.25% of calibrated span. Includes combined effects of linearity, hysteresis, and repeatability
Deadband:	none
Drift:	± 0.2% of Upper Range Limit for 30 months
Temperature Effect:	± (0.15% URL + 0.35% span) per 50 Deg F ambient temperature change.
Over Pressure Effect:	Maximum zero shift after 3000 psi overpressure ±1.0% of URL (Range Code 4)
Static Pressure Zero Effect:	±0.66% of URL per 1000 psi
Static Pressure Span Effect:	±0.5% of reading/1000 psi
Power Supply Effect:	Less than 0.005% of output span/volt
Load Effect:	None
Mounting Position Effect:	Superseded by accuracy specifications
Radiation:	Accuracy within ±(0.2% of URL + 0.2% of span) during first 30 minutes; ±(0.5% URL + 1% span) after 55 megarads TID; ±(0.75% Upper Range Limit + 1% span) after 110 megarads TID gamma radiation exposure.
Seismic:	Accuracy within ± 0.5% of URL during and after a seismic disturbance defined by a required response spectrum with a horizontal ZPA of 8.5 g's, and a vertical ZPA of 5.2 g's.
Steam Pressure/Temperature	Accuracy within ± (1.0% of Upper Range Limit + 1.0% of span) for Range Code 4.
Post DBE Operation	Accuracy at reference conditions shall be within ± 2.5% of URL after exposure to DBE as described above for one year following DBE.

5.4 Rack Design Inputs

This calculation includes rack components for Comparator, Indication and Recording loops (See Section 1.2). The instrument rack uncertainties used in this calculation are the standard Westinghouse rack specifications as described in the Salem Setpoint Technical Standard (Ref. 3.1.1). Per Wiring Diagrams (Ref. 3.4.1-3.4.7), the loop configurations include Westinghouse rack instruments and may include a Comparator (Setpoint loop) an NUS signal isolator (for RG 1.97 isolation, Design Change 2EC-3258 Ref. 3.5.15) and/or a Moore signal isolator (Recorder isolation). The uncertainties for racks including non-Westinghouse instruments were evaluated in Attachment 10.2 and 10.3 and the results of those evaluations provide that standard Westinghouse rack specifications are bounding for this calculation. Therefore, this calculation includes only two typical rack total uncertainties; one typical rack which includes a bistable setting tolerance for use with the comparator loops (Rack1) and a typical rack without the bistable setting tolerance for use with the Indicator and Recorder loops (Rack2).

5.4.1 <u>Safety/Quality Designation</u>
(Ref. 3.5.3)

SFTY RLTD/QAR: SR
CLASS/QGC: IE
EQ: M
SEISMIC CAT: 1

5.4.2 <u>Current to Voltage Converters</u>
(Ref. 3.5.5)

Manufacturer and Model Numbers shown below are typical for all Signal Conditioners (I/V) listed in Section 1.2, unless otherwise noted.

Manufacturer	Westinghouse
Model No.	3110554-000
Accuracy	± 0.010% (Per Ref. 3.1.1, calculation uses 0.100% span)

5.4.3 Signal Comparators
(Ref. 3.5.5)

Manufacturer and Model Numbers shown below are typical for all Signal Comparators listed in Section 1.2, unless otherwise noted.

Manufacturer	Hagan Controls/ Westinghouse (H015)
Model No.	See Above
Input Signal	1-5 VDC
Output	Digital Contact Closure

5.4.4 Signal Isolators
(Ref. 3.5.3, 3.5.5, 3.5.13, 3.5.15) (Attachment 10.2)

1(2) LM-517A	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-527A	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-537A	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-547A	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-518	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-528	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-538	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-548	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-519A	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-529A	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-539A	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-549A	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-519M	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-529M	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-539M	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-549M	H015: 4111083-001 or 089N: FIA801-05-07-08 (*)
1(2) LM-519B	M422: SCT/1-5V/1-5V/AC
1(2) LM-529B	M422: SCT/1-5V/1-5V/AC
1(2) LM-539B	M422: SCT/1-5V/1-5V/AC
1(2) LM-549B	M422: SCT/1-5V/1-5V/AC

Manufacturer	Hagan Controls/ Westinghouse (H015)|NUS Corporation (089N)Moore Industries Inc (M422)
Model No.	See Above
Input Signal	1-5 VDC
Output	1-5 VDC or 4-20 mADC

(*) These signal isolators are either the Westinghouse or the NUS model. This calculation is bounding for both (See Assumption 6.4).

5.4.4.1 NUS Isolator Performance Specifications
(Attachment 10.2)

Accuracy	±0.1% FS
Repeatability	±0.05% FS
Power Supply	.05% change in output for the listed variations, cumulative
Linearity	± 0.1% FS
Temp Effect	± 0.05% FS/ °C.

5.4.4.2 Moore Isolator Performance Specifications
(Attachment 10.3)

Accuracy	±0.1% FS
Line Voltage Effect	±0.005% / 1% line change
Temp Effect	±0.005% per 1 Deg F over -20 to 180 Deg F.
Load Effect	± 0.001% span from 0 to max load resistance

5.4.5 Rack Performance General Specifications
(Ref. 3.1.1, 3.1.3, 3.5.7)

Manufacturer	Westinghouse
Accuracy	± 0.5% span
Temperature Effect	± 0.5% span
Drift	± 1.0% span
Bistable Setting Tol	± 0.25% span

5.5 Control Room Indicator Design Inputs
(Ref. 3.5.3, 3.5.6)

Manufacturer and Model Numbers shown below are typical for all Control Room Indicators listed in Section 1.2, unless otherwise noted.

5.5.1 Safety/Quality Designations
(Ref. 3.5.3)

SFTY RLTD/QAR: SR
CLASS/QGC: IE
EQ: M
SEISMIC CAT: 1

5.5.2 Performance Specifications - Control Room Indicator
(Ref. 3.5.3, 3.5.6)

Manufacturer:	Dixon (Mfg Code D327)
Model:	SH101AXT
Input:	1-5 VDC
Output:	0-100%
Accuracy @ 25 °C	± 0.100% FS
Temperature Effect;	
Zero Stability	± 0.010%/Degree C
Gain Stability	± 0.020%/Degree C
Maximum Accuracy Drift over time @ 25 Degrees C	0.016% / month
Resolution Bar	1.000%
Digital	± 1 count
Operating Temp. Range	0 to 50 Degrees C
Relative Humidity	90% maximum
AC Power Requirements	118 VAC ± 10%

5.6 Hot Shutdown Panel Indicator Design Inputs

Manufacturer and Model Numbers shown below are typical for all Hot Shutdown Panel Indicators listed in Section 1.2, unless otherwise noted.

5.6.1 Safety/Quality Designations
(Ref. 3.5.3)

SFTY RLTD/QAR: SR
CLASS/QGC: IE
EQ: M
SEISMIC CAT: 1

5.6.2 Performance Specifications - Indicator
(Ref. 3.5.3, 3.5.5)

Manufacturer:	Westinghouse (W120)
Model:	107
Input:	1-5 VDC
Output:	0-100 Percent
Accuracy	± 1.5% Range
Temperature Effect	None Supplied
Drift	None Supplied
Resolution	None Supplied

5.7 Recorder Design Inputs
(Ref. 3.5.3, 3.5.9)

5.7.1 Safety/Quality Designations
(Ref. 3.5.4)

SFTY RLTD/QAR: SR
CLASS/QGC: IE
EQ: M
SEISMIC CAT: 1

5.7.2 Performance Specifications - Recorder
(Ref. 3.5.12)

Manufacturer:	Leeds and Northrup
Model:	Speedomax 100 Series, Model 136
Input:	1-5 VDC
Output:	0-100 %
Accuracy:	± 0.5% span
Deadband:	± 0.25% of span maximum
Temperature Effect:	None Specified
Drift:	None Specified
Readability:	None Specified

5.8 M&TE Design Inputs

5.8.1 Transmitter MTE
(Ref. 3.1.1, 3.5.2, 3.6)

The instruments required for calibration of the transmitter are designated in the calibration procedures as a Digital Multimeter (Fluke 8600A or equivalent), and a Dead Weight Tester (range of 140 inWC), Mansfield & Green PK or equivalent.

FLUKE 8600A	Accuracy ± 0.050% span (Ref. 3.5.2)
Dead Weight Tester	Accuracy ± 0.100% reading (Ref. 3.5.2)
Test Point	Calibration performed through an installed Test Point (resistor) 250 ohm; Accuracy 0.100% span (Ref. 3.1.1)

5.8.2 Rack MTE
(Ref. 3.1.1, 3.5.2, 3.6)

The instrument required for calibration of the rack per calibration procedures is the Fluke 8600A, a current simulator and a switch box. Additionally, the signal is fed through an installed resistor (I/V) or a test point resistor. Per Salem Technical Standard for Setpoints, the resistor MTE uncertainty is ± 0.100% span.

FLUKE 8600A	Accuracy ± 0.050% span (Ref. 3.5.2)
I/V	Accuracy ± 0.100% span (Ref. 3.1.1)

5.8.3 Indicator MTE
(Ref. 3.1.1, 3.5.2, 3.6)

The instrument required for calibration of the indicator per calibration procedures is the Fluke 8600A. Additionally, the calibration of the Indicator is performed with readings through the installed resistor used to condition the 4-20 mADC signal to 1-5 Vdc. Per Salem Technical Standard for Setpoints, the resistor contribution is within ± 0.100% span.

FLUKE 8600A	Accuracy ± 0.050% span (Ref. 3.5.2)
I/V	Accuracy ± 0.100% span (Ref. 3.1.1)

5.8.4 Recorder MTE
(Ref. 3.1.1, 3.5.2, 3.6)

The instrument required for calibration of the rack per calibration procedures is the Fluke 8600A. Additionally, the calibration of the Recorder is performed with readings through the installed resistor used to condition the 4-20 mADC signal to 1-5 Vdc. Per Salem Technical Standard for Setpoints, the resistor contribution is within the bounding uncertainty of ± 0.100% span.

FLUKE 8600A	Accuracy ± 0.050% span (Ref. 3.5.4)
I/V	Accuracy ± 0.100% span (Ref. 3.1.1)

6.0 ASSUMPTIONS

6.1 General Assumptions

6.1.1 Drift/Surveillance Interval

This calculation assumes that the maximum calibration interval is 30 months for all devices based on the station desire to move to a 24 month Surveillance interval and assuming a 25% allowance on that value.

6.1.2 Sigma Determination

Per the Salem Setpoint Methodology (Ref. 3.1.1) calculations are to be performed to 2 sigma (approximately 95% confidence). Also per Reference 3.1.1, where no confirmation of sigma is supplied for the instrument specifications used (supplied in support of a Nuclear Safety related system), it is reasonable to assume the data falls within a 95% confidence interval. Since no sigma was supplied for the instrumentation used in this calculation, all data was assumed to be 2 sigma.

6.1.3 Calibration Temperatures

A calibration temperature of 70 Deg F is assumed for calibration of all devices in this calculation.

6.1.4 Seismic Allowances

Per Ref. 3.1.3, Westinghouse does not usually include seismic allowances in their RPS trip and ESF protection function uncertainty calculations. Per the Salem Setpoint Technical Standard (Ref. 3.1.1), a seismic evaluation may be required if the device is used for a Seismic Safe Shutdown. Even though the subject transmitters are included on the Seismic Safe Shutdown Equipment List (SSEL), no adverse effect on the High-High trip function based on a seismic event are assumed to be applicable to the ESFAS High-High trip function (based on normal environmental uncertainties).

For functions within this calculation that may be credited for either a Seismic Safe Shutdown and a DBE (Low trip, Low-Low trip, Indication and Recording) only the larger of the seismic or accident uncertainties would be included since only one event needs to be considered. The accident uncertainties provided by the vendor are significantly larger than the specified seismic uncertainties, therefore, when applicable, accident uncertainties are used in lieu of the seismic uncertainties. 1IR

6.2 Process Assumptions

Per Ref. 3.5.16 (Attachment 10.4), Westinghouse provided notification to PSE&G that previously provided Process Measurement Uncertainties information applicable to the Steam Generator trip functions may not have been conservative. The notification included typical values for the Model 51 Steam Generators assuming that the plant used the same calibration and operating conditions as used in the typical calculation. The calculated values were based on the assumption that transmitter calibration was performed at 110 Deg F and that the maximum normal operating temperature is between 100 and 130 Deg F. The Salem scaling is based on 120 Deg F at 100% power. Interim Revision 1IR0 of this calculation was performed assuming those values were conservative for all functions.

After this revision, Westinghouse prepared a report to PSE&G, Subject: JPO for Overpower Operation, (Ref. 3.5.24, Attachment 10.6) confirming that based on the PSE&G assumptions for 100% RTP, the PMA typical values were conservative for the Low and Low-Low trip functions, but were not conservative for the High-High trip function as calculated in support of the JPO by Westinghouse. Per this report, the PMA values previously used in calculation Rev. 1IR0 were non conservative by approximately 1% NR span. The source of this additional uncertainty is not specifically identified in the JPO, however, the 1% uncertainty is conservatively added to the calculation channel uncertainty under Revision 1IR1 as an additional bias to the total PMA term.

This calculation also includes indication uncertainties for use in the Emergency Operating Procedures. The impact of Process Measurement Uncertainty was not specifically addressed for the adverse Containment conditions in the Westinghouse evaluation. This calculation conservatively assumes that additional uncertainties must be included due to the elevated containment temperature for the Indication and Recorder loops.

The assumed temperature for maximum reference leg temperature at operating conditions is 224 Deg F. This temperature was chosen since the reference leg insulation is assumed to prevent heat transfer for the first hour of the accident environment. Per the EQRR Accident Temperature vs Time Profile (Ref 3.5.4), accident temperature is postulated to be below 224 Deg F after the first hour. The insulation is assumed to prevent heat up effects for temperatures exceeding this value for this time duration. This error is a positive bias since increased temperature will result in indication readings higher than actual. Therefore, this uncertainty is applicable to the EOPs that provide indicated values based on decreasing level. Additionally, no decreasing temperature is postulated and therefore no negative uncertainties for the reference leg error are applicable. However, for ease of calculation purposes, and since the negative reference leg error contribution was small; the same uncertainty for the normal and accident negative uncertainty (used for increasing level) was used in the calculation.

6.3 Transmitter Assumptions

6.3.1 Transmitter Normal Radiation Uncertainty

The transmitters evaluated in this calculation are located behind the biological shield and should not be exposed to the maximum normal TID exposure as provided in the EDC (Ref. 3.5.23). Historical "As-Found-As-Left" data was reviewed to verify this assumption. The data reviewed was primarily for the 1153 transmitters that have since been replaced by 1154 Series HH models. The qualifications for radiation provided by Rosemount are typical for both series and the 1154 transmitters are expected to perform as well or better than the 1153 transmitters. The results of the reviewed data determined that the transmitters did not drift outside of the expected allowance. Therefore, it is assumed in this calculation that normal background radiation is not causing excessive drift and that no additional uncertainty needs to be included in this calculation to account for normal radiation exposure.

1IR1

6.4 Rack Assumptions

No Rack Assumptions are required.

6.5 Indicator Assumptions

6.5.1 Readability

Operator actions utilizing Indicated values based on Control Room Indicators are assumed to be based on the digital readout and not the Bargraph and therefore, this calculation does not require an Indicator readability uncertainty.

6.5.2 Hot Shutdown Panel Readability

The hot shutdown panel indicator is analog with a 0-100% scale. Resolution uncertainty is not provided by the vendor, but a readability uncertainty is assumed in this calculation equal to 1/2 the smallest demarcation. The smallest demarcation; 2% for this scale, was field verified.

6.5.3 Temperature Effects

Westinghouse does not publish a temperature effect for the Model 107 Indicator used in the Hot Shutdown Panel. This calculation assumes a default value of ± 0.5% span based on the Salem Setpoint Technical Standard recommendation (Ref. 3.1.1).

6.6 Recorder Assumptions

6.6.1 Recorder Drift

No Drift uncertainty was supplied by the Vendor. This calculation assumes a default value of ± 0.5% span, applicable over the calibration interval, based on the Salem Setpoint Technical Standard recommendation (Ref 3.1.1).

6.6.2 Recorder Readability

No Readability uncertainty was supplied by the vendor. This calculation assumes that the readability for a 0-100% scale is 1/2 the smallest demarcation. Recorders for these loops have a demarcation every 2% (Ref. 3.4.55, 3.4.56).

6.6.3 Recorder Temperature Effects

No temperature effect was supplied by the vendor. This calculation assumes a standard default value of ± 0.5% span based on the Salem Setpoint Technical Standard recommendation (Ref. 3.1.1).

7.0 CALCULATION OF UNCERTAINTIES

7.1 Process Measurement Uncertainties (PM)

(Ref. 3.5.16, Assumption 6.2)

The following Process Measurement Uncertainties are based on the letter received from Westinghouse informing Salem Generating Station that previous PMA terms may not have been conservative (Ref. 3.5.16). Additionally, Westinghouse letter PSE-94-555 (Ref. 3.5.24) was prepared for PSE&G to provide analysis supporting Justification for Past Operation. This letter confirmed that the low and low-low typical PMA values were conservative, and provided additional information that the High-High value was non conservative for Salem by 1%. (see Assumption 6.2). Therefore, the typical values will be utilized with an additional uncertainty of 1% included for the High-High trip, Indication and Recorder functions. 1IR

There are four Process Measurement accuracy terms provided for Steam Generator Water Level. The terms are Process Pressure Variation, Reference Leg Temperature Variation, Fluid Velocity Effects and Downcomer Subcooling Effects. The four individual effects will be combined together to account for the total process measurement bias. 1IR

7.1.1 Process Pressure Variation Effect

After installation of the level measurement system on the steam generator, it is calibrated for a specific set of operating conditions. When the process pressure changes as a consequence of changing operating conditions, a level measurement error is created. An approximation of this measurement error, due to changes in process pressure was provided by Westinghouse. The typical error calculated for the Model 51 Steam Generator is +1.1% span for Low/Low-Low and -4.0% span for the High-High trip function.

7.1.2 Reference Leg Temperature Variation Effect

In addition to assuming a process pressure when the level measurement system is calibrated, a reference leg temperature is assumed. This uncertainty addresses the changes in normal operation ambient temperature, not the elevated containment ambient temperatures experienced in an inside containment high energy line break. Typically, a specific operational temperature is assumed for the purpose of calibration and an allowed operational band is assumed about the reference temperature. Westinghouse calculates two uncertainties for this variable, one in the high direction (bounded by 130 Deg F.) and one in the low direction (typically 100 Deg F.). The typical errors calculated for the Model 51 Steam Generator for Low/Low-Low and High-High trip functions are as follows: For the Low/ Low-Low trip, the error calculated is +0.7% Span. For the High-High trip, the error calculated is -0.30% span.

7.1.3 Downcomer Subcooling Effects

Another source of measurement error is the subcooling of the fluid in the downcomer region in conjunction with a saturated mixture around the steam generator U-tubes. The magnitude of the subcooling in the downcomer is dependent upon the following process conditions; main feedwater temperature, circulation ratio, and location of the feedwater nozzle with respect to the low level tap. The typical error calculated for the Model 51 Steam Generator is +0.5% span.

7.1.4 Fluid Velocity Effects

The Fluid Velocity Effects is a measurement error introduced by fluid flow across the lower tap creating a differential pressure. The uncertainty is a bias in the indicated low level direction. The typical error calculated for the Model 51 Steam Generator is: 0.7% span.

7.1.5 Accident Process Measurement Uncertainties (PM_A)

Some of the Emergency Operating Procedures (EOPs) (See Footnote evaluation Section 9.4) utilizing the Control Room Indicators require the consideration of adverse containment conditions (See Assumption 6.2). This evaluation includes an accident uncertainty which includes additional uncertainty for reference leg heat up based on elevated containment ambient temperatures.

In addition to the Reference Leg Heat Up Effect, the other three PMA terms used for the normal Process Measurement Uncertainty are also applied to the accident condition. The terms are Process Pressure Variation, Fluid Velocity effects and Downcomer Subcooling Effects. Values for those effects will remain the same as previously calculated. These effects are all considered applicable during the accident condition. Downcomer Subcooling effects will only be present for a short time due to the loss of feedwater, however, it is conservatively included in this calculation. An isolated Steam Generator may not be subject to Process Pressure Variation or Fluid Velocity effects, however, this calculation assumes that the unaffected Steam Generators' Indication loops may still be subject to these effects.

Reference Leg Temperature Effect (Accident)

For calibration values see Attachment A and B. See Assumption 6.2, for process assumptions. The analytical expression used for approximating the error due to temperature change in the reference leg (from Ref. 3.5.16), is as follows:

ε (% of span) = $(H_L / H)\{(\rho_{LC} - \rho_L)(100\%)/(\rho_{fc} - \rho_{gc})\}$

Where:

H_L = vertical distance from lower tap to water level in the condensing pot (ft) at operating conditions (12.04 ft or 144.469 inWC)
H = vertical distance between upper and lower taps on the steam generator (ft) at operating conditions (12.04 ft or 144.469 inWC)
ρ_{LC} = water density at pressure and temperature for which the system was calibrated
ρ_L = water density in the reference leg at the time of interest
ρ_{fc} = saturated water density at the pressure for which the system was calibrated
ρ_{gc} = dry saturated steam density at the pressure for which the system was calibrated

Specific Volumes (Ref. 3.5.19, Attachment A, B)

ρ_{LC} = water at 120 °F and 771.22 PSIA = 1/0.01617 (61.84 lbm/ft^3)
ρ_L = water at 224 °F and 771.22 PSIA = 1/0.01676 (59.67 lbm/ft^3)
ρ_{fc} = water at 514.01 °F and 771.22 PSIA = 1/0.020765 (48.16 lbm/ft^3)
ρ_{gc} = steam at 514.01 °F and 771.22 PSIA = 1/0.591682 (1.69 lbm/ft^3)

ε (% of span) = (144.469/144.469){(61.84-59.67) (100%)/(48.16 - 1.69)}

ε (% of span) = + 4.670% span

7.1.6 Total Process Measurement Accuracy

Process Measurement Effect	Low Level Effects	High Level Effects
Reference Leg Temperature Variation	+0.700% (Normal) +4.670% (Accident)	-0.300%
Process Pressure Variation	+1.100%	-4.000%
Downcomer Subcooling	+0.500%	negligible
Fluid Velocity	negligible	-0.700%
High-High Trip Additional Uncertainty (Assumption 6.2)	N/A	-1.000%
Total Process Measurement Effect	+2.300% Normal +6.270% Accident	-6.000%

1IR1

7.2 Insulation Resistance Uncertainty (IR)
(Ref. 3.5.14)

The insulation resistance for the subject loops was determined based on the Engineering Evaluation of Insulation Effects (Ref. 3.5.14), and the Cable Database (Ref. 3.5.18) take off lengths for the cable from the Transmitter racks to the Penetration.

A conservative uncertainty for all Transmitters of +1.649% span is utilized in this calculation based on that evaluation (Configuration 06X) and the installation configurations and take off lengths from the Cable Data Base.

IR = +1.649% span

7.3 Process Element Accuracy (PE)

No primary element (venturi, orifice or elbow) is part of this loop configuration. Therefore, no primary element accuracy is appropriate to this calculation.

PE = ± 0.000% span

7.4 Calculation of Transmitter Uncertainties (XMTR)

Uncertainties are from Design Inputs, Section 5.3 except where noted.

7.4.1 Transmitter Accuracy (RA_{XMTR})

Per design inputs, the vendor accuracy including the combined effects of linearity, hysteresis, and repeatability is ± 0.25% span.

RA_{XMTR} = ± 0.250% span

7.4.2 Transmitter Drift (DR_{XMTR})

Per design inputs, the vendor specified drift over 30 months is ± 0.2% of Upper Range Limit. Per assumption 6.1.1, the drift interval is also assumed to be 30 months, therefore, the drift in terms of percent of calibrated span (107.673 inWC) is as follows:

DR_{XMTR} = ± 0.200% x (150 inWC /107.673 inWC)

DR_{XMTR} = ± 0.279% span.

7.4.3 Transmitter Temperature Effects - Normal (TE_{XMTR})

Per transmitter design inputs, the vendor specified temperature effect is ± (0.15% URL + 0.35% span) per 50°F ambient temperature change.

Per Environmental Design Inputs (Section 5.1.1), the normal temperature variation inside the Containment is 60 to 120°F and per Assumption 6.1.3, the calibration temperature is 70°F. Therefore, the maximum temperature span is 50°F.

TE_{XMTR} = ± [(0.15% (150 inWC/107.673 inWC) + 0.350%)(50°F/50°F)]

Therefore, TE_{XMTR} = ± 0.559% span

7.4.4 Transmitter Temperature Effects Accident (ATE_{XMTR})

Since the transmitters are located in Containment, for calculation of accident conditions, the vendor specified temperature effect for temperatures above the normal specification of 130 Deg F, specified within the "Steam Pressure/Temperature" effect of ± 1.0% URL + 1.0% span is bounding.

ATE_{XMTR} = ± (1.0% x (150 inWC / 107.673 inWC) + 1.0%

Therefore, ATE_{XMTR} = ± 2.393% span

7.4.5 Transmitter Static Pressure Effects (SPE_{XMTR})

Static Pressure Effects are applicable to devices directly connected to a process pressure and which measure a differential pressure. Normal operating pressure for Unit 1 and Unit 2 are slightly different; 759.2 psig for Unit 1 and 756.52 psig for Unit 2 (Ref. Attachment A and B). The higher pressure of 759.2 psig will result in the most conservative error. The vendor stated effects for static pressure include both a zero effect and a span uncertainty that are assumed in this calculation to be dependent effects. The zero effect is ± 0.66% URL per 1000 psi. The span uncertainty is ± 0.5% of reading/1000 psi. The reading is conservatively taken at 140 inWC (Attachment A and B). The combined uncertainty for this application is as follows:

SPE = ±[0.660% (150/107.673) inWC + 0.500%(140/107.673)inWC](759.2/1000)

SPE_{XMTR} = ± 1.192% span

7.4.6 Transmitter Over Pressure Effects (OPE_{XMTR})

Per the Salem Setpoint Technical Standard (Ref. 3.1.1), the overpressure effect accounts for errors in the transmitter performance after exposure to pressures in excess of its normal design range. The design pressure limit for this range code is 3000 psig, and operation is not expected to be over this pressure, therefore, no overpressure effect is considered applicable.

OPE_{XMTR} = ± 0.000% span

7.4.7 Transmitter Power Supply Effects (PS_{XMTR}):

Per the Salem Setpoint Technical Specification (Ref 3.1.1), the voltage variations of the Hagan 121 power supply is ± 2.5 VDC . The vendor states a Transmitter uncertainty of ± 0.005% of output span per volt (input variation). The total uncertainty due to the power supply variation is PS = ± 0.005% /volt x ± 2.5 Volts, resulting in a power supply effect of ± 0.0125% span. Per the Salem Setpoint Technical Standard, if the PS is less than ± 0.050%, the effect may be ignored, therefore:

PS_{XMTR} = ± 0.000% span

7.4.8 Transmitter Humidity Effects (HE_{XMTR})

Per the transmitter design inputs, the humidity limits for this unit are 0-100% RH (NEMA 4X) with no additional uncertainty provided by the vendor. Therefore, no humidity effect is considered applicable.

HE_{XMTR} = ± 0.000% span

7.4.9 Transmitter RFI/EMI Effects (REE_{XMTR})

No RFI or EMI effects were provided by the vendor. Per the Salem Setpoint Technical Standard (Ref. 3.1.1), when no effect is provided by the vendor for this effect, it may be considered not applicable.

REE_{XMTR} = ± 0.000% span

7.4.10 Transmitter Radiation Uncertainty (RE_{XMTR})

Normal Radiation Exposure

Per Assumption 6.3.1, normal radiation effects are assumed to be negligible.

RE_{XMTR} = ± 0.000% span

7.4.11 Transmitter Accident Radiation Uncertainty (ARE_{XMTR})

These transmitters are required to remain operable 120 days after the Design Basis Event (LOCA/MSLB). Per Ref. 3.5.24, the Containment accident radiation condition is 2.93E7 Rads gamma. Per the Rosemount specification, the radiation effect is ± 0.5% URL + 1% span after 55 megrads TID. This uncertainty is conservatively included in the calculation for both the trip function and accident monitoring. 1IR1

ARE_{XMTR} = ± [0.500% (150 inWC/107.673 inWC) + 1.000%]

ARE_{XMTR} = ± 1.697% span

7.4.12 Transmitter Seismic Effect (SE_{XMTR})

No seismic consideration is included in this calculation per assumption 6.1.4.

SE_{XMTR} = ± 0.000% span

7.4.13 Transmitter Post DBE Effect (PDE)

The post accident uncertainty of ± 2.5% URL will account for the expected reference accuracy shift when using the transmitter for up to a year after a design basis event. This error is assumed to replace normal accuracy specifications after conditions have been normalized and the elevated radiation and temperatures no longer exist.

PDE = ± [2.500% (150 inWC / 107.673 inWC)]

PDE = ± 3.483% span

7.4.14 Transmitter Accident Pressure Effect (APE)

The Rosemount Transmitters are qualified beyond the specified accident Containment Pressure. Per EQ-49-2 (Ref. 3.5.1), the specified pressure is 43 psig and the device was qualified for 85 psig. No additional uncertainty was provided by the vendor and therefore, this uncertainty is assumed to be included in the stated environmental effects.

APE = ± 0.000% span

7.4.15 Transmitter Calibration Tolerance (CAL_{XMTR})

Per the transmitter sensor calibration procedures (Ref. 3.6.1.13-3.6.1.24), the Calibration Tolerance (CAL) for the transmitter is established at ± 0.5% span.

CAL_{XMTR} = ± 0.500% span

7.4.16 Transmitter M&TE Tolerance (MTE_{XMTR})

Per calibration procedures (Ref. 3.6.1.13-3.6.1.24), the transmitter input is measured using a Deadweight tester (± 0.1% reading). The reading is conservatively taken at 140 inWC (Attachment A & B), therefore, the uncertainty for the deadweight tester will be 0.1% x 140/107.673; or; ±0.13% span. The output is measured with a Fluke Model 8600A (± 0.05% span).

Additionally, the transmitter output is calibrated using an installed test point resistor assumed to contribute an uncertainty of ± 0.1% span (Ref. 3.1.1).

Total device M&TE uncertainty is the SRSS combination of the input and output M&TE uncertainties is:

MTE1 = ± 0.13% span (Ref. 3.5.2)
MTE2 = ± 0.05% span (Ref. 3.5.2)
MTE3 = ± 0.10% span (Ref. 3.1.1)

$$MTE_{XMTR} = \pm [(MTE1)^2 + (MTE2)^2 + (MTE3)^2]^{1/2}$$
$$MTE_{XMTR} = \pm [(0.13\%)^2 + (0.05\%)^2 + (0.1\%)^2]^{1/2}$$

$$MTE_{XMTR} = \pm 0.171\% \text{ span}$$

7.4.17 Total Transmitter Uncertainty (Normal) ($XMTR_N$)

All random, independent uncertainties associated with the Transmitter are combined below using the SRSS method of error combination. Since the Calibration Tolerance for this device is greater than the Accuracy, this calculation uses the term 'CAL' in the total SRSS equation.

$$XMTR_N = \pm [CAL^2_{XMTR} + DR^2_{XMTR} + TE^2_{XMTR} + MTE^2_{XMTR} + SPE^2_{XMTR}]^{1/2}$$

$$XMTR_N = \pm [(0.5)^2 + (0.279)^2 + (0.559)^2 + (0.171)^2 + (1.192)^2]^{1/2} \% \text{ span}$$
$$XMTR_N = \pm 1.446\% \text{ span}$$

7.4.18 Total Transmitter Uncertainty (Accident) ($XMTR_A$)

This device is required for reactor protection, accident monitoring, EOP actions and is credited for safe shutdown.

The seismic uncertainty is smaller than the combined accident uncertainties, therefore, the total uncertainty does not include the seismic uncertainty (Assumption 6.1.4).

All random, independent uncertainties associated with the Transmitter are combined below using the SRSS method of error combination. Since the Calibration Tolerance for this device is greater than the Accuracy, this calculation uses the term 'CAL' in the total SRSS equation.

$$XMTR_A = \pm [CAL^2_{XMTR} + DR^2_{XMTR} + ATE^2_{XMTR} + MTE^2_{XMTR} + SPE^2_{XMTR} + ARE^2_{XMTR}]^{1/2}$$

$$XMTR_A = \pm [(0.5)^2 + (0.279)^2 + (2.393)^2 + (0.171)^2 + (1.192)^2 + (1.697)^2]^{1/2} \text{ \% span}$$

$$XMTR_A = \pm 3.222\% \text{ span}$$

7.4.19 Total Transmitter Uncertainty (Post Accident) ($XMTR_{PA}$)

All random, independent uncertainties associated with the Transmitter are combined below using the SRSS method of error combination. Since the Calibration Tolerance is smaller than the Post DBE accuracy, this calculation uses the term 'PDE' in the total SRSS equation. ARE and ATE are assumed to no longer be present for the condition calculated below.

$$XMTR_{PA} = \pm [(PDE_{XMTR})^2 + (DR_{XMTR})^2 + (TE_{XMTR})^2 + (MTE_{XMTR})^2 + (SPE_{XMTR})^2]^{1/2}$$
$$XMTR_{PA} = \pm [(3.483\%)^2 + (0.279\%)^2 + (0.559\%)^2 + (0.171\%)^2 + (1.192\%)^2]^{1/2}$$
$$XMTR_{PA} = \pm 3.738\% \text{ span}$$

7.5 Calculation of Rack Uncertainties (RACK)

7.5.1 Calculation of Rack Uncertainties for RACK1 (Rack including Bistable)

Uncertainties are based on design inputs Section 5.4, unless otherwise noted.

7.5.1.1 Rack Calibration Accuracy (CAL_{RACK1})

Per Design Inputs, the Calibration tolerance for the rack is set at ± 0.5% span.

CAL_{RACK1} = ± 0.500% span

7.5.1.2 Rack Temperature Effect (TE_{RACK1})

Per Design Inputs, the Rack Temperature Effect may be assumed to be within ± 0.5% span.

TE_{RACK1} = ± 0.500% span

7.5.1.3 Rack Drift Effect (DR_{RACK1})

Per Design Inputs, the Rack Drift may be assumed to be within ± 1.0% span.

DR_{RACK} = ± 1.000% span

7.5.1.4 Bistable Setting Tolerance (BST_{RACK1})

Per Design Inputs, the Rack Bistable Setting Tolerance is set at ± 0.25% span.

BST_{RACK} = ± 0.250% span

7.5.1.5 Rack MTE Effect (MTE_{RACK1})

Per Design Inputs, the Rack MTE is the Fluke 8600A with an accuracy of ± 0.05% span.
Additionally, where a test resistor or Installed resistor (See Loop Diagram Section 4.0) is included in the loop calibration, the M&TE uncertainty shall include an additional ± 0.1% span to bound the resistor uncertainties (Ref. 3.1.1).

Therefore, the total M&TE for rack devices is the SRSS of MTE1 and MTE2.

$$MTE_{RACK1} = \pm [(MTE1)^2 + (MTE2)^2]^{1/2}$$
$$MTE_{RACK1} = \pm [(0.05\%)^2 + (0.1\%)^2]^{1/2}$$

$$MTE_{RACK1} = \pm 0.112\% \text{ span}$$

7.5.1.6 Rack Static Pressure Effects (SPE_{RACK1})
(Ref. 3.1.1)

Static Pressure Effects are only applicable to devices directly connected to a process pressure and that measure a differential. Static pressure effects are not applicable to this device.

$$SPE_{RACK1} = \pm 0.000\% \text{ span}$$

7.5.1.7 Rack Over Pressure Effects (OPE_{RACK1})
(Ref. 3.1.1)

Over Pressure effects are only applicable to devices connected directly to a process pressure which may be exposed to an overrange condition. Over pressure effects are not applicable to this device.

$$OPE_{RACK1} = \pm 0.000\% \text{ span}$$

CALC. No.: SC-CN001-01					REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1		
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94			

7.5.1.8 Rack Power Supply Effects (PS_{RACK1})
(Ref. 3.1.1)

No power supply uncertainty was supplied by the vendor. Per Salem Setpoint Technical Standard (Ref. 3.1.1), since no effect is published, and these effects are typically small, no default assumption is required.

PS_{RACK1} = ± 0.000% span

7.5.1.9 Rack Humidity Effects (HE_{RACK1})
(Ref. 3.1.1)

No humidity effects were supplied by the vendor. Per the Salem Setpoint Technical Standard (Ref. 3.1.1), the effect may be assumed to be included within the stated environmental effects.

HE_{RACK1} = ± 0.000% span

7.5.1.10 Rack RFI/EMI Effects (REE_{RACK1})
(Ref. 3.1.1)

No RFI or EMI effects were provided by the vendor. These effects are unlikely due to the shielding and regulation of the use of radios and other interference causing devices in the Control room. Per the Salem Setpoint Technical Standard (Ref. 3.1.1) since no uncertainty is provided by the vendor for this effect it may be considered not applicable.

REE_{RACK1} = ± 0.000% span

7.5.1.11 Rack Normal Radiation Effects (RE_{RACK1})
(Ref. 3.1.1)

No radiation effects are specified by the vendor nor are they considered applicable to the mild environment of the Control Room.

RE_{RACK1} = ± 0.000% span

7.5.1.12 Rack Seismic Effect (SE_{RACK1})
(Ref. 3.1.1, 3.1.3)

Per Assumption 6.1.4, no consideration of seismic uncertainty is applicable for this calculation.

$SE_{RACK1} = \pm 0.000\%$ span

7.5.1.13 Total Westinghouse Rack Uncertainty (including Bistable) (RACK1):

All random, independent uncertainties associated with the rack are combined below using the SRSS method of error combination. Additionally; SPE, OPE, PS, HE, REE, RE, and SE effects are all set to zero, therefore:

$$RACK1 = \pm [CAL^2_{RACK1} + DR^2_{RACK1} + TE^2_{RACK1} + BST^2_{RACK1} + MTE^2_{RACK1}]^{1/2}$$

$$RACK1 = \pm [(0.5\%)^2 + (1.0\%)^2 + (0.5\%)^2 + (0.250\%)^2 + (0.112\%)^2]^{1/2}$$

$$RACK1 = \pm 1.255\% \text{ span}$$

7.5.2 Calculation of Rack Uncertainties for Rack 2 (Rack without Bistable)

Uncertainties are from Section 5.4 unless noted otherwise.

7.5.2.1 Rack Calibration Accuracy (CAL_{RACK2})

Per Design Inputs, the Calibration tolerance for the rack is set at ± 0.500% span.

$CAL_{RACK2} = \pm 0.500\%$ span

7.5.2.2 Rack Temperature Effect (TE_{RACK2})

Per Design Inputs, the Rack Temperature Effect may be assumed to be within ± 0.500% span.

$TE_{RACK2} = \pm 0.500\%$ span

7.5.2.3 Rack Drift Effect (DR_{RACK2})

Per Design Inputs, the Rack Drift may be assumed to be within ± 1.0% span.

DR_{RACK2} = ± 1.000% span

7.5.2.4 Rack MTE Effect (MTE_{RACK2})

Per Design Inputs, the Rack MTE is the Fluke 8600A with an accuracy of ± 0.05% span.

The M&TE uncertainty shall include ± 0.1% span for the I/V to bound the resistor uncertainties.

Therefore, the total M&TE for rack devices is the SRSS of MTE1 and MTE2.

$MTE_{RACK2} = \pm [(MTE1)^2 + (MTE2)^2]^{1/2}$
$MTE_{RACK2} = \pm [(0.05\%)^2 + (0.1\%)^2]^{1/2}$

MTE_{RACK2} = ± 0.112% span

7.5.2.5 Rack Static Pressure Effects (SPE_{RACK2})
(Ref. 3.1.1)

Static Pressure Effects are only applicable to devices directly connected to a process pressure and that measure a differential. Static pressure effects are not applicable to this device.

SPE_{RACK2} = ± 0.000% span

7.5.2.6 Rack Over Pressure Effects (OPE_{RACK2})
(Ref. 3.1.1)

Over Pressure effects are only applicable to devices connected directly to a process pressure which may be exposed to an overrange condition. Over pressure effects are not applicable to this device.

OPE_{RACK2} = ± 0.000% span

7.5.2.7 Rack Power Supply Effects (PS_{RACK2})
(Ref. 3.1.1)

No power supply uncertainty was supplied by the vendor. Per Salem Setpoint Technical Standard (Ref. 3.1.1), since no effect is published, and these effects are typically small, no default assumption is required.

PS_{RACK2} = ± 0.000% span

7.5.2.8 Rack Humidity Effects (HE_{RACK2})
(Ref. 3.1.1)

No humidity effects were supplied by the vendor. Per the Salem Setpoint Technical Standard (Ref. 3.1.1), the effect may be assumed to be included within the stated environmental effects.

HE_{RACK2} = ± 0.000% span

7.5.2.9 Rack RFI/EMI Effects (REE_{RACK2})
(Ref. 3.1.1)

No RFI or EMI effects were provided by the vendor. These effects are unlikely due to the shielding and regulation of the use of radios and other interference causing devices in the Control room. Per the Salem Setpoint Technical Standard (Ref. 3.1.1) since no uncertainty is provided by the vendor for this effect it may be considered not applicable.

REE_{RACK2} = ± 0.000% span

7.5.2.10 Rack Normal Radiation Effects (RE_{RACK2})
(Ref. 3.1.1)

No radiation effects are specified by the vendor nor are they considered applicable to the mild environment of the Control Room.

RE_{RACK2} = ± 0.000% span

7.5.2.11 Rack Seismic Effect (SE_{RACK2})
(Assumption 6.1.4)

Per Assumption 6.1.4, no consideration of seismic uncertainty is applicable for this calculation.

$SE_{RACK2} = \pm 0.000\%$ span

7.5.2.12 Total Rack Uncertainty (without Bistable) (RACK2)

All random, independent uncertainties associated with the rack are combined below using the SRSS method of error combination. Additionally; SPE, OPE, PS, HE, REE, RE, and SE effects are all set to zero, therefore:

$$RACK2 = \pm [(CAL_{RACK2})^2 + (DR_{RACK2})^2 + (TE_{RACK2})^2 + (MTE_{RACK2})^2]^{1/2}$$

$$RACK2 = \pm [(0.5\%)^2 + (1.0\%)^2 + (0.5\%)^2 + (0.112\%)^2]^{1/2}$$

$$RACK2 = \pm 1.230\% \text{ span}$$

7.6 Calculation Of Control Room Indicator Uncertainties (IND_{CR})

Uncertainties are from Design Inputs Section 5.5, unless otherwise noted.

7.6.1 Indicator Accuracy (RA_{IND})

Per Design Inputs, the accuracy of the Indication is ± 0.100% FS at 25 °C (77 °F assumed to be based on approximate calibration temperature).

Therefore: $RA_{IND} = 0.100\%$ span

7.6.2 Indicator Drift (DR_{IND})

Per vendor specification, the Indicator drift is ± 0.016% per month (FS) . This specification is considered a random effect for the drift interval. Per Assumption 6.1.1, the drift interval is 30 months. Therefore, the calculated Indicator drift is as follows:

$DR_{IND} = \pm[(0.016\%)^2 * 30]^{1/2}$
$DR_{IND} = \pm 0.088\%$ span

7.6.3 Indicator Temperature Effect (TE_{IND})

Indicator Temperature effects are stated as having a zero effect of ± 0.010% per Degree C (± 0.006% per °F) and a gain of ± 0.02% per Degree C (± 0.011% per °F). These uncertainties are assumed to be dependent to each other, but independent from any other Indicator uncertainty. They are combined algebraically here for inclusion as a single random term in the total device uncertainty. Per Section 5.1.1, temperature will vary by approximately 15 °F from calibration.

Temperature effect; zero = ± 0.006 × 15 °F = ± 0.090% span
Temperature effect; span = ± 0.011 × 15 °F = ± 0.165% span

$TE_{IND} = \pm (TE_{zero} + TE_{span})$

$TE_{IND} = \pm (0.090\% + 0.165\%)$
$TE_{IND} = \pm 0.255\%$ span

7.6.4 Indicator Static Pressure Effects (SPE_{IND})
(Ref. 3.1.1)

Static Pressure Effects are only applicable to devices directly connected to a process pressure and that measure a differential. Static pressure effects are not applicable to this device.

$SPE_{IND} = \pm 0.000\%$ span

7.6.5 Indicator Over Pressure Effects (OPE_{IND})
(Ref. 3.1.1)

Over Pressure effects are only applicable to devices connected directly to a process pressure which may be exposed to an overrange condition. Over pressure effects are not applicable to this device.

$OPE_{IND} = \pm 0.000\%$ span

7.6.6 Indicator Power Supply Effects (PS_{IND})
(Ref. 3.1.1)

No power supply uncertainty was supplied by the vendor. Per Salem Setpoint Technical Standard, since no effect is published, and these effects are typically small, no default assumption is required.

PS_{IND} = ± 0.000% span

7.6.7 Indicator Humidity Effects (HE_{IND})
(Ref. 3.1.1)

No humidity effects were supplied by the vendor. Per the Salem Setpoint Technical Standard, the effect may be assumed to be included within the other stated environmental effects.

HE_{IND} = ± 0.000% span

7.6.8 Indicator RFI/EMI Effects (REE_{IND})
(Ref. 3.1.1)

No RFI or EMI effects were provided by the vendor. These effects are unlikely due to the shielding and regulation of the use of radios and other interference causing devices in the Control room. Per the Salem Setpoint Technical Standard (Ref. 3.1.1) since no uncertainty is provided by the vendor for this effect it may be considered not applicable.

REE_{IND} = ± 0.000% span

7.6.9 Indicator Radiation Effects (RE_{IND})
(Ref. 3.1.1)

No radiation effects are specified by the vendor nor are they considered applicable to the controlled environment of the Control Room.

RE_{IND} = ± 0.000% span

7.6.10 Indicator Seismic Effect (SE_{IND})
(Ref. 3.1.1)

Per Assumption 6.1.4, no consideration of seismic uncertainty is applicable for this calculation.

SE_{IND} = ± 0.000% span

7.6.11 Indicator Reading Error (RD_{IND})

Based on Assumption 6.5.1, no inclusion of Reading error is applicable to this calculation.

RD_{IND} = ± 0.000% span

7.6.12 Indicator Calibration Tolerance (CAL_{IND})

Per Procedure (Ref. 3.6.1.1-3.6.1.12), the Calibration Tolerance for the Indicator is set at ± 1.0% span.

CAL_{IND} = ± 1.000% span

7.6.13 Indicator M&TE (MTE_{IND})

Per Design Inputs, the Indicator MTE is the Fluke 8600A with an accuracy of ± 0.05% span. Additionally, where a test resistor or Installed resistor (See Loop Diagram Section 4.0) is included in the loop calibration, the M&TE uncertainty shall include an additional ± 0.1% span to bound the resistor uncertainties. (Ref. 3.1.1)

Therefore, the total M&TE for rack devices is the SRSS of MTE1 and MTE2.

$$MTE_{IND} = \pm [(MTE1)^2 + (MTE2)^2]^{1/2}$$
$$MTE_{IND} = \pm [(0.05\%)^2 + (0.1\%)^2]^{1/2}$$

MTE_{IND} = ± 0.112% span

7.6.14 Total Control Room Indicator Uncertainty (IND_{CR})

Since all uncertainties associated with the Indicator performance are considered random and independent, they are combined using the SRSS combination method. Additionally, since Calibration Tolerance is greater than the reference accuracy, this calculation will utilize (CAL) in the SRSS equation. SPE, OPE, PS, HE, REE, RE, RD, and SE are all set to zero, therefore:

$$IND_{CR} = \pm [(CAL_{IND})^2 + (DR_{IND})^2 + (TE_{IND})^2 + (MTE_{IND})^2]^{1/2}$$

$$IND_{CR} = \pm [(1.000\%)^2 + (0.088\%)^2 + (0.255\%)^2 + (0.112\%)^2]^{1/2}$$

$$IND_{CR} = \pm 1.042\% \text{ span}$$

7.7 Calculation Of Hot Shutdown Indicator Uncertainties (IND_{HS})

Uncertainties for the Westinghouse indicators are from Design Inputs Section 5.6.

7.7.1 Hot Shutdown Indicator Accuracy (RA_{IND})

Per Design Inputs, the accuracy of the indicator is ± 1.5% of full scale.

$$RA_{IND} = \pm 1.500\% \text{ span}$$

7.7.2 Hot Shutdown Indicator Drift (DR_{IND})

Westinghouse does not specify a value for Indicator drift. Per the Salem Setpoint Technical Standard recommendation, this calculation includes a default value equal to instrument reference accuracy.

$$DR_{IND} = \pm 1.500\% \text{ span}$$

7.7.3 Hot Shutdown Indicator Temperature Effect (TE_{IND})

Westinghouse does not publish a temperature effect. Per the Salem Setpoint Technical Standard recommendation, this calculation includes a default value of ± 0.5% span.

$$TE_{IND} = \pm 0.500\% \text{ span}$$

7.7.4 Hot Shutdown Indicator Static Pressure Effects (SPE_{IND})
(Ref. 3.1.1)

Static Pressure Effects are only applicable to devices directly connected to a process pressure and that measure a differential. Static pressure effects are not applicable to this device.

SPE_{IND} = ± 0.000% span

7.7.5 Hot Shutdown Indicator Over Pressure Effects (OPE_{IND})
(Ref. 3.1.1)

Over Pressure effects are only applicable to devices connected directly to a process pressure and which may be exposed to an overrange condition. Over pressure effects are not applicable to this device.

OPE_{IND} = ± 0.000% span

7.7.6 Hot Shutdown Indicator Power Supply Effects (PS_{IND})
(Ref. 3.1.1)

No power supply uncertainty was supplied by the vendors. Per Salem Setpoint Technical Standard, since no effect is published, and these effects are typically small, no default assumption is required.

PS_{IND} = ± 0.000% span

7.7.7 Hot Shutdown Indicator Humidity Effects (HE_{IND})
(Ref. 3.1.1)

No humidity effects were supplied by the vendors. Per the Salem Setpoint Technical Standard, the effect may be assumed to be included within the other stated environmental effects.

HE_{IND} = ± 0.000% span

7.7.8 Hot Shutdown Indicator RFI/EMI Effects (REE_{IND})
(Ref. 3.1.1)

No RFI or EMI effects were provided by the vendor. These effects are unlikely due to the shielding and regulation of the use of radios and other interference causing devices in the Control room. Per the Salem Setpoint Technical Standard (Ref. 3.1.1) since no uncertainty is provided by the vendor for this effect it may be considered not applicable.

$REE_{IND} = \pm 0.000\%$ span

7.7.9 Hot Shutdown Indicator Radiation Effects (RE_{IND})
(Ref. 3.1.1)

No radiation effects are specified by the vendors nor are they considered applicable to the controlled environment of the Control Room.

$RE_{IND} = \pm 0.000\%$ span

7.7.10 Hot Shutdown Indicator Seismic Effect (SE_{IND})
(Ref. 3.1.1)

Per Assumption 6.1.4, no consideration of seismic uncertainty is required for this calculation.

$SE_{IND} = \pm 0.000\%$ span

7.7.11 Hot Shutdown Indicator Reading Error (RD_{IND})
(Assumptions 6.5.2)

The Westinghouse indicator has only a bargraph scale so that a reading error is required for this calculation. The reading error is taken as one-half of a minor scale division (Ref. 3.1.1). The scale is linear; 0-100% and the readability is assumed to be within 1.0%.

$RD_{IND} = \pm 1.000\%$ span

7.7.12 Indicator Calibration Tolerance (CAL_{IND})
(Ref. 3.6.1)

The Calibration Tolerance for the Hot Shutdown Panel indicator is ± 1.500% span.

CAL_{IND} = ± 1.500% span

7.7.13 Indicator M&TE (MTE_{IND})

Per Design Inputs, the Indicator MTE is the Fluke 8600A with an accuracy of ± 0.05% span. Additionally, where a test resistor or Installed resistor (See Loop Diagram Section 4.0) is included in the loop calibration, the M&TE uncertainty shall include an additional ± 0.1% span to bound the resistor uncertainties. (Ref. 3.1.1)

Therefore, the total M&TE for rack devices is the SRSS of MTE1 and MTE2.

$$MTE_{IND} = \pm [(MTE1)^2 + (MTE2)^2]^{1/2}$$
$$MTE_{IND} = \pm [(0.05\%)^2 + (0.1\%)^2]^{1/2}$$

MTE_{IND} = ± 0.112% span

7.7.14 Total Hot Shutdown Panel Indicator Uncertainty (IND_{HS})

Since all uncertainties associated with the Indicator performance are considered random and independent, they are combined using the SRSS combination method. Additionally, only the larger value of Calibration Tolerance or Reference Accuracy was utilized in the equation.

$$IND_{HS} = \pm [(CAL_{IND})^2 + (DR_{IND})^2 + (TE_{IND})^2 + (MTE_{IND})^2 + (RD_{IND})^2]^{1/2}$$

$$IND_{HS} = \pm [(1.500\%)^2 + (1.500\%)^2 + (0.500\%)^2 + (0.112\%)^2 + (1.000\%)^2]^{1/2}$$

IND_{HS} = ± 2.401% span

7.8 Calculation Of Recorder Uncertainties (REC)

Uncertainties from Section 5.7 except where noted.

7.8.1 Recorder Reference Accuracy (RA_{REC})

Per design inputs, the accuracy for the recorder, based on Full Range is ± 0.5%.

RA_{REC} = ± 0.500% span

7.8.2 Recorder Deadband (DB_{REC})

Per design inputs, the deadband for this device is ± 0.25% span maximum. This deadband specification represents the sensitivity throughout the output range of the recorder to actual input signal change.

DB_{REC} = ± 0.250% span

7.8.3 Recorder Drift (DR_{REC})

No drift effect was supplied by the vendor. Per Assumption 6.6.1, this calculation includes a default value of ± 0.5% span.

DR_{REC} = ± 0.500% span

7.8.4 Recorder Temperature Effect (TE_{REC})

No temperature effects were specified by the vendor. Per Assumption 6.6.3, this calculation includes a default value of ± 0.5% span.

TE_{REC} = ± 0.500% span

7.8.5 Recorder Static Pressure Effects (SPE_{REC})

Static Pressure Effects are only applicable to devices directly connected to a process pressure and which measure a differential. Static pressure effects are not applicable to this device.

SPE_{REC} = ± 0.000% span

7.8.6 Recorder Over Pressure Effects (OPE_{REC})

Over Pressure effects are only applicable to devices connected directly to a process pressure which may be exposed to an overrange condition. Over pressure effects are not applicable to this device.

$OPE_{REC} = \pm 0.000\%$ span

7.8.7 Recorder Power Supply Effects (PS_{REC})

No power supply uncertainty was supplied by the vendor. Per Salem Setpoint Technical Standard (Ref. 3.1.1), since no effect is published, and these effects are typically small, no default assumption is required.

$PS_{REC} = \pm 0.000\%$ span

7.8.8 Recorder Humidity Effects (HE_{REC})

No humidity effects were supplied by the vendor. Therefore, per the Salem Setpoint Technical Standard (Ref. 3.1.1), the effect is assumed to be included within the stated environmental effects.

$HE_{REC} = \pm 0.000\%$ span

7.8.9 Recorder RFI/EMI Effects (REE_{REC})

No RFI or EMI effects were provided by the vendor. These effects are unlikely due to the shielding and regulation of the use of radios and other interference causing devices in the Control room. Per the Salem Setpoint Technical Standard (Ref. 3.1.1) since no uncertainty is provided by the vendor for this effect it may be considered not applicable.

$REE_{REC} = \pm 0.000\%$ span

7.8.10 Recorder Radiation Effects (RE_{REC})

No radiation effects are specified by the vendor nor are they considered applicable to the controlled environment of the Control Room.

$RE_{REC} = \pm 0.000\%$ span

7.8.11 Recorder Seismic Effect (SE_{REC})

Per Assumption 6.1.4, no consideration of seismic uncertainty is applicable for this calculation.

SE_{REC} = ± 0.000% span

7.8.12 Recorder Reading Error (RD_{REC})

No readability effect was supplied by the vendor for this device. The recorder scale is 0 to 100%. Per Assumption 6.6.2, readability is 1/2 the smallest demarcation. Since the demarcations are every 2%, the readability uncertainty is ± 1% span .

RD_{REC} = ± 1.000% span

7.8.13 Recorder Calibration Tolerance (CAL_{REC})

Per Procedure (Ref. 3.6.1.1-3.6.1.12), the calibration tolerance for the Recorder is set at ± 1.000% span.

CAL_{REC} = ± 1.000% span

7.8.14 Recorder M&TE (MTE_{REC})

Per Design Inputs, the Recorder MTE is the Fluke 8600A with an accuracy of ± 0.05% span. Additionally, where an Installed resistor (See Loop Diagram Section 4.0) is included in the loop calibration, the M&TE uncertainty shall include an additional ± 0.1% span to bound the resistor uncertainties (Ref. 3.1.1).

Therefore, the total M&TE for rack devices is the SRSS of MTE1 and MTE2.

$MTE_{REC} = \pm [(MTE1)^2 + (MTE2)^2]^{1/2}$
$MTE_{REC} = \pm [(0.05\%)^2 + (0.1\%)^2]^{1/2}$
$MTE_{REC} = \pm 0.112\%$ span

CALC. No.: SC-CN001-01			REFERENCE:			
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

7.8.15 Total Recorder Uncertainty (REC)

Since all uncertainties associated with the Recorder performance are considered random and independent, they are combined using the SRSS combination method. Additionally, since Calibration Tolerance is greater than the reference accuracy, this calculation will utilize CAL in the SRSS equation. SPE, OPE, PS, HE, REE, RE, and SE are all set to zero.

$$REC = \pm [CAL^2_{REC} + DB^2_{REC} + DR^2_{REC} + TE^2_{REC} + RD^2_{REC} + MTE^2_{REC}]^{1/2}$$

$$REC = \pm [(1.000)^2 + (0.250)^2 + (0.500)^2 + (0.500)^2 + (1.000)^2 + (0.112)^2]^{1/2} \text{ \% span}$$

$$REC = \pm 1.605\% \text{ span}$$

7.9 Channel Error Analysis

7.9.1 Summary of Uncertainties:

Uncertainty Source	Total Uncertainty % span
Process Measurement Normal (Section 7.1)	+2.300% (For Low Trip Function) -6.000% (For High Trip Function)
Process Measurement Accident (Section 7.1)	+6.270% (For Low Trip Function) -6.000% (For High Trip Function)
Insulation Resistance (Section 7.2)	+1.649%
Section 7.4 Transmitter (Normal) Transmitter (Accident) Transmitter (Post Acc)	± 1.446% ± 3.222% ± 3.738%
Rack1 (Section 7.5.1) Rack2 (Section 7.5.2)	± 1.255% ± 1.230%
Control Room Indicator (Ref. 7.6)	± 1.042%
Hot Shutdown Indicator (Ref. 7.7)	± 2.401%
Recorder (Ref. 7.8)	±1.605%

1IR1

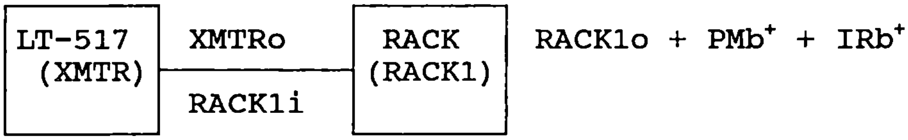
1IR1

7.10 Propagation of Error

7.10.1 Channel Uncertainty Determination for Configuration A and C (Transmitter through Rack/Bistable Low-Low and Low Level Trip)

See Section 1.2 for a complete listing of Component ID's.

The following is a representation of the error propagation throughout the Channel for Configuration A including process uncertainties calculated for the normal and trip conditions, accident transmitter uncertainties and IR effects.



PM = +2.300% span ,
IR = +1.649% span
$XMTR_A$ = ±3.222% span (Accident)
RACK1 = ±1.255% span (with Bistable)

$XMTRo = \pm [(XMTR_A)^2]^{1/2} + PMb^+ + IRb^+$

$XMTRo = \pm [(3.222\%)^2]^{1/2} + 2.300\% + 1.649\%,$

XMTRo = + 7.171% span
- 3.222% span

$RACK1o = \pm[(XMTR)^2 + (RACK1)^2]^{1/2} + PMb^+ + IRb^+$

$RACK1o = \pm[(3.222\%)^2 + (1.255\%)^2]^{1/2} + 2.300\% + 1.649\%$,

RACK1o = + 7.407% span
- 3.458% span

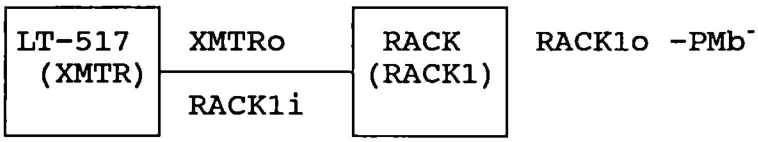
CU = + 7.407% span, - 3.458% span

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET				SHEET: 101 CONT'D ON SHEET:
CALC. No.: SC-CN001-01			REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94	

7.10.2 Channel Uncertainty Determination for Configuration B (Transmitter through Rack/Bistable High-High Trip)

See Section 1.2 for a complete listing of Component ID's.

The following is a representation of the error propagation throughout the Channel for Configuration B, including process uncertainties for the normal and trip conditions. No accident uncertainties are included.



PM = - 6.000% span
$XMTR_N$ = ±1.446% span (Normal)
RACK1 = ±1.255% span (with Bistable)

XMTRo = $\pm [(XMTR)^2]^{1/2} - PMb^-$

XMTRo = $\pm [(1.446\%)^2]^{1/2} - 6.000\%$ span

XMTRo = + 1.446% span, - 7.446% span

RACK1o = $\pm[(XMTR)^2 + (RACK1)^2]^{1/2} - PMb^-$

RACK1o = $\pm[(1.446\%)^2 + (1.255\%)^2]^{1/2} - 6.000\%$

RACK1o = + 1.915% span, - 7.915% span

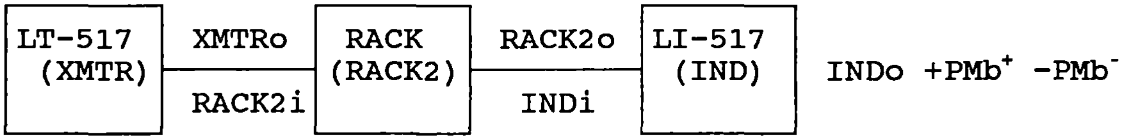
CU = + 1.915% span, - 7.915% span

7.10.3 Channel Uncertainty Determination for Configuration D (Transmitter through Indicator) ($IND_{CR}o$)

7.10.3.1 Control Room Indicator Normal Uncertainties

The following is a representation of the error propagation throughout the Channel for Configuration D under normal conditions.

See Section 1.2 for a complete listing of Component ID's.



PM = +2.300% span , -6.000% span
IR = N/A
$XMTR_N$ = ±1.446% span (Normal)
RACK2 = ±1.230% span

XMTRo = $\pm [XMTR^2]^{1/2} + PMb^+ - PMb^-$
XMTRo = $\pm [(1.446\%)^2]^{1/2} + 2.300\% - 6.000\%$

XMTRo = + 3.746% span, - 7.446% span

RACK2o = $\pm [(XMTR)^2 + (RACK2)^2]^{1/2} + PMb^+ - PMb^-$
RACK2o = $\pm [(1.446\%)^2 + (1.230\%)^2]^{1/2} + 2.300\% - 6.000\%$

RACK2o = + 4.198% span , - 7.898% span

$IND_{CR}o$ = $\pm [(XMTR)^2 + (RACK2)^2 + (IND)^2]^{1/2} + PMb^+ - PMb^-$
$IND_{CR}o$ = $\pm [(1.446\%)^2 + (1.230\%)^2 + (1.042)^2]^{1/2} + 2.300\% - 6.000\%$

$IND_{CR}o$ = + 4.466% span, - 8.166% span

CU = + 4.466% span, - 8.166% span

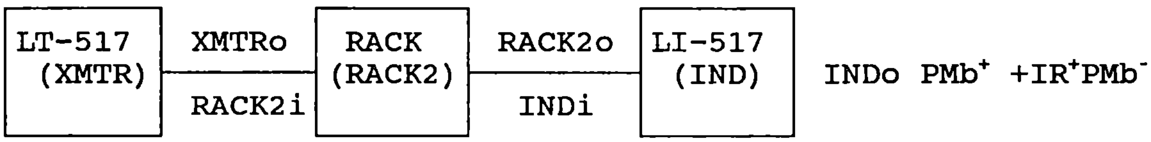
1IR1

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET	SHEET: 103 CONT'D ON SHEET:				
CALC. No.: SC-CN001-01		REFERENCE:				
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

7.10.3.2 Control Room Indicator Accident Uncertainties

The following is a representation of the error propagation throughout the Channel for Configuration D including accident calculated process uncertainties, accident transmitter uncertainties and IR effects.

See Section 1.2 for a complete listing of Component ID's.



$PM = +\ 6.270\%$ span, $-\ 6.000\%$ span
$IR = +\ 1.649\%$ span
$XMTR_A = \pm\ 3.222\%$ span (Accident)
$RACK2 = \pm\ 1.230\%$ span

$XMTRo = \pm\ [(XMTR)^2]^{1/2} + PMb^+ + IRb^+ - PMb^-$
$XMTRo = \pm\ [(3.222\%)^2]^{1/2} + 6.270\% + 1.649\% - 6.000\%$

$XMTRo = +\ 11.141\%$ span, $-\ 9.222\%$ span

$RACK2o = \pm\ [(XMTR)^2 + (RACK2)^2]^{1/2} + PMb^+ + IRb^+ - PMb^-$
$RACK2o = \pm\ [(3.222\%)^2 + (1.230\%)^2]^{1/2} + 6.270\% + 1.649\% - 6.000\%$

$RACK2o = +\ 11.368\%$ span, $-\ 9.449\%$ span

$IND_{CR}o = \pm\ [(XMTR)^2 + (RACK2)^2 + (IND)^2]^{1/2} + PMb^+ + IRb^+ - PMb^-$
$IND_{CR}o = \pm\ [(3.222\%)^2 + (1.230\%)^2 + (1.042\%)^2]^{1/2} + 6.270\% + 1.649\% - 6.000\%$

$IND_{CR}o = +\ 11.522\%$ span, $-\ 9.603\%$ span

CU = + 11.522% span, - 9.603% span

IR1

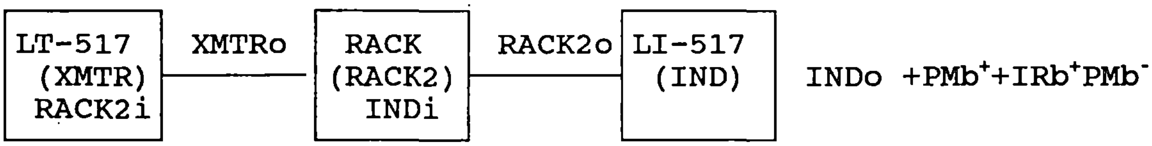
PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET	SHEET: 104 CONT'D ON SHEET:

CALC. No.: SC-CN001-01					REFERENCE:	
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

7.10.3.3 <u>Control Room Indicator Post Accident Uncertainties</u>

The following is a representation of the error propagation throughout the Channel for Configuration D for post accident conditions. The uncertainty is comprised of the normal process uncertainties and post DBE transmitter uncertainties. The IR effect is also included as it is assumed to be residual.

See Section 1.2 for a complete listing of Component ID's.



PM = $+2.300\%$ span , -6.000% span
IR = $+1.649\%$ span
$XMTR_{PA}$ = $\pm 3.738\%$ span (Post Accident)
RACK2 = $\pm 1.230\%$ span

IR1

XMTRo = $\pm [(XMTR)^2]^{1/2} + PMb^+ ,+ IRb^+, -PMb^-$
XMTRo = $\pm [(3.738\%)^2] + 2.300\%, + 1.649\%, - 6.000\%$

XMTRo = $+ 7.687\%$ span, $- 9.738\%$ span

RACK2o = $\pm [(XMTR)^2 + (RACK2)^2]^{1/2} + PMb^+ + IRb^+ -PMb^-$
RACK2o = $\pm [(3.738\%)^2 + (1.230\%)^2]^{1/2} + 2.300\% + 1.649\% - 6.000\%$

RACK2o = $+ 7.884\%$ span , $- 9.935\%$ span

$IND_{CR}o$ = $\pm [(XMTR)^2 + (RACK2)^2 + (IND)^2]^{1/2} + PMb^+ + IRb^+$
$IND_{CR}o$ = $\pm [(3.738\%)^2 + (1.230\%)^2 + (1.042)^2]^{1/2} +2.300\% +1.649\% -6.000\%$

$IND_{CR}o$ = $+ 8.020\%$ span, $- 10.071\%$ span

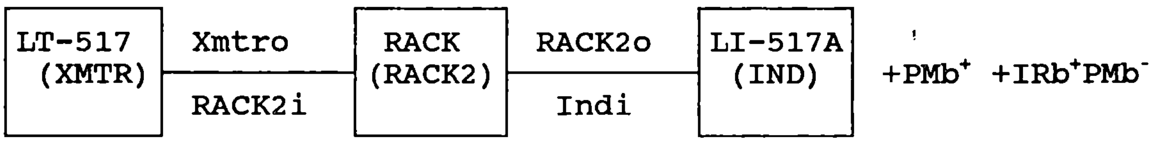
CU = + 8.020% span, - 10.071% span

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET				SHEET: 105 CONT'D ON SHEET:
CALC. No.: SC-CN001-01			REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94	

7.10.4 Channel Uncertainty Determination for Configuration E (Transmitter through Hot Shutdown Indicator) ($IND_{HS}o$)

The following is a representation of the error propagation throughout the Channel for Configuration E. Only normal conditions are calculated.

See Section 1.2 for Complete listing of Component ID's.



PM = +2.300% span , -6.000% span
IR = N/A
$XMTR_N$ = ±1.446% span (Normal)
RACK2 = ±1.230% span

$XMTRo = \pm [(XMTR)^2]^{1/2} + PMb^+ - PMb^-$
$XMTRo = \pm [(1.446\%)^2]^{1/2} + 2.300\% - 6.000\%$

XMTRo = + 3.746% span, - 7.446% span

$RACK2o = \pm [(XMTR)^2 + (RACK2)^2]^{1/2} + PMb^+ - PMb^-$
$RACK2o = \pm [(1.446\%)^2 + (1.230\%)^2]^{1/2} + 2.300\% - 6.000\%$

RACK2o = + 4.198% span , - 7.898% span

$IND_{HS}o = \pm [(XMTR)^2 + (RACK2)^2 + (IND)^2]^{1/2} + PMb^+ - PMb^-$
$IND_{HS}o = \pm [(1.446\%)^2 + (1.230\%)^2 + (2.401\%)^2]^{1/2} + 2.300\% - 6.000\%$

$IND_{HS}o$ = + 5.361% span, -9.061% span

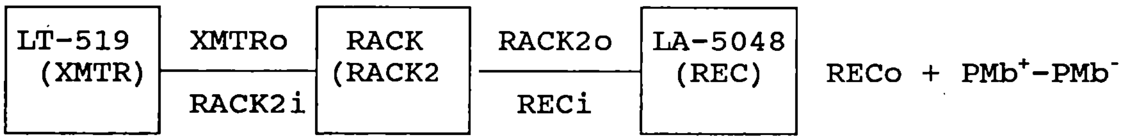
CU = + 5.361% span, - 9.061% span

7.10.5 Total Channel Uncertainty Configuration F (Transmitter through Recorder)

7.10.5.1 Recorder Normal Uncertainties

The following is a representation of the error propagation throughout the Channel for Configuration F for normal conditions.

See Section 1.2 for complete listing of Component ID's.



PM = +2.300% span , -6.000% span
IR = N/A
$XMTR_N$ = ±1.446% span (Normal)
RACK2 = ±1.230% span
REC = ± 1.605% span

1IR1

$XMTRo = \pm [XMTR^2]^{1/2} + PMb^+ - PMb^-$
$XMTRo = \pm [(1.446\%)^2] + 2.300\% - 6.000\%$

XMTRo = + 3.746% span, - 7.446% span

$RACK2o = \pm [(XMTR)^2 + (RACK2)^2]^{1/2} + PMb^+ - PMb^-$
$RACK2o = \pm [(1.446\%)^2 + (1.230\%)^2]^{1/2} + 2.300\% - 6.000\%$

RACK2o = + 4.198% span , - 7.898% span

$RECo = \pm [(XMTR)^2 + (RACK2)^2 + (REC)^2]^{1/2} + PMb^+ - PMb^-$
$RECo = \pm [(1.446\%)^2 + (1.230\%)^2 + (1.605)^2]^{1/2} + 2.300\% - 6.000\%$

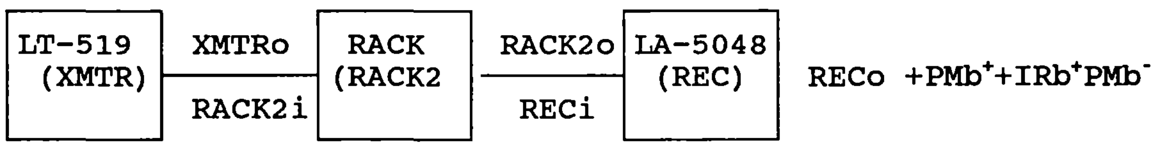
RECo = + 4.786% span, - 8.486% span

CU = + 4.786% span, - 8.486% span

7.10.5.2 Recorder Accident Uncertainties

The following is a representation of the error propagation throughout the Channel for Configuration F for an accident condition. The uncertainty is comprised of accident transmitter effects, accident process uncertainties and IR effects.

See Section 1.2 for complete listing of Component ID's.



PM = $+ 6.270\%$ span , $- 6.000\%$ span
IR = $+ 1.649\%$ span
$XMTR_A$ = $\pm 3.222\%$ span (Accident)
RACK2 = $\pm 1.230\%$ span
REC = $\pm 1.605\%$ span

1IR1

XMTRo = $\pm [(XMTR)^2]^{1/2} + PMb^+ + IRb^+ - PMb^-$
XMTRo = $\pm [(3.222\%)^2] + 6.270\% + 1.649\% - 6.000\%$

XMTRo = $+ 11.141\%$ span, -9.222% span

RACK2o = $\pm [(XMTR)^2 + (RACK2)^2]^{1/2} + PMb^+ + IRb^+ - PMb^-$
RACK2o = $\pm [(3.222\%)^2 + (1.230\%)^2]^{1/2} + 6.270\% + 1.649\% - 6.000\%$

RACK2o = $+ 11.368\%$ span , -9.449% span

RECo = $\pm [(XMTR)^2 + (RACK2)^2 + (REC)^2]^{1/2} + PMb^+ + IRb^+ - PMb^-$
RECo = $\pm [(3.222\%)^2 + (1.230\%)^2 + (1.605\%)^2]^{1/2} + 6.270\% + 1.649\% -6.000\%$

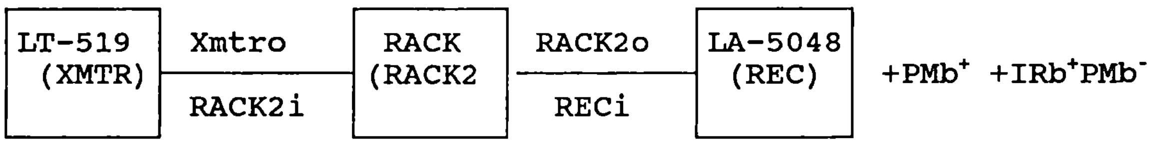
RECo = $+ 11.723\%$ span, $- 9.804\%$ span

CU = $+ 11.723\%$ span, $- 9.804\%$ span

7.10.5.3 Recorder Post Accident Uncertainties

The following is a representation of the error propagation throughout the Channel for Configuration F for post accident conditions.

See Section 1.2 for complete listing of Component ID's.



PM = $+ 2.300\%$ span , $- 6.000\%$ span
IR = $+ 1.649\%$ span
$XMTR_{PA}$ = $\pm 3.738\%$ span (Post Accident)
RACK2 = $\pm 1.230\%$ span
REC = $\pm 1.605\%$ span
XMTRo = $\pm [(XMTR)^2]^{1/2} + PMb^+ + IRb^+ - PMb^-$
XMTRo = $\pm [(3.738\%)^2] + 2.300\% + 1.649\% - 6.000\%$

XMTRo = $+ 7.687\%$ span, $- 9.738\%$ span

RACK2o = $\pm [(XMTR)^2 + (RACK2)^2]^{1/2} + PMb^+ + IRb^+ - PMb^-$
RACK2o = $\pm [(3.738\%)^2 + (1.230\%)^2]^{1/2} + 2.300\% + 1.649\% - 6.000\%$

RACK2o = $+ 7.884\%$ span, $- 9.935\%$ span

RECo = $\pm [(XMTR)^2 + (RACK2)^2 + (REC)^2]^{1/2} + PMb^+ + IRb^+ - PMb^-$
RECo = $\pm [(3.738\%)^2 + (1.230\%)^2 + (1.605\%)^2]^{1/2} + 2.300\% + 1.649\% - 6.000\%$

RECo = $+ 8.199\%$ span, $- 10.250\%$ span

CU = $+ 8.199\%$ span, $- 10.250\%$ span

1IR1

7.11 Summary of Channel Uncertainties

SUMMARY OF UNCERTAINTIES			
Configuration	Normal	Accident	Post Accident
A (Low-Low Trip) C (Low Trip)	N/A	+ 7.407%, - 3.458%	N/A
B (High-High Trip)	+ 1.915%, - 7.915%	N/A	N/A
D (Control Room Indication)	+ 4.466%, -8.166%	+ 11.522%, -9.603%	+8.020%, -10.071%
E (Hot Shutdown Indication)	+ 5.361%, - 9.061%	N/A	N/A
F (Recorder)	+ 4.786%, -8.486%	+11.723%, -9.804%	+8.199%, -10.250%

1IR1

8.0 CALCULATION OF SETPOINTS

This section includes the Calculated Setpoints and the Allowable Values used to support Technical Specification compliance. In addition, this calculation section includes the Acceptable Values for instruments other than the setpoints to provide administrative controls for total loop performance.

8.1 Calculated Setpoints

8.1.1 Calculated Setpoint for the Low-Low Trip

Per Section 2.2.2, the existing Technical Specification setpoint and allowable value is:

Functional Unit	Trip Setpoint	Allowable Value
Steam Generator Water Level Low-Low	≥ 16% of NR Instr span each Steam Generator	≥ 14.8% of NR Instr span each Steam Generator

The Analytical Limit for the Low-Low Trip is 0% span, since a level in the Narrow Range in any intact Steam Generator is sufficient to ensure an adequate secondary inventory for a secondary heat sink.

The Calculated Setpoint for the Low Low Trip is established by adding the positive direction Channel Uncertainty (CU) to the Analytical limit. Margin is added for conservatism.

Where: $AL = 0\%$
$CU = 7.407\%$

$CS = AL + CU + M$
$CS = 0\% + 7.407\% + 1.593\%$

$CS = 9.0\%$ span

The calculated setpoint shown above is the minimum value which the setpoint may be set in the field for a 95% confidence that the Analytical Limit is protected. The actual setpoint in the field is currently set conservatively away from this value.

The Low-Low trip setpoint may be set at 9.0%, and adequately protect the Analytical Limit. This calculation recommends that this value be established.

Recommended Low-Low Setpoint Tech Spec Change

Functional Unit	Trip Setpoint	Allowable Value
Steam Generator Water Level Low-Low	≥ 9% of NR Instr span each Steam Generator	≥ 8% of NR Instr span each Steam Generator

1IR1

8.1.2 Calculated Setpoint for the Low Trip

Per Section 2.2.2, the existing Technical Specification setpoint and allowable value is:

Functional Unit	Trip Setpoint	Allowable Value
Steam Generator Water Level Low	≥ 25% of NR Instr Span each Steam Generator	≥ 24% of NR Instr Span each Steam Generator

The Low Steam Generator Water Level signal coincident with the Steam Flow/Feed Flow Mismatch signal initiates a reactor trip. This signal is not credited in any safety analyses, but increases the overall reliability of the reactor protection system. The Analytical Limit of 0% NR span (any level inside the Narrow Range is sufficient to ensure an adequate secondary inventory for a heat sink) used for the Low-Low trip is the same physical restriction impacting the determination of an adequate setting for the Low trip. Since any value equal to or greater than the Low-Low setpoint will satisfy the requirement, and since this calculation recommends that the Low-Low setpoint be revised to ≥9%, this calculation supports a Low setpoint equal to or greater than this value. The Low setpoint may be established at ≥10% (just above the Low-Low trip providing an anticipatory function in the scenario of a Steam Flow/Feed Flow Mismatch). The Low Setpoint is therefore recommended at ≥10% and the Allowable Value to be set at ≥9% NR span. 1IR1

Recommended Low Setpoint Tech Spec Change:

Functional Unit	Trip Setpoint	Allowable Value
Steam Generator Water Level Low	≥ 10% of NR Instr Span each Steam Generator	≥ 9% of NR Instr Span each Steam Generator

8.1.3 Calculated Setpoint for the High-High Trip

The analytical limit for the High-High Trip is 75% based on Attachment 10.5. 1IR1

Per Section 2.2.3, the existing Technical Specification setpoint and allowable limit is:

Functional Unit	Trip Setpoint	Allowable Value
Turbine Trip and Feedwater Isolation	≤ 67% of NR span each Steam Generator	≤ 68% of NR span each Steam Generator

The Calculated Setpoint for the High High Limit is established by subtracting the negative direction Channel Uncertainty (CU) from the Analytical limit (AL).

Where: AL = 75%
CU = 7.915% 1IR1

CS = AL - CU
CS = 75% - 7.915%
CS = 67.085%

This calculated setpoint is higher than the existing setpoint. The calculated setpoint demonstrates that the current Technical Specification value is acceptable.

8.2 Allowable Value /Acceptable Value Evaluation

Allowable Values are listed within the Technical Specifications which provide a criteria for determining the operability of the trip channel upon periodic testing of the bistable 'as found' values. Exceeding these limits requires an operability determination. For devices in Technical Specification loops where no Allowable Value is provided, such as the transmitters, indicators and recorders, an administrative limit (Acceptable Value) was established to aid the plant in determining acceptable performance. Allowable values and Acceptable Values are based on the SRSS of the CAL, Drift, and M&TE Uncertainties applicable to the string calibration. This calculation evaluates existing Technical Specification Allowable Values and establishes new Acceptable Values for all applicable devices in this calculation.

8.2.1 Allowable Values

8.2.1.1 Low-Low Setpoint

The existing Allowable Value for the Low Low Setpoint is 14.8%. To determine the acceptability of this value, the SRSS of the rack Calibration Tolerance, Drift, and M&TE effects was performed as follows. Uncertainties used in this evaluation are from Calculation section 7.5.

$$AV = \pm [(CAL_{RACK})^2 + (DR_{RACK})^2 + (MTE_{RACK})^2 + (BST_{RACK})^2]^{1/2}$$

$$AV = \pm [(0.5\%)^2 + (1.0\%)^2 + (0.112\%)^2 + (0.25\%)^2]^{1/2}$$

$$AV = \pm 1.151\% \text{ span}$$

From Section 8.1.1, the calculated (recommended) Low-Low Setpoint is 9.0%. Subtracting the calculated Allowable Value tolerance of ± 1.151% (conservatively 1%), the minimum Technical Specification Allowable Value would be 8.0%. This value is significantly lower than the current Technical Specification Allowable Value of 14.8%, and therefore, the current value is conservative and acceptable.

8.2.1.2 Low Setpoint

The existing Allowable Value for the Low Setpoint is 24%. To determine the acceptability of this value, the SRSS of the rack Calibration Tolerance, Drift, and M&TE effects was performed as follows. Uncertainties used in this evaluation are from Calculation section 7.5.

$$AV = \pm [(CAL_{RACK})^2 + (DR_{RACK})^2 + (MTE_{RACK})^2 + (BST_{RACK})^2]^{1/2}$$

$$AV = \pm [(0.5\%)^2 + (1.0\%)^2 + (0.112\%)^2 + (0.25\%)^2]^{1/2}$$

$$AV = \pm 1.151\% \text{ span}$$

Subtracting the calculated Allowable Value tolerance of ± 1.151% (conservatively 1%), from the Setpoint of ≥25%, the Technical Specification Allowable Value of ≥24%, is acceptable. However, per the recommendation in Section 8.1.2, the recommendation for Allowable Value is ≥9% span. 1IR1

8.2.1.3 High-High Setpoint

The existing Allowable Value for the High-High Setpoint is 68%. To determine the acceptability of this value, the SRSS of the rack Calibration Tolerance, Drift, and M&TE effects was performed as follows. Uncertainties used in this evaluation are from Calculation section 7.5.

To determine the acceptability of the Allowable Value, the SRSS of the rack Calibration Tolerance, Drift and M&TE effects was performed as follows. Uncertainties used in this evaluation are from Calculation Section 7.5.

$$\text{Acceptable Value}_{RACK1} = \pm [CAL^2_{RACK1} + DR^2_{RACK1} + MTE^2_{RACK1} + BST^2_{RACK1}]^{1/2}$$

$$\text{Acceptable Value}_{RACK1} = \pm [(0.5\%)^2 + (1.0\%)^2 + (0.112\%)^2 + (0.25\%)^2]^{1/2}$$

$$\text{Acceptable Value}_{RACK1} = \pm 1.151\% \text{ span (Conservatively 1\%)}$$

The Technical Specification is 67%. The Calculated Setpoint is 68%. Adding the Acceptable Value tolerance of 1% to the calculated setpoint, the Allowable Value would be 69%. This value is higher than the existing Allowable Value, and therefore the existing value is conservative and acceptable.

The tolerance which was used to develop the Allowable Value of ± 1.0% span may be used to establish an administrative limit for equipment setpoints that are lower than the Technical Specification setpoint.

For setpoints established at 61%, the Acceptable value is determined below. The Technical Specification Allowable Value is still the licensing limit, however, since the setpoint is set significantly below this point, an administrative value is also utilized.

$$\text{Acceptable Value}_{RACK1} = \pm 1\%$$

$$\text{Acceptable Value} = SP + \text{Acceptable Value}_{RACK1}$$
$$\text{Acceptable Value} = 61\% + 1\% = \leq 62\%$$

8.2.2 Acceptable Values

8.2.2.1 Transmitter Acceptable Value

The Transmitter acceptable value is a device based uncertainty considering the Calibration, Drift and MTE for the device. No string devices are applicable.

CAL_{XMTR} = ± 0.500% span
DR_{XMTR} = ± 0.279% span
MTE_{XMTR} = ± 0.171% span

Acceptable Value $= \pm [(0.5\%)^2 + (0.279\%)^2 + (0.171\%)^2]^{1/2}$

Acceptable $Value_{XMTR}$ = ± 0.598% span

8.2.2.2 Control Room Indicator Acceptable Value

The Control Room Indicator calibration string is read through the rack components. Therefore, the Indicator Acceptable value is comprised of the setting tolerance for the Indicator, the drifts for the rack and the Indicator and the MTE used to calibrate the string.

CAL_{IND} = ± 1.000% span
DR_{IND} = ± 0.088% span
DR_{RACK} = ± 1.000% span
MTE_{IND} = ± 0.112% span

Acceptable $Value_{IND} = \pm [(1.0\%)^2 + (0.088\%)^2 + (1.0\%)^2 + (0.112\%)^2]^{1/2}$

Acceptable $Value_{IND}$ = ± 1.421% span

8.2.4 Hot Shutdown Panel Indicator Acceptable Value

The Hot Shutdown Panel Indicator calibration string is read through the rack components. Therefore, the Indicator Acceptable value is comprised of the setting tolerance for the Indicator, the drifts for the rack and the Indicator and the MTE used to calibrate the string.

CAL_{IND} = ± 1.500% span
DR_{IND} = ± 1.500% span
DR_{RACK} = ± 1.000% span
MTE_{IND} = ± 0.112% span

$$\text{Acceptable Value}_{IND} = \pm [(1.5\%)^2 + (1.5\%)^2 + (1.0\%)^2 + (0.112\%)^2]^{1/2}$$

$$\text{Acceptable Value}_{IND} = \pm 2.348\% \text{ span}$$

8.2.5 Recorder Acceptable Value

The Recorder calibration string is read through the rack components. Therefore, the Recorder Acceptable value is comprised of the setting tolerance for the Recorder, the drifts for the rack and the Recorder and the MTE used to calibrate the string.

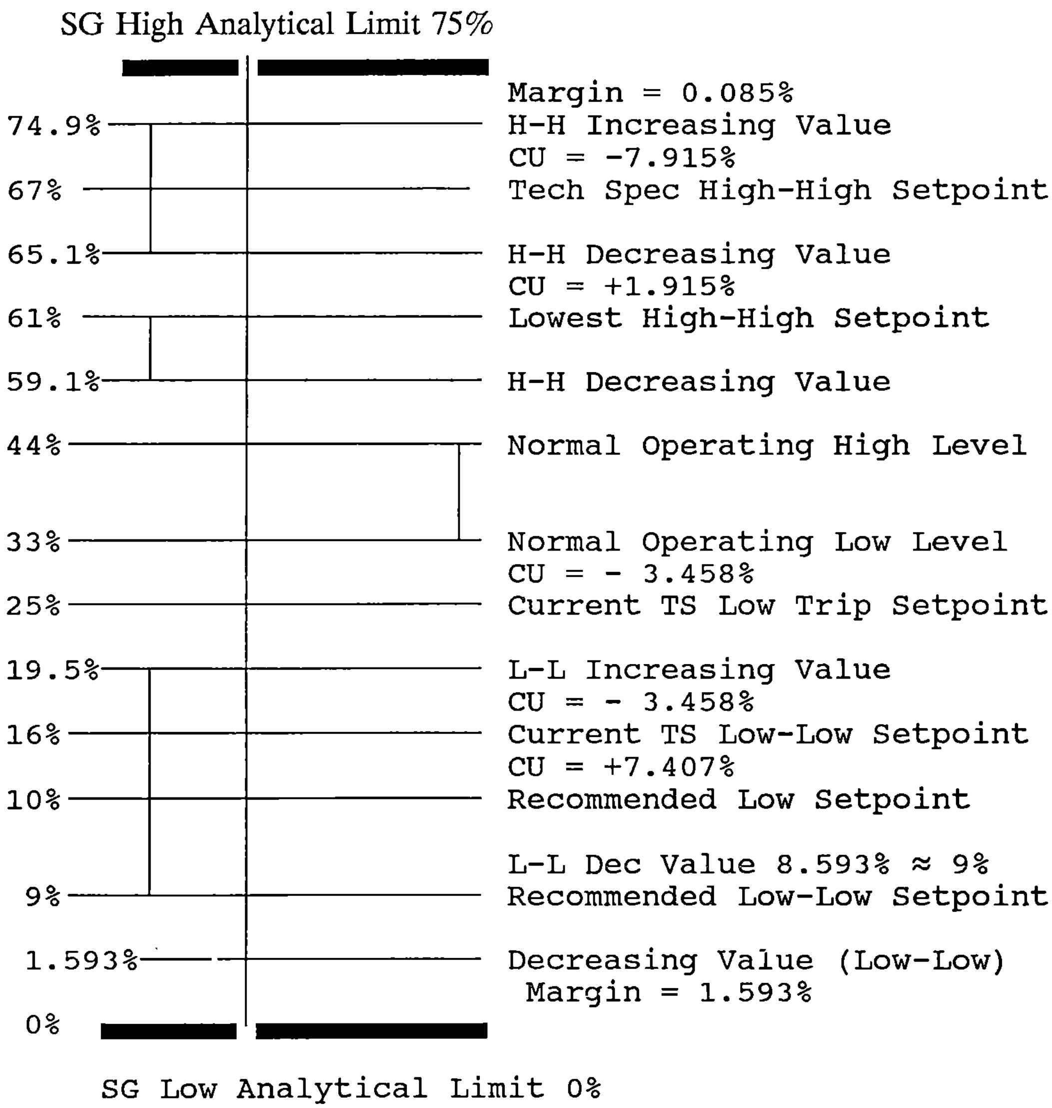
CAL_{REC} = ± 1.000% span
DR_{REC} = ± 0.500% span
DR_{RACK} = ± 1.000% span
MTE_{REC} = ± 0.112% span

$$\text{Acceptable Value}_{REC} = \pm [(1.0\%)^2 + (0.5\%)^2 + (1.0\%)^2 + (0.112\%)^2]^{1/2}$$

$$\text{Acceptable Value}_{REC} = \pm 1.504\% \text{ span}$$

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET		SHEET: 117 CONT'D ON SHEET:		
CALC. No.: SC-CN001-01			REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94	

8.3 Setpoint Relationships



From this diagram, the Current Technical Specification High-High Setpoint is demonstrated to be adequate. SP (67%) + CU (7.915%) = 74.915% . Since Analytical Limit is 75%, positive margin exists. Channels that are set at 61% in the field, are shown above to be conservative to the Analytical Limit and sufficiently away from the Normal Operating High Level.

From this diagram, the Current Technical Specification Low-Low Setpoint is demonstrated to be conservative (positive margin). The calculated setpoint is significantly lower than the Technical Specification setpoint and therefore, may be lowered. The recommended change is 9%, which is adequate to protect the Low Analytical Limit. The existing Low Setpoint is also adequate but may be changed to 10%, which is acceptable based on incorporating the recommended change to the Low-Low setpoint.

9.0 DISCUSSION OF RESULTS

9.1 Low-Low Setpoint

Per Calculation Section 8.1.1, the calculated setpoint for the Low-Low trip is ≥9.0%.

The current Technical Specification Setpoint is ≥16%. This value is significantly higher than the minimum requirement. Therefore, the current setpoint is conservative and acceptable, however, it could be lowered to gain operating margin.

9.1.1 Recommended Setpoint

The results of this calculation support a recommended setpoint of ≥9.0%. This value would result in increased operating margin and still protect the Analytical limit.

9.2 Low Setpoint

Per Calculation Section 8.1.2, the calculated setpoint for the Low trip is ≥10.0%.

The current Technical Specification Setpoint is ≥25%. This value is significantly higher than the minimum requirement. Therefore, the current setpoint is conservative and acceptable, however, it could be lowered to gain operating margin. 1R1

9.2.1 Recommended Setpoint

The results of this calculation support a recommended setpoint of ≥10.0%. This value would result in increased operating margin and still actuate prior to the process limit (Low-Low Analytical Limit).

9.3 High-High Setpoint

The re-analysis of the High-High Setpoint provided in this calculation was required primarily due to a Westinghouse Letter (Ref. 3.5.16) which indicated that additional Process Measurement Uncertainties should be evaluated. As a result of that evaluation, the Total Channel Uncertainties are larger than previously calculated.

The current Technical Specification Setpoint is ≤67%. Per the evaluation provided in Section 8.1.3, the calculated setpoint is ≤67.085%. Comparing the total channel uncertainties to the available margin between calculated setpoint and the Analytical Limit of 75%, the High-High setpoint value is still acceptable. 1IR

Current plant equipment settings for this function are set as low as 61%. This value is acceptable since it is set below the minimum calculated setpoint and above the normal operating high level of 44% (Ref 3.1.4).

9.4 Indicator and Recorder

9.4.1 Control Room Indication Uncertainties

Per Section 7.10.3, the Control Room Indication uncertainty during normal conditions is + 4.466% and - 8.166% span, + 11.522%, and - 9.603% span for accident conditions. Post accident uncertainties are + 8.020% span, and -10.071% span. 1IR1

The results of this calculation demonstrate that the calculated uncertainties are greater than the uncertainties specified in the UFSAR Tables (Ref Section 2.2.4). **The results of this calculation recommends that the values provided in the UFSAR tables be changed from 4% (normal and operational occurrences) and 10% (accident); to: 8% (normal and operational occurrences) and 12% (accident).**

9.4.2 Hot Shutdown Panel Uncertainties

Per Section 7.10.4, the Hot Shutdown Panel Indication uncertainty during normal conditions is + 5.361% and - 9.061% span. No accident or post accident uncertainties are applicable.

9.4.3 Recorder Uncertainties

For Technical Specification monitoring and EOP evaluations, the Indicator Uncertainty will be utilized, since this is the primary device used by the Operator and due to its greater precision.

RG 1.97 requirements as specified in FSAR Table 7.5-1 does credit the channels used for control for the purpose of detecting steam generator tube rupture and to monitor steam generator water level following a steam line break.

Per Section 7.10.5, the Control Room Recorder uncertainty for normal conditions is + 4.786% and - 8.486% span, + 11.723% and - 9.804% span for accident conditions. The post accident uncertainty is +8.199%, -10.250% span. 1IR1

The results of this calculation demonstrate that the Channel Uncertainties are greater than the uncertainties specified in the UFSAR Tables (Ref Section 2.2.4).

The results of this calculation determined that the values provided in the UFSAR tables be changed from 4% (normal and operational occurrences) and 10% (accident); to: 8% (normal and operational occurrences) and 12% (accident).

9.5 EOP Evaluation

9.5.1 EOP Uncertainties

The table below is an excerpt from the Calculation main body, showing the Control Room Indication Channel Uncertainties. EOPs are assumed to utilize the Indicator instead of the recorder since the Indicator is more accurate. These uncertainties will be used as determined to be appropriate to the Emergency Guideline Footnote requirements.

SUMMARY OF INDICATOR UNCERTAINTIES		
Configuration	Normal	Accident
D (Indication)	+ 4.466% - 8.166%	+11.522% - 9.603%

1IR1

9.5.2 EOP Results and Conclusions

The EOP Indicated Values listed in Section 2.2.5 were reviewed against the requirements of the Emergency Response Guidelines (ERGs) as listed in 2.2.6.

The normal or adverse uncertainties from Section 9.4.1 were applied as specified based on the footnotes and compared against limits and/or other limiting criteria listed in the footnotes. Values equal or more conservative were determined to be acceptable. In some cases, EOP steps are not directly tied back to the ERGs with a footnote. These values were verified to be consistent with the values that were based on a footnote and are acceptable or not acceptable based on that criteria.

The following EOP footnotes are typical for the EOPs evaluated in Section 2.5. Wording of the individual footnotes may vary slightly from the typical footnote shown below but the values evaluated are the same.

Typical Footnote: Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy.

Evaluation: *This footnote requires that the EOP value be established at 0% SG Level plus the positive normal channel uncertainties for the Indicator (+4.466%). The current EOP value is established at 8%. This is acceptable.*

Typical Footnote: Enter plant specific value showing SG level just in narrow range, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors, not to exceed 50%.

Evaluation: *This footnote requires that the EOP value be established at 0% SG Level plus the accident uncertainties for the Indicator (+11.522%). The current EOP value is established at 12%. This is acceptable.*

Typical Footnote: Enter plant specific value showing SG level greater than the AFW actuation setpoint

Evaluation: *This footnote requires that the EOP be based on a value equal to or greater than SG Low-Low setpoint currently established at 16%, being recommended for change to a value of 9%.*

1IR1

Typical Footnote: Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin.

Evaluation: *The high-high setpoint is 67%. This value minus the 5% is 62%. The current EOP value is established at 62%. This is acceptable.*

Typical Footnote: Enter plant specific value corresponding to high-high SG level setpoint, minus 5% for operating margin, including allowances for post accident transmitter errors and reference leg process errors, not less than 50%.

Evaluation: *This footnote requires that the EOP value be established at the high high setpoint (67%f) minus 5% operating margin, minus the negative direction accident Indication uncertainties (-9.603%.). Therefore a value of 52.397% satisfies the criteria. The current EOP is set at 53%. This value is slightly higher than the criteria and therefore this calculation recommends that this value be revised to encompass the additional uncertainty.*

Typical Footnote: Enter plant specific value corresponding to SG level at the upper tap, including allowances for normal channel accuracy.

Evaluation: *This footnote requires that the EOP value be established at the 100% SG Narrow Range Level minus the negative normal channel uncertainties of -8.166%. Therefore a value of 91.834% or less will satisfy the criteria. The current values are established at 92%. This value is slightly higher than the criteria and therefore this calculation recommends that this value be revised to encompass the additional uncertainty.*

Typical Footnote: Enter plant specific value corresponding to SG level at the upper tap, including allowances for normal channel accuracy, post accident transmitter errors, and reference leg process errors.

Evaluation: *This footnote requires that the EOP value be established based on SG level at 100% minus the negative directioned accident channel uncertainties of 9.603%. Therefore, a value of 90.397% or less will satisfy the criteria. The current values are established at 91%. This value is slightly higher than the criteria and therefore this calculation recommends that this value be revised to encompass the additional uncertainty.* 1IR1

CALC. No.: SC-CN001-01			REFERENCE:			
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

EOP Recommendations

Since this calculation supports Unit 1 and Unit 2 Design Changes 1EC-3345 Pkg 2 and 2EC-3306 Pkg 2 initiated to lower the Low and Low-Low Setpoints, this calculation recommends that the EOPs currently based on the Low-Low setpoint (i.e. various EOP values currently utilizing a 16% setpoint or range of 16%-33%) be revised to coincide with that change.

With the finalization of the Design Changes listed above, the EOP values that are currently established at 16% (16%-33%) may be revised to 12% or a range of 12% -33% and will continue to meet the intent of the footnote guidance.

Additionally, as noted above, the EOP values that are based on High-High trip values slightly exceed the footnote criteria with the recent addition of a 1% bias not previously calculated in Revision 1IR0 (See Assumption 6.2). Therefore, this calculation recommends that these values be revised to encompass the additional uncertainty.

1IR1

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET					SHEET: i CONT'D ON SHEET:	
CALC. No.:SC-CN001-01 Attachment A			REFERENCE:				
ORIGINATOR, DATE	REV:	CMM 12/16/93	1	CMM 8/16/94	1IR1		
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94			

ATTACHMENT A

N/R STEAM GENERATOR LEVEL TRANSMITTER SPAN AND COLD CALIBRATION VALUES

1IR1

N/R STEAM GENERATOR LEVEL TRANSMITTER SPAN AND COLD CALIBRATION VALUES

CONTROL ID. NO. ATTACHMENT A SC-CN001-01	
PREPARED BY/DATE 2/12/92	J. ASHCRAFT
VERIFIED BY/DATE 2/13/92	J. CASH
PAGE 1 OF 8	

1.0 Instrument number(s):

1.1 2LT517, 2LT518, 2LT519
1.2 2LT527, 2LT528, 2LT529
1.3 2LT537, 2LT538, 2LT539
1.4 2LT547, 2LT548, 2LT549

2.0 References:

2.1 ASME STEAM TABLES
2.2 ASME B&PV Code (1974), Section III, Table I-5.0
2.3 UNIT 2 STEAM FLOW COMPENSATION CALCULATION (CALC # S-2-MS-CDC-0827 REV 0.)
2.4 DWG 240662-B-9656-8, NO.21 S/G LEVEL AND STEAM FLOW INSTRUMENT SCHEMATIC
2.5 DWG 240663-B-9656-8, NO.22 S/G LEVEL AND STEAM FLOW INSTRUMENT SCHEMATIC
2.6 DWG 240664-B-9656-9, NO.23 S/G LEVEL AND STEAM FLOW INSTRUMENT SCHEMATIC
2.7 DWG 240665-B-9656-9, NO.24 S/G LEVEL AND STEAM FLOW INSTRUMENT SCHEMATIC
2.8 DWG 233609-B-9611-8, S/G LEVEL ARRANGEMENT, PANELS 444-1A-1M
2.9 DWG 233025-A-1399-8, RX COMP EXT TUBING, NE & SE QUADRANTS EL 130'-0"
2.10 DWG 233026-A-1399-8, RX COMP EXT TUBING, NW & SW QUADRANTS EL 130'-0"

3.0 Assumptions:

3.1 Normal temperature in containment is 120 DEGF.
3.2 The high pressure side of the transmitter senses the head from the reference leg pressure and the low pressure side of the transmitter senses the vessel head due to level in S/G.
3.3 Containment temperature during calibration is assumed to be 70 DEGF.
3.4 Condensate pots are supported directly from the S/G vessel. Therefore, condensate pot elevation varies due to thermal growth of the S/G.
3.5 Cold distance between level taps (H) recorded at 70 DEGF.
3.6 Instrument tubing between the S/G taps and level transmitter is routed togther to the maximum extent possible. Therefore, since there will be no variations in fluid density in the two sensing lines, the location of the level transmitter relative to the lower level connection does not influence the results of the head correction calculation.
3.7 Final transmitter scaling will be based on saturated conditions at the mean average steam pressure for 100% load as taken from section 4.4 of reference 2.3.
3.8 The condensate pots are located at the same elevation as the upper S/G level connections.

CONTROL ID. NO. ATTACHMENT A SC-CN001-01
PREPARED BY/DATE [signature] 2/12/92
VERIFIED BY/DATE [signature] 2/13/92

4.0 Information Given: (From References)

4.1 Specific Volumes;

water at 70 DEGF and 14.7 PSIA	$v_{w70} := 0.01605$
water at 120 DEGF and 771.22 PSIA	$v_{w120} := 0.01617$
water at 514.01 DEGF and 771.22 PSIA	$v_{sw} := 0.020765$
steam at 514.01 DEGF and 771.22 PSIA	$v_{ss} := 0.591682$

4.2 Vessel and instrument installation dimensions;

Centerline of the condensate pot to the lower level tap (cold)	$A_c := 144$
Upper level tap to the centerline of condensate pot	$B := 0$
Reference level (0%) to centerline of the lower level tap	$C := 0$
Distance between upper and lower level connections (cold)	$H_c := 144$

5.0 Calculations:

5.1 Calculate input and output values for bench calibration.

5.1.1 Thermal growth of vessel between cold (70) and operating (514.01) temperature.

Mean coefficient of thermal expansion of vessel material,

$$\alpha := 7.33 \cdot 10^{-6} \quad \text{in/in/DEGF}$$

Hot distance between taps,

$$H := H_c \cdot (1 + \alpha \cdot (514.01 - 70))$$

$$H = 144.469$$

CONTROL ID. NO ATTACHMENT A SC-CN002-01
PREPARED BY/DATE [signature] 2/12/92
VERIFIED BY/DATE [signature] 2/13/92
PAGE 3 OF 8

Hot distance between condensate pot and lower level tap,

$$A := A_c \cdot (1 + \alpha \cdot (514.01 - 70))$$

$$A = 144.469$$

NOTE: Since the instrument tubing between the S/G taps and level transmitter is routed togther to the maximum extent possible there will be no variations in fluid density in the two sensing lines. Therefore, the difference in elevation between the lower level connection and level transmitter can be ignored when calculating the head sensed at the transmitter's HP and LP connections.

5.1.2 Weight of reference leg under normal conditions

Height of the reference leg,

$$h_r := A$$

$$h_r = 144.469$$

Weight of the reference leg,

$$w_r := h_r \cdot \frac{v_{w70}}{v_{w120}}$$

$$w_r = 143.397$$

5.1.3 Weight of water inside the S/G;

Normal operating conditions at 100 % level,

Height of water above lower level tap,

$$h_{w100} := H$$

CONTROL ID. NO. ATTACHMENT A
SC-CN001-01
PREPARED BY/DATE 2/12/92
VERIFIED BY/DATE 2/13/92
PAGE 4 OF 8

Weight of water in S/G,

$$w_{w100} := h_{w100} \cdot \frac{v_{w70}}{v_{sw}}$$

$$w_{w100} = 111.665$$

5.1.5 Weight of steam inside the S/G;

Normal operating conditions at 0 % level,

Height of steam above lower level tap,

$$h_{s0} := H$$

Weight of steam in S/G,

$$w_{s0} := h_{s0} \cdot \frac{v_{w70}}{v_{ss}}$$

$$w_{s0} = 3.919$$

5.1.6 Calculate the DP sensed by the transmitter.

At 100 % level,

$$dp_{100} := w_r - w_{w100}$$

$$dp_{100} = 31.732$$

At 0 % level,

$$dp_0 := w_r - w_{s0}$$

$$dp_0 = 139.478$$

CONTROL ID. NO. ATTACHMENT A
SC-CN001-01
PREPARED BY/DATE [signature] 2/12/92
VERIFIED BY/DATE [signature] 2/13/92
PAGE 5 OF 8

/P TRANSMITTER STATIC PRESSURE CORRECTION CALCULATION

INSTRUMENT NUMBERS: 2LT517, 2LT518, 2LT519
2LT527, 2LT528, 2LT529
2LT537, 2LT538, 2LT539
2LT547, 2LT548, 2LT549

Assume transmitter manufacturer/model; Rosemount 1154HH4RA

1. Uncorrected Span:

Input;	Min (i)	Max (I)	Units
	$i := 139.478$	$I := 31.732$	INWC
Output;	Min (o)	Max (O)	Units
	$o := 1$	$O := 5$	VDC

2. Correction Factor:

Vendor's correction factor (K) expressed in precent;

$K := .75$ Percent Span

Normal static pressure (NOP);

$NOP := 756.52$ PSIG

Calculated correction factor (CF), expressed in percent;

$$CF := K \cdot \frac{NOP}{1000}$$

$CF = 0.567$ Span

3. Zero adjustment in terms of input units (ZP):

$$ZP := CF \cdot \% \cdot i$$

$ZP = 0.791$ INWC

4. Zero adjustment in terms of span (ZS):

$$ZS := \frac{ZP}{I - i}$$

$ZS = -0.007$ Span

CONTROL ID. NO. ATTACHMENT A SC-CN001-01
PREPARED BY/DATE [signature] 2/12/92
VERIFIED BY/DATE [signature] 2/13/92
PAGE 6 OF 8

5. Correction in terms of output span (ZC):

$$ZC := ZS \cdot (O - o)$$

$$ZC = -0.029 \quad \text{VDC}$$

6. Ideal Zero output + correction (oC):

$$oC := o + ZC$$

$$oC = 0.971 \quad \text{VDC}$$

7. Full Scale adjustment in terms of input units (FSP):

$$FSP := CF \cdot \% \cdot I$$

$$FSP = 0.18 \quad \text{INWC}$$

8. Full Scale adjustment in terms of span (FSS):

$$FSS := \frac{FSP}{I - i}$$

$$FSS = -0.002 \quad \text{Span}$$

9. Correction in terms of output span (FSC):

$$FSC := FSS \cdot (O - o)$$

$$FSC = -0.007 \quad \text{VDC}$$

10. Ideal Full Span output + correction (OC):

$$OC := O + FSC$$

$$OC = 4.993 \quad \text{VDC}$$

11. Revised Signal Span:

$$SC := (OC - oC)$$

$$SC = 4.023 \quad \text{VDC}$$

12. Calibration information

Number of calibration points (n);

$n := 1 .. 9$

Calibration points (INPUT)

$INPUT_n :=$

140
113
86
59
33
59
86
113
140

Calibration Inputs (PCT)

$$PCT_n := \frac{INPUT_n - i}{I - i} \cdot 100$$

Calibration Outputs (OUTPUT)

$$OUTPUT_n := \frac{INPUT_n - i}{I - i} \cdot SC + oC$$

ATTACHMENT 4 SC-CN001-01
PREPARED BY/DATE [signature] 2/12/92
VERIFIED BY/DATE [signature] 2/13/92
PAGE 8 OF 8

C. McNall 1/11/94
AF Shaw 1/11/94

13. Calibration Table:

PCT n	INPUT n	OUTPUT n
-0.484	140	0.951
24.574	113	1.959
49.633	86	2.967
74.692	59	3.975
98.823	33	4.946
74.692	59	3.975
49.633	86	2.967
24.574	113	1.959
-0.484	140	0.951

TRIP 67%:

0.67 x 4.023 VDC + 0.971 VDC = 3.666 VDC

0.67 x (-107.746) = -72.190 + 139.478 = 67.288 INWC

ROUND TO WHOLE INWC: 67 INWC

$\frac{67 - 139.478}{-107.746} \times 4.023 + 0.971 = 3.677$ VDC

TEST PT @ 67%

67 INWC	3.677 VDC

[initials] 3-19-92
MA 3/20/92

TRIP @ 61%

0.61 x 4.023 VDC + 0.971 VDC = 3.425 VDC

0.61 x (-107.746) + 139.478 = 73.753 INWC

ROUND TO WHOLE INWC: 74 INWC

$\frac{74 - 139.478}{-107.746} \times 4.023 + 0.971 = 3.416$ VDC

TEST PT @ 61%:

74 INWC	3.416 VDC

[initials] 3-19-92
MA 3/20/92

1

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET				SHEET: i CONT'D ON SHEET:	
CALC. No.:SC-CN001-01 Attachment B			REFERENCE:			
ORIGINATOR, DATE	REV:	CMM 12/16/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

ATTACHMENT B

N/R STEAM GENERATOR LEVEL TRANSMITTER SPAN AND COLD CALIBRATION VALUES

1IR1

N/R STEAM GENERATOR LEVEL TRANSMITTER SPAN
ND COLD CALIBRATION VALUES

CONTROL ID. NO. ATTACHMENT B SC-CN001-01	
PREPARED BY/DATE 2/12/92	J. ASHCRAFT
VERIFIED BY/DATE 2/13/92	J. CASH
PAGE 1 OF 8	

1.0 Instrument number(s):

1.1 1LT517, 1LT518, 1LT519
1.2 1LT527, 1LT528, 1LT529
1.3 1LT537, 1LT538, 1LT539
1.4 1LT547, 1LT548, 1LT549

2.0 References:

2.1 ASME STEAM TABLES
2.2 ASME B&PV Code (1974), Section III, Table I-5.0
2.3 DCP 1EC-3039 PKG. 2 CALCULATION FOR MULTIPLIER/SQUARE -ROOT EXTRACTOR CALIBRATION (S-1-CN-CDC-0611 REV 0.)
2.4 DWG 211301-B-9508-11, NO.11 S/G LEVEL AND STEAM FLOW INSTRUMENT SCHEMATIC
2.5 DWG 211302-B-9508-12, NO.12 S/G LEVEL AND STEAM FLOW INSTRUMENT SCHEMATIC
2.6 DWG 211303-B-9508-12, NO.13 S/G LEVEL AND STEAM FLOW INSTRUMENT SCHEMATIC
2.7 DWG 211304-B-9508-11, NO.14 S/G LEVEL AND STEAM FLOW INSTRUMENT SCHEMATIC
2.8 DWG 233609-B-9611-8, S/G LEVEL ARRANGEMENT, PANELS 444-1A-1M
2.9 DWG 229928-A-1327-10, RX COMP EXT TUBING, NE & SE QUADRANTS EL 130'-0"
2.10 DWG 229929-A-1327-12, RX COMP EXT TUBING, NW & SW QUADRANTS EL 130'-0"

3.0 Assumptions:

3.1 Normal temperature in containment is 120 DEGF.
3.2 The high pressure side of the transmitter senses the head from the reference leg pressure and the low pressure side of the transmitter senses the vessel head due to level in S/G.
3.3 Containment temperature during calibration is assumed to be 70 DEGF.
3.4 Condensate pots are supported directly from the S/G vessel. Therefore, condensate pot elevation varies due to thermal growth of the S/G.
3.5 Cold distance between level taps (H) recorded at 70 DEGF.
3.6 Instrument tubing between the S/G taps and level transmitter is routed togther to the maximum extent possible. Therefore, since there will be no variations in fluid density in the two sensing lines, the location of the level transmitter relative to the lower level connection does not influence the results of the head correction calculation.
3.7 Final transmitter scaling will be based on saturated conditions at the mean average steam pressure for 100% load as taken from section 4.4 of reference 2.3.
3.8 The condensate pots are located at the same elevation as the upper S/G level connections.

CONTROL ID. NO. ATTACHMENT B SC-CN001-01
PREPARED BY/DATE [signature] 2/12/92
VERIFIED BY/DATE [signature] 2/13/92
PAGE 2 OF 8

4.0 Information Given: (From References)

4.1 Specific Volumes;

water at 70 DEGF and 14.7 PSIA $v_{w70} := 0.01605$

water at 120 DEGF and 773.9 PSIA $v_{w120} := 0.01617$

water at 514.40 DEGF and 773.9 PSIA $v_{sw} := 0.020776$

steam at 514.40 DEGF and 773.9 PSIA $v_{ss} := 0.589511$

4.2 Vessel and instrument installation dimensions;

Centerline of the condensate pot to the lower level tap (cold) $A_c := 144$

Upper level tap to the centerline of condensate pot $B := 0$

Reference level (0%) to centerline of the lower level tap $C := 0$

Distance between upper and lower level connections (cold) $H_c := 144$

5.0 Calculations:

5.1 Calculate input and output values for bench calibration.

5.1.1 Thermal growth of vessel between cold (70) and operating (514.40) temperature.

Mean coefficient of thermal expansion of vessel material,

$$\alpha := 7.33 \cdot 10^{-6} \quad \text{in/in/DEGF}$$

Hot distance between taps,

$$H := H_c \cdot (1 + \alpha \cdot (514.40 - 70))$$

$$H = 144.469$$

Hot distance between condensate pot and lower level tap,

$$A := A_c \cdot (1 + \alpha \cdot (514.40 - 70))$$

$$A = 144.469$$

NOTE: Since the instrument tubing between the S/G taps and level transmitter is routed togther to the maximum extent possible there will be no variations in fluid density in the two sensing lines. Therefore, the difference in elevation between the lower level connection and level transmitter can be ignored when calculating the head sensed at the transmitter's HP and LP connections.

5.1.2 Weight of reference leg under normal conditions

Height of the reference leg,

$$h_r := A$$

$$h_r = 144.469$$

Weight of the reference leg,

$$w_r := h_r \cdot \frac{v_{w70}}{v_{w120}}$$

$$w_r = 143.397$$

5.1.3 Weight of water inside the S/G;

Normal operating conditions at 100 % level,

Height of water above lower level tap,

$$h_{w100} := H$$

Weight of water in S/G,

$$w_{w100} := h_{w100} \cdot \frac{v_{w70}}{v_{sw}}$$

$$w_{w100} = 111.606$$

5.1.5 Weight of steam inside the S/G;

Normal operating conditions at 0 % level,

Height of steam above lower level tap,

$$h_{s0} := H$$

Weight of steam in S/G,

$$w_{s0} := h_{s0} \cdot \frac{v_{w70}}{v_{ss}}$$

$$w_{s0} = 3.933$$

5.1.6 Calculate the DP sensed by the transmitter.

At 100 % level,

$$dp_{100} := w_r - w_{w100}$$

$$dp_{100} = 31.791$$

At 0 % level,

$$dp_0 := w_r - w_{s0}$$

$$dp_0 = 139.464$$

CONTROL ID. NO. ATTACHMENT B
SC-CN001-01
PREPARED BY/DATE [signature] 2/12/92
VERIFIED BY/DATE [signature] 2/13/92
PAGE 5 OF 8

D/P TRANSMITTER STATIC PRESSURE CORRECTION CALCULATION

INSTRUMENT NUMBERS: 1LT517, 1LT518, 1LT519
1LT527, 1LT528, 1LT529
1LT537, 1LT538, 1LT539
1LT547, 1LT548, 1LT549

Assume transmitter manufacturer/model; Rosemount 1154HH4RA

1. Uncorrected Span:

Input;	Min (i)	Max (I)	Units
	i := 139.464	I := 31.791	INWC
Output;	Min (o)	Max (O)	Units
	o := 1	O := 5	VDC

2. Correction Factor:

Vendor's correction factor (K) expressed in precent;

K := .75 Percent Span

Normal static pressure (NOP);

NOP := 759.2 PSIG

Calculated correction factor (CF), expressed in percent;

$$CF := K \cdot \frac{NOP}{1000}$$

CF = 0.569 Span

3. Zero adjustment in terms of input units (ZP):

$$ZP := CF \cdot \% \cdot i$$

ZP = 0.794 INWC

4. Zero adjustment in terms of span (ZS):

$$ZS := \frac{ZP}{I - i}$$

ZS = -0.007 Span

5. Correction in terms of output span (ZC):

$$ZC := ZS \cdot (O - o)$$

$$ZC = -0.03 \quad \text{VDC}$$

6. Ideal Zero output + correction (oC):

$$oC := o + ZC$$

$$oC = 0.97 \quad \text{VDC}$$

7. Full Scale adjustment in terms of input units (FSP):

$$FSP := CF \cdot \% \cdot I$$

$$FSP = 0.181 \quad \text{INWC}$$

8. Full Scale adjustment in terms of span (FSS):

$$FSS := \frac{FSP}{I - i}$$

$$FSS = -0.002 \quad \text{Span}$$

9. Correction in terms of output span (FSC):

$$FSC := FSS \cdot (O - o)$$

$$FSC = -0.007 \quad \text{VDC}$$

10. Ideal Full Span output + correction (OC):

$$OC := O + FSC$$

$$OC = 4.993 \quad \text{VDC}$$

11. Revised Signal Span:

$$SC := (OC - oC)$$

$$SC = 4.023 \quad \text{VDC}$$

CONTROL ID. NO. ATTACHMENT B SC-CN001-01	
PREPARED BY/DATE	2/12/92
VERIFIED BY/DATE	2/13/92
PAGE 7 OF 8	

12. Calibration information

Number of calibration points (n);

$n := 1 .. 9$

Calibration points (INPUT)

$INPUT_n :=$

140
113
86
59
33
59
86
113
140

Calibration Inputs (PCT)

$$PCT_n := \frac{INPUT_n - i}{I - i} \cdot 100$$

Calibration Outputs (OUTPUT)

$$OUTPUT_n := \frac{INPUT_n - i}{I - i} \cdot SC + oC$$

CONTROL I.D. NO. ATTACHMENT B SC-CN001-01	
PREPARED BY/DATE	2/12/92
VERIFIED BY/DATE	2/13/92
PAGE 8 OF 8	

C. McNall 1/11/94

A F Shaw 1/11/94

13. Calibration Table:

PCT n	INPUT n	OUTPUT n
-0.498	140	0.95
24.578	113	1.959
49.654	86	2.968
74.73	59	3.977
98.877	33	4.948
74.73	59	3.977
49.654	86	2.968
24.578	113	1.959
-0.498	140	0.95

TRIP 67%

0.67 x 4.023 VDC + .970 = 3.665 VDC

0.67 (-107.673) + 139.464 = 67.323 INWC

ROUND TO WHOLE INWC: 67 INWC

$\frac{67 - 139.464}{-107.673} \times 4.023 + 0.970 = 3.677$ VDC

TEST PT @ 67%

67 INWC	3.677 VDC

3-19-92 MB 3/20/92

TRIP 25%

0.25 x 4.023 + 0.970 = 1.976 VDC

0.25 (-107.673) + 139.464 = 112.546 INWC

ROUND TO WHOLE INWC: 113 INWC

$\frac{113 - 139.464}{-107.673} \times 4.023 + 0.970 = 1.959$ VDC

TEST PT @ 25%

113 INWC	1.959 VDC

3-19-92 MB 3/20/92

TRIP 16%

0.16 x 4.023 + 0.970 = 1.614 VDC

0.16 (-107.673) + 139.464 = 122.236 INWC

ROUND TO WHOLE INWC: 122 INWC

$\frac{122 - 139.464}{-107.673} \times 4.023 + 0.970 = 1.623$ VDC

TEST PT 16%

122 INWC	1.623 VDC

3-19-92 MB 3/20/92

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET				SHEET: i CONT'D ON SHEET:
CALC. No.:SC-CN001-01 Attachment C			REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/16/93	1	CMM 8/16/94	1IR1
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94	

ATTACHMENT C

LINEAR INSTRUMENT SCALING CALCULATION

1IR1

CONTROL ID. NO. ATTACHMENT C SC-CN001-01
PREPARED BY/DATE [signature] 2/12/92
VERIFIED BY/DATE [signature]
PAGE 1 OF 2

J. ASHCRAFT

J. CASH

INEAR INSTRUMENT SCALING CALCULATION

1.0 Instrument number(s):

1.1 1LM517A, 1LM518, 1LM519A
1.2 1LM527A, 1LM528, 1LM529A
1.3 1LM537A, 1LM538, 1LM539A
1.4 1LM547A, 1LM548, 1LM549A
1.5 2LM517A, 2LM518, 2LM519A
1.6 2LM527A, 2LM528, 2LM529A
1.7 2LM537A, 2LM538, 2LM539A
1.8 2LM547A, 2LM548, 2LM549A

2.0 References:

2.1 IISCS DATA BASES

3.0 Information Given: (From References)

3.1 Instrument Input Range;

Min (i)	Max (I)	Units
i := 1	I := 5	VDC

3.2 instrument Output Range;

Min (o)	Max (O)	Units
o := 1	O := 5	VDC

4.0 Calculations:

4.1 Calculate input and output values for bench calibration.

4.1.1 Instrument input span (INSPAN)

$INSPAN := |I - i|$

INSPAN = 4   VDC

4.1.2 Instrument output span (OUTSPAN)

$OUTSPAN := |O - o|$

OUTSPAN = 4   VDC

CONTROL ID. NO. ATTACHMENT C SC-CN001-01
PREPARED BY/DATE [signature] 2/12/92
VERIFIED BY/DATE [signature] 2/13/92
PAGE 2 OF 2

4.1.3 Calibration information

Number of calibration points (n);

$n := 1 .. 9$

Calibration points (INPUT)

$INPUT_n :=$

1
2
3
4
5
4
3
2
1

Calibration Inputs (PCT)

$$PCT_n := \frac{INPUT_n - i}{INSPAN} \cdot 100$$

Calibration Outputs (OUTPUT)

$$OUTPUT_n := \frac{INPUT_n - i}{INSPAN} \cdot OUTSPAN + o$$

4.2 Calibration Table:

PCT_n	$INPUT_n$	$OUTPUT_n$
0	1	1
25	2	2
50	3	3
75	4	4
100	5	5
75	4	4
50	3	3
25	2	2
0	1	1

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET				SHEET: i CONT'D ON SHEET:	
CALC. No.:SC-CN001-01 Attachment D			REFERENCE:			
ORIGINATOR, DATE	REV:	CMM 12/16/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

ATTACHMENT D

LINEAR INSTRUMENT SCALING CALCULATION

1IR1

CONTROL ID. NO. ATTACHMENT D SC-CN001-01	
PREPARED BY/DATE 2/12/92	J.ASHCRAFT
VERIFIED BY/DATE 2/13/92	J.Cash
PAGE 1 OF 2	

INEAR INSTRUMENT SCALING CALCULATION

1.0 Instrument number(s):

1.1 1LI517, 1LI517A, 1LI518, 1LI519
1.2 1LI527, 1LI527A, 1LI528, 1LI529
1.3 1LI537, 1LI537A, 1LI538, 1LI539
1.4 1LI547, 1LI547A, 1LI548, 1LI549
1.5 2LI517, 2LI517A, 2LI518, 2LI519
1.6 2LI527, 2LI527A, 2LI528, 2LI529
1.7 2LI537, 2LI537A, 2LI538, 2LI539
1.8 2LI547, 2LI547A, 2LI548, 2LI549

2.0 References:

2.1 IISCS DATA BASES

3.0 Information Given: (From References)

3.1 Instrument Input Range;

Min (i)	Max (I)	Units
i := 1	I := 5	VDC

3.2 instrument Output Range;

Min (o)	Max (O)	Units
o := 0	O := 100	PERCENT SPAN

4.0 Calculations:

4.1 Calculate input and output values for bench calibration.

4.1.1 Instrument input span (INSPAN)

$$INSPAN := |I - i|$$

INSPAN = 4 VDC

4.1.2 Instrument output span (OUTSPAN)

$$OUTSPAN := |O - o|$$

OUTSPAN = 100 PERCENT SPAN

CONTROL ID. NO. ATTACHMENT D SC-CN001-01
PREPARED BY/DATE [signature] 2/12/92
VERIFIED BY/DATE [signature] 2/13/92
PAGE 2 OF 2

4.1.3 Calibration information

Number of calibration points (n);

$n := 1 \,..9$

Calibration points (INPUT)

$INPUT_n :=$

1
2
3
4
5
4
3
2
1

Calibration Inputs (PCT)

$$PCT_n := \frac{INPUT_n - i}{INSPAN} \cdot 100$$

Calibration Outputs (OUTPUT)

$$OUTPUT_n := \frac{INPUT_n - i}{INSPAN} \cdot OUTSPAN + o$$

4.2 Calibration Table:

PCT_n	$INPUT_n$	$OUTPUT_n$
0	1	0
25	2	25
50	3	50
75	4	75
100	5	100
75	4	75
50	3	50
25	2	25
0	1	0

ATTACHMENT 10.1

SCALING ADDENDUM FOR ALLOWABLE VALUE AND SETPOINTS - STEAM GENERATOR LEVEL INSTRUMENTATION

1IR1

1.0 INSTRUMENT NUMBERS

See Calculation Section 1.2 for complete list of Component ID's.

2.0 PURPOSE

The purpose of this scaling calculation is to provide the five point calibration tables necessary to ensure proper transmitter, rack, indicator and recorder input to output relationships. This document is provided to supplement previous scaling performed in Attachment A.

3.0 REFERENCES

See setpoint Calculation SC-CN001-01, Section 3.0

4.0 ASSUMPTIONS

4.1 This calculation assumes that where readings are not possible due to resolution or demarcations on the scale that it is acceptable to round in a conservative manner.

5.0 DESIGN INPUTS

(See Calculation SC-CN001-01)

Calibrated Span: 33 TO 140 in wc
Indicated Span: 0-100% Level (Narrow Range)

6.0 Linear Device Scaling

Individual scaling is not provided for rack components including signal conditioners and isolators unless used as an output monitoring point in the calibration procedure. These devices may be checked individually, if desired using the linear scaling formulas below.

6.1 Linear Device scaling is based on the following:

Input Span: = | I-i |

Min (i)	Max (I)	Units
i = 4	I = 20	mADC
i = 1	I = 5	VDC

Input Span = 16 mADC
Input Span = 4 VDC

Output Span: = | O-o |

Min (o)	Max (O)	Units
o = 1	O = 5	VDC

Output Span = 4 VDC

No non-linear devices are included in this calculation.

7.0 ACCEPTABLE OR ALLOWABLE VALUES

7.1 Transmitters

1(2)LT-517, 1(2)LT-527, 1(2)LT-537, 1(2)LT-547
1(2)LT-518, 1(2)LT-528, 1(2)LT-538, 1(2)LT-548
1(2)LT-519, 1(2)LT-529, 1(2)LT-539, 1(2)LT-549

Manufacturer:	Rosemount
Model No.	1154HH4RH
Input	33 TO 140 INWC
Output	1-5 Vdc (at test point)

The Calibrated spans for the following transmitters is compensated for operating conditions. See Attachment A and B for determination of these values.

Unit 1 Steam Generator Narrow Range Level 1LT-517 (typical)		
Required Input (in WC)	Required Tolerance ± 0.02 Vdc	Acceptable Value (Vdc) ± 0.024 Vdc
140.0	0.950 (0.930 to 0.970)	(0.926 to 0.974)
113.0	1.959 (1.939 to 1.979)	(1.935 to 1.983)
86.0	2.968 (2.948 to 2.988)	(2.944 to 2.992)
59.0	3.977 (3.957 to 3.997)	(3.953 to 4.001)
33.0	4.948 (4.928 to 4.968)	(4.924 to 4.972)

Unit 2 Steam Generator Narrow Range Level 2LT-517 (typical)		
Required Input (in WC)	Required Tolerance ± 0.02 Vdc	Acceptable Value (Vdc) ± 0.024 Vdc
140.0	0.951 (0.931 to 0.971)	(0.927 to 0.975)
113.0	1.959 (1.939 to 1.979)	(1.935 to 1.983)
86.0	2.967 (2.947 to 2.987)	(2.943 to 2.991)
59.0	3.975 (3.955 to 3.995)	(3.951 to 3.999)
33.0	4.946 (4.926 to 4.966)	(4.922 to 4.970)

7.2 **Indicators**

1(2)LI-517, 1(2)LI-527, 1(2)LI-537, 1(2)LI-547
1(2)LI-518, 1(2)LI-528, 1(2)LI-538, 1(2)LI-548
1(2)LI-519, 1(2)LI-529, 1(2)LI-539, 1(2)LI-549

Manufacturer: Dixon Model: SH101AXT
Input : 1-5 Vdc Output : 0-100%

CONTROL ROOM INDICATOR SCALING

Monitoring Point 1(2)TP-517-1	1(2) LI-517 (typical) Cal Tol = ± 1% span *	Acceptable Value (%) ± 1.421% span *
Required Input Vdc	Required Tolerance (%)	
1.000	0 (0 to 1.0)	(0 to 1.4)
2.000	25.0 (24.0 to 26.0)	(23.6 to 26.4)
3.000	50.0 (49.0 to 51.0)	(48.6 to 51.4)
4.000	75.0 (74.0 to 76.0)	(73.6 to 76.4)
5.000	100.0 (99.0 to 100.0)	(98.6 to 100.0)

* This calculation supports ± values for all points. Off scale values are acceptable if determined to be within the specified tolerance.

1IR1

7.3 Hot Shut Down Indicators

1(2)LI-517A, 1(2)LI-527A, 1(2)LI-537A, 1(2)LI-547A

Manufacturer: Westinghouse
Model: 107
Input : 1-5 Vdc
Output : 0-100%

Monitoring Point 1(2)TP-517-1	1(2) LI-517A Cal Tolerance ± 1.5% span *	Acceptable Value (%) ± 2.0% span*
Required Input Vdc	Required Tolerance (%)	
1.000	0 (0 to 1.5)	(0 to 2.0)
2.000	25.0 (23.5 to 26.5)	(23.0 to 27.0)
3.000	50.0 (48.5 to 51.5)	(48.0 to 52.0)
4.000	75.0 (73.5 to 76.5)	(73.0 to 77.0)
5.000	100.0 (98.5 to 100.0)	(98.0 to 100.0)

1IR1

* This calculation supports ± values for all points. Off scale values are acceptable if determined to be within specified tolerance.

7.4 Recorders

1(2)LA-5048, 1(2)LA-5049, 1(2)LA-5050, 1(2)LA-5051

Manufacturer: Leeds and Northrup
Model No.: Speedomax 136
Input Range : 1-5 Vdc
Output: 0-100%

Monitoring Point TP-517-1	1(2)LA-5048 Cal Tol = ± 1.0% span *	Acceptable Value (%) AV = ±1.5% span *
Required Input Vdc	(%)	(%)
1.000	0 (0 to 1.0)	(0 to 1.5)
2.000	25.0 (24.0 to 26.0)	(23.5 to 26.5)
3.000	50.0 (49.0 to 51.0)	(48.5 to 51.5)
4.000	75.0 (74.0 to 76.0)	(73.5 to 76.5)
5.000	100.0 (99.0 to 100.0)	(98.5 to 100.0)

1IR1

* This calculation supports ± values for all points. Off scale values are acceptable if determined to be within the specified tolerance. 1IR1

7.5 Comparators

1(2)LC-517A-B, 1(2)LC-527A-B, 1(2)LC-537A-B, 1LC-547A-B
1(2)LC-517C, 1(2)LC-527C, 1(2)LC-537C, 1(2)LC-547C
1(2)LC-518A-B, 1(2)LC-528A-B, 1(2)LC-538A-B, 1LC-548A-B
1(2)LC-518C, 1(2)LC-528C, 1(2)LC-538C, 1(2)LC-548C
1(2)LC-519A-B, 1(2)LC-529A-B, 1(2)LC-539A-B, 1LC-549A-B

Manufacturer: Westinghouse
Model No. Model 118
Input: 1-5 Vdc
Output: Contact

7.5.1 High-High Setpoint

7.5.1.1 Where trip is established at ≤67%:
Voltage = 0.67 x 4.000 Vdc + 1.000 = 3.680 Vdc
Where Allowable Value is established at ≤68%:
Voltage = 0.68 x 4.000 Vdc + 1.000 = 3.720 Vdc

1IR1

1BS-517A, 1BS-518A, 1BS-519A, 1BS-527A, 1BS-528A, 1BS-529A,
1BS-537A, 1BS-538A, 1BS-539A, 1BS-547A, 1BS-548A, 1BS-549A
2BS-517A, 2BS-519A, 2BS-527A, 2BS-528A,
2BS-537A, 2BS-539A, 2BS-548A, 2BS-549A

Output Monitoring Point BS-517A	Setpoint ≤67% (Cal Tol 0.25%)	Allowable Value (≤68%)
Steam Generator Level High High Trip	Trip (inc) 3.680 Vdc (3.670 to 3.680 Vdc)	(≤ 3.720 Vdc)
	Reset (dec) 40 mV (30 to 50 mV) from trip	

1IR1

7.5.1.2 High High Setpoint (Field Adjusted Lower than Tech Spec)

Due to process requirements, the following Comparator Outputs are set at 61% which is conservative to the existing Technical Specification Setpoint of 67% . (Ref main calculation section 8.0). While no adjustment to these setpoints is necessary, it is important to note that, while the Technical Specification Allowable Value will assure that the Analytical Limit is protected, it will not serve as an adequate means to determine that the loop is performing correctly, since it is set significantly beyond the calculated Acceptable Value (1% = 0.04 Vdc) for the Rack Components. This calculation recommends an administrative tolerance of 1% be established for technician alert of questionable loop performance.

2BS-518A, 2BS-529A, 2BS-538A, 2BS-547A

Where trip is set at 61%:
Voltage = 0.61 x 4.000 Vdc + 1.000 = 3.440 Vdc

Scaling to support the Setpoint from Calibration procedures:

Output Monitoring Point 2BS-518A (typical above)	Setpoint (Currently set at 61%) (Cal Tol 0.25%)	Acceptable Value 1% (0.040 Vdc) (note 1)
Steam Generator Level High High Trip	Trip (inc) 3.440 Vdc (3.430 to 3.440 Vdc)	(≤ 3.480 Vdc)
	Reset (dec) 40 mV (30 to 50 mV) from trip	

Note 1. The Acceptable Value shown above is provided to allow the technician to determine acceptable loop performance for the equipment setpoints set at 61%. The actual Technical Specification Allowable Value which is the licensing limit, is ≤68% or ≤ 3.720 Vdc.

7.5.2 Current Low Low Setpoint

Where trip is Trip ≥16%
Voltage = 0.160 x 4.000 Vdc + 1.000 = 1.640 Vdc
Where Allowable Value is ≥ 14.8%
Voltage = 0.148 x 4.000 Vdc + 1.000 = 1.592 Vdc

The current low-low setpoint is based on previously calculated uncertainties. Per the current analysis, this setpoint is conservative and acceptable, but may be lowered for operational margin. The following is the setpoint calibration tolerances and Allowable Value to support the existing setpoint.

Output Monitoring Point BS-517B	Setpoint ≥16% (Cal Tol 0.25%)	Allowable Value ≥ 14.8%
Steam Generator Low Low Trip	Trip (dec) 1.640 Vdc (1.640 - 1.650 Vdc)	(≥1.592 Vdc)
	Reset (inc) at 40 mV (30 to 50 mV) from trip	

7.5.3 RECOMMENDED Low-Low Setpoint

The calculation recommends setting the Low-Low trip setpoint at 9%. The following calibration information is provided to support that recommendation.

Where trip is Trip ≥9%
Voltage = 0.09 x 4.000 Vdc + 1.000 = ≥1.360 Vdc
Where Allowable Value is ≥8%

Voltage = 0.08 x 4.000 Vdc + 1.000 = ≥1.320 Vdc

Output Monitoring Point BS-517B (typical)	Setpoint ≥9% (Cal Tol 0.25%)	Allowable Value ≥ 8%
Steam Generator Low Low Trip	Trip (dec) 1.360 Vdc (1.360 - 1.370 Vdc)	(≥1.320 Vdc)
	Reset (inc) at 40 mV (30 to 50 mV) from trip	

1IR1

1IR1

7.5.4 Current Steam Generator Low Setpoint

Where trip is Trip ≥25%
Voltage = 0.250 x 4.000 Vdc + 1.000 = 2.000 Vdc
Where Allowable Value is ≥24%
Voltage = 0.240 x 4.000 Vdc + 1.000 = 1.960 Vdc

Low Trip Setpoint

Output Monitoring Point BS-517C (typical)	Setpoint ≥25% (Cal Tol 0.25%)	Allowable Value ≥ 24%
Steam Generator Low Low Trip	Trip (dec) 2.000 Vdc (2.000 - 2.010 Vdc)	(≥1.960 Vdc)
	Reset (inc) at 40 mV (30 to 50 mV) from trip	

7.5.5 RECOMMENDED Steam Generator Low Setpoint

Where trip is Trip ≥10%
Voltage = 0.10 x 4.000 Vdc + 1.000 = 1.400 Vdc
Where Allowable Value is ≥9%
Voltage = 0.09 x 4.000 Vdc + 1.000 = 1.360 Vdc

1IR1

Output Monitoring Point BS-517C (typical)	Setpoint ≥10% (Cal Tol 0.25%)	Allowable Value ≥ 9%
Steam Generator Low Low Trip	Trip (dec) 1.400 Vdc (1.400 to 1.410 Vdc)	(≥1.360 Vdc)
	Reset (inc) at 40 mV (30 to 50 mV) from trip	

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET					SHEET: i CONT'D ON SHEET:
CALC. No.:SC-CN001-01 Attachment 10.2			REFERENCE:			
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

ATTACHMENT 10.2

NUS SIGNAL ISOLATOR /RACK EVALUATION

1IR1

1.0 Purpose

The purpose of this evaluation is to determine if the total rack uncertainties currently used for a standard Westinghouse Rack (with no comparator) are bounding if the Westinghouse Model 4111083-001 is replaced with the equivalent model manufactured by NUS, Model FIA801-05-07-08. This evaluation is possible since the rack being evaluated does not contain any other significant modules other than the signal isolators.

2.0 Scope

This evaluation is applicable to the Instrument rack for Narrow range Steam Generator Level Indicator and Recorder loops. The isolators that are scheduled for replacement include the following tag numbers. Unit 2 will be replaced first, under DCP 2EC-3178, Pkg 2, the Unit 1 DCP number has not been determined at this calculation issuance.

1(2) LM-517A
1(2) LM-527A
1(2) LM-537A
1(2) LM-547A
1(2) LM-518
1(2) LM-528
1(2) LM-538
1(2) LM-548
1(2) LM-519A
1(2) LM-529A
1(2) LM-539A
1(2) LM-549A

3.0 References

3.1 NUS Signal Isolator Performance Specification Sheets (Attached)
3.2 Salem Setpoint Technical Standard SC. DE-TS.ZZ-1904 (Q)
3.3 For Additional References See Calculation Section 3.0

4.0 Design Inputs

4.1 Standard Westinghouse Rack Performance Specifications (Ref 3.2)

Accuracy	± 0.500% span
Temperature Effect	± 0.500% span
Drift	± 1.000% span

$$RACK = \pm [(RA_{RACK})^2 + (DR_{RACK})^2 + (TE_{RACK})^2]^{1/2}$$
$$RACK = \pm [(0.500\%)^2 + (1.000\%)^2 + (0.500\%)^2]^{1/2}$$
$$RACK = \pm 1.225\% \text{ span}$$

4.2 NUS Performance Specification (Ref 3.1)

Accuracy	± 0.1% FS
Repeatability	± 0.05% FS
Temperature Effect	± 0.05% span per Deg C
Power Supply	0.05% change in output for the listed variations, cumulative
Linearity	± 0.1% FS

5.0 Comparison of NUS to Rack Uncertainties

5.1 Calculation of NUS Uncertainties

5.1.1 NUS Reference Accuracy (RA_{NUS}):

Per Design Inputs, the Accuracy for the NUS Isolator is ± 0.100% span. In addition, accuracy includes the specified linearity of 0.100% and repeatability of 0.050%. Total reference accuracy is considered the SRSS of the components of accuracy such that:

$$RA_{NUS} = \pm [(0.100\%)^2 + (0.050\%)^2 + (0.100\%)^2]^{1/2}$$
$$RA_{NUS} = \pm 0.150\% \text{ span}$$

5.1.2 NUS Temperature Effect (TE_{NUS}):

Per Design Inputs, the Isolator Temperature Effect is less than the 0.050% of output full scale change for a 1 Deg C change in temperature over the specified range. Per the Design Inputs Section 5.1.1 of Ref 3.3, the temperature difference between the maximum room temperature vs calibration temperature and the difference between minimum room temperature and calibration temperature are both 15 deg F.

TE_{NUS} = ± (0.050% /1.8) x 15 Deg F
TE_{NUS} = ± 0.417% span

5.1.3 NUS Drift Effect (DR_{NUS})

No drift was supplied by the vendor for this device. Per the Salem Technical Standard, (Ref 3.2) a default value should be established. A drift of ±0.250% span is established for this device which is greater than the reference accuracy.

DR_{NUS} = ± 0.250% span

5.1.4 NUS Rack Power Supply Effects (PS_{NUS})
(Ref 3.1)

The NUS specified power supply effect is 0.050% change in output for the listed variations. Per Salem Setpoint Technical Standard (Ref 3.2), a power supply effect of this magnitude or less may be ignored. Therefore,

PS_{NUS} = ± 0.000% span

5.1.5 NUS Rack Humidity Effects (HE_{NUS})
(Ref 3.2)

No humidity effects were supplied by the vendor. Per the Salem Setpoint Technical Standard (Ref 3.2), the effect may be assumed to be included within the stated effects.

HE_{NUS} = ± 0.000% span

5.1.6 NUS Rack RFI/EMI Effects (REE_{NUS})
(Ref 3.2)

No RFI or EMI effects were provided by the vendor. These effects are unlikely due to the shielding and regulation of the use of radios and other interference causing devices in the Control room. Per the Salem Setpoint Technical Standard (Ref 3.2) since no uncertainty is provided by the vendor for this effect it may be considered not applicable.

$REE_{NUS} = \pm 0.000\%$ span

5.1.7 NUS Rack Normal Radiation Effects (RE_{NUS})
(Ref 3.2)

No radiation effects are specified by the vendor nor are they considered applicable to the mild environment of the Control Room.

$RE_{NUS} = \pm 0.000\%$ span

5.1.8 Total NUS Uncertainty (NUS):

All random, independent uncertainties associated with the NUS isolator are combined below using the SRSS method of error combination. PS, HE, REE, and RE effects are negligible. therefore:

$NUS = \pm [(RA_{NUS})^2 + (DR_{NUS})^2 + (TE_{NUS})^2]^{1/2}$
$NUS = \pm [(0.150\%)^2 + (0.250\%)^2 + (0.417\%)^2]^{1/2}$
$NUS = \pm 0.509\%$ span

6.0 Conclusions

The standard rack uncertainties are ± 1.225% span (Reference Section 4.1)

The total NUS Isolator uncertainties are ± 0.509% span (analysis performed above)

Based on the above, the Standard Westinghouse Rack total uncertainties are greater than those calculated with the NUS performance specification. Therefore, for a rack including an NUS isolator the Standard Westinghouse rack uncertainties are bounding.

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET				SHEET: i CONT'D ON SHEET:		
CALC. No.:SC-CN001-01 Attachment 10.3			REFERENCE:				
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1		
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94			

ATTACHMENT 10.3

MOORE SIGNAL ISOLATOR /RACK EVALUATION

1R1

1.0 Purpose

The purpose of this evaluation is to determine if the total rack uncertainties currently used for a standard Westinghouse Rack are bounding if the Moore signal isolator Model SCT is considered part of the rack. This evaluation assumes that the rack already includes either a standard Westinghouse Model 110 isolator or an NUS Model FIA801-05-07-08. (Ref Attachment 10.2 for NUS evaluation).

2.0 Scope

This evaluation is applicable to the Instrument rack for Narrow range Steam Generator Level Recorder loops.

3.0 References

3.1 PSBP 301669, Moore Isolator specification sheet (Attached)
3.2 Salem Setpoint Technical Standard SC.DE-TS.ZZ-1904 (Q)
3.3 Calculation SC-CN001-01 Attachment 10.2
3.4 Calibration Procedures S1(2).IC-CC-RCP-0033 (Channel IV)
Calibration Procedures S1(2).IC-CC-RCP-0034 (Channel III)
Calibration Procedures S1(2).IC-CC-RCP-0035 (Channel II)

4.0 Analysis Assumption

Westinghouse Isolator Model 131-110 is a high impedance, solid-state differential dc amplifier with a single input and a single-ended dc isolator circuit used in control circuits requiring dc stability and floating dc output. The NUS Model FCA-801 isolator is a comparable model with the exception of having 4 separate isolated outputs.

The Westinghouse specifications do not include uncertainties specific to the isolators. Westinghouse does provide a general specification for the overall rack performance which is comprised of a ±0.5% span accuracy and a ± 0.5% temperature effect. Considering that the rack general specification is applicable for racks with multiple instruments, it can be assumed that the individual uncertainty of the isolator may be significantly less than the overall rack specification. The NUS isolator is being purchased as an equivalent replacement for this model, therefore, this calculation assumes that the individual uncertainties for the Westinghouse isolator are comparable to the NUS specifications.

The NUS specifications were evaluated (see Ref 3.3), and the calculated uncertainty is ±0.509% span. The total uncertainty for the Westinghouse rack (Ref 3.2) including the NUS or the Westinghouse isolator for the effects of Rack Accuracy, Drift and Temperature Effects, is ± 1.225% span.

Based on the assumption that the NUS uncertainties and the Westinghouse Isolator uncertainties are comparable, this calculation assumes that the addition of another device within this rack would not affect the analysis, as long as the uncertainty of the additional device combined SRSS with the isolator is still within ± 1.225%.

5.0 Design Inputs

5.1 Westinghouse Rack Accuracy ±1.225% (Ref 3.3)

5.2 NUS Accuracy ± 0.509% span (Ref 3.3)

5.3 Moore Isolator Performance Specification (Ref 3.1)

Accuracy	± 0.1% of span (linearity and repeatability)
Load Effect	± 0.01% span from 0 to max load resistance
Temperature Effect	± 0.005% span per Deg F over -20 to 180 Deg F.
Line Voltage Effect	± 0.005%/1% line change

6.0 Determination of Moore Isolator Uncertainty

6.1 Uncertainties for the Moore Signal Isolator are from Design Inputs (taken from Reference 3.1) unless otherwise noted.

Signal Isolator Reference Accuracy (RA_{ISO})

Per Design Inputs, the Reference accuracy is 0.1% span.

RA_{ISO} = ± 0.1% span

6.2 Isolator Temperature Effect (TE_{ISO})

Per Design Inputs, the Isolator Temperature Effect may be assumed to be within ± 0.005% span per Deg F change within the specified operational range of -20 to 180 Deg F. The control room temperature variation from calibration is 15 Deg F. Therefore, the total temperature effect is:

TE_{ISO} = ± (0.005% / 1 Deg F) x 15 Deg F.

TE_{ISO} = ± 0.075% span

6.3 Isolator Power Supply Effects (PS_{ISO})

Per design inputs, the line voltage effect is ± 0.005%/1% variation. Per the power supply regulation, the variation may be ± 2%. Therefore, the total uncertainty will be 0.010% span.

PS_{ISO} = ± 0.010% span

6.4 Isolator Drift (DR_{ISO})

No drift was supplied by the vendor for this device. Per the Salem Technical Standard, (Ref 3.2), a default value should be established. A drift of ± 0.250% span is established for this device which is greater than twice the reference accuracy.

DR_{ISO} = ± 0.250% span

6.5 Isolator Miscellaneous Effects (ME_{ISO})

Per design inputs, the isolator has a load effect of ± 0.010% of span.

ME_{ISO} = ± 0.010% span

6.6 Total Isolator Uncertainty (ISO)

The total uncertainty is the SRSS combination of all calculated uncertainties associated with the isolator.

$$ISO = \pm [(RA_{ISO})^2 + (TE_{ISO})^2 + (PS_{ISO})^2 + (ME_{ISO})^2 + (DR_{ISO})^2]^{1/2}$$

$$ISO = \pm [(0.100\%)^2 + (0.075\%)^2 + (0.010\%)^2 + (0.010\%)^2 + (0.250\%)^2]^{1/2}$$

$$ISO = \pm 0.280\% \text{ Span}$$

7.0 Rack with NUS/Westinghouse Isolator and the Moore Isolator

Per Assumption 4.1, the Westinghouse Isolator is assumed to have the same accuracy as the NUS isolator at 0.509% span.

Rack with Moore = $\pm\ [(\text{NUS/Westinghouse})^2 + (\text{Moore})^2]^{1/2}$

Rack with Moore = $\pm\ [(0.509\%)^2 + (0.280\%)^2]^{1/2}$

Rack with Moore = ± 0.581% span

8.0 Conclusions

Per the analysis of section 4.0, the addition of the Moore uncertainty is acceptable with no change in the standard rack uncertainties, providing the Moore uncertainties are within the remaining standard rack uncertainties available after the Westinghouse or NUS isolator uncertainties are accounted for.

Based on the Moore uncertainty calculated above, and assuming that the Westinghouse or NUS isolators in the loop are within 0.509% span, the addition of the Moore isolator uncertainty of ± 0.280% span results in a combined uncertainty of 0.581% span. This uncertainty is within the 1.225% which is used as the standard rack assumption for Accuracy, Temperature Effect and Drift. Since the rack only includes the two isolators, the Moore uncertainties do not cause the rack to exceed the uncertainties assumed for the rack. Therefore, the standard rack assumptions are bounding for this particular case.

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET	SHEET: i CONT'D ON SHEET:

CALC. No.:SC-CN001-01 Attachment 10.4						REFERENCE:
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1	
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94		

ATTACHMENT 10.4

WESTINGHOUSE LETTER; S/G WATER LEVEL PMA TERM INACCURACIES

1IR1

SC-CN001-81 REV 1 ATTACHMENT 10.4 pg 1 of 10

Westinghouse Electric Corporation

Energy Systems

Pittsburgh Pennsylvania 15230-0355

Noted
VP-Nuclear Operations
Ops. Assessment
Prin. Eng.-Reliability
Proj. Mgr.-Prev. Maint.
Sr. Secretary
Co. Det. By
JUN 18 1992
PSE-92-106
Reply By
Return
Suspense
File

JUN 26 '92

Mr. J. A. Nichols, Manager
Reliability & Assessment
Public Service Electric and Gas Company
P. O. Box 236
Hancocks Bridge, New Jersey 08038

Public Service Electric and Gas Company
Salem Units No. 1 and 2
S/G Water Level PMA Term Inaccuracies

Dear Mr. Nichols:

The purpose of this letter is to inform your plant that the Process Measurement Accuracy (PMA) term, based on standard Westinghouse Methodology, for Steam Generator Water Level instrumentation uncertainty calculations may be non-conservative. This would impact the protection functions which use this parameter, i.e. Steam Generator Water Level - Low, Low-Low, and High-High. The magnitude of the impact is plant specific. It is affected by the steam generator model number and is sensitive to the calibration conditions used by the plant (process pressure and reference leg temperature) and tap locations.

The standard Westinghouse methodology used a random value of ±2.0% span for this term in setpoint uncertainty calculations for all models of steam generator design. This value was based on the density variation as a function of power and level, and the assumption that calibration was performed at 50% power conditions. For several of the models, the fluid velocity effect was known to introduce a significant bias in the low direction and a separate allowance was incorporated for this effect for Steam Generator Water Level - High-High.

More recently, an improved understanding of ΔP level measurement system errors based on scientific work documented in an Instrument Society of America paper (G. E. Lang and J. P. Cunningham, "Delta-P Level Measurement Systems," "Instrumentation, Controls, and Automation in the Power Industry," Vol. 34, Proceedings of the Thirty-Fourth Power Instrumentation Symposium, June 1991), has led to a reinvestigation of the Steam Generator Level Process Measurement Accuracy terms. The conclusions are that two other error components should be accounted for explicitly (i.e., reference leg temperature changes from calibration temperature, and downcomer subcooling) and that fluid velocity effects should be considered for all steam generator models. In addition, the assumption of calibration at 50% power may not be conservative with respect to actual calibration conditions used by the plants. These error components are not considered to be random in nature, and should therefore be treated as biases.

Two cases were evaluated to determine the potential magnitude of the impact of the additional errors on the total channel uncertainty, and are discussed in detail in the attachment. The first case used plant specific data for a three loop plant with a Model 51, and is expected to be typical of the effects for that steam generator model. The second case is considered to be a bounding evaluation for a Model F steam generator. Based on these evaluations, the previous uncertainty calculations for Steam Generator Water Level - Low and Low-Low may be nonconservative by approximately 1 to 2% span. The potential nonconservatism for Steam Generator Water Level - High-High ranges from 1 to 16%. It must be emphasized that the magnitude of the impact is plant specific as well as model specific, and is sensitive to the calibration conditions used by the plant (process pressure and reference leg temperature) and tap locations.

Based on engineering judgement, Westinghouse believes that, although potentially outside the existing licensing basis, the required safety functions can still be performed by either 1) existing automatic systems on a best estimate basis, or 2) operator action. Therefore, this issue would not constitute a Substantial Safety Hazard pursuant to the requirements of 10 CFR Part 21. It is recommended, however, that the impact of this issue on your plant be evaluated.

If there are any questions, please contact the undersigned.

Very truly yours,

J. N. Steinmetz, Project Manager
Central Area
Domestic Customer Projects

0269K

Steam Generator Water Level Process Measurement Accuracy Terms and Setpoint Uncertianties

SUMMARY

Westinghouse has determined that the Process Measurement Accuracy term, based on standard Westinghouse methodology, for Steam Generator Water Level instrumentation uncertainty calculations may be nonconservative. This would impact the protection functions which use this parameter, i.e. Steam Generator Water Level - Low, Low-Low, and High-High. Westinghouse has performed evaluations of two cases which are described below to determine the potential impact of the increased uncertainty. Based on these evaluations, the previous uncertainty calculations for Steam Generator Water Level - Low and Low-Low may be nonconservative by approximately 1 to 2% span. The potential nonconservatism for Steam Generator Water Level - High-High ranges from 1 to 16%. The magnitude of the impact is plant specific. It is affected by the steam generator model and is sensitive to the calibration conditions used by the plant (process pressure and reference leg temperature) and tap locations. Although potentially outside the existing licensing basis, the required safety functions can still be performed by either 1) existing automatic systems on a best estimate basis, or 2) operator action. It is recommended, however, that the impact of this issue on your plant be evaluated.

ISSUE DESCRIPTION

Basic Component

The basic component involved in this issue is the Steam Generator Water Level instrumentation and the associated uncertainty analysis. This uncertainty analysis, if based on standard Westinghouse methodology, includes an uncertainty term to account for Process Measurement Accuracy. Historically, a random value of ±2.0% span has been used for this term in setpoint uncertainty calculations for all models of steam generator design. This value was based on the density variation as a function of power and level, and the assumption that calibration was performed at 50% power conditions. For several of the models, the fluid velocity effect was known to introduce a significant bias in the low direction and a separate allowance was incorporated for this effect for Steam Generator Water Level - High-High.

Deviation

The issue concerning the Steam Generator Water Level Process Measurement Accuracy term is that the use of a random ±2.0% value may be nonconservative. A paper presented at an Instrument Society of America (ISA) conference in June, 1991 (G. E. Lang and J. P. Cunningham, "Delta-P Level Measurement Systems","Instrumentation, Controls, and Automation in the Power Industry", Vol. 34, Proceedings of the Thirty-Fourth Power Instrumentation Symposium) provided information leading to the conclusion that this uncertainty term should be re-evaluated. In particular, process pressure variation effects on density, reference leg temperature changes under normal operating conditions, downcomer subcooling, and fluid velocity effects for all steam generator models should be accounted for explicitly. In addition, the assumption of calibration at 50% power may not be conservative with respect to actual calibration conditions used by a particular plant. These error components are not considered to be random in nature, and should therefore be treated as biases. The equations used in determining these error components were presented in the ISA paper referenced and are repeated below.

Process Pressure Variations

After installation of the level measurement system on the steam generator, it is calibrated for a specific set of operating conditions, i.e., a reference leg temperature and process pressure. If the process pressure changes as a consequence of changing operating conditions, then a level measurement error is created. An approximation of the measurement error, due to changes in process pressure (assuming the temperature of the fluid in the vessel is at the saturation temperature corresponding to the steam pressure) is:

$$\varepsilon_p = \left[\frac{\left[\frac{H_L}{H}\right]\left[\rho_g - \rho_{gc}\right] + \left[\frac{L}{H}\right]\left[\rho_f - \rho_g\right]}{\left[\rho_{fc} - \rho_{gc}\right]} - \left[\frac{L}{H}\right] \right] (100)$$

where:

ε_p	=	measurement uncertainty in percent of the level span
L	=	actual water level in the vessel above the lower tap (ft)
H_L	=	maximum vertical distance from the lower tap to water level in the condensate pot at the upper tap (ft)
H	=	vertical distance between upper and lower taps on the vessel, i.e., the level span (ft)
ρ_g	=	dry saturated steam density at the process pressure (lbm/ft^3)
ρ_f	=	saturated water density at the process pressure (lbm/ft^3)
ρ_{gc}	=	saturated steam density at the calibration pressure (lbm/ft^3)
ρ_{fc}	=	saturated water density at the calibration pressure if the system is hot calibrated, or water density at the calibration pressure and temperature if the system is cold calibrated (lbm/ft^3).

For a given protection function, this uncertainty will be a bias, e.g., for Steam Generator Water Level - Low-Low, assuming calibration at 100% Rated Thermal Power (RTP) conditions, the process pressure variation is a negative bias for 0% level at 0% RTP and a positive bias for 100% level at 0% RTP (the two limiting conditions for instrumentation for feedwater line break and feedwater malfunction).

Reference Leg Temperature Variations

In addition to assuming a process pressure when the level measurement system is calibrated, a reference leg temperature is assumed. This uncertainty addresses the changes in normal operation ambient temperature, not the elevated containment ambient temperatures experienced in an inside containment high energy line break. Typically, a specific operational temperature is assumed for the purpose of calibration and an allowed operational band is assumed about the reference temperature. Westinghouse calculates two uncertainties for this variable, one in the high direction (bounded by 130 °F) and one in the low direction (typically 100 °F). These are considered reasonable operational limits for this purpose. The equation used to determine the reference leg temperature variation uncertainty is:

$$\varepsilon_T = \frac{\left[\frac{H_L}{H}\right]\left[\rho_{Lc} - \rho_L\right] (100)}{\left[\rho_{fc} - \rho_{gc}\right]}$$

where:

ε_T = measurement uncertainty in percent of level span

H_L = maximum vertical distance from the lower tap to the water level in the condensate pot at the upper tap (ft)

H = vertical distance between the upper and lower taps on the vessel, i.e., the level span (ft)

ρ_{Lc} = water density at the calibration ambient conditions (process pressure and reference leg temperature at which the calibration was performed) (lbm/ft^3)

ρ_L = water density in the reference leg (lbm/ft^3)

ρ_{fc} = saturated water density at the calibration pressure if the system is hot calibrated, or water density at the calibration pressure and temperature if the system is cold calibrated (lbm/ft^3).

ρ_{gc} = saturated steam density at the calibration pressure (lbm/ft^3).

For a given protection function, this uncertainty will be a bias, e.g., for Steam Generator Water Level - Low-Low, assuming calibration at a reference condition of 110 °F and allowed temperature swings of up to 130 °F and down to 100 °F, the 130 °F error is a bias in the indicated high level direction and the 100 °F error is a bias in the indicated low direction. Thus to be conservative, for the Low-Low reactor trip, the indicated high error is used. For Steam Generator Water Level - High-High the indicated low direction is conservative and the low temperature error is used.

Fluid Velocity Effects

When performing a calibration of the Steam Generator Water Level channels, the fluid velocity near the tap locations has been assumed to be negligible such that a differential pressure would not be induced due to fluid flow. However, this is not the case for the lower tap due to shell and internals design. The upper tap is assumed to be in the steam space. An approximation of the error introduced by fluid velocity effects past the lower tap is:

$$\varepsilon_v = \frac{-\left[\frac{W}{A}\right]^2 \left[1.0 + K_f\right] (100)}{2(H)(g_c)(\rho_{WT})\left[\rho_{fc} - \rho_{gc}\right]}$$

$$K_f = 288(g_c)(\rho_{WT})(\Delta p)\left[\frac{A}{(W_R)(CR_R)}\right]^2$$

where:

ε_v	=	measurement uncertainty in percent of the level span
W	=	fluid flow rate normal to the lower tap (lbm/sec)
A	=	flow area at the lower tap (ft^2)
K_f	=	friction and form loss factor
H	=	vertical distance between the upper and lower taps on the vessel, i.e., the level span (ft)
g_c	=	gravitational constant (ft/sec^2)
ρ_{WT}	=	water density in the vicinity of the lower tap (lbm/ft^3)
ρ_{fc}	=	saturated water density at the calibration pressure if the system is hot calibrated, or water density at the calibration pressure and temperature if the system is cold calibrated (lbm/ft^3).
ρ_{gc}	=	saturated steam density at the calibration pressure (lbm/ft^3).
Δp	=	pressure drop in the downcomer to the lower tap (lbm)
W_R	=	steam flow at rated thermal power conditions
CR_R	=	circulation ratio at rated thermal power conditions.

This uncertainty is a bias in the indicated low level direction. The magnitude varies as a function of power, thus an appropriate value must be used for each specific protection function depending on the conditions for the event, e.g., Steam Generator Water Level - Low-Low is used for both zero power and 100% power events. The smallest magnitude negative error is at zero power, thus it is acceptable to use the zero power value for both zero power and 100% power events. The highest magnitude negative error typically occurs between 50 and 70% power, thus for Steam Generator Water Level - High-High, it is conservative to use the part power value for a Feedwater Malfunction event.

Downcomer Subcooling Effects

Another source of measurement error is the subcooling of the fluid in the downcomer region in conjunction with a saturated mixture around the steam generator U-tubes. The magnitude of the subcooling in the downcomer is dependent upon the following process conditions; main feedwater temperature, circulation ratio, and location of the feedwater nozzle with respect to the low level tap. This uncertainty is determined by the following:

$$\varepsilon_s = \frac{[\rho_{WT} - \rho_f](100)}{[\rho_{fc} - \rho_{gc}]} \left[\frac{H_s}{H}, \frac{L}{H}\right]^{min}$$

where:

ε_s	=	measurement uncertainty in percent of the level span
ρ_{WT}	=	water density in the vicinity of the lower tap (lbm/ft^3)
ρ_f	=	saturated water density at the process pressure (lbm/ft^3)
ρ_{gc}	=	saturated steam density at the calibration pressure (lbm/ft^3)
ρ_{fc}	=	saturated water density at the calibration pressure if the system is hot calibrated, or water density at the calibration pressure and temperature if the system is cold calibrated (lbm/ft^3).
H_s	=	the maximum height of the water column above the lower tap that is assumed to be subcooled (ft)
H	=	vertical distance between upper and lower taps on the vessel, i.e., the level span (ft)
L	=	actual water level in the vessel above the lower tap (ft).

This uncertainty is a bias in the indicated high direction, thus it is non-conservative for the Steam Generator Water Level - Low-Low function (and should therefore be accounted for) and conservative for the High-High function (and may be ignored).

TECHNICAL EVALUATIONS

Two cases were evaluated to determine the potential magnitude of the impact of the additional errors on the total channel uncertainty, and are discussed in detail below. The first case used plant specific data from a three loop plant, and is expected to be typical of the effects for a Model 51 steam generator. The second case is considered to be a bounding evaluation for a Model F steam generator. Based on these evaluations, the previous uncertainty calculations for Steam Generator Water Level - Low and Low-Low may be nonconservative by approximately 1 to 2% span. The potential nonconservatism for Steam Generator Water Level - High-High ranges from 1 to 16%. It must be emphasized that the magnitude of the impact is plant specific as well as model specific, and is sensitive to the calibration conditions used by the plant (process pressure and reference leg temperature) and tap locations.

For the three loop plant the reference conditions and the magnitudes of the effects are as follows:

Reference conditions	110°F Reference Leg Temperature, 792 psia, 100% RTP
Process pressure variation	+1.1% span [110°F, 1020 psia, 0% level]
	-4.0% span [110°F, 1020 psia, 100% level]
Reference leg temperature	+0.7% span [130°F, 790 psia, any level]
	-0.3% span [100°F, 790 psia, any level]

Fluid velocity effects	-0.7% span
Downcomer subcooling	+0.5% span

For Steam Generator Water Level - Low-Low, the summation of the applicable terms is:

+1.1 + 0.7 - 0.7 + 0.5 = +1.6% span.

For Steam Generator Water Level - High-High, the summation of the applicable terms is:

-4.0 - 0.3 - 0.7 + 0.5 = -4.5% span.

Using these values as biases in the uncertainty calculations, resulted in increases of approximately 1.0% span in the total channel uncertainty for Steam Generator Water Level - Low-Low, and approximately 3.9% span for High-High, relative to using the ±2.0 random term. It was determined that sufficient margin existed to accommodate these values for this specific plant.

For a generic case assuming a Model F Steam Generator, the reference conditions and the magnitudes of the effects are based on a two loop plant and are considered to be bounding:

Reference conditions	110°F, 760 psia, 100% RTP
Process pressure variation	+1.0% span [110°F, 954 psia, 0% level] -3.4% span [110°F, 954 psia, 100% level]
Reference leg temperature	+0.7% span [130°F, 760 psia, any level] -0.3% span [100°F, 760 psia, any level]
Fluid velocity effects	-14.2% span [70% RTP] 0.0 to -2.0% span [0% RTP]
Downcomer subcooling	+1.6% span

For Steam Generator Water Level - Low-Low, the summation of the applicable terms is:

+1.0 + 0.7 - 0.0 + 1.6 = +3.3% span (conservative calculation)

or

+1.0 + 0.7 - 2.0 + 1.6 = +1.3% span (better estimate calculation).

For Steam Generator Water Level - High-High, the summation of the applicable is:

-3.4 - 0.3 - 14.2 + 1.6 = -16.3% span.

Using these values as biases in the uncertainty calculations, resulted in increases of approximately 1.7 to 2.7% span in the total channel uncertainty for Steam Generator Water Level - Low-Low, and approximately 15.7% span for High-High, relative to using the ±2.0 random term. It should be noted that calibration at any power level less than 100% RTP will result in decreases in the process pressure variation terms for both low and high levels. Therefore the above is a worst case situation. Calibration at 50% RTP results in process pressure variation terms of +0.7% span and -1.6% span for the low and high levels, respectively. This change results in correspondingly lower total channel uncertainties since the term is applied as a bias.

SAFETY SIGNIFICANCE

The safety significance of this issue is a function of calibration conditions, steam generator model, and the margin present in the existing trip setpoints and safety analyses. Without specific knowledge of the calibration conditions used at the plants, Westinghouse cannot make a definitive determination of safety significance. However, based on engineering judgement as discussed below, the increase in uncertainty on Steam Generator Water Level Low-Low is small, and on a best estimate basis the existing acceptance criteria for currently analyzed events would be maintained.

For the Steam Generator Water Level Low-Low uncertainty calculation, there is typically a small degree of margin (0.5 to 1.0% span) between the total channel allowance (Safety Analysis Limit minus Nominal Trip Setpoint) and the total channel uncertainty. Based on a bounding increase in total channel uncertainty of 2.0%, an additional 1.0 to 1.5% must be accommodated. This can be found on an interim basis in the Environmental Allowance (EA) term. Westinghouse typically specifies an EA magnitude based on the postulated Steambreak environment, which is enveloped by a maximum temperature of 420°F. Each transmitter supplied by Westinghouse is temperature compensated at a steady state 320°F based on the belief that the electronics will not see the maximum temperature due to thermal shielding and inertia of the transmitter casing. Typical maximum Feedwater line break ambient temperatures are postulated to be approximately 350°F several minutes into the event, while a typical time of reactor trip is less than 60 seconds into the event. This would indicate that the transmitter will see an ambient temperature significantly less than 350°F and the electronics would see an even lower temperature. Assuming that the EA magnitude is linear from 6% at 320°F to 0% at 130°F, a steady state temperature of approximately 250°F would result in an EA term of 4% span. This is significantly more than postulated containment ambient temperatures at 60 seconds into a Feedwater line break. Thus it is reasonable to assume that an additional 2% span is available for interim margin considerations. These assumptions are based on engineering judgment and may be outside the plant licensing basis, but may be considered in developing the basis for continued plant operation until a plant specific evaluation can be completed.

The Steam Generator Water Level - High-High reactor trip is provided for a Feedwater Malfunction event which results in an uncontrolled increase in level. The primary effect of this event is an increase in moisture carryover which can cause significant turbine blade erosion if not corrected. This is primarily a commercial concern, i.e. not an immediate safety concern, and there would be time for operator action to terminate the event if this were the only concern. An additional concern, however, is the filling of the steam generator with subsequent filling of the steam lines with water. The steam line piping supports may not be designed to support the dead weight of water in the steam lines, therefore the event must be terminated prior to creation of a steam line break due to piping support failure.

A small increase in uncertainty in the High-High trip (on the order of 5% span or less) can typically be accommodated within the margin in this channel or by increases in the Safety Analysis Limit. However for large increases as exhibited in the bounding Model F evaluation above, more detailed evaluation may be necessary. Although typically outside plant licensing bases, control system alarms are available to initiate operator action for mitigation. That is, when level deviates outside the control band (typically 5% span), or when there is a significant mismatch between steam flow and feedwater flow, an alarm sounds for operator notification. This would initiate operator action to terminate the event, thus preventing the filling of the steam generator or the steam lines.

REPORTABILITY CONSIDERATIONS

Westinghouse has concluded that this issue would not constitute a Substantial Safety Hazard pursuant to the requirements of 10 CFR Part 21 based on the availability and use of existing automatic systems on a best estimate basis or operator action. Since Westinghouse does not have the capability (i.e., Westinghouse does not have knowledge of plant specific calibration conditions) to perform a plant specific evaluation of this issue, it is being communicated so that a regulatory evaluation can be performed.

RECOMMENDED ACTIONS

The potential increase in total channel uncertainty for those channels involving Steam Generator Level should be evaluated based on the above discussion, and a determination made as to whether the current trip setpoints are acceptable.

WESTINGHOUSE ACTIONS

As described in the technical evaluation section Westinghouse performed evaluations for two cases, one of which was for a specific plant with a Model 51 steam generator and the other was for a bounding configuration with a Model F steam generator. A letter will be sent to all utilities for whom Westinghouse has performed a setpoint uncertainty evaluation informing them of the potential issue. In addition, in all future setpoint uncertainty evaluations performed by Westinghouse, these Process Measurement Accuracy terms will be explicitly included. –

PSEG	CALCULATION CONTINUATION/ REVISION HISTORY SHEET			SHEET: i CONT'D ON SHEET:	
CALC. No.:SC-CN001-01 Attachment 10.5			REFERENCE:		
ORIGINATOR, DATE	REV:	CMM 12/13/93	1	CMM 8/16/94	1IR1
REVIEWER/VERIFIER, DATE		AFS/SJJ 1/11/94		LFP 8/16/94	

ATTACHMENT 10.5

WESTINGHOUSE LETTER; SAFETY ANALYSIS LIMITS

1IR1

NUCLEAR FUEL GROUP

FEB 14 '94
NFS-94-092

Westinghouse Electric Corporation   **Energy Systems**

PSE-94-532
Box 355
Pittsburgh Pennsylvania 15230-0355

☑ Rec'd By TK Ross
☑ Copy to TKR, PBC
☑ Copy to S. Jannetty (I&C)
☐ Route to
☑ Copy to H. Onorato (Lic)
☐ Return to
ICF Orig. ☑ Copy ☐ NSR ☐
Cover only to ICF ☐
Attachments filed

Mr. E. S. Rosenfeld, Manager
Nuclear Fuel
Public Service Electric & Gas Company
P.O. Box 236 MC N20
Hancocks Bridge, NJ 08038

February 11, 1994
ET-NSL-OPL-II-94-063

Public Service Electric & Gas Company
Salem Units 1 and 2
Subject: Safety Evaluation for an Increase in Steam Generator High-High Level Setpoint Analysis Value

Dear Mr. Rosenfeld:

The purpose of this letter is to transmit to you a safety evaluation of an increase in the steam generator water level high-high ESF safety analysis limit setpoint from 73% NRS to 75% NRS. The current Technical Specification nominal setpoint (T. S. Table 3.3-4) is 67% of narrow range span (NRS). The Salem UFSAR (Section 15.1.3) indicates that the accident analysis assumes a safety analysis limit setpoint of 75% NRS, while more recent information such as the Setpoint Study, WCAP-12103, indicates that the accident analysis assumes 73% NRS.

The effect of the increased steam generator water level high-high ESF safety analysis limit setpoint on the Salem UFSAR Chapter 15 accident analyses has been evaluated and shown to be acceptable for both current operation and after implementation of the FU/MRP analyses.

If you have any questions or comments, please contact the undersigned.

Very truly yours,

Jeff Huckabee
Special Sales Representative
Power Systems Field Sales

AMS/

cc:	R. S. Kent	MC N20	1L, 1A
	T. K. Ross	MC N20	1L, 1A

Attachment: SECL-94-042, "Increase in Steam Generator High-High Level Setpoint Analysis Value, 7 pages.

WESTINGHOUSE
SAFETY EVALUATION CHECK LIST

1) NUCLEAR PLANTS: Salem Units1 and 2

2) CHECK LIST APPLICABLE TO: Increase in Steam Generator High-High Level Setpoint Analysis Value

3) The written safety evaluation of the revised procedure, design change or modification required by 10CFR50.59 has been prepared to the extent required and is attached. If a safety evaluation is not required or is incomplete for any reason, explain on Page 2. Parts A and B of this Safety Evaluation Check List are to be completed only on the basis of the safety evaluation performed.

CHECK LIST - PART A

3.1) Yes__ No X A change to the plant as described in the FSAR?
3.2) Yes__ No X A change to procedures as described in the FSAR?
3.3) Yes__ No X A test or experiment not described in the FSAR?
3.4) Yes__ No X A change to the plant technical specifications (Appendix A to the Operating License)?

4) CHECK LIST - PART B (Justification for Part B answers must be included on page 2.)

4.1) Yes__ No X Will the probability of an accident previously evaluated in the FSAR be increased?

4.2) Yes__ No X Will the consequences of an accident previously evaluated in the FSAR be increased?

4.3) Yes__ No X May the possibility of an accident which is different than any already evaluated in the FSAR be created?

4.4) Yes__ No X Will the probability of a malfunction of equipment important to safety previously evaluated in the FSAR be increased?

4.5) Yes__ No X Will the consequences of a malfunction of equipment important to safety previously evaluated in the FSAR be increased?

4.6) Yes__ No X May the possibility of a malfunction of equipment important to safety different than any already evaluated in the FSAR be created?

4.7) Yes__ No X Will the margin of safety as defined in the bases to any technical specification be reduced?

If the answers to any of the above questions are unknown, indicate under 5) REMARKS and explain below.

If the answer to any of the above questions in Part (3.4) or Part B cannot be answered in the negative, the change review requires an application for license amendment in accordance with 10 CFR 50.59 (c) and submitted to the NRC pursuant to 10 CFR 50.90.

5) REMARKS:

The answers given in Section 3, Part A, and Section 4, Part B, of the Safety Evaluation Checklist, are based on the attached Safety Evaluation.

Reference document(s):

FOR FSAR UPDATE

Section: N/A Pages:______ Tables:______ Figures:______

Reason for / Description of Change:

No change was made to the FSAR value of the S/G High-High level setpoint.

SIGNATURES

Prepared by (Licensing): [signature] A. M. Sicari Date: 2-11-94

Independently Reviewed by: [signature] R. H. Owoc Date: 2/11/94

Salem Units 1 and 2
Safety Evaluation for an Increase in the Steam Generator High-High Level Setpoint Analysis Value

Introduction and Summary of Results

Recent Salem setpoint uncertainty calculations have indicated the need to justify a relaxed safety analysis assumption for the steam generator water level high-high ESF setpoint, which actuates a turbine trip and feedwater isolation.

The purpose of this evaluation is to address an increase in the steam generator water level high-high ESF safety analysis limit setpoint from 73% NRS to 75% NRS. The current Technical Specification nominal setpoint (T. S. Table 3.3-4) is 67% of narrow range span (NRS). However, there is conflicting documentation concerning the accident analysis assumption for this setpoint. The Salem UFSAR (Section 15.1.3) indicates that the accident analysis assumes a safety analysis limit setpoint of 75% NRS, while more recent information such as the Setpoint Study, WCAP-12103, indicates that the accident analysis assumes 73% NRS.

The effect of the increased steam generator water level high-high ESF safety analysis limit setpoint on the Salem UFSAR Chapter 15 accident analyses has been evaluated and shown to be acceptable for both current operation and after implementation of the FU/MRP analyses. The calculated flow capacity does not result in an unreviewed safety question as defined in 10CFR50.59.

Licensing Basis

The only Salem licensing basis event that assumes protection functions initiated by the high-high steam generator water level setpoint is the non-LOCA feedwater malfunction event presented in UFSAR Section 15.2.10. The high-high steam generator water level protection function is assumed to close all feedwater control and bypass valves, and the feedwater isolation valves, trip the main feedwater pumps, and trip the turbine. For convenience, the event is terminated by a reactor trip on turbine trip.

The feedwater malfunction event is an ANS Condition II event. The Condition II acceptance criteria are satisfied for this event by demonstrating that the DNB design basis is met. Another concern for this event, not specifically addressed in the UFSAR, is steam generator overfill.

Evaluation

The feedwater malfunction analysis is performed at zero and full power. The analysis assumes that a control system malfunction or operator error causes one or more feedwater control valves to open fully, resulting in a step increase in feedwater flow. The zero power analysis does not assume the high-high steam generator water level protection function and is not affected by a change in the setpoint value. The full power analysis credits the high-high steam generator water level protection function to terminate the event by isolating the main feedwater and tripping the turbine. Reactor trip occurs on turbine trip.

The high-high steam generator water level protection functions are not required to meet the DNBR limit. Although the UFSAR analysis shows that the minimum DNBR occurs after the turbine trip but prior to reactor trip and feedwater isolation occur, the DNBR had reached a new equilibrium value well above the limit value. The Fuel Upgrade/Margin Recovery Program (FU/MRP) analysis DNBR also had reached a new equilibrium value which was well above the DNBR limit before the high-high steam generator water level protection functions were actuated. In either case, had the core thermal limits been approached, the overtemperature ΔT and/or overpower ΔT reactor trips would prevent the reactor core from reaching a condition which could result in a violation of the DNB design basis.

With respect to steam generator overfill, the analyses assume a feedwater isolation 32 seconds after the high-high level setpoint is reached. Although not explicitly credited in the analysis, prior to feedwater isolation valve closure, the feedwater pumps are tripped on a high-high steam generator water level signal. These functions will continue to prevent steam generator overfill.

The evaluation of the pertinent non-LOCA events demonstrates that the as-installed capacity of the condenser steam dump system does not change the conclusions of the UFSAR. In addition, the conclusions presented in the UFSAR remain bounding for:

- LOCA and LOCA-Related Accidents
- Steam Generator Tube Rupture
- Containment Integrity
- Instrumentation and Control Systems Performance
- Radiological Consequences
- Equipment Qualification/Component Performance
- Technical Specifications/Setpoints
- Emergency Operating Procedures

Conclusion

This evaluation concludes that an increase in the safety analysis limit high-high steam generator water level setpoint from 73% NRS to 75% NRS will not significantly affect the safety analyses. For the feedwater malfunction event all applicable criteria continue to be met.

Assessment of Unreviewed Safety Question

1. Will the probability of an accident previously evaluated in the UFSAR be increased?

   The revised safety analysis limit high-high steam generator water level setpoint does not involve an increase in the probability of an accident previously evaluated. The high-high steam generator water level setpoint is a part of the accident mitigation response and is not itself an initiator for any transient. The accident which relies on the high-high level setpoint has been evaluated and all applicable safety criteria continue to be met. Therefore, the change will not result in any additional challenges to plant equipment. The consideration of a revised high-high level setpoint analysis value does not result in a situation where the design, material, and construction standards that were applicable prior to the change are altered. The evaluation of the change indicates that it will not affect the operability of systems related to accident mitigation. Since the actual plant configuration, performance of systems, and initiating event mechanisms are not being changed as a result of this evaluation, the probability of any accident previously evaluated in the UFSAR is not changed.

2. Will the consequences of an accident previously evaluated in the UFSAR be increased?

   The change to the safety analysis limit high-high steam generator water level setpoint does not increase the consequences of an accident previously evaluated. All applicable accident analysis acceptance criteria continue to be met. The transient which is affected by the change to the high-high level setpoint safety analysis limit has been evaluated and all applicable safety criteria continue to be met. The revised safety analysis limit does not degrade or prevent the response of other plant systems such that their function in the control of radiological consequences is adversely affected. The safety evaluation shows that the design limits continue to be met and therefore fission barrier integrity is not challenged. The slight increase in the safety analysis value has been shown not to adversely affect the response of the plant to postulated accident scenarios. Nor does this change affect the mitigation of the radiological consequences of any accident described in the UFSAR. Therefore, since the actual plant configuration and performance of systems is not being changed, and since it has been concluded that the transient results are unaffected by this parameter modification, the consequences of an accident previously evaluated in the UFSAR will not be increased.

3. May the possibility of an accident which is different than any already evaluated in the UFSAR be created?

The revised safety analysis limit high-high steam generator water level setpoint does not create the possibility of a new or different kind of accident from any accident previously evaluated. The evaluation of the change shows that all safety criteria continue to be met. The setpoint adjustment does not affect the assumed accident initiation sequences. Therefore, this change neither causes the initiation of any different accident nor creates any new failure mechanisms. The possibility of an accident which is different than any already evaluated in the UFSAR is not created since the revised steam generator high-high level setpoint safety analysis limit does not result in a change to the main steam system or any other plant system design basis. No new operating configuration is being imposed by the setpoint adjustment that would create a new failure scenario. In addition, no new failure modes are being created for any plant equipment. This change does not result in any event previously deemed incredible being made credible. Therefore, the types of accidents defined in the UFSAR continue to represent the credible spectrum of events to be analyzed which determine safe plant operation and the possibility of an accident different than any already evaluated in the UFSAR is not created.

4. Will the probability of a malfunction of equipment important to safety previously evaluated in the UFSAR be increased?

The revised safety analysis limit high-high steam generator water level setpoint will not adversely affect system performance or safety system functions assumed in the accident analyses. The original design specifications such as for seismic requirements, electrical separation and environmental qualification are unaffected. In addition, this change does not result in equipment used in accident mitigation to be exposed to an adverse environment nor does it create an adverse condition for any other safety-related equipment. Component integrity is not challenged. Therefore, it will not affect the failure modes or failure probability of any equipment important to safety; no new failure modes are being created for any plant equipment. The revised setpoint will not adversely affect the operation of the Reactor Protection System, or any other device required for accident mitigation. Therefore, probability of a malfunction of equipment important to safety previously evaluated in the UFSAR will not be increased.

5. Will the consequences of a malfunction of equipment important of safety previously evaluated in the UFSAR be increased?

The previously identified most limiting single failures are still limiting, and the performance and effectiveness of equipment important to safety is unchanged despite the change to the safety analysis limit high-high steam generator water level setpoint. This change does not adversely affect the ability of existing components and systems to mitigate the radiological dose consequences of any accident. The revised high-high level safety analysis limit does not result in response to accident scenarios different than that postulated in the UFSAR. The increased capacity does not introduce any new equipment other than that previously evaluated in the UFSAR, nor does it create any new failure modes for existing safety-related equipment. Both the margin to DNB and fuel temperature limits remain protected. Component integrity is not challenged. Because the licensing basis safety analysis criteria continue to be met, there is no increase in the consequences of a malfunction of equipment important to safety previously evaluated in the UFSAR.

6. May the possibility of a malfunction of equipment important to safety different than any already evaluated in the UFSAR be created?

With the revised safety analysis limit high-high steam generator water level setpoint, all original design and performance criteria continue to be met, and no new failure modes have been created for any system, component, or piece of equipment. No new single failure mechanisms have been introduced nor will the core operate in excess of pertinent design basis operating limits. The licensing basis safety analysis criteria continue to be met. The steam generator level setpoints and the Reactor Protection System will operate as designed. The change to the high-high level safety analysis limt does not create a new scenario for a malfunction of equipment different from any previously evaluated. Component integrity is not challenged. Since the revised setpoint is not expected to result in more adverse conditions and is not expected to result in any increase in the challenges to safety systems, there is no new circumstance or condition created which could result in any malfunction of equipment important to safety different than already evaluated in the UFSAR.

7. Will the margin of safety as defined in the bases to any technical specification be reduced?

The accident analysis acceptance criteria continue to be met assuming the revised safety analysis limit high-high steam generator water level setpoint. There are no adversely impacted Technical Specifications, and safety margins are not reduced. Thus, the margin of safety as defined in the bases for the technical specifications will not be changed.

<table>
<tr><td>PSEG</td><td colspan="4">CALCULATION CONTINUATION/
REVISION HISTORY SHEET</td><td colspan="3">SHEET: i
CONT'D ON SHEET:</td></tr>
<tr><td colspan="3">CALC. No.:SC-CN001-01 Attachment 10.6</td><td colspan="5">REFERENCE:</td></tr>
<tr><td>ORIGINATOR, DATE</td><td>REV:</td><td></td><td></td><td>CMM 8/16/94</td><td>1IR1</td><td></td><td></td></tr>
<tr><td colspan="2">REVIEWER/VERIFIER, DATE</td><td colspan="2"></td><td colspan="2">LFP 8/16/94</td><td colspan="2"></td></tr>
</table>

ATTACHMENT 10.6

WESTINGHOUSE LETTER; JPO FOR OVERPOWER OPERATION

SC-CN001-01
ATTACHMENT 10.6
Pg 1 of 7

J. Sylvester

PSE-94-555

Westinghouse Electric Corporation Energy Systems

Nuclear Technology Division

Box 355
Pittsburgh Pennsylvania 15230-0355

NFSI 94 201

Mr. E. S. Rosenfeld, Manager
Nuclear Fuels
Public Service Electric & Gas Company
P.O. Box 236 MC N20
Hancocks Bridge, NJ 08038

March 24, 1994
ET-NSL-OPL-II-94-143

Public Service Electric & Gas Company
Salem Units 1 and 2
Subject: JPO for Overpower Operation

Dear Mr. Rosenfeld:

The purpose of this letter is to transmit the report providing the justification of past operation of Salem Unit 2 during Cycles 7 and 8 at power levels up to 104.5% rated thermal power. The report examines each of the licensing basis accident analyses and for each event, the impact of the overpower operation is evaluated and it is concluded for Salem Unit 2 that the safety of the plant was not compromised. For some of the licensing-basis events an engineering evaluation was adequate to confirm that no significant safety concern existed. This was possible, either because the licensing analysis was not affected by the overpower operation, or that more than sufficient margin exists to offset the adverse consequences associated with overpower operation. For other events a more detailed analysis, including computer simulation, was needed, due to a lack of available margin, or the unavailability of sensitivities to assess the impact of overpower operation.

Included with the report are two appendices. Appendix 1 provides the detailed report of the evaluation of the Reactor Protection System (RPS) and Engineered Safety Feature Actuation System (ESFAS) setpoints. The acceptability of the actual setpoint with respect to the Technical Specifications is identified in this report. Appendix 2 contains pressure and temperature plots and digitized data for PSE&G's use in performing inside containment equipment qualification (EQ) evaluations.

SC-CN001-01
ATTACHMENT 10.6
Pg. 2 of 7

If you have any questions or comments, please contact the undersigned.

Very truly yours,

Jeff Huckabee
Special Sales Representative
Power Systems Field Sales

AMS/

cc:	T. K. Ross	MC N21	1L, 1A
	R. S. Kent	MC N21	1L, 1A

SC-CN001-01
ATTACHMENT 10.6
pg 3 of 7

Table of Contents

Determination of Impacts on the Reactor Protection System and the Engineered Safety Feature Actuation System for Operation of Salem Unit 2 at 104.5% Rated Thermal Power

March 1994

C. F. Ciocca

channel uncertainties the safety analyses appear preserved and the Allowable Value was not impacted.

12. Loss of Flow, Setpoint (≤90% TDF/Loop), Allowable Value (≤89% TDF/ Loop)-

Westinghouse recommends that the Loss of Flow Setpoint be normalized to the precision flow calorimetric determination of 100% RCS flow and the bistable be set at 90% of the precision flow calorimetric. Implementation requires that each cycle would need to be re-scaled. Salem has utilized a previous cycle for determination of the precision flow calorimetric and continued to maintain the bistable setting based on the early scaling calculation. This in effect has preserved the Thermal Design Flow and as flow is reduced (due to tube plugging, etc.) the bistable setpoint is approached. This in effect has put the plant closer to a trip than the safety analyses require. The conclusion is that the plant has the trip setpoint higher than 90% of the TDF and has been operating in a conservative manner.

Information received from PSE&G has identified that PSE&G calibration provides a 5.4% instrument span (120% flow) channel uncertainty for this function. This value corresponds to a 6.5% flow uncertainty. The current TS setpoint is 90% flow and the current Safety Analysis Limit is at 87% flow. PSE&G calculations, based on the benchmarck flow calorimetric, set the bistable at 82087 gpm. This corresponds to a setpoint of 94% flow. This provides a 0.5% flow margin, therefore the channel would have been within the Safety Analysis Limit. Further discussions with PSE&G representatives indicates that the above discussion on holding the bistable at a constant value between cycles is consistent with the plant past practice.

13. Steam Generator Water Level Low-Low, Setpoint (≤16% NR Span), Allowable Value (≤14.8% NR Span)-

Steam Generator Level Low and Low-Low Level for Loss of Normal Feed and Feedline Break setpoints are impacted as the changes in pressures and flows have impacts on the PMA biases. The extent of the impact is determined by calculating the biases for the operating conditions and comparing the results to the values previously calculated by PSE&G. The differences are then compared to the available margin between the nominal trip setpoint and the safety analyses limits. Based on the PSE&G assumptions for 100% RTP the PMA values chosen by PSE&G were conservative to those calculated by Westinghouse. Therefore the available margin in this function was adequate to protect the Safety Analysis Limit and was in accordance with the TS.

SC-CN001-01
ATTACHMENT 10.6
PG 6 OF 7

14. Steam Flow/Feed Flow Mismatch and Low SG Water Level, Setpoint (≤40% of Full Flow @ RTP & ≥25% NR Span), Allowable Value (≤42.5% of Full Flow @ RTP & ≥24% NR Span)-

Steam Flow Feed Flow Mismatch coincident with the Steam Generator Water Level Low function must be evaluated as Steam Flow Feed Flow Mismatch operability and Steam Generator Water Level Low operability.

For the Steam Flow Feed Flow Mismatch function, Salem normalizes the steam flow transmitters to the daily power calorimetric on a bi-monthly schedule. Given a power level higher than indicated the mismatch function would have normalized the steam input at a value lower than actual. The result is that the mismatch would not have been operating closer to the trip setpoint as the steam flow input would have been indicating 4.5% RTP lower than actual with the Feedflow input being higher than indicated by a value corresponding to 4.5% RTP. This function is not explicitly modeled in the safety analyses, however the analyses should be evaluated for operating at higher than indicated steam and feed water flows.

Steam Generator Level Low is impacted as the changes in pressures and flows have impacts on the PMA biases. The extent of the impact is determined by calculating the biases for the operating conditions and comparing the results to the values previously calculated by PSE&G. The differences are then compared to the available margin between the nominal trip setpoint and the safety analyses limits. The extent of the impact is determined by calculating the biases for the operating conditions and comparing the results to the values previously calculated by PSE&G. The differences are then compared to the available margin between the nominal trip setpoint and the safety analyses limits. Based on the PSE&G assumptions for 100% RTP the PMA values chosen by PSE&G were conservative to those calculated by Westinghouse. Therefore the available margin in this function was adequate to protect the Safety Analysis Limit and was in accordance with the TS.

15. Undervoltage RCP Volts/bus, Setpoint (≥2900 Volts/bus), Allowable Value (≥2850)-

The Undervoltage RCP Volts/bus setpoint is not impacted by operating at higher reactor power levels. Plant electrical conditions are independent of the reactor power levels. Therefore, there is no impact on this function.

16. Underfrequency RCP, Setpoint (≥56.5 HZ), Allowable Value (≥56.4 HZ)-

5. Turbine Trip and Feedwater Isolation
   A. Steam Generator Water Level High High,
      Setpoint(≤67% of NR Span), Allowable Value(≤68% of NR Span)-

The Steam Generator Water Level High High function is impacted due to the changes in pressures and flows have impacts on the PMA biases. The extent of the impact is determined by calculating the biases for the operating conditions and comparing the results to the values previously calculated by PSE&G. The differences are then compared to the available margin between the nominal trip setpoint and the safety analyses limits. Based on the PSE&G assumptions for 100% RTP the PMA values chosen by PSE&G were non-conservative to those calculated by Westinghouse by approximately 1% NR span. However the available margin in this function was adequate to protect the Safety Analysis Limit and the setpoint was in accordance with the TS.

6. Safeguards Equipment Control System, Setpoint (NA),
   Allowable Value (NA)-

There is no nominal trip setpoint or allowable value which can be explicitly attributed to this function. Therefore there is no impact for this function for an overpower condition.

7. Undervoltage, Vital Bus
   A. Loss of Voltage, Setpoint (≥70% bus voltage)
      Allowable Value (≥65% voltage)-

The Undervoltage, Vital Bus setpoint is not impacted by operating at higher reactor power levels. Plant electrical conditions are independent of the reactor power levels. Therefore, there is no impact on this function.

   B. Sustained Degraded Voltage, Setpoint (≥91.6% bus voltage for ≤13 seconds), Allowable Value(≥91% voltage for ≤15 seconds)-

The Sustained Degraded Voltage setpoint is not impacted by operating at higher reactor power levels. Plant electrical conditions are independent of the reactor power levels. Therefore, there is no impact on this function.

FORM NC.DE-AP.ZZ-0010-1

CERTIFICATION FOR DESIGN VERIFICATION

Reference No. SC-CN001-01

SUMMARY STATEMENT

Reviewed All Design Inputs and Assumptions
Reviewed design basis and Function.
Reviewed that Environmental Effects were applied appropriately. Reviewed that all outputs were Reasonable with respect to inputs
Rev 1 is a significant Revision which affected the entire calculation therefore a Review of entire Calculation was performed

The undersigned hereby certifies that the design verification for the subject document has been completed, the questions from the generic checklist have been reviewed and addressed as appropriate, and all comments have been adequately incorporated.

L. J. Rajkowski Design Verifier Assigned By	[signature] 1/17/94 Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date

Page 1 of 3

CERTIFICATION FOR DESIGN VERIFICATION

REFERENCE DOCUMENT NO. /REV. SC-CN001-01

COMMENTS	RESOLUTION	
1. Need to Address Steam Gen Lvl Low Trip now that calculation is not being performed in Digital Feedwater Pkg.	ADDED LOW TRIP	[initials] 1/17/94
2. Section 6.2 and Sec 7.0 PM for Ref Leg heat-up during accident conditions should credit the insulated Ref Leg for not exceeding a temp of 224, not the fact that 224 °F is what the EOPs consider to be abnormal temp.	CHANGED ASSUMPTION AND REVISED VALUES	
3. PM for Ref Leg Heat-up is calculated assuming 224 °F and 4 psig. These values are too conservative. Secondary pressures on a faulted SG could be as low as 4 psig if pressure equalizes to Containment Amb. Pressure, however remaining SGs shouldn't be that low.	CHANGED VALUES TO BE LESS CONSERVATIVE	
S J Jannetty — 1/14/94 SUBMITTED BY — DATE	C McNall — 1/14/94 RESOLVED BY — DATE	Acceptance of Resolution

Page 2 of 3

FORM NC.DE-AP.ZZ-0010-1

CERTIFICATION FOR DESIGN VERIFICATION

REFERENCE DOCUMENT NO. /REV. SC - ON001-01

COMMENTS	RESOLUTION	
4. TRANSMITTER STATIC PRESSURE EFFECTS, SPAN UNCERTAINTY IS TAKEN A % OF SPAN ; SHOULD BE TAKEN AS % OF READING WHICH IS MORE LIMITING	INCORPORATED	SJJ 1/14/94 ↓
5. MTE, FOR TRANSMITTER (DWT) SPEC STATES % OF READING. SINCE SPAN IS NON ZERO BASED % OF READING IS GREATER THAN % OF SPAN. % OF READING SHOULD BE CALCULATED.	INCORPORATED	
6. SEC 9.0 CONCLUSIONS MUST ADDRESS CRITERIA IN UFSAR SEC 7.5-1, 7.5-2	INCORPORATED	
7. ATTACHMENT 10.1 HAS AN ERROR ON THE TRANSMITTER TOLERANCE & ACCEPTABLE VALUE FOR THE 33 INWC INPUT & ON COMPARATOR TOLERANCE	INCORPORATED	
SJ JANNETTY 1/14/94 SUBMITTED BY DATE	C McNall 1/14/94 RESOLVED BY DATE	Acceptance of Resolution

Page 3 of 3

GENERIC VERIFICATION CHECKLIST	REFERENCE DOCUMENT NUMBER/REVISION 5C-CN001-01 / Rev 1				
	YES	NO	N/A	WHERE FOUND PAGE NO.	COMMENTS (Y/N)
1. WERE DESIGN INPUTS CORRECTLY SELECTED AND INCORPORATED INTO DESIGN?	✓			p. 28	N
2. ARE ASSUMPTIONS NECESSARY TO PERFORM THE DESIGN ACTIVITY ADEQUATELY DESCRIBED AND REASONABLE? WHERE NECESSARY, ARE THE ASSUMPTIONS IDENTIFIED FOR SUBSEQUENT RE-VERIFICATION WHEN THE DETAILED DESIGN ACTIVITIES ARE COMPLETED?	✓ / ~~✓~~	✓	~~✓~~	p. 40 / ~~SEC 6.1.5~~ ~~p. 43~~	N / N
3. ARE THE APPROPRIATE QUALITY AND QUALITY ASSURANCE REQUIREMENTS SPECIFIED?			✓		
4. ARE THE APPLICABLE CODES, STANDARDS AND REGULATORY REQUIREMENTS INCLUDING ISSUES AND ADDENDA PROPERLY IDENTIFIED AND ARE THEIR REQUIREMENTS FOR DESIGN MET?	✓		~~✓~~	p. 17	N
5. HAVE APPLICABLE CONSTRUCTION AND OPERATING EXPERIENCE BEEN CONSIDERED?	~~✓~~		✓		
6. HAVE THE DESIGN INTERFACE REQUIREMENTS BEEN SATISFIED?			✓		
7. WAS AN APPROPRIATE DESIGN METHOD USED?			✓		
8. IS THE OUTPUT REASONABLE COMPARED TO INPUTS?	✓			p. 85	N
9. ARE THE SPECIFIED PARTS, EQUIPMENT, AND PROCESSES SUITABLE FOR THE REQUIRED APPLICATION?			✓		
10. ARE THE SPECIFIED MATERIALS COMPATIBLE WITH EACH OTHER AND THE DESIGN ENVIRONMENTAL CONDITIONS TO WHICH THE MATERIAL WILL BE EXPOSED?			✓		
11. HAVE ADEQUATE MAINTENANCE FEATURES AND REQUIREMENTS BEEN SPECIFIED?			✓		
12. ARE ACCESSIBILITY AND OTHER DESIGN PROVISIONS ADEQUATE FOR PERFORMANCE OF NEEDED MAINTENANCE AND REPAIR?			✓		
13. HAS ADEQUATE ACCESSIBILITY BEEN PROVIDED TO PERFORM THE IN-SERVICE INSPECTION EXPECTED TO BE REQUIRED DURING THE PLANT LIFE?			✓		

GENERIC VERIFICATION CHECKLIST (CONTINUED)				REFERENCE DOCUMENT NUMBER/REVISION 5C-CW001-01 / Rev 1	
	YES	NO	N/A	WHERE FOUND PAGE NO.	COMMENTS (Y/N)
14. HAS THE DESIGN PROPERLY CONSIDERED RADIATION EXPOSURE TO THE PUBLIC AND PLANT PERSONNEL? HAVE ALARA CONSIDERATIONS BEEN ADDRESSED?	✓		✓	p. 42	N
15. ARE THE ACCEPTANCE CRITERIA INCORPORATED IN THE DESIGN DOCUMENTS SUFFICIENT TO ALLOW VERIFICATION THAT DESIGN REQUIREMENTS HAVE BEEN SATISFACTORILY ACCOMPLISHED?	✓			p. 15 & 16	N
16. HAS VERIFICATION OF THE ELECTRIC LOAD CONTROL PROGRAM [DE-TS.ZZ-2908(Q)] BEEN PERFORMED?			✓		
17. HAS THE EFFECT ON THE DIESEL GENERATOR LOAD SEQUENCE STUDY BEEN ANALYZED?			✓		
18. HAVE ADEQUATE PRE-OPERATIONAL AND SUBSEQUENT PERIODIC TEST REQUIREMENTS BEEN APPROPRIATELY SPECIFIED?			✓		
19. ARE ADEQUATE HANDLING, STORAGE, CLEANING AND SHIPPING REQUIREMENTS SPECIFIED?			✓		
20. ARE ADEQUATE IDENTIFICATION REQUIREMENTS SPECIFIED?			✓		
21. ARE REQUIREMENTS FOR RECORD PREPARATION REVIEW, APPROVAL, RETENTION, ETC. ADEQUATELY SPECIFIED?			✓		

CERTIFICATION FOR DESIGN VERIFICATION

REF DOC. NO./REV SC-CN001-01/0

COMMENTS	RESOLUTION
No Comments	

SUBMITTED ____________________
DATE

RESOLVED ____________________
DATE

Page 1 of 5

<u>CERTIFICATION FOR DESIGN VERIFICATION</u>

Reference No. SC-CN001-01

SUMMARY STATEMENT

See continuation sheet

The undersigned hereby certifies that the design verification for the subject package has been completed and all comments have been adequately addressed.

J. D. Carey Jr.	[signature] 1/3/92
Design Verifier Assigned By	Signature of Design Verifier/Date
Design Verifier Assigned By	Signature of Design Verifier/Date
Design Verifier Assigned By	Signature of Design Verifier/Date
Design Verifier Assigned By	Signature of Design Verifier/Date

Page 2 of 5

CERTIFICATION FOR DESIGN VERIFICATION
CONTINUATION

Verified the applicable items as designated on the Generic Verification Check-list.

Verified that the choice of environmental conditions, (normal, accident, MSLB, etc.) was appropriate.

Verified that the values for rack accuracy and drift were assigned properly depending on whether the instruments were installed in a Westinghouse rack and with regard to the calibration procedures.

Verified that normal radiation affects were not duplicated for accident conditions.

Verified that the values used in the Attachments, if any, accurately reflected the values used in, or generated by, the calculation.

Verified that the objectives were adequately addressed, the assumptions were reasonable, and that the conclusions accurately reflected the results of the calculation.

GENERIC VERIFICATION CHECK-LIST	REFERENCE DOCUMENT NUMBER/REVISION SC-CW001-01 / 0

		YES	NO	NA	WHERE FOUND PAGE NO.	COMMENTS (Y/N)
1.	WERE DESIGN INPUTS CORRECTLY SELECTED AND INCORPORATED INTO THE DESIGN DOCUMENT?	1 ✓			See Calc Index	N
2.	ARE ASSUMPTIONS NECESSARY TO PERFORM THE DESIGN ADEQUATELY DESCRIBED AND REASONABLE? WHERE NECESSARY ARE THE ASSUMPTIONS IDENTIFIED FOR SUBSEQUENT RE-VERIFICATIONS WHEN THE DETAILED DESIGN ACTIVITIES ARE COMPLETED?	2 ✓			See Calc Index	N
3.	ARE THE APPROPRIATE QUALITY ASSURANCE REQUIREMENTS SPECIFIED?	3		N/A		
4.	ARE THE APPLICABLE CODES, STANDARDS AND REGULATORY REQUIREMENTS INCLUDING ISSUES AND ADDENDA PROPERLY IDENTIFIED AND ARE THEIR DESIGN REQUIREMENTS MET?	4		N/A		
5.	HAS APPLICABLE CONSTRUCTION AND OPERATING EXPERIENCE BEEN CONSIDERED?	5		N/A		
6.	HAS DESIGN INTERFACE WITH OTHER FUNCTIONAL UNITS' REQUIREMENTS BEEN UTILIZED?	6		N/A		
7.	WAS AN APPROPRIATE DESIGN METHOD USED?	7		N/A		
8.	IS THE DESIGN DOCUMENT REASONABLE COMPARED TO THE INPUTS?	8 ✓			See Calc Index	N
9.	ARE THE SPECIFIED PARTS, EQUIPMENT AND PROCESSES SUITABLE FOR THE REQUIRED APPLICATION?	9		N/A		
10.	ARE THE SPECIFIED MATERIALS COMPATIBLE WITH EACH OTHER AND THE DESIGN ENVIRONMENTAL CONDITIONS TO WHICH THE MATERIAL WILL BE EXPOSED?	10		N/A		
11.	HAVE ADEQUATE MAINTENANCE FEATURES AND REQUIREMENTS BEEN SPECIFIED?	11		N/A		
12.	ARE ACCESSIBILITY AND OTHER DESIGN PROVISIONS ADEQUATE FOR PERFORMANCE OF NEEDED MAINTENANCE AND REPAIR?	12		N/A		
13.	HAS ADEQUATE ACCESSIBILITY BEEN PROVIDED TO PERFORM THE IN-SERVICE INSPECTION EXPECTED TO BE REQUIRED DURING PLANT LIFETIME?	13		N/A		
14.	HAS THE DESIGN PROPERLY CONSIDERED RADIATION EXPOSURE TO THE PUBLIC AND PLANT PERSONNEL? HAVE ALARA CONSIDERATIONS BEEN ADDRESSED?	14		N/A		

GENERIC VERIFICATION CHECK-LIST	REF DOC. NO./REV SC-CN001-01 /0			WHERE FOUND PAGE NO.	COMMENTS (Y/N)
	YES	NO	NA		
15. ARE THE ACCEPTANCE CRITERIA INCORPORATED IN THE DESIGN DOCUMENTS SUFFICIENT TO ALLOW VERIFICATION THAT DESIGN REQUIREMENTS HAVE BEEN SATISFACTORILY ACCOMPLISHED?	✓			SEE CALC INDEX	N
16. HAS VERIFICATION OF THE PLANT VOLTAGE STUDY BEEN PERFORMED?			N/A		
17. HAS THE IMPACT ON THE DIESEL GENERATOR LOAD SEQUENCE STUDY BEEN ANALYZED?			N/A		
18. HAVE ADEQUATE PRE-OPERATIONAL AND SUBSEQUENT PERIODIC TEST REQUIREMENTS BEEN APPROPRIATELY SPECIFIED?			N/A		
19. ARE ADEQUATE HANDLING, STORAGE, CLEANING AND SHIPPING REQUIREMENTS SPECIFIED?			N/A		
20. ARE ADEQUATE IDENTIFICATION REQUIREMENTS SPECIFIED?			N/A		
21. ARE REQUIREMENTS FOR RECORD PREPARATION, REVIEW, APPROVAL, RETENTION, ETC. ADEQUATELY SPECIFIED?			N/A		

FORM NC.DE-AP.ZZ-0010-1

CERTIFICATION FOR DESIGN VERIFICATION

Reference No. SC-CN001-01 REV. 1IR1

SUMMARY STATEMENT

REVIEWED ALL DESIGN INPUTS & ASSUMPTIONS,
REVIEWED DESIGN BASIS & FUNCTION.
REVIEWED THAT ALL OUTPUTS ARE REASONABLE
WITH RESPECT TO INPUTS.
REV. 1IR1 IS A LIMITED REVISION THAT
ANALYSES THE ACCEPTABILITY OF LOWERING SGNR
LEVEL
~~THE~~ LOW SETPOINT.

The undersigned hereby certifies that the design verification for the subject document has been completed, the questions from the generic checklist have been reviewed and addressed as appropriate, and all comments have been adequately incorporated.

L. J. RAJKOWSKI	[signature] 8/19/94
Design Verifier Assigned By	Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date
Design Verifier Assigned By	Signature of Design Verifier / Date

Page 1 of 2

FORM NC.DE-AP.ZZ-0010-1

CERTIFICATION FOR DESIGN VERIFICATION

REFERENCE DOCUMENT NO. /REV. SC-CN001-01 1R1

COMMENTS	RESOLUTION	
NO COMMENTS	N/A	
[signature] 8/19/94 SUBMITTED BY DATE	RESOLVED BY DATE	Acceptance of Resolution

Page 2 of 2

FORM NC.DE-AP.ZZ-0010-2

GENERIC VERIFICATION CHECKLIST				REFERENCE DOCUMENT NUMBER/REVISION SC-CN001-01 / 1IR1	
	YES	NO	N/A	WHERE FOUND PAGE NO.	COMMENTS (Y/N)
1. WERE DESIGN INPUTS CORRECTLY SELECTED AND INCORPORATED INTO DESIGN?	✓			14, 57, 68, 69, 110	N
2. ARE ASSUMPTIONS NECESSARY TO PERFORM THE DESIGN ACTIVITY ADEQUATELY DESCRIBED AND REASONABLE?	✓			68, 69	N
WHERE NECESSARY, ARE THE ASSUMPTIONS IDENTIFIED FOR SUBSEQUENT RE-VERIFICATION WHEN THE DETAILED DESIGN ACTIVITIES ARE COMPLETED?			✓		
3. ARE THE APPROPRIATE QUALITY AND QUALITY ASSURANCE REQUIREMENTS SPECIFIED?			✓		
4. ARE THE APPLICABLE CODES, STANDARDS AND REGULATORY REQUIREMENTS INCLUDING ISSUES AND ADDENDA PROPERLY IDENTIFIED AND ARE THEIR REQUIREMENTS FOR DESIGN MET?			✓		
5. HAVE APPLICABLE CONSTRUCTION AND OPERATING EXPERIENCE BEEN CONSIDERED?			✓		
6. HAVE THE DESIGN INTERFACE REQUIREMENTS BEEN SATISFIED?			✓		
7. WAS AN APPROPRIATE DESIGN METHOD USED?	✓			71	N
8. IS THE OUTPUT REASONABLE COMPARED TO INPUTS?	✓			100, ATT. 10.1	N
9. ARE THE SPECIFIED PARTS, EQUIPMENT, AND PROCESSES SUITABLE FOR THE REQUIRED APPLICATION?			✓		
10. ARE THE SPECIFIED MATERIALS COMPATIBLE WITH EACH OTHER AND THE DESIGN ENVIRONMENTAL CONDITIONS TO WHICH THE MATERIAL WILL BE EXPOSED?			✓		
11. HAVE ADEQUATE MAINTENANCE FEATURES AND REQUIREMENTS BEEN SPECIFIED?			✓		
12. ARE ACCESSIBILITY AND OTHER DESIGN PROVISIONS ADEQUATE FOR PERFORMANCE OF NEEDED MAINTENANCE AND REPAIR?			✓		
13. HAS ADEQUATE ACCESSIBILITY BEEN PROVIDED TO PERFORM THE IN-SERVICE INSPECTION EXPECTED TO BE REQUIRED DURING THE PLANT LIFE?			✓		

GENERIC VERIFICATION CHECKLIST (CONTINUED)	REFERENCE DOCUMENT NUMBER/REVISION SC-CN001-01 / R1				
	YES	NO	N/A	WHERE FOUND PAGE NO.	COMMENTS (Y/N)
14. HAS THE DESIGN PROPERLY CONSIDERED RADIATION EXPOSURE TO THE PUBLIC AND PLANT PERSONNEL? HAVE ALARA CONSIDERATIONS BEEN ADDRESSED?			✓		
15. ARE THE ACCEPTANCE CRITERIA INCORPORATED IN THE DESIGN DOCUMENTS SUFFICIENT TO ALLOW VERIFICATION THAT DESIGN REQUIREMENTS HAVE BEEN SATISFACTORILY ACCOMPLISHED?	✓			110	N
16. HAS VERIFICATION OF THE ELECTRIC LOAD CONTROL PROGRAM [DE-TS.ZZ-2908(Q)] BEEN PERFORMED?			✓		
17. HAS THE EFFECT ON THE DIESEL GENERATOR LOAD SEQUENCE STUDY BEEN ANALYZED?			✓		
18. HAVE ADEQUATE PRE-OPERATIONAL AND SUBSEQUENT PERIODIC TEST REQUIREMENTS BEEN APPROPRIATELY SPECIFIED?			✓		
19. ARE ADEQUATE HANDLING, STORAGE, CLEANING AND SHIPPING REQUIREMENTS SPECIFIED?			✓		
20. ARE ADEQUATE IDENTIFICATION REQUIREMENTS SPECIFIED?			✓		
21. ARE REQUIREMENTS FOR RECORD PREPARATION REVIEW, APPROVAL, RETENTION, ETC. ADEQUATELY SPECIFIED?			✓		