CP&L
A Progress Energy Company

James Scarola
Vice President
Harris Nuclear Plant

SERIAL: HNP-01-081
10CFR50.4

MAY 1 8 2001

United States Nuclear Regulatory Commission
ATTENTION: Document Control Desk
Washington, DC 20555

SHEARON HARRIS NUCLEAR POWER PLANT
DOCKET NO. 50-400/LICENSE NO. NPF-63
RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION
REGARDING THE STEAM GENERATOR REPLACEMENT
AND POWER UPRATE LICENSE AMENDMENT APPLICATIONS

Dear Sir or Madam:

By letters dated October 4, 2000 and December 14, 2000, Carolina Power & Light Company (CP&L) submitted license amendment requests to revise the Harris Nuclear Plant (HNP) Facility Operating License and Technical Specifications to support steam generator replacement and to allow operation at an uprated reactor core power level of 2900 megawatts thermal (Mwt). NRC letter dated April 12, 2001 requested additional information to support staff review of the proposed license amendment requests. The requested information is provided by the Enclosures to this letter.

The enclosed information is provided as a supplement to our October 4, 2000 and December 14, 2000 submittals and does not change the purpose or scope of the submittals, nor does it change our initial determinations that the proposed license amendments represent a no significant hazards consideration.

Please refer any questions regarding the enclosed information to Mr. Eric McCartney at (919) 362-2661.

A001

P.O. Box 165
New Hill, NC 27562

T> 919.362.2502
F> 919.362.2095

Sincerely,

James Scarola

James Scarola
Vice President
Harris Nuclear Plant

James Scarola, having been first duly sworn, did depose and say that the information contained herein is true and correct to the best of his information, knowledge, and belief, and the sources of his information are employees, contractors, and agents of Carolina Power & Light Company.

Darlene S. Yarborough
Notary (Seal)

DARLENE S. YARBOROUGH
NOTARY
***
PUBLIC
HARNETT COUNTY, NC

My commission Expires: 2-21-2005

KWS/kws

Enclosures:

(1) RAI Responses (2 pages)
(2) Calculation No. HNP-I/INST-1010, Revision 0 (119 pages)

c: Mr. J. B. Brady, NRC Senior Resident Inspector (w/o Enclosure 2)
Mr. Mel Fry, NCDENR (w/o Enclosure 2)
Mr. R. J. Laufer, NRC Project Manager
Mr. L. A. Reyes, NRC Regional Administrator (w/o Enclosure 2)

NRC Questions:

The staff has reviewed the RTS/ESFAS Technical Specifications setpoint changes. The licensee stated that setpoint and time constants changes are based on Westinghouse margin improvement methodology previously approved for Farley Nuclear Plant.

(1) Please provide the Shearon Harris plant-specific instrument channel uncertainty calculations documentation that shows how all of the proposed TS setpoint changes in TS Tables 2.2-1 and 3.3-4 were calculated.

(2) Explain the process used to generate and verify the uncertainty numbers listed in the setpoint documents.

(3) Describe the licensee's practice to maintain the accuracy of the setpoint documents when a plant protection system instrumentation is modified.

CP&L Response to NRC Question (1):

Calculation HNP-I/INST-1010, Rev. 0, "Evaluation of Tech Spec Related Setpoints, Allowable Values, and Uncertainties Associated With RTS/ESFAS Functions for Steam Generator Replacement (with Current 2787 MWT-NSSS Power or Uprate to 2912.4 MWT-NSSS Power)," is provided in its entirety to support this information request.

Note: CP&L letter HNP-01-044, dated March 27, 2001 submitted a proposed change to the operability determination (Z) term on page 3/4 3-32 of TS Table 3.3-4 for the Steam Generator Water Level High-High (P-14) setpoint. This proposed TS page change was submitted to the NRC as a replacement page to the initial TS page 3/4 3-32 mark-up submitted by CP&L letter HNP-00-142, dated October 4, 2000 and reflects CP&L's plans to replace the existing Tobar Model 32DP1 steam generator level transmitters with new Barton Model 764 transmitters. Please note, however, that calculation HNP-I/INST-1010 (enclosed herein) was prepared to support the use of both transmitter types in this application and thus includes calculations of Tech Spec terms for both the Tobar and Barton transmitters.

CP&L Response to NRC Question (2):

The calculation provided in response to NRC question 1 (HNP-I/INST-1010, Rev 0) also explains the process used to generate and verify the uncertainty numbers listed in the setpoint documents. That process is consistent with ISA Standard S67.04-1994, NRC Reg Guide 1.105, and the current Harris plant licensing basis. Tables 1-1 and 1-2 in the calculation define and compare the terms used to perform the original and proposed channel uncertainty analysis. Also, Figures 1 and 2 of the calculation depict the relationship between various Harris TS terms and channel uncertainty terms.

CP&L Response to NRC Question (3):

The existing plant modification procedure provides programmatic requirements to maintain the accuracy of setpoint documentation with respect to design change reviews and subsequent implementation associated with the protection [RTS/ESFAS] system. This procedure contains a screening criteria process, which includes three questions related to instrumentation and controls (I&C) setpoints and time response. The design engineer must determine if the proposed modification will:

- affect the response time characteristics of equipment that are part of a required reactor trip or engineered safety features response time?
- affect any actuation or interlock circuit components which are part of a surveillance test used to verify operability of a reactor trip or engineered safety features actuation systems?
- affect any setpoints or margins to setpoints?

RTS/ESFAS-related setpoints are implemented only after scaling documents, surveillance test procedures, and the engineering database are revised to reflect the new setpoints. In addition, the Westinghouse NSSS Precautions, Limitations, and Setpoint (PLS) Document is maintained at HNP as a "living" document. For example, the PLS Document was revised for the T_{hot} Reduction and the RTD Bypass Manifold Elimination modifications. Similarly, implementation of Steam Generator Replacement and Power Uprate design modifications includes revision to the PLS Document as well.

Clarifying Information

In the paragraph preceding the NRC questions, the "Westinghouse margin improvement methodology previously approved for Farley Nuclear Plant" is mentioned. Please note that, as stated in Enclosure 1 to CP&L letter HNP-00-142 dated October 4, 2000, the aforementioned methodology applies only to the development of OPΔT and OTΔT trip setpoint coefficients and time constants.

CALCULATION NO. HNP-I/INST-1010

For

EVALUATION OF TECH SPEC RELATED SETPOINTS, ALLOWABLE VALUES, AND UNCERTAINTIES ASSOCIATED WITH RTS/ESFAS FUNCTIONS FOR STEAM GENERATOR REPLACEMENT (WITH CURRENT 2787 MWT-NSSS POWER OR UPRATE TO 2912.4 MWT-NSSS POWER)

(119 PAGES TOTAL)

SYSTEM # 1080, 1090

CALC. TYPE DD

CATEGORY B

CAROLINA POWER & LIGHT COMPANY

CALCULATION NO. HNP-I/INST-1010

FOR

EVALUATION OF TECH SPEC RELATED SETPOINTS, ALLOWABLE VALUES, AND UNCERTAINTIES ASSOCIATED WITH RTS/ESFAS FUNCTIONS FOR STEAM GENERATOR REPLACEMENT (WITH CURRENT 2787 MWT-NSSS POWER OR UPRATE TO 2912.4 MWT-NSSS POWER)

FOR

SHEARON HARRIS NUCLEAR POWER PLANT

NUCLEAR ENGINEERING DEPARTMENT

QUALITY CLASS: ■ A ☐ B ☐ C ☐ D ☐ E

Rev. No.	RESPONSIBLE ENGINEER DATE	■ DESIGN VERIFIED BY ☐ ENGINEERING REVIEW BY DATE	APPROVED BY RESPONSIBLE SUPERVISOR DATE
0	A J Phillips 8/31/2000	C. FLETCHER 8/31/2000	TONY GROBLEWSKI 9/12/00
REASON FOR CHANGE:			
REASON FOR CHANGE:			
REASON FOR CHANGE:			

LIST OF EFFECTIVE PAGES

PAGE	REV	PAGE	REV	PAGE	REV
Cover Sheet	0				
i	0				
ii	0				
iii	0				
iv	0				
1	0	31	0	61	0
2	0	32	0	62	0
3	0	33	0	63	0
4	0	34	0	64	0
5	0	35	0	65	0
6	0	36	0	66	0
7	0	37	0	67	0
8	0	38	0	68	0
9	0	39	0	69	0
10	0	40	0	70	0
11	0	41	0	71	0
12	0	42	0	72	0
13	0	43	0	73	0
14	0	44	0	74	0
15	0	45	0	75	0
16	0	46	0	76	0
17	0	47	0	77	0
18	0	48	0	78	0
19	0	49	0	79	0
20	0	50	0	80	0
21	0	51	0	81	0
22	0	52	0	82	0
23	0	53	0	83	0
24	0	54	0	84	0
25	0	55	0	85	0
26	0	56	0	86	0
27	0	57	0	87	0
28	0	58	0	88	0
29	0	59	0	89	0
30	0	60	0	90	0

LIST OF EFFECTIVE PAGES (Cont'd)

PAGE	REV	PAGE	REV	PAGE	REV
91	0	**ATTACHMENTS**			
92	0	A1-1	0		
93	0	A1-2	0		
94	0				
95	0	A2-1	0		
96	0	A2-2	0		
97	0	A2-3	0		
98	0				
99	0	A3-1	0		
100	0	A3-2	0		
101	0	A3-3	0		
102	0	A3-4	0		
103	0	A3-5	0		
		A3-6	0		

TABLE OF CONTENTS

TABLE OF CONTENTS (Cont'd)

1.0 PURPOSE

1.1 Objective and Applicability

This calculation documents the basis for 'final' values specified in HNP Technical Specification Tables 2.2-1 and 3.3-4 [References 2.1 and 2.2], as a result of steam generator replacement [SGR] and/or power uprate [PUR] projects implementation. It serves to reconcile values shown in other documents produced for these projects, and to clarify determinations/specification of such values within these Tech Spec Tables for post-SGR/PUR operation.

1.2 Functional and Operational Description

Tech Spec RTS/ESFAS Trip Setpoint Tables [References 2.1 and 2.2] and their associated Bases define limiting safety system settings [LSSS] and operability limits for Reactor Trip System [RTS] and Engineered Safety Features Actuation Systems [ESFAS] functions. Various instrumentation channel surveillances [e.g., channel calibrations and functional checks per MSTs and LPs] are performed to demonstrate compliance with these RTS/ESFAS Tech Spec requirements. Acceptance criterion for these surveillances are generally defined within corresponding instrumentation channel scaling calculations (or electrical calculations, for RTS/ESFAS-related relay settings); scaling calculations, as revised for SGR/PUR implementation, should reflect the conclusions documented herein.

1.3 Additional Background

Original engineering methodology and operability determination bases, for values defined in the Tech Spec RTS/ESFAS Trip Setpoint Tables, were contained in Westinghouse Letter Report FCQL-355 [Reference 2.3]. This methodology has been described as a "five-column" Tech Spec format. Its original intent was to minimize the number of licensing event reports (LERs) issued for inoperable instrumentation channels. The need for LER issuance was further reduced by NRC changes to 10CRF50.73 in 1983; reportability was only required if a loss of safety function occurred (versus the loss of a single channel).

Tech Spec-related RTS/ESFAS trip functions have also been defined within various site calculations [as listed within Reference 2.4 documentation]. Additionally, HNP FSAR Section 1.8 specifies a licensing commitment to RG 1.105, Rev. 1 [Reference 2.5].

Subsequent industry guidance was provided by ISA Standard S67.04 [Reference 2.6] and by RG 1.105 [as recently updated per Rev. 3 (dated 12/99)]. NGGC procedural guidance (per Reference 2.7) allows for the use of vendor-prepared calculations which comply with newly-updated ISA calculational methodology and/or maintain consistency with current licensing bases.

Westinghouse SGR/PUR-related evaluation of RTS/ESFAS trip functions was performed and documented by WCAP-15249 [Reference 2.8] and various supporting Westinghouse uncertainty calculations [listed within Reference 2.9 documentation]. (This methodology has been described as a "two-column" Tech Spec format, which consists of the Trip Setpoint and the Allowable Value.) In general, this evaluation process was intended to update original methodology/bases to more current industry practices (with respect to a more standardized Tech Spec format, as well as an updated treatment of measurement uncertainties [relative to notifications listed by Reference 2.11]). For reference purposes, correspondence listed per Reference 2.12 acknowledges CP&L design inputs (provided to Westinghouse) and other Westinghouse analysis inputs (specific for the HNP PUR/SGR projects) as noted within the Reference 2.10 listing.

Owing to the existing HNP licensing bases, the Tech Spec RTS/ESFAS Trip Setpoint Tables will be retained in their original "five-column" format. By retaining the existing HNP licensing bases, the current plant controls (for channel calibrations/surveillances and for operability determinations) can be maintained for the PUR/SGR implementation.

In most cases (i.e., except for steam generator [SG] narrow-range [N-R] level, Overtemperature/Overpower ΔT [OTΔT/OPΔT] trip channels) the instrument channels are physically (and/or analytically [by nominal setpoints and safety analysis limits]) unchanged, for PUR/SGR implementation, from their current plant operational and design requirements. Therefore, the current (pre-PUR/SGR) Tech Spec values shall be compared to those values computed herein, to evaluate the continued acceptability of current Tech Spec values (for post-PUR/SGR operation). Furthermore, it can be concluded that existing Tech Spec term values shall continue to apply for all channels, unless a specific technical justification requires the modification of Tech Spec term values.

2.0 LIST OF REFERENCES

1. HNP Technical Specification Table 2.2-1, "Reactor Trip System Instrumentation Trip Setpoints" [mark-up included in Table 4-1 herein].

2. HNP Technical Specification Table 3.3-4, "Engineered Safety Features Actuation System Instrumentation Trip Setpoints" [mark-up included in Table 4-2 herein].

3. Westinghouse Letter Report FCQL-355, Rev. 1, dated July 1985, "Westinghouse Setpoint Methodology for Protection Systems, Shearon Harris" [EMDRAC 1364-053067, Rev. 3 contains the current revision of this methodology, at the time of issuance of this calculation].

4. HNP Calculations [associated with RTS/ESFAS trip functions]:
   a. HNP-I/INST-1002, Rev. 1, "Reactor Coolant Loss of Flow Error Analysis".
   b. HNP-I/INST-1003, Rev. 2, "Pressurizer Pressure Protection Error Analysis (Loops P-455, P-456, P-457)".
   c. HNP-I/INST-1030, Rev. 1, "Refueling Water Storage Tank Level Accuracy Calculation / L-990, L-991, L-992, L-993 for Shearon Harris EOP Setpoints / HESS I&C".
   d. HNP-I/INST-1045, Rev. 1, "Steam Generator Narrow Range Level: Low, Low-Low, and High-High Setpoints/Setpoint Accuracy Calculation; L-473 through L-476, L-483 through L-486, and L-493 through L-496".

      NOTE: Bechtel-generated revision [Rev. 1C, dated 4/11/00] of HNP-I/INST-1045 has been prepared in support of the SG Replacement Project [as transmitted by Bechtel project letter BH/2000-029].
   e. HNP-I/INST-1049, Rev. 0, "Replacement of RCS Narrow Range RTDs; Acceptability Calculation; TE-412B1, 412B2, 412B3, 422B1, 422B2, 422B3, 432B1, 432B2, 432B3, 412D, 422D, 432D".
   f. HNP-I/INST-1054, Rev. 0, "Turbine Throttle Valve Closure Uncertainty and Scaling Calculation".

g. HNP-I/INST-1055, Rev. 0, "Turbine Low Hydraulic Pressure Trip Uncertainty and Scaling Calculation".

h. EQS-2, Rev. 6, "Refueling Water Storage Tank Level Setpoint".

i. E2-0010, Rev. 5, "Undervoltage Relays: Reactor Coolant Pump Motors 1A, 1B & 1C".

j. E2-0011, Rev. 4, "Underfrequency Relays: Reactor Coolant Pump Motors 1A, 1B & 1C".

k. E2-0005.09, Rev. 1, "Degraded Grid Voltage Protection for 6.9KV Busses 1A-SA & 1B-SB".

l. 0054-JRG, Rev. 2, "PSB-1 Loss of Offsite Power Relay Settings".

5. NRC Regulatory Guide 1.105, "Instrument Setpoints For Safety Related Systems".

   NOTE: FSAR Section 1.8 states HNP commitment to Rev. 1 of this RG; current version of RG is Rev. 3 (issued 12/99).

6. ISA Standard S67.04, Part I, 1994, "Setpoints for Nuclear Safety-Related Instrumentation".

7. CP&L Procedure EGR-NGGC-0153, Rev. 7, "Engineering Instrument Setpoints"

8. WCAP-15249, Rev. 0, dated April 2000, "Westinghouse Protection System Setpoint Methodology for Harris Nuclear Plant (for Uprate to 2912.4 MWT - NSSS Power and Replacement Steam Generators)" [designated as Westinghouse Proprietary Class 2C; transmitted by project letter CQL-00-141].

9. Westinghouse Calculation Notes [associated with RTS/ESFAS setpoint uncertainties]; designated as Westinghouse Proprietary Class 2:

   a. CN-TSS-98-19, Rev. 2, dated 3/99, "Harris (CQL) Control/Protection Uncertainty and Setpoint Analysis for Delta-75 Replacement Steam Generators (RSG) and Uprate to 2912.4 MWt-NSSS Power" [transmitted to CP&L by Bechtel project letter BH/98-067].

   b. CN-TSS-98-33, Rev. 1, dated 9/13/99, "Harris (CQL) Overtemperature and Overpower Delta-T Reactor Trip Setpoints for Uprate to 2912.4 Mwt-NSSS Power" [transmitted by project letter CQL-99-088].

   c. CN-SSO-99-03, Rev. 1, dated 9/17/99, "Harris (CQL) Pressurizer Pressure - Low Reactor Trip, Pressurizer Pressure - High Reactor Trip, Pressurizer Pressure - Low Safety Injection and P-11 Permissive Setpoints for Uprate to 2912.4 Mwt - NSSS Power" [transmitted by project letter CQL-99-092].

   d. CN-SSO-99-5, Rev. 1, dated 9/7/99, "Pressurizer Water Level - High Reactor Trip Setpoint Uncertainty Calculation for Harris Uprate to 2912.4 MWt, NSSS Power" [transmitted by project letter CQL-99-084].

   e. CN-SSO-99-7, Rev. 1, dated 9/21/99, "Harris Steamline Pressure-Low and Negative Steamline Pressure Rate-High Technical Specification Setpoint for Uprate to 2912.4 Mwt-NSSS Power" [transmitted by project letter CQL-99-101].

   f. CN-SSO-99-8, Rev. 1, dated 9/21/99, "Harris Steamline Differential Pressure-High Technical Specification Setpoint for Uprate to 2912.4 Mwt-NSSS Power" [transmitted by project letter CQL-99-100].

   g. CN-SSO-99-13, Rev. 1, dated 9/7/99, "Nuclear Instrumentation System Power Range Protection Functions for Harris Uprate to 2912.4 Mwt-NSSS Power" [transmitted by project letter CQL-99-085].

h. CN-SSO-99-14, Rev. 1, dated 12/17/99, "Harris (CQL) Nuclear Instrumentation System Intermediate Range Protection Function for the Uprate to 2912.4 Mwt NSSS Power" [transmitted by project letter CQL-99-229].

i. CN-SSO-99-15, Rev. 1, dated 11/9/99, "Harris (CQL) Nuclear Instrumentation System Source Range Protection Function for the Uprate to 2912.4 Mwt NSSS Power" [transmitted by project letter CQL-99-176].

j. CN-SSO-99-16, Rev. 1, dated 9/17/99, "Containment Pressure Functions for Harris Uprate to 2912.4 Mwt-NSSS Power" [transmitted by project letter CQL-99-091].

k. CN-SSO-99-17, Rev. 1, dated 11/9/99, "Harris Reactor Coolant Pump Under Voltage/Under Frequency Setpoint Calculations for Uprate to 2912.4 Mwt - NSSS Power" [transmitted by project letter CQL-99-175].

l. CN-SSO-99-18, Rev. 1, dated 10/20/99, "Harris (CQL) Steam Flow / Feedwater Flow Mismatch Function (Coincident with Steam Generator Water Level- Low) for Uprate to 2912.4 Mwt - NSSS Power" [transmitted by project letter CQL-99-146].

m. CN-SSO-99-32, Rev. 0, dated 11/24/99, "Harris (CQL) Low, Low Tavg (P-12) Technical Specification Setpoint for Uprate to 2912.4 Mwt - NSSS Power" [transmitted by project letter CQL-99-199].

n. CN-SSO-99-33, Rev. 0, dated 11/30/99, "Harris (CQL) Low Reactor Coolant Flow Technical Specification Setpoint for Uprate to 2912.4 Mwt-NSSS Power" [transmitted by project letter CQL-99-203].

10. Westinghouse Project Letters (PUR/SGR design information sent to CP&L):

a. CQL-98-028, dated 6/8/98, "Unverified Uncertainty Estimates".

b. CQL-98-032, dated 7/6/98, "Unverified Uncertainty Estimates Corrections".

c. CQL-98-030, Rev. 1, dated 7/8/98, "Final PCWG Parameters for the SGR/ Uprating Analysis and Licensing Project".

d. CQL-99-013, dated 5/11/99, "Revision to CQL Streaming Uncertainties".

e. CQL-99-029, dated 5/14/99, "Harris Hot Leg Streaming Evaluation Supporting Documentation".

f. CQL-99-105, Rev. 1, dated 4/3/00, "OTDT and OPDT Setpoints Operating Margins Evaluation for Harris Plant Margin Recovery Program (WX705)".

g. CQL-98-050, dated 11/3/98, "Revised RSG Level & Trip Setpoints in Consideration of Moisture Separator Modifications".

h. CQL-98-052, dated 11/12/98, "Calculation Note - Harris RSG Recommended SG Level Setpoints" [transmitted Calculation Note OPES(98)-025, dated 10/23/98, "SG NR Level Setpoints and PMA Inputs For Shearon Harris Model Δ75 Replacement Steam Generators with Modified Moisture Separator Design"].

11. Westinghouse Technical and Nuclear Safety Notifications:

a. Westinghouse Technical Bulletin ESBU-TB-97-02, dated 5/1/97, "Analog Process Rack Operability Determination Criteria".

b. Westinghouse Technical Bulletin ESBU-TB-97-03, dated 5/1/97, "W Non-Conservative Aspect of the Generic Westinghouse Instrument Uncertainty Algorithm".

c. Westinghouse Nuclear Safety Advisory Letter NSAL-97-01, dated 6/30/97, "Transmitter Drift".

12. CP&L Project Letters (design input information provided to Westinghouse):
    a. HW/98-013, dated 8/4/98, "Reference: Letter 97-CQL-901: Request for Input Information for Setpoint/Uncertainty Analysis".
    b. HW/99-038, dated 4/1/99, "Design Inputs for WA Task 6 Protection System Setpoint Methodology for Uprated Power Conditions".
    c. HW/99-033, dated 3/22/99, "Design Inputs for WA Task 5 Pressurizer Water Level Control System Uncertainty Calculations for Uprated Power Conditions".
    d. HW/99-032, dated 3/22/99, "Design Inputs for WA Task 4 Control Systems Uncertainty Calculations for Uprated Power Conditions".
    e. HW/99-097, dated 6/21/99, "Design Inputs for RCP Undervoltage & Underfrequency Protection System Trip Setpoints for Uprated Power Conditions (WA Task 6)".
    f. HW/99-116, dated 7/14/99, "Response/Clarification to Open Issues in Letter CQL-99-035".
    g. HW/99-136, dated 8/12/99, "Additional Design Inputs for ITDP Calorimetric Uncertainty Calculations".
    h. HW/99-199, dated 10/12/99, "Clarification of Final Design Inputs and Owner's Review Comments for ITDP Calorimetric Uncertainty Calculations".
    i. HW/99-021, dated 2/19/99, "Calibration Procedures for WCAP 12340 (ITDP) Instrument Channels".
    j. HW/98-032, dated 12/28/98, "Design Input for RCS Streaming Evaluation . . . Task #2".
    k. HW/99-030, dated 3/10/99, "Harris Cycle 8 Quadrant Power Tilt Ratio Design Input Data for the RCS Streaming Report . . . Task #2".
    l. HW/99-009, dated 2/3/99, "Design Inputs for Overtemperature and Overpower reactor Trip Setpoints".
    m. HW/99-019, dated 2/18/99, "Design Input, Analysis Value Trip Coefficients for the OPΔT/OTΔT Setpoint Evaluation".
    n. HW/99-147, dated 8/25/99, "HNP SGR/PUR CP&L Approval of Final OPΔT/OTΔT Setpoints and Tau's".
    o. HW/99-144, dated 7/14/99, "Additional Design Input Information for NIS Source Range (SR) and Intermediate Range (IR) Protection Trip Uncertainty Calculations".
    p. HW/99-034, dated 3/26/99, "Design Input, RCS Streaming Uncertainties for the Westinghouse Design Verified Setpoint Uncertainty Calculation".
    q. HW/99-151, dated 9/3/99, "Review Comments for Uncertainty Calculation associated with WBS Activity WX939 and WX971".
    r. HW/99-123, dated 7/16/99, "Pressurizer Pressure Control Uncertainty Calculation Inputs/Clarifications".
    s. HW/99-162, dated 9/10/99, "Review Comments for Uncertainty Calculation associated with WBS Activity WX987 and WX979".
    t. HW/99-202, dated 10/14/99, "Owner's Review Comments for Steam Flow/Feedwater Flow Mismatch Uncertainty Calculation".
    u. HW/99-248, dated 12/9/99, "Owner's Review Comments for NIS Intermediate Range Protection Function Uncertainty Calculation".

13. Other CP&L-Generated PUR/SGR Design Input Documents:
    a. Uprate Fuel Analysis Plant Parameters Document [UFAPPD], Rev. 3 [contained within Nuclear Fuels Section Calculation HNP-F/NFSA-0034, Rev. 3, "HNP SGR/PUR Fuel Related Design Input Calculations"].
    b. HB/98-037, dated 6/2/98, "Letter BH/98-015 dated February 27, 1998, Design Input Required From CP&L".

14. Plant Configuration Drawings:
    a. EMDRAC 1364-001328 S01 through S42, Westinghouse Process Control Block Diagrams [Westinghouse Drawing 108D803 Sheets 1 through 42].
    b. EMDRAC 1364-000864 through 1364-000878, Westinghouse Functional Diagrams [Westinghouse Drawing 108D831 Sheets 1 through 15].
    c. Drawing 2166-S-0302 Sheets 02, 07, & 08, Medium Voltage Relay Settings 6900 V Auxiliary Bus 1A, 1B, & 1C.
    d. Drawing 2166-S-0302 Sheets 20, 23, & 24, Medium Voltage Relay Settings 6900 V Auxiliary Emergency Bus 1A-SA & 1B-SB.
    e. EMDRAC 1364-002795 S01 and EMDRAC 1364-003319, [Turbine Trip Low Fluid Oil Pressure Schematic and Wiring Diagram]
    f. Drawing 2165-S-0553 S03 and EMDRAC 1364-002724 [Turbine Throttle Valve Closure Turbine Trip Schematic and Wiring Diagram]

3.0 BODY OF CALCULATION

3.1 Current Engineering/Licensing Basis Methodology

As stated in Section 1.3 above, the original engineering methodology and operability determination bases, for values defined in the Tech Spec RTS/ESFAS Trip Setpoint Tables, were contained in Westinghouse Letter Report FCQL-355 [Reference 2.3]. This "five-column" Tech Spec formatted methodology defines the following terms and their corresponding definitions.

- Trip Setpoint [TS]:
  Considered a nominal Reactor Trip value setting.
- Allowable Value [AV]:
  Accommodates instrument drift assumed between operational tests and the accuracy to which Trip Setpoint can be measured and calibrated. Defined using a "trigger value" ['T_N'] per Letter Report FCQL-355.
- 'TA' or Total Allowance:
  Difference (in percent of span) between Trip Setpoint and Safety Analysis Limit [SAL] assumed for Reactor Trip function; e.g., $TA = |TS - SAL|$. Defined within Tech Spec Equation 2.2-1 [$Z + R + S \leq TA$]; where 'R' includes Rack Drift and Calibration Uncertainties.
- 'Z' Term:
  Statistical summation of analysis errors excluding Sensor and Rack Drift and Calibration Uncertainties.
- 'S' (Sensor Error) Term:
  Sensor Drift and Calibration Uncertainties.

The last three terms were intended to further quantify channel operability (when an As-Found calibration is outside its [rack] Allowable Value tolerance <u>or</u> Sensor Error 'S' allowance), by demonstrating that sufficient margin exists from the safety analysis limit.

Figure 1 herein was adapted from Figure 4-2 of Letter Report FCQL-355, to conceptually illustrate typical channel uncertainties in relation to the Safety

Analysis Limit, Allowable Value, and Trip Setpoint. Figure 2 herein depicts the implementation for an instrument channel nominal setpoint, with respect to its (two-sided) rack calibration tolerance, its administratively controlled Tech Spec allowable value, and its normal operating range [or 'margin to trip']. Furthermore, Figure 2 shows the setpoint's relationship between its corresponding (FSAR Chapter 15) analytical limit and overall plant design safety limit.

Note that, an As-Found rack condition which exceeds a '± R' tolerance will require readjustment to an acceptable As-Left condition [i.e., at nominal trip setpoint 'TS' plus or minus 'R' tolerance]. (Similarly, sensor surveillance will confirm that the sensor is within an error tolerance defined by 'S'.)

Table 1-1 herein provides a summary of general equations/relationships per FCQL-355, used for computing each of the original "five-column" Tech Spec formatted terms. To demonstrate similarity with this original methodology, Table 1-2 herein provides a further summary of equations/relationships used for the updated "five-column" Tech Spec formatted term computations, given the [applicable PUR/SGR project-generated] uncertainty components. (For clarity of presentation, updated "five-column" Tech Spec terms will be denoted herein as primed [X'] terms.) As seen in Table 1-2, the need to 'minimize' sensor and rack uncertainties for operability purposes has been accomplished through the final definition used for the S' and AV' Tech Spec terms (i.e., consideration of <u>only</u> calibration and drift terms [as identified by {SD + SCA} and {RD + RCA}, for sensor and rack, respectively]); this assures that a conservatively small tolerance is used to administratively control/evaluate the As-Found/As-Left sensor and rack measurements, consistent with the FCQL-355 approach used for selection of the smallest of multiple trigger values and for operability determinations.

Note that the 'Allowable Value' term contained in an updated Westinghouse "two-column" Tech Spec format (i.e., per methodology in WCAP-15249 and supporting Westinghouse calculation notes [References 2.8 and 2.9, respectively]) is <u>not</u> synonymous with the above "five-column" 'Allowable Value' definition.

In addition to the above-noted Tech Spec terminology, total loop uncertainty [TLU], which is usually defined within Westinghouse uncertainty calculations as the channel statistical allowance [CSA], employs a calculational method that combines uncertainty components by <u>either</u>: a square root of the sum of the squares (SRSS) technique for statistically and functionally independent [random] uncertainty errors; <u>or</u> by a conservatively treated arithmetic summation technique of dependent uncertainties, and subsequent combination by SRSS with independent terms. These approaches are compliant with industry practices and CP&L guidance specified by References 2.6 and 2.7, respectively. Therefore, each instrument channel is evaluated for its applicable instrument uncertainty (including process measurement effects, M&TE/calibration accuracy, reference accuracy, pressure effects, temperature effects, drift, and other biases [where applicable]) for the sensor and rack electronics. Note that these uncertainties are similar to those shown in Figures 1 and 2 herein.

3.2 <u>Inputs and Assumptions</u>

CP&L design inputs to Westinghouse uncertainty calculations [Reference 2.9 listing] included conservative CP&L determination of various uncertainty effects for sensors and rack electronics [e.g., reference accuracy, calibration accuracy, measurement & test effects, applicable sensor pressure and temperature effects, electronics temperature effects, drift, etc.]. These determinations were provided as CP&L design inputs by Reference 2.12 project correspondence.

The following inputs and assumptions are specifically noteworthy, and have been applied within computations summarized herein (unless noted otherwise):

1. Continued use of "five-column" formatted terms and their corresponding definitions (per current Tech Spec surveillance requirements and bases) remain applicable. Since References 2.8 and 2.9 were prepared to the Westinghouse "two-column" methodology, 'Allowable Value' terms specified in References 2.8 and 2.9 do not apply, and should be ignored (to avoid confusion with conclusions herein). [However, for ease of reference, Table 2-1 herein consists an excerpt of WCAP-15249, Table 3-21.]

2. CP&L and/or Westinghouse-generated design inputs [per References 2.13 and 2.10 listings, respectively] define PUR/SGR-related nominal trip setpoints and associated analytical limits for specific RTS/ESFAS functions. As noted in Tables 3-1 through 3-29, some protection functions do not have identified safety analysis limits (within existing Chapter 15 safety analyses); these channels are used for diversity, but the analysis do not explicitly model or take credit for their actuation.

3. Unless specifically designated to be a dependent uncertainty component, process measurement uncertainty effects (designated as PMA or PEA) are generally considered to be independent (or random) of both sensor and rack uncertainty parameters. Examples of PMA components include effects due to neutron flux, calorimetric power measurement uncertainty assumptions, fluid density changes, reference leg heatup, effects of head correction, and temperature stratification/streaming assumptions. Examples of PEA components include uncertainties due to metering devices (such as flow elbows and venturis).

   When the condition monitored has a trip on an increasing process condition, only the negative uncertainties are considered for the calculation. When the condition being monitored has a trip on a decreasing process condition, only the positive uncertainties are considered for the calculation. The calculation below groups both the positive and negative uncertainties together in a conservative manner, that may be applied in either direction.

4. Calibration (i.e., SCA and RCA) and Drift (i.e., SD and RD) uncertainties are defined as random with normal distributions [see Reference 2.8, Sections 2.2 and 2.3]. Calibrations are performed under [MST/LP] procedural control with two-sided calibration tolerances. Sensors will drift either high or low from the as-left values. For these reasons, the uncertainties are expected to be random with normal distributions.

5. Uncertainty components are defined using a 95% probability and high confidence level, consistent with the original Westinghouse FCQL-355 methodology [Reference 2.3] and PUR/SGR-generated documents [per References 2.8 and 2.9].

6. Published sensor manufacturers' performance specifications generally show drift over a specific time duration. Where such specifications are cited, an 18-month $\pm$ 25% [or 22.5-month] minimum MST/LP calibration frequency has been used within Westinghouse uncertainty calculations [per References 2.8 and 2.9].

7. Sensor drift component was chosen as 'bounding' [worst-case maximum] values (based upon As-Found and previous As-Left MST/LP calibration data comparisons), which was considered to be conservative for the computation purposes of each CSA term; these SD values have been re-

tained within the computation of applicable "five-column" Tech Spec terms. [See Reference 2.8, Section 2.1 for additional discussion.] Where a turndown factor exists for a specific sensor function, each SD value will be multiplied by its corresponding turndown factor, unless justified otherwise (within its Tables 3-1 through 3-29 details).

8. Three-up/three-down calibrations are not performed for transmitters within MST/LP procedures. Therefore, CSA results are computed using the sensor reference accuracy (SRA) term. SRA values are generally obtained from manufacturer's published product specifications. Although procedure revisions are unlikely, if calibration techniques included multiple passes over the entire instrument range (to verify conformity, hysteresis, and repeatability effects), then the SRA term could be eliminated from the CSA uncertainty computation.

9. Based upon MST/LP calibration methods, credit is taken in the uncertainty calculation for the loop-calibration of process channels (with a test signal at the input of the process instrument channel and a complete loop calibration to the final device). Therefore, only <u>one</u> RCA term is used for the total rack calibration tolerance; a rack comparator setting accuracy [RCSA], as originally specified in Reference 2.3, is <u>not</u> used in the CSA (or in Tech Spec Allowable Value term).

10. Heise (or equivalent) pressure gauges used for transmitter calibrations are temperature compensated to 95°F; calibrations performed in ambients above 95°F will compensate for the specific increased ambient. The DVM (of a type as required by the MST/LP) is used generally within the temperature range of 15°C to 35°C [59°F to 95°F], as identified in the DMV specification.

11. Sensor and rack M&TE [SMTE and RMTE] uncertainties have been specified as statistically dependent upon drift and calibration uncertainties in (Reference 2.9) Westinghouse calculation notes, which assures that the CSA determination is more conservative (than without such consideration of interactive parameters).

12. Sensor pressure effects [SPE] and sensor temperature effects [STE], where applicable, are generally based upon manufacturer's published product specifications. (SPE components are typically applicable only to differential pressure transmitters.) STE values will incorporate applicable turndown factors, unless justified otherwise.

13. Rack temperature effects [RTE] are based upon historical Westinghouse performance data, and can be considered to reflect uncertainty values at a 95% probability and 95% confidence level. In general, an RTE term of 0.5% of span was used in the CSA/Tech Spec uncertainty calculations, based upon Reference 2.3.

14. Rack drift [RD] was generally assumed as a (worst-case) conservative value of 1.0% of span for the purpose of CSA uncertainty calculations.

15. Environmental allowance [EA] uncertainty components are generally limited to RTS/ESFAS trip functions which must be postulated to occur at a delayed post-accident [LOCA/MSLB] time duration. Sensors installed in containment or steam tunnel locations may require an EA component. A basis for EA uncertainty component values has been included in the applicable Table 3-x reference.

16. Seismic effects are not assumed, owing to the fact that (previously performed) seismic qualification testing has demonstrated successful response/acceptance criterion. Furthermore, after a seismic event, the plant is shutdown and instruments would be recalibrated (to required performance specifications/tolerances).

In addition, seismic effects on OTΔT/OPΔT channels have been further evaluated (as noted in Reference 2.12.1 [HW/99-009]). A seismic allowance is not required for the OTΔT reactor trip, since the HNP design basis requirements do not postulate a seismic event simultaneously with a non-LOCA transient that may require the OTΔT trip. The OTΔT trip is not required for LOCA events. In the event of a seismic disturbance, the pressure transmitter calibration would be suspect and require evaluation and possible recalibration.

17. This calculation will address, in particular, those changes to trip setpoints and/or analytical limits that have been changed specifically for PUR/SGR-related analyses and/or system configurations. Tables 2-2 and 2-3 provide a summary of such changes to trip setpoints and analytical limits, for RTS and ESFAS functions, respectively. These changes are a result of the following:

    - For SG N-R Level trip functions, the [Model Δ75] replacement steam generators [RSGs] have a different physical design configuration (e.g., larger tap-to-tap dimension, different top of U-tube bundle, elimination of pre-heat feedwater design, etc.), which results in the need for different normal operating control water level and for RTS/ESFAS trip setpoints [for Low-Low, Low, and High-High trip functions, as defined per References 2.10.g and 2.10.h.]. PUR/SGR analyses have utilized updated safety analysis limits [as originally defined in References 2.10.a, 2.10.b, & 2.13.a and subsequently reconciled per Reference 2.9]. Revised Tech Spec term values correspond to these new RSG setpoint requirements, as noted in Tables 3-10A through 3-10C and Tables 3-18A through 3-18B herein.
    - For OTΔT/OPΔT trip functions, Reference 2.10.f provides the justification for: elimination of T_1/T_2 lead/lag compensation and addition of T_3 lag filter (for each RCS loop's measured ΔT); and changes to other trip function coefficients/time constants. PUR/SGR implementation will be based upon updated safety analysis limits [compatible with function values defined in Reference 2.10.f]. Tech Spec values must be revised accordingly, as shown in Tables 3-5 and 3-6 herein.
    - Containment Pressure High-1 and High-2 setpoints have slightly increased safety analysis values (as compared to Reference 2.3). Refer to Table 3-12A herein for Tech Spec term changes.
    - A Pressurizer Level High setpoint uncertainty [of 6.75% level span] has been [recently] defined within PUR/SGR safety analyses; this uncertainty was applied against a 100% filled pressurizer level condition. (Reference 2.3 did not previously specify a safety analysis limit.) As such, the current Tech Spec trip setpoint continues to apply, in relation to a 100% level analytical limit, as noted per Table 3-8 herein.

18. In lieu of simplified loop diagrams, refer to existing HNP process control block diagrams, functional diagrams, and/or other plant configuration drawings [as noted per Reference 2.14 listing above].

3.3 Calculation Synopsis

This document delineates the channel statistical allowance (CSA) and the "five-column" Tech Spec terms for each RTS/ESFAS Trip Setpoint function. Tables 3-1 through 3-29 herein summarize these calculation results. (For ease of reference, Table 3-0 contains an index of these calculation summaries for each trip function [with its corresponding Tech Spec Table Item No.].)

The CSA result combines applicable uncertainty components [described in Section 3.1] using a "square root of the sum of the squares" (SRSS) calculational technique. This technique has been used in both past and current Westinghouse methodologies [per References 2.3 and 2.8], as well as within current industry and CP&L guidance [per References 2.6 and 2.7]. The 'updated' Westinghouse uncertainty calculations and associated WCAP [References 2.8 and 2.9], which were produced for the PUR/SGR projects, combine uncertainty components in the following general equation formula [also 'Eq. 2.1' of Reference 2.8]:

$$CSA = \left[(PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (SPE)^2 + (STE)^2 + (SRA)^2 + (SMTE + SCA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RMTE + RCA)^2 \right]^{1/2} + EA + SEISMIC + BIAS$$

where:

PMA	=	Process Measurement Accuracy
PEA	=	Primary Element Accuracy
SRA	=	Sensor Reference Accuracy
SCA	=	Sensor Calibration Accuracy
SMTE	=	Sensor Measurement and Test Equipment (Accuracy)
SPE	=	Sensor Pressure Effects
STE	=	Sensor Temperature Effects
SD	=	Sensor Drift
RCA	=	Rack Calibration Accuracy
RMTE	=	Rack Measurement and Test Equipment (Accuracy)
RTE	=	Rack Temperature Effects
RD	=	Rack Drift
EA	=	Environmental Allowance [treated as a Bias]
SEISMIC	=	Seismic Allowance [treated as a Bias]
BIAS	=	Other Non-Random/Dependent Uncertainty Component(s)

The CSA results from 'updated' Westinghouse uncertainty calculations (produced for the PUR/SGR projects [per References 2.9]), for each RTS/ESFAS trip function, have been summarized within Table 3-21 of WCAP-15249 [Reference 2.8]. In addition, Table 3-21 of WCAP-15249 has also been excerpted as Table 2-1 herein, for ease of reference to uncertainty terms and CSA results for each trip function.

Based upon the relationships shown in Figures 1 and 2, portions of the overall CSA have been defined in terms of the Tech Spec terms (as specified above in Section 3.1, and within Tables 1-1 and 1-2). Any variations from the above generalized equation format and/or uncertainty components are defined in specific trip function summaries (within Tables 3-1 through 3-29).

Although interrelated, the CSA uncertainty and the Tech Spec terms are generally evaluated in different ways, as noted by the following evaluation circumstances:

- The CSA term is typically composed of conservatively-chosen (increased) values for uncertainty components, to maximize the overall channel uncertainty (for comparison of available margin between the nominal setpoint and safety analysis limit) relative to their 95% probability and high (or 95%, as applicable for power/flow calorimetric functions) confidence level.

- However, the "five-column" Tech Spec allowable value [AV] has been conservatively chosen (smaller) based upon the smallest trigger term [T_N] as defined/required by Reference 2.3, to minimize the Tech Spec surveillance tolerance used for rack calibration/drift allowances. Sensor Error [S] is also correspondingly minimized using calibration/drift allowances only.

In addition, deviations from current Tech Spec term values must be balanced in relation to: the level of conservatism provided by the current surveillance; the operational conditions/considerations associated with the RTS/ESFAS trip function; and the practicality of surveillance testing (e.g., ease of testing process, repeatability of test results, etc.). Where post-PUR/SGR implementation includes no hardware changes (independent of channel normalization/scaling), evaluation of specific trip function summaries [per Tables 3-1 through 3-29] will detail those cases where deviations from current Tech Spec values are not warranted.

4.0 CONCLUSIONS

Computation summaries of (post-PUR/SGR) instrument channel uncertainties and "five-column" Tech Spec terms for each RTS/ESFAS function are presented [with a corresponding documentation source reference] in Tables 3-1 through 3-29 herein. The applicability and acceptability of these results are discussed per the following:

4.1 Channel Statistical Allowance (CSA) Results

The acceptance criterion for the trip channel results requires that positive setpoint margin exists. This calculational margin is defined as the difference between the channel's total allowance [TA] and the channel statistical allowance [CSA]. (As specified in Section 3.0, the total allowance is defined as the difference between safety analysis limit and the nominal trip setpoint [in percent of span].)

References 2.8 and 2.9 results, as excerpted within Table 2-1 and as specified within Tables 3-1 through 3-29, demonstrate that all trip setpoints possess a specific positive calculational margin between its TA and CSA result; therefore, acceptability of each function's nominal trip setpoint is demonstrated.

Unless specifically excepted (and reconciled) herein, the CSA terms presented herein agree with values specified in PUR/SGR-related Westinghouse documentation listed under References 2.8 and 2.9. These results supercede the original values provided within Reference 2.3 [FCQL-355], and comply with updated calculational methodology (as described per Section 3.3).

4.2 Summary of "Five-Column" Tech Spec Terms

Tables 3-1 through 3-29 also detail applicable "five-column" Tech Spec terms [TA, Z, S, Trip Setpoint, and Allowable Value] for each trip function. These Tech Spec terms are based upon either: values evaluated to be the same as current Tech Spec terms; or values computed by general equations shown in Table 1-2.

Tables 4-1 and 4-2 include a mark-up of current Tech Spec Tables 2.2-1 and 3.3-4, respectively, to support the PUR/SGR licensing amendment; furthermore, for ease of comparison, PUR/SGR Tech Spec changes have also been highlighted within Table 4-3. These Tech Spec changes retain the original HNP engineering and licensing bases (as defined in Reference 2.3 [FCQL-355]), and demonstrate continued (post-PUR/SGR) compliance to HNP Tech Spec RTS/ESFAS Trip Setpoint requirements. As such, use of these updated Tech Spec terms are suitable within corresponding scaling calculations, MSTs/LPs, and other documents that require update as a result of PUR/SGR project implementation.

The "five-column" Tech Spec terms presented herein will not agree with "two-column" values/terminology specified in PUR/SGR-related Westinghouse documentation listed under References 2.8 and 2.9. Similar to CSA results (as noted in Section 4.1 above), the "five-column" Tech Spec terms presented herein supercede the original values provided in Reference 2.3; however, operability methodology of Reference 2.3, Section 4.0 remains applicable (owing to its compliance with the existing HNP licensing bases [as delineated in Tech Spec Bases B 2.2, B 3/4.3.1, and B 3/4.3.2]).

FIGURE 1

CHANNEL UNCERTAINTY COMPONENTS RELATIVE TO
SAFETY ANALYSIS LIMIT, ALLOWABLE VALUE, AND TRIP SETPOINT

Safety Analysis Limit (SAL)

Process Measurement Accuracy

Primary Element Accuracy

Sensor Temperature Effects

Sensor Pressure Effects

Sensor Calibration Accuracy

Sensor Drift

Environmental Allowance

Rack Temperature Effects

STS Allowable Value (AV)

Rack Calibration Accuracy *

Rack Drift

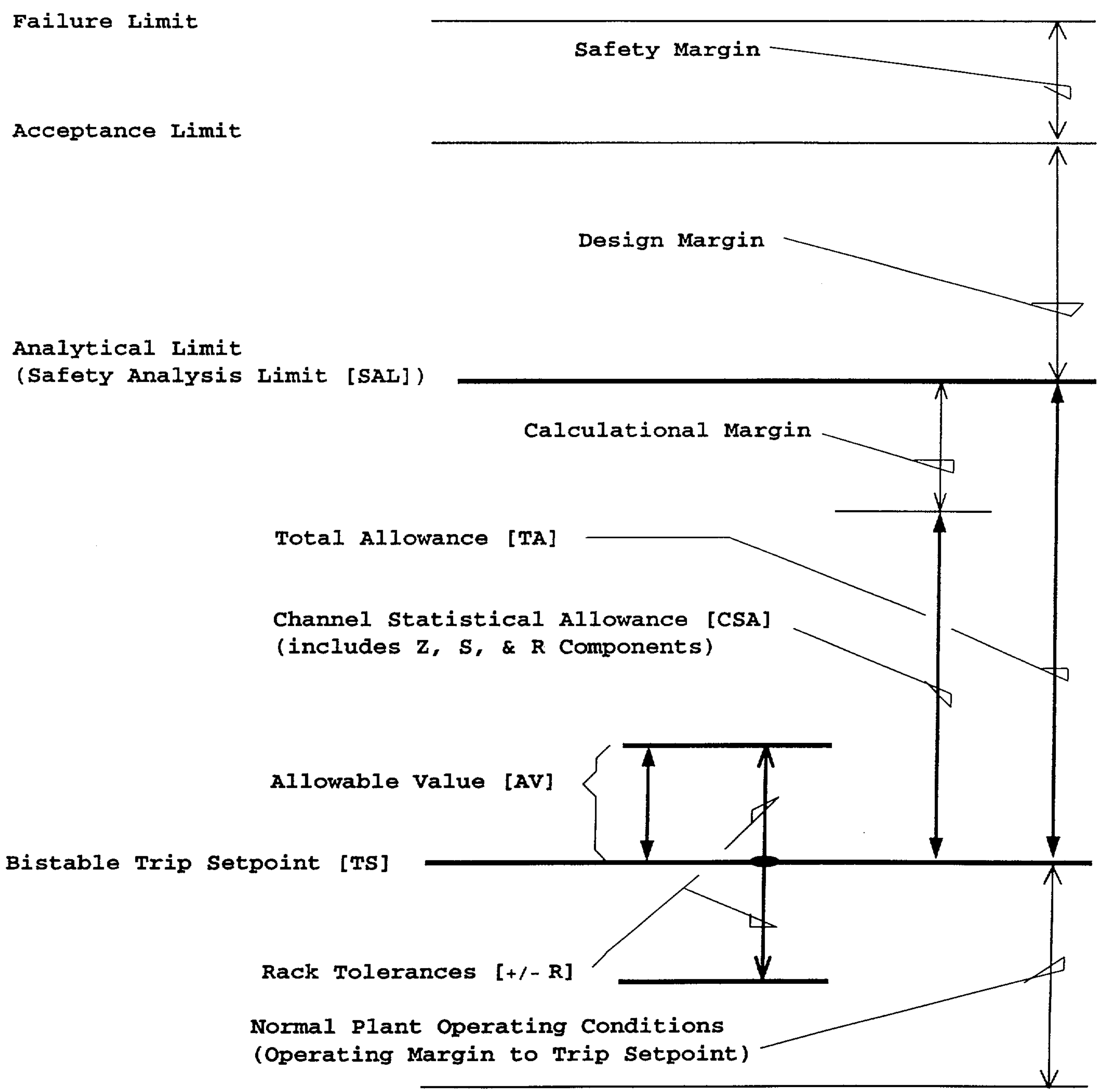
STS Trip Setpoint (TS)

* - Includes Rack Comparator Setting Accuracy (RCSA).

(Adapted from W Letter Report FCQL-355 (Rev. 1), Figure 4-2 [Page 4-11].)

FIGURE 2

OPERATING CONDITIONS, UNCERTAINTIES, AND MARGINS RELATIVE TO SAFETY ANALYSIS LIMIT, ALLOWABLE VALUE, AND TRIP SETPOINT



<u>Note:</u> Figure is intended to provide relative position and not to imply direction.

(Adapted from ISA S67.04-1994, Figure 1)

TABLE 1-1

SUMMARY OF GENERAL EQUATIONS/RELATIONSHIPS USED IN REPORT FCQL-355 FORMAT

General Notes: All terms are in Percent of Span, unless noted otherwise.
'*' designates one of the "five-column" Tech Spec terms.

CSA = Channel Statistical Allowance

$= \{(PMA)^2 + (PEA)^2 + (SCA + SD)^2 + (STE)^2 + (SPE)^2 + (RCA + RCSA + RD)^2 + (RTE)^2\}^{1/2} + EA$

S = Sensor Error Term *

= SCA + SD

A = Sum of the squares of all Random Errors that are <u>not</u> associated with SCA, SD, RCA, RCSA, or RD

$= (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2$

SAL = Safety Analysis Limit (in engineering units)

TS = Trip Setpoint (in engineering units) *

TA = Total Allowance [where TA $\geq$ Z + R + S] *

= TS - SAL [for a Low Setpoint] <u>OR</u>
SAL - TS [for a High Setpoint]

T = Rack Trigger Value

$= TA - [(A + S^2)^{1/2} + \text{all Bias terms}]$ <u>OR</u> (RCA + RCSA + RD)

AV = Allowable Value (in engineering units) *

= TS - T [for a Low Setpoint] <u>OR</u> TS + T [for a High Setpoint]

Z = Statistical summation of errors excluding those associated with SD, SCA, SMTE, RD, RCA, RCSA, and RMTE *

$= (A)^{1/2} + \text{any Bias terms}$

Margin = TA - CSA

TABLE 1-2

SUMMARY OF GENERAL EQUATIONS/RELATIONSHIPS USED FOR THE UPDATED "FIVE-COLUMN" TECH SPEC FORMAT

General Notes:

All terms are in Percent of Span, unless noted otherwise.

'*' designates one of the "five-column" Tech Spec terms.

Primed terms (X') represent updated [PUR/SGR-related] terms.

CSA' uncertainty components below reflect updated PUR/SGR values.

Background/Development:

CSA' = Channel Statistical Allowance

$$= \{(PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (SPE)^2 + (STE)^2 + (SMTE + SCA)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RMTE + RCA)^2\}^{1/2} + EA + Biases$$

This equation can be rearranged per FCQL-355 terminology, by inspection:

$$CSA' = \{ A' + S'^2 + R'^2 \}^{1/2} + EA' + Biases'$$

where:

$$A' = (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2$$

$$S' = [(SMTE + SD)^2 + (SMTE + SCA)^2 + (SRA)^2]^{1/2}$$

$$R' = [(RMTE + RD)^2 + (RMTE + RCA)^2]^{1/2}$$

$$Z' = (A')^{1/2} + EA + Biases$$

However, to conservatively maintain minimum tolerances on S' and R' terms, define S' and R' (as originally specified in FCQL-355) in terms of updated PUR/SGR components (where RCA includes bistable accuracy [i.e., original FCQL-355 RCSA term]):

$$S' = SD + SCA$$

$$R' = RD + RCA$$

Since FCQL-355 relationship {TA' $\geq$ Z' + R' + S'} must remain valid, alternately confirm the acceptability for R', by solving the TA' inequality relationship for a minimum R' [once S', Z', and TA' are known].

$$R' = \{ TA' - Z' - S' \}$$

Note that the above "check" yields an equal (or smaller) value for R' than use of the FCQL-355 $T_2' = \{ TA' - [(A' + (S')^2)^{1/2} + \text{all Biases}] \}$ expression.

TABLE 1-2 (Cont'd)

SUMMARY OF GENERAL EQUATIONS/RELATIONSHIPS USED
FOR THE UPDATED "FIVE-COLUMN" TECH SPEC FORMAT

Computational Methodology:

All Tech Spec terms can be determined in the following manner, given known values [denoted below by '**']. (Provide reference for '**' known values.)

CSA' = Per equation (above) containing all upgraded PUR/SGR uncertainties

SAL' = Safety Analysis Limit (in engineering units) **

Margin' = TA' - CSA'

TS' = Trip Setpoint (in engineering units) *,**

TA' = Total Allowance * = TS' - SAL' [for a Low Setpoint] OR
SAL' - TS' [for a High Setpoint]

S' = SD + SCA [as noted above] *

A' = $(PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2$ [as noted above]

Z' = $(A')^{1/2}$ + EA + Biases [as noted above] *

T' = Rack Trigger Value
= lesser of: R' = [RD + RCA] OR [TA' - Z' - (SD + SCA)]

AV' = Allowable Value (in engineering units) *
= TS' - T' [for a Low Setpoint] OR
TS' + T' [for a High Setpoint]

WESTINGHOUSE PROPRIETARY CLASS 2C

Excerpted from WCAP-15249, Rev. 0

TABLE 2-1
Calc. No. HNP-I/INST-1010
Rev. 0
Page 19

TABLE 3-21 (Rev.0)
REACTOR TRIP SYSTEM / ENGINEERED SAFETY FEATURES ACTUATION SYSTEM
CHANNEL UNCERTAINTY ALLOWANCES
HARRIS NUCLEAR PLANT

		SENSOR										PROCESS RACK										
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	
	PROTECTION CHANNEL	PROCESS MEASUREMENT ACCURACY (PMA) (1)	PRIMARY ELEMENT ACCURACY (PEA) (1)	REFERENCE ACCURACY (SRA) (1)	CALIBRATION ACCURACY (SCA) (1)	MEASUREMENT & TEST EQUIPMENT ACCURACY (SMTE) (1)	PRESSURE EFFECTS (SPE) (1)	TEMPERATURE EFFECTS (STE) (1)	DRIFT (SD) (1)	ENVIRON-MENTAL ALLOWANCE (EA) OR BIAS (1)	SEISMIC ALLOWANCE (1)	CALIBRATION ACCURACY (RCA) (1)	MEASUREMENT & TEST EQUIPMENT ACCURACY (RMTE) (1)	TEMPERATURE EFFECTS (RTE) (1)	DRIFT (RD) (1)	SAFETY ANALYSIS LIMIT (SAL) (2)	TECHNICAL SPECIFICATION ALLOWABLE VALUE (3)	TECHNICAL SPECIFICATION TRIP SETPOINT (3)	TOTAL ALLOWANCE (TA) (1)	CHANNEL STATISTICAL ALLOWANCE (CSA) (1)	SAFETY MARGIN (1)	
1	POWER RANGE, NEUTRON FLUX - HIGH SETPOINT, REACTOR TRIP	1.7(4) & 4.2	—	—	(5)	(5)	—	(5)	(5)	—	—	0.5	0.1	0.8	1.0]a,c	118% RTP	109.6% RTP	109.0% RTP	7.5	4.7	+2.8]a,c	1
2	POWER RANGE, NEUTRON FLUX - LOW SETPOINT, REACTOR TRIP	1.7(4) & 4.2	—	—	(5)	(5)	—	(5)	(5)	—	—	0.5	0.1	0.8	1.0	35% RTP	25.6% RTP	25.0% RTP	8.3	4.7	+3.6	2
3	POWER RANGE, NEUTRON FLUX - HIGH POSITIVE RATE, REACTOR TRIP	(6)	—	—	(6)	(6)	—	(6)	(6)	—	—	0.5	0.1	0.8	1.0	(7)	5.6% RTP	5.0% RTP	—	1.4	—	3
4	POWER RANGE, NEUTRON FLUX - HIGH NEGATIVE RATE, REACTOR TRIP	(6)	—	—	(6)	(6)	—	(6)	(6)	—	—	0.5	0.1	0.8	1.0	8.0% RTP	5.6% RTP	5.0% RTP	2.5	1.4	+1.1	4
5	INTERMEDIATE RANGE, NEUTRON FLUX - HIGH, REACTOR TRIP	8.3	—	—	(8)	(8)	—	(8)	(8)	—	—	2.0	0.1	1.2	4.2	(7)	27.4% RTP	25.0% RTP	—	9.7	—	5
6	SOURCE RANGE, NEUTRON FLUX - HIGH, REACTOR TRIP	10.0	—	—	(8)	(8)	—	(8)	(8)	—	—	0.5	0.5	0.5	3.0	(7)	1.05×10^5 CPS	1.0×10^5 CPS	—	10.7	—	6
7	OVERTEMPERATURE ΔT REACTOR TRIP																					
	ΔT CHANNEL	—	—	—	—	—	—	—	—	—	...	0.4	0.3	0.5	1.0	FUNCTION	FUNCTION(17)	FUNCTION(17)	9.0	8.4	+0.6	7
	TAVG CHANNEL	+0.6(11) 1.3(12) +0.5(11) +1.5(13) +1.1(14)	—	0.2	—	—	—	—	—	—	—	0.5	0.4	—	1.5							
	PRESSURIZER PRESSURE CHANNEL	—	—	0.2	0.3	0.5	—	0.9	0.6	—	—	0.1	0.1	—	0.3							
	ΔI CHANNEL	3.0(15)&1.3(16)	—	—	—	—	—	—	—	—	—	0.1	0.1	—	0.6							
8	OVERPOWER ΔT REACTOR TRIP																					
	ΔT CHANNEL	—	—	—	—	—	—	—	—	—	—	0.4	0.3	0.5	1.0	FUNCTION	FUNCTION(18)	FUNCTION(18)	4.0	3.0	+1.0	8
	TAVG CHANNEL	+0.6(11) 1.3(12) 0.0(11) +0.1(13) +0.1(14)	—	0.2	—	—	—	—	—	—	...	0.1	0.0	—	0.1							
9	PRESSURIZER PRESSURE - LOW, REACTOR TRIP	—	—	0.3	0.5	0.7	—	1.4	1.0	—	—	0.5	0.5	0.5	1.0	1920 PSIG	1956 PSIG	1960 PSIG	5.0	3.2	+1.8	9
10	PRESSURIZER PRESSURE - HIGH, REACTOR TRIP	—	—	0.3	0.5	0.7	—	1.4	1.0	—	—	0.5	0.5	0.5	1.0	2445 PSIG	2389 PSIG	2385 PSIG	7.5	3.2	+4.3	10
11	PRESSURIZER WATER LEVEL - HIGH, REACTOR TRIP	-0.9(9) & -1.7(10)	—	0.5	0.5	0.6	0.5	0.5	1.3	—	—	0.5	0.2	0.5	1.0	(7)	92.5% SPAN	92.0% SPAN	—	5.3	—	11
12	REACTOR COOLANT FLOW - LOW, REACTOR TRIP	0.4(19), 1.3(20) & +0.1(20)	0.3	0.2	(21)	(21)	(21)	(21)	0.5	—	—	0.3	0.3	0.3	0.7	85.0% LOOP FLOW	90.1% LOOP FLOW	90.5% LOOP FLOW	4.6	2.1	+2.5	12
13	STEAM GEN. WATER LEVEL - LOW,LOW REACTOR TRIP (FEEDWATER LINE BREAK)(BARTON 764 TRANSMITTER)	+4.4(22)	—	0.5	0.5	0.5	0.6	0.5	2.0	+10.0(23), +1.5(24), +1.0(25)	— —	0.5	0.1	0.5	1.0	0% SPAN	24.5% SPAN	25.0% SPAN	25.0	20.1	+4.9	13
14	STEAM GEN. WATER LEVEL - LOW,LOW REACTOR TRIP (LOSS OF NORMAL FEEDWATER)(BARTON 764 TRANSMITTER)	+4.4(22)	—	0.5	0.5	0.5	0.6	0.5	2.0	—	—	0.5	0.1	0.5	1.0	16.1% SPAN	24.5% SPAN	25.0% SPAN	8.9	7.6	+1.3	14
15	STEAM GEN. WATER LEVEL - LOW, REACTOR TRIP (BARTON 764 TRANSMITTER)	+4.4(22)	—	0.5	0.5	0.5	0.6	0.5	2.0	—	—	0.5	0.1	0.5	1.0	(7)	24.5% SPAN	25.0% SPAN	—	7.6	—	15
16	STEAM FLOW-FEEDWATER FLOW MISMATCH, REACTOR TRIP																					16
	STEAM FLOW	2.6(26)	—	0.3	0.3	0.3	0.3	0.3	0.7	—	—	0.5	0.2	0.5	1.0	(7)	40.6% STEAM FLOW	40.0% STEAM FLOW	—	5.4	—	
	FEEDWATER FLOW	—	0.4	0.2	0.5	0.5	0.3	1.1	1.2	—	—	0.5	0.2	—	1.0							
	STEAM PRESSURE	—	—	0.6	0.6	0.7	—	0.6	1.8	—	—	0.6	0.2	—	1.2							
17	CONTAINMENT PRESSURE - HIGH-1, SAFETY INJECTION	—	—	0.5	0.5	0.7	—	0.5	1.3	—	—	0.5	0.5	0.5	1.0	5.0 PSIG	3.3 PSIG	3.0 PSIG	3.6	3.1	+0.5	17
18	CONTAINMENT PRESSURE - HIGH-2, STEAM LINE ISOLATION	—	—	0.5	0.5	0.7	—	0.5	1.3	—	—	0.5	0.5	0.5	1.0	(7)	3.3 PSIG	3.0 PSIG	—	3.1	—	18
19	CONTAINMENT PRESSURE - HIGH-3, CONTAINMENT SPRAY	—	—	0.5	0.5	0.7	—	0.5	1.3	—	—	0.5	0.5	0.5	1.0	12.0 PSIG	10.3 PSIG	10.0 PSIG	3.6	3.1	+0.5	19
20	PRESSURIZER PRESSURE - LOW, SAFETY INJECTION	—	—	0.3	0.5	0.7	—	1.4	1.0	+8.0(23), +1.0(23)	—	0.5	0.5	0.5	1.0	1700 PSIG	1846 PSIG	1850 PSIG	18.8	12.1	+6.7	20
21	STEAMLINE DIFFERENTIAL PRESSURE - HIGH, AUXILIARY FEEDWATER INITIATION A	—	—	0.5	0.5	0.7	—	0.5	1.5	—	—	0.5	0.5	0.5	1.0	165 PSI	106.5 PSI	100 PSI	5.0	4.5	+0.5	21
	B	—	—	0.5	0.5	0.7	—	0.5	1.5	—	—	0.5	0.5		1.0							
22	NEGATIVE STEAMLINE PRESSURE RATE - HIGH,STEAM LINE ISOLATION	(6)	—	(6)	(6)	(6)	—	(6)	(6)	—	—	0.5	0.5	0.5	1.0	(7)	106.5 PSI	100 PSI	—	1.9	—	22
23	TAVG - LOW, LOW, P-12 INTERLOCK	+1.0,(27)+0.5(27)	—	0.2	0.5	—	—	—	0.4	0.0(30)	—	0.5	0.3	0.5	1.0	(7)	552.5°F	553°F	—	3.2	—	23
24	STEAMLINE PRESSURE - LOW, SAFETY INJECTION	—	—	0.5	0.5	0.7	—	0.5	1.5	—	—	0.5	0.5	0.5	1.0	370.9 PSIG	594.5 PSIG	601 PSIG	17.7	3.2	+14.5	24
25	STEAM GEN. WATER LEVEL - HIGH,HIGH TURBINE TRIP (BARTON 764 TRANSMITTER)	-7.1(22)	—	0.5	0.5	0.5	0.6	0.5	2.0	—	—	0.5	0.1	0.5	1.0	91.2% SPAN(28)	78.5% SPAN	78.0% SPAN	13.2	10.2	+3.0	25
26	STEAM GEN. WATER LEVEL - HIGH,HIGH TURBINE TRIP (TOBAR 32DP1 TRANSMITTER)	-7.1(22)	--	0.5	0.5	0.5	0.6	0.5	2.0	1.6(29)	...	0.5	0.1	0.5	1.0	91.2% SPAN(28)	78.5% SPAN	78.0% SPAN	13.2	11.8	+1.4	26
27	REACTOR COOLANT PUMP UNDERVOLTAGE - LOW, REACTOR TRIP	—	0.9	5.7	5.3	1.8	—	—	3.0	--	—	—	--	—	—	(7)	5053 VOLTS	5148 VOLTS	..	10.3	...	27
28	REACTOR COOLANT PUMP UNDERFREQUENCY - LOW, REACTOR TRIP	—	—	—	1.0	—	—	—	1.5	...	—	—	...	—	—	57.0 HZ	57.4 HZ	57.5 HZ	5.0	1.8	+3.2	28

NOTES:
1. ALL VALUES IN PERCENT OF SPAN
2. AS NOTED IN TABLE 15.0.6-2 OF THE FSAR
3. AS NOTED IN TABLE 2.2-1 OR 3.3-4 OF THE TECHNICAL SPECIFICATIONS
4. [POWER CALORIMETRIC MEASUREMENT ALLOWANCE]+a,c
5. [INCLUDED IN CALORIMETRIC ALLOWANCE IN PROCESS MEASUREMENT ACCURACY]+a,c
6. [USE OF RATE (DERIVATIVE) ELIMINATES STEADY-STATE ERRORS]+a,c
7. NOT USED IN THE SAFETY ANALYSIS
8. [INCLUDED IN PROCESS MEASUREMENT ACCURACY]+a,c
9. [PROCESS PRESSURE VARIATION - TREATED AS A BIAS]+a,c
10. [REFERENCE LEG TEMPERATURE VARIATION - TREATED AS A BIAS]+a,c
11. [CORE - BURNDOWN EFFECTS - TREATED AS A BIAS]+a,c
12. [POWER CALORIMETRIC MEASUREMENT ALLOWANCE]+a,c
13. [TAVG ASYMMETRY - TREATED AS A BIAS]+a,c
14. [T' - TREF TOLERANCE - TREATED AS A BIAS]+a,c
15. INCORE / EXCORE ΔI COMPARISON AS NOTED IN TABLE 4.3-1 OF THE PLANT TECHNICAL SPECIFICATIONS
16. [INCORE FLUX MAP ΔI UNCERTAINTY]+a,c
17. AS NOTED IN TABLE 2.2-1, NOTE 1 OF THE TECHNICAL SPECIFICATIONS
18. AS NOTED IN TABLE 2.2-1, NOTE 3 OF THE TECHNICAL SPECIFICATIONS
19. [DENSITY EFFECTS ON DELTA-P TRANSMITTER]+a,c
20. [CALORIMETRIC RCS FLOW MEASUREMENT UNCERTAINTY]+a,c
21. [NORMALIZATION OF ELBOW TAPS TO CALORIMETRIC RCS FLOW MEASUREMENT ELIMINATES SENSOR CALIBRATION, M&TE, PRESSURE, AND TEMPERATURE ERRORS]+a,c
22. [PROCESS PRESSURE VARIATIONS, REFERENCE LEG TEMPERATURE VARIATIONS (NORMAL), SUBCOOLING, AND VELOCITY EFFECTS - TREATED AS A BIAS]+a,c
23. [TRANSMITTER ENVIRONMENTAL ALLOWANCE - TREATED AS A BIAS]+a,c
24. [REFERENCE LEG HEATUP EFFECT (ACCIDENT) - TREATED AS A BIAS]+a,c (CPL CALCULATION EQS-042)
25. [CABLE INSULATION RESISTANCE DEGRADATION - TREATED AS A BIAS]+a,c
26. [NORMALIZATION OF STEAM FLOW TO FEEDWATER FLOW]+a,c
27. [HOT & COLD LEG TEMPERATURE STREAMING - TREATED AS A BIAS]+a,c
28. [100% IS USED IN THE FSAR EXCESSIVE FEEDWATER EVENT. THIS LIMIT ADDRESSES VOIDING]+a,c
29. [BIAS ASSOCIATED WITH TOBAR TRANSMITTER TEMPERATURE COMPENSATION]+a,c
30. [R/E NONLINEAR CURVE FIT - TREATED AS A BIAS]+a,c

TABLE 2-2

PUR/SGR-RELATED CHANGES TO RTS SETPOINTS AND ANALYTICAL LIMITS

TS Table 2.2-1 Item / Trip Parameter	TS Trip Setpoint	Safety Analysis Limit
2.a / Power Range High Setting	≤ 109% of RTP	118% of RTP (1)
2.b / Power Range Low Setting	≤ 25% of RTP	35% of RTP (1)
3 / PR High Positive Flux Rate	≤ 5% of RTP with a time constant of ≥ 2 sec (5)	N/A (5)
4 / PR High Negative Flux Rate	≤ 5% of RTP with a time constant of ≥ 2 sec	-8.00% of RTP with a ≥ 2 sec time constant (2)
19.c / Neutron Flux P-8 Interlock (for Single Loop Loss of Flow Trip Block)	≤ 49% of RTP	58% of RTP (1)
5 / Intermediate Range High	≤ 25% of RTP (5)	N/A (5)
6 / Source Range High	≤ 10^5 cps (5)	N/A (5)
7 & 8 / Overtemperature and Overpower Delta-T	Delta-T setpoints, per function as defined by Tech Spec revision (1)	Delta-T allowable values, per function as defined by Tech Spec revision (1)
9 / Low PZR Pressure Trip	≥ 1960 psig (1)	1920 psig (1)
10 / High PZR Pressure Trip	≤ 2385 psig (1)	2445 psig (1)
11 / Pressurizer Water Level - High	≤ 92% of span (5)	N/A (5) 100% (max. value) assumed for uncertainty calculation; SPC Safety Analysis assumes a 6.75% control channel uncertainty.
12 / Low Primary Coolant Flow	≥ 90.5% of loop full indicated flow (1)	85% of loop full indicated flow (2)
13 / Low-Low SG Level Trip	≥ 25% of N-R span (3),(4)	See (3) below.

TABLE 2-2 (Cont'd)

TS Table 2.2-1 Item / Trip Parameter	TS Trip Setpoint	Safety Analysis Limit
14 / Low SG Level (coincident with Steam/Feedwater Flow Mismatch)	$\geq$ 25% of N-R span (3),(4)	See (3) below.
14 / Steam/Feedwater Flow Mismatch (coincident with Low SG Level)	$\leq$ 40% of full steam flow at RTP (5)	N/A (5)

Table 2-2 Notes:

(1) - As noted in Reference 2.10.a [CQL-98-028] and/or Reference 2.10.b [CQL-98-032]. Reference 2.13.a [UFAPPD] confirms this value for SPC Safety Analysis.

(2) - As revised by Reference 2.10.a [CQL-98-028] and/or Reference 2.10.b [CQL-98-032]. Reference 2.13.a [UFAPPD] confirms this value for SPC Safety Analysis.

(3) - 5/5/98 & 5/6/98 meeting minutes attached to CQL-98-028 recommended the following analysis values:

a. For outside containment steam line breaks, accident cases should use a 0% of span SAL for the SG Low-Low Level Trip.
b. For loss of normal feedwater and for auxiliary feedwater initiation, a 16.1% of span SAL (corresponding to the top of the RSG tubes) should be used.
c. For feedwater line breaks, a 0% of span SAL should be used.

Reference 2.13.a [UFAPPD] confirms this value for SPC Safety Analysis.

(4) - Specified within CQL-98-050. (Note that High-High SG Level setpoint and SAL [for a feedwater system malfunction] were originally specified as 79% and 100%, respectively, in CQL-98-032; the 'final' 78% of span setpoint value was selected based upon the evaluation documented per CQL-98-050.) Reference 2.13.a [UFAPPD] confirms this value for SPC Safety Analysis.

(5) - Not used in SPC Safety Analysis. Current TS trip setpoint value shown.

TABLE 2-3

PUR/SGR-RELATED CHANGES TO
ESFAS SETPOINTS AND ANALYTICAL LIMITS

TS Table 3.3-4 Item / Trip Parameter	TS Trip Setpoint	Safety Analysis Limit
1.c / Containment Pressure High-1 Safety Injection	≤ 3.0 psig (1)	5.0 psig (1) SAL subsequently increased in SPC Safety Analysis and in RNI containment analysis
3.a(3) and 3.c(3) / Containment Pressure High-1 for Phase A Cont. Isol. and Cont. Ventilation Isol.	≤ 3.0 psig (6)	5.0 psig (6) SAL increased (as noted above)
4.c / Containment Pressure High-2 MS Line Isolation	≤ 3.0 psig (5)	N/A (5)
2.c / Containment Pressure High-3 Containment Spray	≤ 10.0 psig (1)	12.0 psig (1)
3.b(3) / Containment Pressure High-3 Phase B Containment Isol.	≤ 10.0 psig (6)	12.0 psig (6)
1.d / Low PZR Pressure - SI Trip	≥ 1850 psig (1)	1699.6 psig (1)
5.b and 10.d / High-High SG Level for Turbine Trip & FW Isolation [P-14]	≤ 78% of N-R span (4)	100% of N-R span (4)
6.c / Low-Low SG Level for Auxiliary Feedwater Initiation	≥ 25% of N-R span (3)	See (3) below.
10.b / Low-Low Tavg, P-12 ESF Interlock	≥ 553 °F (5)	N/A (5)
1.e / Steamline Pressure - Low (Safety Injection)	≥ 601 psig (1)	370.9 psig (1), (7)
4.d / Steamline Pressure - Low (MS Line Isolation)	≥ 601 psig (1)	370.9 psig (1), (7)

TABLE 2-3 (Cont'd)

TS Table 3.3-4 Item / Trip Parameter	TS Trip Setpoint	Safety Analysis Limit
4.e / Negative Steamline Rate - High (for MS Line Isol.)	≤ 100 psi (5)	N/A (5)
6.g / Steamline Differential Pressure - High, coincident with MS Line Isolation (Aux FW Isolation)	≤ 100 psi (1)	165 psi (1)

Table 2-3 Notes:

(1) - As noted in Reference 2.10.a [CQL-98-028] and/or Reference 2.10.b [CQL-98-032]. Reference 2.13.a [UFAPPD] confirms this value for SPC Safety Analysis.

(2) - As revised by Reference 2.10.a [CQL-98-028] and/or Reference 2.10.b [CQL-98-032]. Reference 2.13.a [UFAPPD] confirms this value for SPC Safety Analysis.

(3) - 5/5/98 & 5/6/98 meeting minutes attached to CQL-98-028 recommended the following analysis values:

a. For outside containment steam line breaks, accident cases should use a 0% of span SAL for the SG Low-Low Level Trip.
b. For loss of normal feedwater and for auxiliary feedwater initiation, a 16.1% of span SAL (corresponding to the top of the RSG tubes) should be used.
d. For feedwater line breaks, a 0% of span SAL should be used.

Reference 2.13.a [UFAPPD] confirms this value for SPC Safety Analysis.

(4) - Specified within CQL-98-050. (Note that High-High SG Level setpoint and SAL [for a feedwater system malfunction] were originally specified as 79% and 100%, respectively, in CQL-98-032; the 'final' 78% of span setpoint value was selected based upon the evaluation documented per CQL-98-050.) Reference 2.13.a [UFAPPD] confirms this value for SPC Safety Analysis.

(5) - Not used in SPC Safety Analysis. Current TS trip setpoint value shown.

(6) - Per current TS Table, same value as Item 1.c (for High-1) or Item 2.c (for High-3).

(7) - Westinghouse PUR analysis used an analytical value of 542.2 psig, which excludes MSLB-related environmental allowances (EA) uncertainties.

TABLE 3-0

SUMMARY OF CSA AND FIVE-COLUMN TECH SPEC TERMS
INDEX OF CALCULATION SUMMARY TABLES

FUNCTION DESCRIPTION	TS TABLE 2.2-1 ITEM(s)	WCAP-15249 TABLE	INST-1010 TABLE	W CALC OR OTHER HNP CALC REF(s)
Power Range, Neutron Flux-High Setpoint	2.a	3-1	3-1A	CN-SSO-99-13
Power Range, Neutron Flux-Low Setpoint	2.b	3-1	3-1B	CN-SSO-99-13
Power Range, Neutron Flux-High Positive Rate	3	3-2	3-2B	CN-SSO-99-13
Power Range, Neutron Flux-High Negative Rate	4	3-2	3-2A	CN-SSO-99-13
Intermediate Range, Neutron Flux	5	3-3	3-3	CN-SSO-99-14
Source Range, Neutron Flux	6	3-4	3-4	CN-SSO-99-15
Overtemperature ΔT	7	3-5	3-5	CN-TSS-98-33
Overpower ΔT	8	3-6	3-6	CN-TSS-98-33
Pressurizer Pressure - Low, Reactor Trip	9	3-7	3-7A	CN-SSO-99-03
Pressurizer Pressure - High, Reactor Trip	10	3-7	3-7B	CN-SSO-99-03
Pressurizer Water Level - High	11	3-8	3-8	CN-SSO-99-5
Reactor Coolant Flow - Low	12	3-9	3-9	CN-SSO-99-33
SG Water Level, Low-Low (FW Line Break)	13	3-10a	3-10A	CN-TSS-98-19
SG Water Level, Low-Low (Loss of Normal FW)	13	3-10b	3-10B	CN-TSS-98-19
Steam Generator Water Level, Low	14	3-10c	3-10C	CN-TSS-98-19
Steam / Feedwater Flow Mismatch	14	3-11	3-11	CN-SSO-99-18
Reactor Coolant Pump Undervoltage - Low	15	3-19	3-19	CN-SSO-99-17; E2-0010
Reactor Coolant Pump Underfrequency - Low	16	3-20	3-20	CN-SSO-99-17; E2-0011
Low Fluid Oil Pressure, Turbine Trip	17.a	N/A	3-21	INST-1055
Turbine Throttle Valve Closure, Turbine Trip	17.b	N/A	3-22	INST-1054
P-6, Intermediate Range Neutron Flux	19.a	N/A	3-26	CN-SSO-99-14
P-7, Low Power Rx Trip Block (from P-10 input)	19.b(1)	N/A	3-27	CN-SSO-99-13
P-7, Low Power Rx Trip Block (from P-13 input)	19.b(2)	N/A	3-27	N/A
P-8, Power Range Neutron Flux	19.c	N/A	3-28	CN-SSO-99-13
P-10, Power Range Neutron Flux	19.d	N/A	3-27	CN-SSO-99-13
P-13, Turbine Impulse Chamber Pressure	19.e	N/A	3-27	N/A

TABLE 3-0 (Cont'd)

SUMMARY OF CSA AND FIVE-COLUMN TECH SPEC TERMS

INDEX OF CALCULATION SUMMARY TABLES

FUNCTION DESCRIPTION	TS TABLE 3.3-4 ITEM(s)	WCAP-15249 TABLE	INST-1010 TABLE	W CALC OR OTHER HNP CALC REF(s)
Containment Pressure - High-1	1.c	3-12	3-12A	CN-SSO-99-16
Containment Pressure - High-2	4.c	3-12	3-12A	CN-SSO-99-16
Containment Pressure - High-3	2.c	3-12	3-12B	CN-SSO-99-16
Pressurizer Pressure - Low, Safety Injection	1.d	3-13	3-13	CN-SSO-99-03
Steamline Differential Pressure - High	6.g	3-14	3-14	CN-SSO-99-8
Negative Steamline Pressure Rate - High	4.e	3-15	3-15	CN-SSO-99-7
Steamline Pressure - Low	1.e	3-17	3-17	CN-SSO-99-7
SG Water Level - High-High, Barton 764 Xmtrs	5.b	3-18a	3-18A	CN-TSS-98-19
SG Water Level - High-High, Tobar 32DP1 Xmtrs	5.b	3-18b	3-18B	CN-TSS-98-19
SG Water Level, Low-Low	6.c	3-10a	3-10A	CN-TSS-98-19
RWST Level - Low-Low	7.b	N/A	3-23	INST-1030
6.9 KV E-Bus Undervoltage - Primary, LOOP	9.a	N/A	3-24	0054-JRG
6.9 KV E-Bus Undervoltage - Secondary, LOOP	9.b	N/A	3-25	E2-0005.09
P-11, Pressurizer Pressure	10.a	N/A	3-29	CN-SSO-99-03
NOT P-11, Pressurizer Pressure	10.a	N/A	3-29	CN-SSO-99-03
P-12, Low-Low Tavg	10.b	3-16	3-16	CN-SSO-99-32

TABLE 3-1A
POWER RANGE, NEUTRON FLUX - HIGH SETPOINT
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(PMA_1)^2 + (PMA_2)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2}$$

$$= [(1.67)^2 + (4.17)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.05 + 1.00)^2 + (0.83)^2 + (0.50 + 0.05)^2]^{1/2}$$

= 4.72 % Span [Reference 2.9.g & Reference 2.8 (WCAP Table 3-1)]

Note that all sensor uncertainties are set to zero, owing to channel normalization based upon daily power calorimetric surveillance [and adjustment (as required)] <u>or</u> based upon STE accounted for through PMA neutron flux effects uncertainty.

TS = 109.0 % RTP [Reference 2.13.a (UFAPPD, Table 2.2)]

SAL = 118.0 % RTP [Reference 2.13.a (UFAPPD, Table 2.2)]

TA = { (SAL – TS) / 120 % RTP Span } x 100 % Span = 7.50 % Span

Margin = TA - CSA' = 2.78 % Span

S' = { SD + SCA } = { 0.00 + 0.00 } = 0.00 % Span

$$A' = (PMA_1)^2 + (PMA_2)^2 + (PEA)^2 + (STE)^2 + (SPE)^2 + (RTE)^2$$
$$= (1.67)^2 + (4.17)^2 + (0.00)^2 + (0.00)^2 + (0.00)^2 + (0.83)^2$$

= 20.87 % Span

$$Z' = (A')^{1/2} + EA + Biases$$
$$= (20.87)^{1/2} + 0.00 + 0.00$$
= 4.57 % Span

R' = T' is the lesser of:

T_1' = { RD + RCA } = { 1.00 + 0.50 } = 1.50 % Span

T_2' = TA' - S' - Z' = 7.50 – 0.00 – 4.57 = 2.93 % Span

AV' = { TS + [T_1'/100%Span] x 120%RTP } = 110.80 % RTP

The above-computed AV' is slightly less than that allowed by FCQL-355 (given current Tech Spec requirements of TA = 7.5 %Span, Z = 4.56 %Span, S = 0.00 %Span and AV $\leq$ 111.1 % RTP, with a CSA of 4.9 %Span).

Since TA', Z', and S' remain at current Tech Spec values and since CSA' has been slightly reduced (primarily due to elimination of the originally assumed 0.25 %Span rack comparator setting accuracy [RCSA]), the above-computed value for R' can be increased to the original trigger term T of 1.75 %Span (to retain the original AV). This increase to retain the original AV is justified given that <u>no</u> PUR/SGR hardware changes are proposed for the Power Range NIS channels; channels will be scaled

TABLE 3-1A (Cont'd)
POWER RANGE, NEUTRON FLUX - HIGH SETPOINT
Summary of CSA and Five-Column Tech Spec Terms

commensurate for the increased RTP (consistent with the detectors' increased output).

A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	7.5 % Span	7.5 % Span
Z Term	4.56 % Span	4.56 % Span
Sensor Error (S)	0.0 % Span	0.0 % Span
Trip Setpoint (TS)	≤ 109.0 % RTP	≤ 109.0 % RTP
Allowable Value (AV)	≤ 111.1 % RTP	≤ 111.1 % RTP

TABLE 3-1B
POWER RANGE, NEUTRON FLUX - LOW SETPOINT
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(PMA_1)^2 + (PMA_2)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2}$$

$$= [(1.67)^2 + (4.17)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.05 + 1.00)^2 + (0.83)^2 + (0.50 + 0.05)^2]^{1/2}$$

$= 4.72$ % Span [Reference 2.9.g & Reference 2.8 (WCAP Table 3-1)]

Note that all sensor uncertainties are set to zero (similar to the Power Range NIS High Setpoint), owing to channel normalization based upon daily power calorimetric surveillance [and adjustment (as required)] <u>or</u> based upon STE accounted for through PMA neutron flux effects uncertainty.

TS = 25.0 % RTP [Reference 2.13.a (UFAPPD, Table 2.2)]

SAL = 35.0 % RTP [Reference 2.13.a (UFAPPD, Table 2.2)]

TA = { (TS - SAL) / 120 % RTP Span } x 100 % Span = 8.33 % Span

Margin = TA - CSA' = 3.61 % Span

S' = { SD + SCA } = { 0.00 + 0.00 } = 0.00 % Span

$$A' = (PMA_1)^2 + (PMA_2)^2 + (PEA)^2 + (STE)^2 + (SPE)^2 + (RTE)^2$$
$$= (1.67)^2 + (4.17)^2 + (0.00)^2 + (0.00)^2 + (0.00)^2 + (0.83)^2$$
$= 20.87$ % Span

$$Z' = (A')^{1/2} + EA + Biases$$
$$= (20.87)^{1/2} + 0.00 + 0.00 = 4.57$$ % Span

R' = T' is the lesser of:

T_1' = { RD + RCA } = { 1.00 + 0.50 } = 1.50 % Span

T_2' = TA' - S' - Z' = 8.33 - 0.00 - 4.57 = 3.76 % Span

AV' = { TS + [T_1'/100%Span] x 120%RTP } = 26.80 % RTP

The above-computed AV' is slightly less than that allowed by FCQL-355 (given current Tech Spec requirements of TA = 8.33 %Span, Z = 4.56 %Span, S = 0.00 %Span and AV $\leq$ 27.1 % RTP, with a CSA of 4.9 %Span).

Since TA', Z', and S' remain at current Tech Spec values and since CSA' has been slightly reduced (primarily due to elimination of the originally assumed 0.25 %Span rack comparator setting accuracy [RCSA]), the above-computed value for R' can be increased to the original trigger term T of 1.75 %Span (to retain the original AV and for consistency with the Power Range NIS High Setpoint). This increase to

TABLE 3-1B (Cont'd)
POWER RANGE, NEUTRON FLUX - LOW SETPOINT
Summary of CSA and Five-Column Tech Spec Terms

retain the original AV is justified given that no PUR/SGR hardware changes are proposed for the Power Range NIS channels; channels will be scaled commensurate for the increased RTP (consistent with the detectors' increased output).

A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	8.3 % Span	8.3 % Span
Z Term	4.56 % Span	4.56 % Span
Sensor Error (S)	0.0 % Span	0.0 % Span
Trip Setpoint (TS)	≤ 25.0 % RTP	≤ 25.0 % RTP
Allowable Value (AV)	≤ 27.1 % RTP	≤ 27.1 % RTP

TABLE 3-2A
POWER RANGE, NEUTRON FLUX - HIGH NEGATIVE RATE
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [\ (PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2\ ]^{1/2}$$

$$= [\ (0.00)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.10 + 1.00)^2 + (0.83)^2 + (0.50 + 0.10)^2\ ]^{1/2}$$

$= 1.45$ % Span [Reference 2.9.g & Reference 2.8 (WCAP Table 3-2)]

Note that all sensor uncertainties are set to zero, owing to the use of a rate (derivative) function to eliminate steady-state measurement errors.

TS = 5.0 % RTP [Reference 2.13.a (UFAPPD, Table 2.2)]

SAL′ = 8.0 % RTP [Reference 2.13.a (UFAPPD, Table 2.2)]

TA′ = { (SAL′ − TS) / 120 % RTP Span } x 100 % Span = 2.50 % Span

Margin = TA′ − CSA′ = 1.05 % Span

S′ = { SD + SCA } = { 0.00 + 0.00 } = 0.00 % Span

$$A' = (PMA)^2 + (PEA)^2 + (STE)^2 + (SPE)^2 + (RTE)^2$$
$$= (0.00)^2 + (0.00)^2 + (0.00)^2 + (0.00)^2 + (0.83)^2$$
$= 0.69$ % Span

$$Z' = (A')^{1/2} + EA + Biases$$
$$= (0.69)^{1/2} + 0.00 + 0.00$$
$= 0.83$ % Span

R′ = T′ is the lesser of:

T_1' = { RD + RCA } = { 1.00 + 0.50 } = 1.50 % Span

T_2' = TA′ − S′ − Z′ = 2.50 − 0.00 − 0.83 = 1.67 % Span

AV′ = { TS + [T_1'/100%Span] x 120%RTP } = 6.80 % RTP

The above-computed AV′ is greater than that allowed by FCQL-355 (given current Tech Spec requirements of TA = 1.6 %Span, Z = 0.5 %Span, S = 0.0 %Span and AV $\leq$ 6.3 % RTP, with a CSA of 1.4 %Span). Therefore, the original AV $\leq$ 6.3 % RTP should continue to be used within existing MSTs, given its trigger of 1.1 %Span.

TA′ and Z′ have been increased based upon the larger SAL′ value used. No PUR/SGR hardware changes are proposed for the Power Range NIS channels; channels will be scaled commensurate for the increased RTP (consistent with the detectors′ increased output).

A comparison of current and post-PUR/SGR values are summarized as follows:

TABLE 3-2A (Cont'd)
POWER RANGE, NEUTRON FLUX - HIGH NEGATIVE RATE
Summary of CSA and Five-Column Tech Spec Terms

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	1.6 % Span	2.5 % Span
Z Term	0.5 % Span	0.83 % Span
Sensor Error (S)	0.0 % Span	0.0 % Span
Trip Setpoint (TS)	$\leq$ 5.0 % RTP	$\leq$ 5.0 % RTP
Allowable Value (AV)	$\leq$ 6.3 % RTP	$\leq$ 6.3 % RTP

TABLE 3-2B
POWER RANGE, NEUTRON FLUX - HIGH POSITIVE RATE
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2}$$

$$= [(0.00)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.10 + 1.00)^2 + (0.83)^2 + (0.50 + 0.10)^2]^{1/2}$$

$= 1.45$ % Span [Reference 2.9.g & Reference 2.8 (WCAP Table 3-2)]

Similar to the High Negative Rate trip function, all sensor uncertainties are set to zero, owing to the use of a rate (derivative) function to eliminate steady-state measurement errors.

TS = 5.0 % RTP [Reference 2.1]

SAL = N/A [References 2.3 and 2.13.a]

TA' = { (SAL - TS) / 120 % RTP Span } x 100 % Span
= N/A; Set to 2.50 %Span (per High Negative Rate trip TA' per Table 3-2A)

Use of High Negative Rate TA (and TA') value is consistent with Reference 2.3 and with current Tech Spec Table 2.2-1.

Margin = TA - CSA' = 1.05 % Span

S' = { SD + SCA } = { 0.00 + 0.00 } = 0.00 % Span

$$A' = (PMA)^2 + (PEA)^2 + (STE)^2 + (SPE)^2 + (RTE)^2$$
$$= (0.00)^2 + (0.00)^2 + (0.00)^2 + (0.00)^2 + (0.83)^2$$
$= 0.69$ % Span

$$Z' = (A')^{1/2} + EA + Biases$$
$$= (0.69)^{1/2} + 0.00 + 0.00 = 0.83 \text{ \% Span}$$

R' = T' is the lesser of:

T_1' = { RD + RCA } = { 1.00 + 0.50 } = 1.50 % Span

T_2' = TA' - S' - Z' = 2.50 - 0.00 - 0.83 = 1.67 % Span

AV' = { TS + [T_1'/100%Span] x 120%RTP } = 6.80 % RTP

The above-computed AV' is greater than that allowed by FCQL-355 (given current Tech Spec requirements of TA = 1.6 %Span, Z = 0.5 %Span, S = 0.0 %Span, and AV $\leq$ 6.3 % RTP, with a CSA of 1.4 %Span); therefore, the original AV $\leq$ 6.3 % RTP should be retained within existing MSTs, given its trigger of 1.1 %Span. Since the High Negative Rate SAL' value has been increased, the High Positive Rate TA and Z terms can be increased for post-PUR/SGR values (for consistency). No PUR/SGR hardware

TABLE 3-2B (Cont'd)
POWER RANGE, NEUTRON FLUX - HIGH POSITIVE RATE
Summary of CSA and Five-Column Tech Spec Terms

changes are proposed for the Power Range NIS channels; channels will be scaled commensurate for the increased RTP (consistent with the detectors' increased output).

A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	1.6 % Span	2.5 % Span
Z Term	0.5 % Span	0.83 % Span
Sensor Error (S)	0.0 % Span	0.0 % Span
Trip Setpoint (TS)	$\leq$ 5.0 % RTP	$\leq$ 5.0 % RTP
Allowable Value (AV)	$\leq$ 6.3 % RTP	$\leq$ 6.3 % RTP

TABLE 3-3
INTERMEDIATE RANGE, NEUTRON FLUX
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2}$$

$$= [(8.33)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.10 + 4.20)^2 + (1.18)^2 + (2.00 + 0.10)^2]^{1/2}$$

= 9.68 % Span [Reference 2.9.h & Reference 2.8 (WCAP Table 3-3)]

Note that sensor uncertainties are considered as zero, due to channel normalization (per power calorimetrics) or through inclusion of neutron flux measurement uncertainties within the process measurement accuracy (PMA) term.

TS = 25.0 % RTP [Reference 2.1]

SAL = N/A [Reference 2.3]

TA′ = SAL − TS
= N/A; Set to 17.0 % Span (based on current Tech Spec TA).

Margin = TA′ − CSA′ = 7.32 % Span

S′ = { SD + SCA } = { 0.00 + 0.00 } = 0.00 % Span

$$Z' = (A')^{1/2} + EA = \{ (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA$$

$$= \{ (8.33)^2 + 0^2 + 0^2 + 0^2 + (1.18)^2 \}^{1/2} + 0 = 8.413 \text{ \% Span}$$

R′ = T′ is the lesser of:

T_1' = { RD + RCA } = { 4.20 + 2.00 } = 6.20 % Span

T_2' = TA′ − S′ − Z′ = 17.00 − 0.00 − 8.41 = 8.59 % Span

AV′ = { TS + [R′/100%Span] x 120%RTP } = 32.44 % RTP

The above-computed AV′ is higher than that allowed by FCQL-355 (given current Tech Spec requirements of Z = 8.41 %Span, T = 5.00 %Span, and AV $\leq$ 30.9 % RTP, with a CSA of 9.8 %Span). Therefore, since no PUR/SGR hardware changes are proposed for the Intermediate Range NIS channels, the current AV shall be retained.

Channels will be scaled commensurate for the increased RTP (consistent with the detectors′ increased output). A comparison of current and post-PUR/SGR values are summarized as follows:

TABLE 3-3 (Cont'd)
INTERMEDIATE RANGE, NEUTRON FLUX
Summary of CSA and Five-Column Tech Spec Terms

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	17.0 % Span	17.0 % Span
Z Term	8.41 % Span	8.41 % Span
Sensor Error (S)	0.0 % Span	0.0 % Span
Trip Setpoint (TS)	$\leq$ 25.0 % RTP	$\leq$ 25.0 % RTP
Allowable Value (AV)	$\leq$ 30.9 % RTP	$\leq$ 30.9 % RTP

TABLE 3-4
SOURCE RANGE, NEUTRON FLUX
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2}$$
$$= [(10.00)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.00)^2 + (0.00 + 0.00)^2 + (0.00)^2 + (0.50 + 3.00)^2 + (0.50)^2 + (0.50 + 0.50)^2]^{1/2}$$
$= 10.65$ % Span [Reference 2.9.i & Reference 2.8 (WCAP Table 3-4)]

Note that sensor uncertainties are considered as zero, due to channel normalization (per power calorimetrics) or through inclusion of neutron flux measurement uncertainties within the process measurement accuracy (PMA) term.

TS = 1.0×10^5 CPS [Reference 2.1]

SAL = N/A [Reference 2.3]

TA' = SAL - TS
= N/A; Set to 17.0 % Span (based on current Tech Spec TA).

Margin = TA' - CSA' = 6.35 % Span

S' = { SD + SCA } = { 0.00 + 0.00 } = 0.00 % Span

$$Z' = (A')^{1/2} + EA = \{ (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA$$
$$= \{ (10.00)^2 + 0^2 + 0^2 + 0^2 + (0.50)^2 \}^{1/2} + 0 = 10.01 \text{ \% Span}$$

R' = T' is the lesser of:
T_1' = { RD + RCA } = { 3.00 + 0.50 } = 3.50 % Span
T_2' = TA' - S' - Z' = 17.00 – 0.00 – 10.01 = 6.99 % Span

AV' = { TS + [R'/100%Span] x 1.0×10^6 CPS } = 1.35×10^5 CPS

The above-computed AV' is comparable to that allowed by FCQL-355 (given current Tech Spec requirements of Z = 17.0 %Span, T = 3.8 %Span, and AV $\leq 1.4 \times 10^5$ CPS, with a CSA of 10.7 %Span). Therefore, since no PUR/SGR hardware changes are proposed for the Source Range NIS channels, the current AV shall be retained.

Channels will be scaled commensurate for the increased CPS (consistent with the channels' increased output). A comparison of current and post-PUR/SGR values are summarized as follows:

TABLE 3-4 (Cont'd)
SOURCE RANGE, NEUTRON FLUX
Summary of CSA and Five-Column Tech Spec Terms

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	17.0 % Span	17.0 % Span
Z Term	10.01 % Span	10.01 % Span
Sensor Error (S)	0.0 % Span	0.0 % Span
Trip Setpoint (TS)	$\leq 1.0 \times 10^5$ CPS	$\leq 1.0 \times 10^5$ CPS
Allowable Value (AV)	$\leq 1.4 \times 10^5$ CPS	$\leq 1.4 \times 10^5$ CPS

TABLE 3-5
OVERTEMPERATURE ΔT
Summary of CSA and Five-Column Tech Spec Terms

The setpoint for the Overtemperature ΔT trip function is based upon the equation as specified in the current Tech Spec Table 2.2-1. For PUR/SGR operation, the trip function coefficients and time constants were updated, based upon the joint Westinghouse/Siemens analyses (including that documented per Reference 2.10.f [CQL-99-105, Rev. 1]). These updated values are contained within "Note 1" of the Tech Spec mark-up (included in Table 4-1 herein).

Owing to the complex function and its associated hardware implementation (which uses ΔT channel inputs along with compensation from Pressurizer Pressure, Power Range NIS ΔI, and Tavg), discrete allowable values have been computed (by Westinghouse, per Reference 2.9.b [CN-TSS-98-33, Rev. 1]) to correlate to each of these channel inputs. This computational practice reflects actual [MST] surveillance calibration tolerances; these Westinghouse proposed allowable values have been adjusted/reconciled herein (for consistency with other RTS/ESFAS trip functions), and the updated values are contained within "Note 2" of the Tech Spec mark-up (included in Table 4-1 herein). In lieu of current use of a single Allowable Value for the overall channel, the use of discrete allowable values (for each of these inputs) satisfies NRC requirements for fixed Allowable Value requirement, and is consistent with Westinghouse recommendations within Reference 2.11.a.

Post-PUR/SGR Tech Spec terms can be computed, by solving for the equations generally shown per Table 1-2 herein. Uncertainties calculated in Reference 2.8 (Table 3-22) and Reference 2.9.b are based upon the normalization of ΔT_o (performed per EPT-156).

CSA′ = 8.38% of ΔT span [Ref. 2.9.b, Page 26 & Ref. 2.8 (Table 3-5)]

This CSA′ consists of: Process Measurement Accuracy terms (noted on Pages 20, 21, 23, and 25 of Ref. 2.9.b); RCS N-R RTD and pressurizer pressure transmitter uncertainties; R/E conversion and nonlinearity rack uncertainties; as well as other process rack uncertainties for ΔT, Tavg, pressurizer pressure, and ΔI channels.

TS′ = 1.185 K_1 nominal and
SAL′ = 1.32 K_1 maximum [Ref. 2.9.b, Pages 20 & 26]

TA′ = { (K_1max − K_1nom) x ($T_{HotLeg} - T_{ColdLeg}$) / (ΔT Span at 150% Power) } x 100% Span
= { (1.32 − 1.185) x (620.2 − 557.4) / (94.2) } x 100% Span
= 9.00% of ΔT span [Ref. 2.9.b, Page 26]

Margin = TA′ − CSA′ = 0.62% of ΔT span [Ref. 2.9.b, Page 26]

Comparable S′, R′, and Z′ terms can be defined using the "csa1" [above CSA′] relationship on Page 26 of Ref. 2.9.b, by discretely recognizing each of the CSA′ components (noted above); note that S′ and R′ terms can be computed for the inputs to this ΔT trip function, using Table 1-2 methodology. (Terminology and values are shown consistent with those obtained from Ref. 2.9.b.)

$S'_{pressure}$ = Variation of $(S_{prz})^{1/2}$ per Ref. 2.9.b, Page 25
= { (sd_ps) + (sca_ps) } x Conv2 = { (1.00) + (0.50) } x 0.64
= 1.50% of pressurizer pressure span x 0.64 % DT span/% pressure span
= 0.96% of ΔT span ~= 1.0% of ΔT span

TABLE 3-5 (Cont'd)
OVERTEMPERATURE ΔT
Summary of CSA and Five-Column Tech Spec Terms

$S'_{temperature}$ = $(S_{RTD})^{1/2}$ = 0.25% of ΔT span [Ref. 2.9.b, Page 25]

Note the above $S'_{temperature}$ value is lower than its original Tech Spec temperature sensor error, since Reference 2.9.b RTD uncertainties (e.g., scartd, smtertd, and sdrtd) are set to zero due to normalization process. Since RTD cross-calibrations are performed prior to channel normalization, further acceptance criterion is required to define each RTD's acceptability. Reference 2.4.e [INST-1049], Section 6.2 allows for a $\leq$ 1.2°F temperature accuracy for each T_{hot} or T_{cold} RTD (based upon a 0.5°F RTD calibration accuracy and a 0.7°F 18-month RTD drift [as confirmed by the RTD cross-calibration procedure EST-104]). This can be translated into a Tech Spec sensor error of 1.3% of ΔT span [by {[1.2°F error/94.2°F ΔT span] x 100%} = 1.27 % ΔT span]. Round-up allows for the possibility of a slightly lower ΔT span (e.g., ~90°F ΔT at current plant levels with SG replacement).

As noted above, Allowable Values for ΔT, Tavg, pressurizer pressure, and ΔI channels [in terms of ΔT span] as well as pressurizer pressure transmitter Operability Limit [in terms of % of pressure span] have been recomputed (from those shown on Ref. 2.9.b, Page 26), based upon the following uncertainty terms (using Ref. 2.9.b terminology and values [including conversions shown in Ref. 2.9.b, Page 25]):

$R'_{\Delta T}$	=	$RackAV_{\Delta T}$	=	{ (dtrd) + (dtrcal) }	
			=	{ (1.0) + (0.35) }	
			=	1.35% of ΔT span	~= 1.4% of ΔT span
R'_{Tavg}	=	$RackAV_{Tavg}$	=	{ (Tavg_rd) + (Tavg_rca) } x Conv3	
			=	{ (1.0) + (0.35) } x 1.493	
			=	2.015% of ΔT span	~= 2.0% of ΔT span
R'_{prz}	=	$RackAV_{prz}$	=	{(rrd_ps) + (rcal_ps)} x Conv2	
			=	{ (0.5) + (0.1) } x 0.64	
			=	0.384% of ΔT span	~= 0.4% of ΔT span
$R'_{\Delta I}$	=	$RackAV_{\Delta I}$	=	{(rrd_ΔI) + (rcal_ΔI)} x Conv4	
			=	{(0.5) + (0.1)} x 1.2	
			=	0.72% of ΔT span	~= 0.7% of ΔT span

$S'_{pressure}$ = $Operable_{prz\_trans}$ = 1.5% of pressurizer pressure span

EPT-156 (performed each calendar quarter) will assure that ΔT trip channels are maintained in a normalized condition. A -1% ΔT tolerance is used as the limiting EPT-156 acceptance criterion [to preclude the need for renormalization], which is comparable to the above-noted ΔT channel input rack drift.

Furthermore, Tech Spec term Z' can be calculated using the $(A')^{1/2}$ + Biases equation, per the following determination (based upon the terminology within Ref. 2.9.b):

$$A' = (PMA)^2 + (PEA)^2 + (STE)^2 + (SPE)^2 + (RTE)^2$$

where: $PMA = \{ (pma_{Th})^2 + (pma_{\Delta I\_1})^2 + (pma_{\Delta I\_2})^2 + (pma_{pwr\_cal})^2 \}^{1/2}$

$PMA = \{ (0.00)^2 + (3.00)^2 + (1.30)^2 + (1.33)^2 \}^{1/2} = 3.53$ % ΔT span ,

TABLE 3-5 (Cont'd)
OVERTEMPERATURE ΔT
Summary of CSA and Five-Column Tech Spec Terms

which accounts for all random process measurement effects (i.e., ΔT Hot Leg streaming [Th], incore/excore mismatch [ΔI_1], incore map ΔI uncertainty [ΔI_2], and secondary side calorimetric uncertainty present at normalization [pwr_cal]), after conversion to % ΔT span [per Ref. 2.9.b, Page 23].

PEA and SPE = 0, since these components are not specified within Ref. 2.9.b.

STE = ste = ste_ps x Conv2 = 1.4375 x 0.64 = 0.92 % ΔT span [per Ref. 2.9.b, Pages 22 & 24]

RTE = dtrte = 0.5 % ΔT span [per Ref. 2.9.b, Page 21]

Therefore, $A' = (3.53)^2 + (0.00)^2 + (0.92)^2 + (0.00)^2 + (0.50)^2 = 13.5573$ % ΔT span

In addition, all PMA terms treated as Biases have been included (i.e., the ΔT burndown effect [budt], the Tavg burndown effect [butavg], the Tavg asymmetry [Tavg_asym], and the T' - Tref mismatch [Tp_Tr]; per Ref. 2.9.b, Page 20 defines these terms as biases, and Page 23 provides conversions in terms of % ΔT span):

$$\text{Biases} = (pma_{budt}) + (pma_{butavg}) + (pma_{Tavg\_asym}) + (pma_{Tp\_Tr})$$
$$= (0.64) + (0.45) + (1.49) + (1.05) = 3.63 \text{ \% } \Delta T \text{ span}$$

Therefore, Z' can be solved based on the above determined A' and Biases:

$$Z' = (A')^{1/2} + \text{Biases} = (13.5573)^{1/2} + 3.63 = 7.312 \sim= 7.31 \text{ \% } \Delta T \text{ span}$$

Note that this computed Z' term is slightly larger than the previous Tech Spec value, for consistency with the PUR/SGR uncertainty calculation and its associated uncertainty component accounting.

Tech Spec terms can be summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	8.7 % Span	9.0 % Span
Z Term	6.02 % Span	7.31 % Span
Sensor Error (S)	Per current Note 5	Per new Note 5 (see below)
Trip Setpoint (TS)	Per current Note 1	Per new Note 1 (see below)
Allowable Value (AV)	Per current Note 2	Per new Note 2 (see below)

Post-PUR/SGR Note 1: Overtemperature ΔT Function, Coefficients, and Time Constants will be updated consistent with format specified in References 2.9.b and 2.10.f. See Tech Spec mark-up contained in Table 4-1 herein.

Post-PUR/SGR Note 2: The channel's maximum Trip Setpoint shall not exceed its computed Trip Setpoint by more than: 1.4% of ΔT span for ΔT

TABLE 3-5 (Cont'd)

OVERTEMPERATURE ΔT

Summary of CSA and Five-Column Tech Spec Terms

channel input; 2.0% of ΔT span for Tavg input; 0.4% of ΔT span for pressurizer pressure input; and 0.7% of ΔT span for the ΔI input.

Post-PUR/SGR Note 5: The sensor error is: 1.3% of ΔT span for ΔT/Tavg temperature measurements; and 1.0% of ΔT span for pressurizer pressure measurements.

TABLE 3-6
OVERPOWER ΔT
Summary of CSA and Five-Column Tech Spec Terms

The setpoint for the Overpower ΔT trip function is based upon the equation as specified in the current Tech Spec Table 2.2-1. For PUR/SGR operation, the trip function coefficients and time constants were updated, based upon the joint Westinghouse/Siemens analyses (including that documented per Reference 2.10.f [CQL-99-105, Rev. 1]). These updated values are contained within "Note 3" of the Tech Spec mark-up (included in Table 4-1 herein).

Owing to the complex function and its associated hardware implementation (which uses ΔT channel inputs along with compensation from Tavg), discrete allowable values have been computed (by Westinghouse, per Reference 2.9.b [CN-TSS-98-33, Rev. 1]) to correlate to each of these channel inputs. This computational practice reflects actual [MST] surveillance calibration tolerances; these Westinghouse proposed allowable values have been adjusted/reconciled herein (for consistency with other RTS/ESFAS trip functions), and the updated values are contained within "Note 4" of the Tech Spec mark-up (included in Table 4-1 herein). Similar to that noted in Table 3-5 herein, the use of discrete allowable values (for each of these inputs) satisfies NRC requirements for fixed Allowable Value requirement, and is consistent with Westinghouse recommendations within Reference 2.11.a.

Post-PUR/SGR Tech Spec terms can be computed, by solving for the equations generally shown per Table 1-2 herein. Uncertainties calculated in Reference 2.8 (Table 3-22) and Reference 2.9.b are based upon the normalization of ΔT_o (performed per EPT-156).

CSA′ = 2.95% of ΔT span [Ref. 2.9.b, Page 32 & Ref. 2.8 (Table 3-6)]

This CSA′ consists of: Process Measurement Accuracy terms (noted on Pages 20, 21, 23, and 25 of Ref. 2.9.b); RCS N-R RTD uncertainties; R/E conversion and non-linearity rack uncertainties; as well as other process rack uncertainties for ΔT and Tavg channels.

TS = 1.12 K_4 nominal and
SAL′ = 1.18 K_4 maximum [Ref. 2.9.b, Pages 28 & 32]

TA′ = $\{ (K_4max - K_4nom) \times (T_{HotLeg} - T_{ColdLeg}) / (\Delta T \text{ Span at } 150\% \text{ Power}) \} \times 100\%$ Span
= $\{ (1.18 - 1.12) \times (620.2 - 557.4) / (94.2) \} \times 100\%$ Span
= 4.00% of ΔT span [Ref. 2.9.b, Page 32]

Margin = TA′ − CSA′ = 1.05% of ΔT span [Ref. 2.9.b, Page 32]

Comparable S′, R′, and Z′ terms can be defined using the "csa1" [above CSA′] relationship on Page 32 of Ref. 2.9.b, by discretely recognizing each of the CSA′ components (noted above); note that S′ and R′ terms can be computed for the inputs to this ΔT trip function. (Terminology and values are shown consistent with those obtained from Ref. 2.9.b.)

$S'_{temperature}$ = $(S_{RTD})^{1/2}$ = 0.25% of ΔT span [Ref. 2.9.b, Page 31]

As discussed in Table 3-5 herein, the 1.3% ΔT span acceptance criterion is also applicable (prior to channel normalization) to define the RTDs' OPΔT Tech Spec sensor error S′ term, in lieu of the (already normalized) above-noted $S'_{temperature}$.

TABLE 3-6 (Cont'd)
OVERPOWER ΔT
Summary of CSA and Five-Column Tech Spec Terms

As noted above, Allowable Values for ΔT and Tavg channels [in terms of ΔT span] have been recomputed (from those shown on Ref. 2.9.b, Page 32), based upon the following uncertainty terms (using terminology and values obtained from Ref. 2.9.b [including the OPΔT "Conv2" conversion factor specified on Page 31 of Ref. 2.9.b]):

$R'_{\Delta T}$	= $RackAV_{\Delta T}$	=	{ (dtrd) + (dtrcal) }	
		=	{ (1.0) + (0.35) }	
		=	1.35% of ΔT span	~= 1.4% of ΔT span

R'_{Tavg}	= $RackAV_{Tavg}$	=	{ (Tavg_rd) + (Tavg_rca) } x [OPΔTConv2]	
		=	{ (1.0) + (0.35) } x 0.133	
		=	0.179% of ΔT span	~= 0.2% of ΔT span

As noted in Table 3-5, limiting EPT-156 renormalization criterion assures channel normalization comparable to the above-computed ΔT channel input rack drift.

Also similar to the process shown in Table 3-5, Tech Spec term Z' can be calculated using the $(A')^{1/2}$ + Biases equation, per the following OPΔT determination (based upon the terminology and % ΔT span conversions, respectively, within Ref. 2.9.b, Pages 28 and 30):

$$A' = (PMA)^2 + (PEA)^2 + (STE)^2 + (SPE)^2 + (RTE)^2$$

where: $PMA = \{ (pma_{Th})^2 + (pma_{pwr\_cal})^2 \}^{1/2}$

$PMA = \{ (0.00)^2 + (1.33)^2 \}^{1/2} = 1.33$ % ΔT span

which accounts for all random process measurement effects (i.e., ΔT Hot Leg streaming [Th], and secondary side calorimetric uncertainty present at normalization [pwr_cal]), after conversion to % ΔT span [per Ref. 2.9.b, Page 30].

PEA, STE, and SPE = 0, since these components are not specified within Ref. 2.9.b.

RTE = dtrte = 0.5 % ΔT span [per Ref. 2.9.b, Page 21]

Therefore, $A' = (1.33)^2 + (0.00)^2 + (0.00)^2 + (0.00)^2 + (0.50)^2 = 2.0189$ % ΔT span

In addition, all PMA terms treated as Biases have been included (i.e., the ΔT burndown effect [budt], the Tavg burndown effect [butavg], the Tavg asymmetry [Tavg_asym], and the T' - Tref mismatch [Tp_Tr]; per Ref. 2.9.b, Page 28 defines these terms as biases, and Page 30 provides [OPΔT] conversions in terms of % ΔT span):

$$\text{Biases} = (pma_{budt}) + (pma_{butavg}) + (pma_{Tavg\_asym}) + (pma_{Tp\_Tr})$$
$$= (0.64) + (0.04) + (0.13) + (0.09) = 0.90 \text{ \% } \Delta T \text{ span}$$

Therefore, Z' can be solved based on the above determined A' and Biases:

$$Z' = (A')^{1/2} + \text{Biases} = (2.0189)^{1/2} + 0.90 = 2.3208 \approx 2.32 \text{ \% } \Delta T \text{ span}$$

TABLE 3-6 (Cont'd)
OVERPOWER ΔT
Summary of CSA and Five-Column Tech Spec Terms

Note that this computed Z' term is slightly larger than the previous Tech Spec value, for consistency with the PUR/SGR uncertainty calculation and its associated uncertainty component accounting.

In summary, Tech Spec terms can be summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	4.7 % Span	4.0 % Span
Z Term	1.50 % Span	2.32 % Span
Sensor Error (S)	1.9 % Span	1.3 % Span
Trip Setpoint (TS)	Per current Note 3	Per new Note 3 (see below)
Allowable Value (AV)	Per current Note 4	Per new Note 4 (see below)

Post-PUR/SGR Note 3: Overpower ΔT Function, Coefficients, and Time Constants will be updated consistent with format specified in References 2.9.b and 2.10.f. See Tech Spec mark-up contained in Table 4-1 herein.

Post-PUR/SGR Note 4: The channel's maximum Trip Setpoint shall not exceed its computed Trip Setpoint by more than: 1.4% of ΔT span for ΔT input; and 0.2% of ΔT span for Tavg input.

TABLE 3-7A
PRESSURIZER PRESSURE - LOW, REACTOR TRIP
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2}$$

$$= [(0.00)^2 + (0.00)^2 + (0.71 + 1.00)^2 + (1.44)^2 + (0.00)^2 + (0.50 + 0.71)^2 + (0.25)^2 + (0.50 + 1.00)^2 + (0.50)^2 + (0.50 + 0.50)^2]^{1/2}$$

= 3.16 % Span [Reference 2.9.c & Reference 2.8 (WCAP Table 3-7)]

TS = 1960 psig [Reference 2.13.a (UFAPPD, Table 2.2)]

SAL = 1920 psig [Reference 2.13.a (UFAPPD, Table 2.2)]

TA = { (TS - SAL) / 800 psig Span } x 100 % Span = 5.00 % Span

Margin = TA - CSA' = 1.84 % Span

S' = { (SD) + (SCA) } = { (1.0) + (0.5) } = 1.50 % Span

$$Z' = (A')^{1/2} + EA = \{ (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA$$

$$= \{ 0^2 + 0^2 + 0^2 + (1.44)^2 + (0.50)^2 \}^{1/2} + 0.00 = 1.522 \text{ \% Span}$$

R' = T' is the lesser of:

T_1' = { RD + RCA } = { (1.0) + (0.5) } = 1.50 % Span

T_2' = TA' - S' - Z' = 5.00 - 1.50 - 1.52 = 1.98 % Span

AV' = { TS - [R'/100%Span] x 800 psig } = 1948 psig

The above-computed AV' is comparable to the originally 1946 psig value specified by FCQL-355 (with current Tech Spec requirements of Z = 2.21 %Span, T = 1.8 %Span, and S = 1.5 %Span, based upon a CSA of 3.9 %Span). Given the reduction in CSA', Z', and T', the computed AV' will be used for post-PUR/SGR Allowable Value. A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	5.0 % Span	5.0 % Span
Z Term	2.21 % Span	1.52 % Span
Sensor Error (S)	1.5 % Span	1.5 % Span
Trip Setpoint (TS)	$\geq$ 1960 psig	$\geq$ 1960 psig
Allowable Value (AV)	$\geq$ 1946 psig	$\geq$ 1948 psig

TABLE 3-7B
PRESSURIZER PRESSURE - HIGH, REACTOR TRIP
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [\ (PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2\ ]^{1/2}$$

$$= [\ (0.00)^2 + (0.00)^2 + (0.71 + 1.00)^2 + (1.44)^2 + (0.00)^2 + (0.50 + 0.71)^2 + (0.25)^2 + (0.50 + 1.00)^2 + (0.50)^2 + (0.50 + 0.50)^2\ ]^{1/2}$$

$= 3.16$ % Span [Reference 2.9.c & Reference 2.8 (WCAP Table 3-7)]

TS = 2385 psig [Reference 2.13.a (UFAPPD, Table 2.2)]

SAL = 2445 psig [Reference 2.13.a (UFAPPD, Table 2.2)]

TA = { (SAL - TS) / 800 psig Span } x 100 % Span = 7.50 % Span

Margin = TA - CSA' = 4.34 % Span

S' = { (SD) + (SCA) } = { (1.0) + (0.5) } = 1.50 % Span

$$Z' = (A')^{1/2} + EA = \{\ (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2\ \}^{1/2} + EA$$
$$= \{\ 0^2 + 0^2 + 0^2 + (1.44)^2 + (0.50)^2\ \}^{1/2} + 0.00 = 1.522 \text{ \% Span}$$

R' = T' is the lesser of:

T_1' = { RD + RCA } = { (1.0) + (0.5) } = 1.50 % Span

T_2' = TA' - S' - Z' = 7.50 - 1.50 - 1.52 = 4.48 % Span

AV' = { TS + [R'/100%Span] x 800 psig } = 2397 psig

The above-computed AV' is comparable to the originally 2399 psig value specified by FCQL-355 (with current Tech Spec requirements of Z = 5.01 %Span, T = 1.8 %Span, and S = 0.5 %Span, based upon a CSA of 6.3 %Span). Given the reduction in CSA', Z', and T', the computed AV' will be used for post-PUR/SGR Allowable Value. A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	7.5 % Span	7.5 % Span
Z Term	5.01 % Span	1.52 % Span
Sensor Error (S)	0.5 % Span	1.5 % Span
Trip Setpoint (TS)	≤ 2385 psig	≤ 2385 psig
Allowable Value (AV)	≤ 2399 psig	≤ 2397 psig

TABLE 3-8
PRESSURIZER WATER LEVEL - HIGH
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2} + PMA_{Pressure} + PMA_{RefLegTemp}$$

$$= [(0.00)^2 + (0.56 + 1.25)^2 + (0.50)^2 + (0.50)^2 + (0.50 + 0.56)^2 + (0.50)^2 + (0.20 + 1.00)^2 + (0.50)^2 + (0.50 + 0.20)^2]^{1/2} + 0.87 + 1.68$$

$= 5.25$ % Span [Reference 2.9.d & Reference 2.8 (WCAP Table 3-8)]

TS = 92.0 % Level Span [Reference 2.13.a (UFAPPD, Table 2.2)]

SAL = 100 % Level Span [based on original FCQL-355 value, that Przr fills; Ref. 2.13.a, Table 2.2 conservatively specifies the current Tech Spec AV]

TA = { (SAL – TS) / 100 % level } x 100 % Span = 8.0 % Span

Margin = TA - CSA' = 2.75 % Span

S' = { (SD) + (SCA) } = { (1.25) + (0.5) } = 1.75 % Span

$$Z' = (A')^{1/2} + Biases = \{ (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA + PMA_{Biases}$$

$$= \{ 0^2 + (0.5)^2 + (0.5)^2 + (0.5)^2 \}^{1/2} + 0 + (0.87 + 1.68) = 3.416 \text{ \% Span}$$

R' = T' is the lesser of:

T_1' = { RD + RCA } = { (1.0) + (0.5) } = 1.50 % Span

T_2' = TA' - S' - Z' = 8.00 – 1.75 – 3.42 = 2.83 % Span

AV' = { TS + [R'/100%Span] x 100 % Level } = 93.5 % Level Span

The above-computed AV' should be used in lieu of the current Tech Spec AV of 93.8 % level span (owing to the original 1.8% Span trigger value). A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	8.0 % Span	8.0 % Span
Z Term	2.18 % Span	3.42 % Span
Sensor Error (S)	1.5 % Span	1.75 % Span
Trip Setpoint (TS)	$\leq$ 92.0 % level span	$\leq$ 92.0 % level span
Allowable Value (AV)	$\leq$ 93.8 % level span	$\leq$ 93.5 % level span

TABLE 3-9
REACTOR COOLANT FLOW - LOW
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equation format shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function. In addition, uncertainty components are adjusted for the flow conversion factor of 0.663 (used to convert uncertainties from % DP transmitter span to % RCS flow span), which was computed on Page 21 of Reference 2.9.n; see Reference 2.8, Table 3-24 [ΔP Measurements Expressed in Flow Units] for further derivation of conversion factor. Channel normalization, based upon EST-709 calorimetric measurement and EST-708/OST-1021 surveillances, allows sensor calibration tolerance [SCA], sensor M&TE [SMTE], and sensor pressure & temperature effects [SPE & STE] to be defined with zero uncertainty.

$$CSA' = [(PMA_1)^2 + (PMA_2)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SRA)^2 + (SCA + SMTE)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2} + \text{CalorimetricBias}$$

$$= [(0.40)^2 + (1.33)^2 + (0.33)^2 + (0.0 + 0.5)^2 + (0.0)^2 + (0.0)^2 + (0.17)^2 + (0.0 + 0.0)^2 + (0.33 + 0.66)^2 + (0.33)^2 + (0.33 + 0.33)^2]^{1/2} + 0.13$$

$= 2.1$ % Flow Span [Reference 2.9.n & Reference 2.8 (WCAP Table 3-9)]

TS = 90.5 % RCS Flow [Reference 2.13.a (UFAPPD, Table 2.2)]

SAL' = 85.0 % RCS Flow [Reference 2.13.a (UFAPPD, Table 2.2)]

TA' = { (TS - SAL') / 120 % flow } x 100 % Span = 4.58 % Flow Span

Margin = TA - CSA' = 2.48 % Flow Span

S' = { (SD) + (SCA) } = { (0.50) + (0.00) } = 0.50 % Flow Span

$$Z' = (A')^{1/2} + \text{Biases}$$

$$= \{(PMA_1)^2 + (PMA_2)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2\}^{1/2} + \text{CalorimetricBias}$$

$$= \{(0.40)^2 + (1.33)^2 + (0.33)^2 + 0^2 + 0^2 + (0.33)^2\}^{1/2} + (0.13)$$

= 1.602 % Flow Span

R' = T' is the lesser of:

T_1' = { RD + RCA } = { (0.666) + (0.333) } = 1.00 % Flow Span

T_2' = TA' - S' - Z' = 4.58 - 0.50 - 1.60 = 2.48 % Flow Span

Since above computations are already converted to % RCS Flow Span:

AV' = { TS - R' } = 89.5 % RCS Flow

The above-computed TA' reflects the increased PUR/SGR analytical limit (from the current TA of 2.9% Flow Span). Since Z' and S' values computed are slightly smaller than the current Tech Spec S and Z terms, it is acceptable to maintain S' = S = 0.60% Flow Span and Z' = Z = 1.98% of Flow Span (based upon the increased TA' term, and given that no PUR/SGR-related hardware changes [other than normalization for new RCS flow conditions at uprated power operation] are being implemented). A comparison of current and post-PUR/SGR values are summarized as follows:

TABLE 3-9 (Cont'd)
REACTOR COOLANT FLOW - LOW
Summary of CSA and Five-Column Tech Spec Terms

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	2.9 % Span	4.58 % Span
Z Term	1.98 % Span	1.98 % Span
Sensor Error (S)	0.6 % Span	0.6 % Span
Trip Setpoint (TS)	≥ 90.5 % RCS Flow	≥ 90.5 % RCS Flow
Allowable Value (AV)	≥ 89.5 % RCS Flow	≥ 89.5 % RCS Flow

TABLE 3-10A
SG WATER LEVEL, LOW-LOW (FW LINE BREAK)
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$
\begin{aligned}
CSA' &= [\ (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + \\
&\quad (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2\ ]^{1/2} + EA_{RefLeg} + EA_{HELB} + \\
&\quad PMA_{RefLegTemp} + PMA_{Pressure} + PMA_{Subcool} + PMA_{FluidVelocity} + PMA_{MidPlateDP} \\
&= [\ (0.50 + 1.50)^2 + (0.50)^2 + (0.63)^2 + (0.50 + 0.50)^2 + (0.50)^2 + \\
&\quad (0.08 + 1.00)^2 + (0.50)^2 + (0.50 + 0.08)^2\ ]^{1/2} + (1.50) + (10.00) + \\
&\quad (0.40) + (0.00) + (1.90) + (0.00) + (2.10) \\
&= 18.67\ \%\ \text{Span}
\end{aligned}
$$

[Reference 2.9.a and Reference 2.8 (WCAP Table 3-10a)]

Note that above CSA′ computation includes a 1.5% Span sensor drift uncertainty (versus the 2.0% Span value originally assumed in References 2.8 and 2.9.a), based upon subsequent review of As-Found/As-Left transmitter drift data.

In addition, no uncertainty [bias] due to cable insulation resistance degradation was assumed above (versus the 1.0% Span value originally assumed in Reference 2.9.a); this is based upon the short-lived (i.e., less than 30-second) Feedwater Line Break accident environment prior to the reactor trip (for consistency with assumption in INST-1045, Rev. 1, Section 6.10 [Reference 2.4.d]).

$TS' = 25.0\ \%$ Level [Reference 2.13.a (UFAPPD, Table 2.2)]

$SAL' = 0.0\ \%$ Level [Reference 2.13.a (UFAPPD, Table 2.2)]

$TA' = \{\ (\ TS' - SAL'\ )\ /\ 100\ \%\ \text{level}\ \} \times 100\ \%\ \text{Span} = 25.00\ \%\ \text{Span}$

$\text{Margin} = TA' - CSA' = 6.33\ \%\ \text{Span}$

$S' = \{\ (SD) + (SCA)\ \} = \{\ (1.50) + (0.50)\ \} = 2.00\ \%\ \text{Span}$

$$
\begin{aligned}
Z' &= (A')^{1/2} + \text{Biases} \\
&= \{\ (SPE)^2 + (STE)^2 + (RTE)^2\ \}^{1/2} + EA_{RefLeg} + EA_{HELB} + PMA_{RefLeg} + \\
&\quad PMA_{Pressure} + PMA_{Subcool} + PMA_{Fluid} + PMA_{MidPlateDP} \\
&= \{\ (0.63)^2 + (0.50)^2 + (0.50)^2\ \}^{1/2} + (1.50) + (10.0) + (0.40) + \\
&\quad (0.00) + (1.90) + (0.00) + (2.10) = 16.85\ \%\ \text{Span}
\end{aligned}
$$

Note that Biases shown conservatively reflect a worst-case value over the entire instrument span, and not specifically at the 25% Level trip setpoint.

$R' = T'$ is the lesser of:

$T_1' = \{\ RD + RCA\ \} = \{\ (1.0) + (0.5)\ \} = 1.50\ \%\ \text{Span}$

$T_2' = TA' - S' - Z' = 25.00 - 2.00 - 16.85 = 6.15\ \%\ \text{Span}$

$AV' = \{\ TS' - [\ R'/100\%\text{Span}\ ] \times 100\ \%\ \text{Level}\ \} = 23.5\ \%\ \text{Level}$

Since the above-noted trip setpoint corresponds to a requirement for the Model Δ75 replacement steam generators [RSGs], the current Tech Spec values (associated with

TABLE 3-10A (Cont'd)
SG WATER LEVEL, LOW-LOW (FW LINE BREAK)
Summary of CSA and Five-Column Tech Spec Terms

the Model D-4 SGs) are not directly comparable. The summary which follows (for current and post-PUR/SGR values) has been provided for completeness only:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	19.2 % Span	25.0 % Span
Z Term	14.06 % Span	16.85 % Span
Sensor Error (S)	2.97 % Span	2.0 % Span
Trip Setpoint (TS)	≥ 38.5 % level	≥ 25.0 % level
Allowable Value (AV)	≥ 36.5 % level	≥ 23.5 % level

Table 3.3-4, Item 6.c [Auxiliary Feedwater Initiation] also specifies the Low-Low SG Level RTS trip setpoint for this ESFAS function. Since the same RTS channels perform this ESFAS function, the above RTS post-PUR/SGR values can be applied to its corresponding ESFAS Tech Spec requirement. (This is consistent with the practice used in the current Tech Spec Table 2.2-1, Item 13 and Table 3.3-4, Item 6.c.)

TABLE 3-10B
SG WATER LEVEL, LOW-LOW (LOSS OF NORMAL FW)
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [\ (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2\ ]^{1/2} + EA_{RefLeg} + EA_{HELB} + PMA_{RefLegTemp} + PMA_{Pressure} + PMA_{Subcool} + PMA_{FluidVelocity} + PMA_{MidPlateDP}$$

$$= [\ (0.50 + 1.50)^2 + (0.50)^2 + (0.63)^2 + (0.50 + 0.50)^2 + (0.50)^2 + (0.08 + 1.00)^2 + (0.50)^2 + (0.50 + 0.08)^2\ ]^{1/2} + (0.00) + (0.00) + (0.40) + (0.00) + (1.90) + (0.00) + (2.10)$$

$= 7.17$ % Span [Reference 2.9.a and Reference 2.8 (WCAP Table 3-10b)]

As noted per Table 3-10A, the above CSA' computation includes: a 1.5% Span sensor drift uncertainty (versus the 2.0% Span value originally assumed in References 2.8 and 2.9.a); and conservatively chosen Biases which reflect worst-case values.

TS' = 25.0 % Level [Reference 2.13.a (UFAPPD, Table 2.2)]

SAL' = 16.1 % Level [Reference 2.13.a (UFAPPD, Table 2.2)]

TA' = { (TS' − SAL') / 100 % level } x 100 % Span = 8.9 % Span

Margin = TA' − CSA' = 1.73 % Span

S' = { (SD) + (SCA) } = { (1.50) + (0.50) } = 2.00 % Span

$$Z' = (A')^{1/2} + \text{Biases}$$

$$= \{\ (SPE)^2 + (STE)^2 + (RTE)^2\ \}^{1/2} + EA_{RefLeg} + EA_{HELB} + PMA_{RefLeg} + PMA_{Pressure} + PMA_{Subcool} + PMA_{Fluid} + PMA_{MidPlateDP}$$

$$= \{\ (0.63)^2 + (0.50)^2 + (0.50)^2\ \}^{1/2} + (0.00) + (0.0) + (0.40) + (0.00) + (1.90) + (0.00) + (2.10) = 5.35 \text{ \% Span}$$

R' = T' is the lesser of:

T_1' = { RD + RCA } = { (1.0) + (0.5) } = 1.50 % Span

T_2' = TA' − S' − Z' = 8.90 − 2.00 − 5.35 = 1.55 % Span

AV' = { TS' − [R'/100%Span] x 100 % Level } = 23.5 % Level

Since the current licensing basis for the Low-Low SG Narrow-Range Level specifies the Tech Spec TA and Z for only the Feedwater Line Break (and not for the Loss of Normal Feedwater condition), the values within Table 3-10A continue to apply for the Low-Low setpoint Tech Spec requirements for TA' and Z'.

The summary which follows (for current [Model D-4 SG] and post-PUR/SGR [Model Δ75 RSG] values) has been provided for completeness only, and is consistent with that shown in Table 3-10A (absent a specific current Tech Spec listing associated with this channel's function under Loss of Normal Feedwater, and owing to the common hardware implementation for these trip functions):

TABLE 3-10B (Cont'd)
SG WATER LEVEL, LOW-LOW (LOSS OF NORMAL FW)
Summary of CSA and Five-Column Tech Spec Terms

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	19.2 % Span	25.0 % Span
Z Term	14.06 % Span	16.85 % Span
Sensor Error (S)	2.97 % Span	2.0 % Span
Trip Setpoint (TS)	$\geq$ 38.5 % level	$\geq$ 25.0 % level
Allowable Value (AV)	$\geq$ 36.5 % level	$\geq$ 23.5 % level

TABLE 3-10C
STEAM GENERATOR WATER LEVEL, LOW
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2} + EA_{RefLeg} + EA_{HELB} + PMA_{RefLegTemp} + PMA_{Pressure} + PMA_{Subcool} + PMA_{FluidVelocity} + PMA_{MidPlateDP}$$

$$= [(0.50 + 1.50)^2 + (0.50)^2 + (0.63)^2 + (0.50 + 0.50)^2 + (0.50)^2 + (0.08 + 1.00)^2 + (0.50)^2 + (0.50 + 0.08)^2]^{1/2} + (0.00) + (0.00) + (0.40) + (0.00) + (1.90) + (0.00) + (2.10)$$

$= 7.17$ % Span [Reference 2.9.a and Reference 2.8 (WCAP Table 3-10c)]

As noted per Table 3-10A, the above CSA' computation includes: a 1.5% Span sensor drift uncertainty (versus the 2.0% Span value originally assumed in References 2.8 and 2.9.a); and conservatively chosen Biases which reflect worst-case values.

TS' = 25.0 % Level [Reference 2.13.a (UFAPPD, Table 2.2)]

SAL' = 16.1 % Level [Reference 2.13.a (UFAPPD, Table 2.2)]

Note that Reference 2.4.d acknowledges that Low-Low RSG Level SAL was assumed for conservatism, since an SAL value is not credited in the Safety Analysis for an assumed loss of normal feedwater.

$TA' = \{ (TS' - SAL') / 100 \% \text{ level} \} \times 100 \% \text{ Span} = 8.9$ % Span

$\text{Margin} = TA' - CSA' = 1.73$ % Span

$S' = \{ (SD) + (SCA) \} = \{ (1.50) + (0.50) \} = 2.00$ % Span

$$Z' = (A')^{1/2} + \text{Biases}$$

$$= \{ (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA_{RefLeg} + EA_{HELB} + PMA_{RefLeg} + PMA_{Pressure} + PMA_{Subcool} + PMA_{Fluid} + PMA_{MidPlateDP}$$

$$= \{ (0.63)^2 + (0.50)^2 + (0.50)^2 \}^{1/2} + (0.00) + (0.0) + (0.40) + (0.00) + (1.90) + (0.00) + (2.10) = 5.35 \text{ \% Span}$$

R' = T' is the lesser of:

$T_1' = \{ RD + RCA \} = \{ (1.0) + (0.5) \} = 1.50$ % Span

$T_2' = TA' - S' - Z' = 8.90 - 2.00 - 5.35 = 1.55$ % Span

$AV' = \{ TS' - [R'/100\%\text{Span}] \times 100 \% \text{ Level} \} = 23.5$ % Level

Since the above-noted trip setpoint corresponds to a requirement for the Model Δ75 replacement steam generators [RSGs], the current Tech Spec values (associated with the Model D-4 SGs) are not directly comparable. The summary which follows (for current and post-PUR/SGR values) has been provided for completeness only:

TABLE 3-10C (Cont'd)
STEAM GENERATOR WATER LEVEL, LOW
Summary of CSA and Five-Column Tech Spec Terms

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	19.2 % Span	8.9 % Span
Z Term	2.23 % Span	5.35 % Span
Sensor Error (S)	2.97 % Span	2.0 % Span
Trip Setpoint (TS)	≥ 38.5 % level	≥ 25.0 % level
Allowable Value (AV)	≥ 36.5 % level	≥ 23.5 % level

TABLE 3-11
STEAM/FEEDWATER FLOW MISMATCH
Summary of CSA and Five-Column Tech Spec Terms

This trip function is based upon a high mismatch setpoint signal between steam flow and feedwater flow, coincident with the SG N-R Level Low setpoint. The steam flow input is density-compensated from the main steamline pressure channel. The current and post-PUR/SGR mismatch trip setpoints [TS and TS'] have been maintained at a 40% flow mismatch (i.e., original accident analyses scenario assumed a 100% steam flow and a 60% feedwater flow). This mismatch trip function is considered a backup to the SG N-R Level Low-Low trip function; as such, no credit is taken for this RTS trip function within current (and post-PUR/SGR) SPC Safety Analyses.

The initial CP&L design input provided to Westinghouse per Reference 2.12.b [HW/99-038] assumed that existing steam and feedwater flow spans would be maintained (to preclude hardware replacements), and that renormalization of flow loops would be performed to correspond to the increased flows at 100% operation. Therefore, a reduction for the original, nominal 120% flow range to an expected 116.55% flow range was assumed (given the 4.29 MPPH maximum PCWG 100% uprated flow condition, relative to the existing 5.0 MPPH maximum range [PCWG Case 35 per Ref. 2.10.c]). In addition, a slightly lower 100% uprated flow of 4.24 MPPH (relative to the 5.0 MPPH maximum range [PCWG Case 30 per Ref. 2.10.c]) has been identified, which would yield an expected 117.93% flow range.

For comparison to RSG only operation at current power conditions, computations at an expected 122.94% flow range can also be evaluated, based upon the current 100% operation at 4.067 MPPH (relative to the 5.0 MPPH maximum range [PCWG Case 1 per Ref. 2.10.c]). The use of this design assumption maximizes (or conservatively bounds) the mismatch trip channel uncertainty, independent of the flow range selected for final design implementation.

Using the terminology within Reference 2.9.1 [CN-SSO-99-18, Rev. 1], Pages 23 and 24, the following adjusted conversion factors were computed for use herein:

Feedwater Flow Conversion (to convert uncertainties from % DP xmtr span to % flow span; Ref. 2.9.1 used 0.97):

$$CFF_{at\ 122.94\%} = FMAX/(2 \times FFNOM) = 122.94/(2 \times 60) = 1.0245$$

$$CFF_{at\ 117.93\%} = FMAX/(2 \times FFNOM) = 117.93/(2 \times 60) = 0.9827$$

Steam Flow Conversion (to convert uncertainties from % DP xmtr span to % flow span; Ref. 2.9.1 used 0.58):

$$CSF_{at\ 122.94\%} = FMAX/(2 \times SFNOM) = 122.94/(2 \times 100) = 0.6147$$

$$CSF_{at\ 117.93\%} = FMAX/(2 \times SFNOM) = 117.93/(2 \times 100) = 0.5896$$

An additional conservative input assumption for the steam pressure span to flow span conversion factor [CSP] was used by Westinghouse, by rounding off the 1.142 proportionality constant to 1.2, for <u>all</u> steam pressure transmitter and process rack uncertainties.

This conversion process is consistent with the methodology originally used in Reference 2.3 [FCQL-355], and per PUR/SGR project documentation within Table 3-24 of Reference 2.8 [WCAP-15249]. Using the following equations generally shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

TABLE 3-11 (Cont'd)
STEAM/FEEDWATER FLOW MISMATCH
Summary of CSA and Five-Column Tech Spec Terms

$$CSA' = [(SF\_pma)^2 + (FF\_pea)^2 + (SF\_rte)^2 + (SF\_smte + SF\_sd)^2 + (SF\_spe)^2 + (SF\_ste)^2 + (SF\_sra)^2 + (SF\_sca + SF\_smte)^2 + (SF\_rmte + SF\_rd)^2 + (SF\_rca + SF\_rmte)^2 + (FF\_smte + FF\_sd)^2 + (FF\_spe)^2 + (FF\_ste)^2 + (FF\_sra)^2 + (FF\_sca + FF\_smte)^2 + (FF\_rmte + FF\_rd)^2 + (FF\_rca + FF\_rmte)^2 + (SP\_smte + SP\_sd)^2 + (SP\_ste)^2 + (SP\_sra)^2 + (SP\_sca + SP\_smte)^2 + (SP\_rmte + SP\_rd)^2 + (SP\_rca + SP\_rmte)^2]^{1/2}$$

Using the above CSA' equation, reconciled channel Uncertainty Components have been determined in the following manner. This computation also considered the possibility of replacement of existing Barton 764 steam flow transmitters with Rosemount 1154DP5 series transmitters. This calculation utilizes the maximum uncertainty component of % Flow Span and transmitter model.

Steam Flow Channels:

	Barton 764			Rosemount 1154DP5			
Parameter	% DP span	% Flow Span [122.94% Span]	% Flow Span [117.93% Span]	% DP span	% Flow Span [122.94% Span]	% Flow Span [117.93% Span]	Maximum % Flow Span
SF_pma	---	2.44	2.54	---	2.44	2.54	2.54
SF_pea	---	---	---	---	---	---	---
SF_sra	0.50	0.31	0.29	0.25	0.15	0.15	0.31
SF_sca	0.50	0.31	0.29	0.50	0.31	0.29	0.31
SF_smte	0.54	0.33	0.32	0.54	0.33	0.32	0.33
SF_spe	0.50	0.31	0.29	0.30	0.18	0.18	0.31
SF_ste	0.50	0.31	0.29	0.95	0.59	0.56	0.59
SF_sd	1.25	0.77	0.74	1.25	0.77	0.74	0.77
SF_rca	---	0.50	0.50	---	0.50	0.50	0.50
SF_rmte	---	0.20	0.20	---	0.20	0.20	0.20
SF_rte	---	0.50	0.50	---	0.50	0.50	0.50
SF_rd	---	1.00	1.00	---	1.00	1.00	1.00

Feedwater Flow Channels:

Parameter	% DP span	% Flow Span [122.94% Span]	% Flow Span [117.93% Span]	Maximum % Flow Span
FF_pma	---	---	---	---
FF_pea	---	0.41	0.42	0.42
FF_sra	0.25	0.26	0.25	0.26
FF_sca	0.50	0.51	0.49	0.51
FF_smte	0.54	0.55	0.53	0.55
FF_spe	0.30	0.31	0.29	0.31
FF_ste	1.10	1.13	1.08	1.13
FF_sd	1.25	1.28	1.23	1.28
FF_rca	---	0.50	0.50	0.50
FF_rmte	---	0.20	0.20	0.20
FF_rte	---	---	---	---
FF_rd	---	1.00	1.00	1.00

Steam Pressure Channels:

Parameter	% span	% Flow Span [all Spans]
SP_pma	---	---
SP_pea	---	---
SP_sra	0.50	0.60
SP_sca	0.50	0.60
SP_smte	0.54	0.65
SP_spe	---	---
SP_ste	0.50	0.60
SP_sd	1.50	1.80
SP_rca	0.50	0.60
SP_rmte	0.20	0.24
SP_rte	---	---
SP_rd	1.00	1.20

TABLE 3-11 (Cont'd)
STEAM/FEEDWATER FLOW MISMATCH
Summary of CSA and Five-Column Tech Spec Terms

$$CSA' = [(2.54)^2 + (0.42)^2 + (0.50)^2 + (0.33 + 0.77)^2 + (0.31)^2 + (0.59)^2 + (0.31)^2 + (0.31 + 0.33)^2 + (0.20 + 1.00)^2 + (0.50 + 0.20)^2 + (0.55 + 1.28)^2 + (0.31)^2 + (1.13)^2 + (0.26)^2 + (0.51 + 0.55)^2 + (0.20 + 1.00)^2 + (0.50 + 0.20)^2 + (0.65 + 1.80)^2 + (0.60)^2 + (0.60)^2 + (0.60 + 0.65)^2 + (0.24 + 1.20)^2 + (0.60 + 0.24)^2]^{1/2} = 5.466 \text{ \% Flow Span}$$

TS = 40.0 % Rated Flow [Reference 2.1]
SAL' = N/A [References 2.3 and 2.13.a]

TA = 20.0 % Flow Span [Reference 2.1]
Current Tech Spec TA was used, for evaluation of S' & Z'.

Margin = TA - CSA' = 20.0 - 5.47 ~= 14.53 % Flow Span

$S'_{StmFlow}$ = { (SF_sd) + (SF_sca) }
= { (0.77) + (0.31) } = 1.08 % Flow Span ~= 1.1 % Flow Span

S'_{FWFlow} = { (FF_sd) + (FF_sca) }
= { (1.28) + (0.51) } = 1.79 % Flow Span ~= 1.8 % Flow Span

$S'_{StmPres}$ = { (SP_sd) + (SP_sca) }
= { (1.80) + (0.60) } = 2.4 % Flow Span

$$Z' = (A')^{1/2} + \text{Biases}$$
$$= \{ (PMA)^2 + (PEA)^2 + (\text{Total } SPE)^2 + (\text{Total } STE)^2 + (RTE)^2 \}^{1/2} + EA + \text{Bias}$$
$$= \{ (SF\_pma)^2 + (FF\_pea)^2 + ([(SF\_spe)^2 + (FF\_spe)^2]^{1/2})^2 + ([(SF\_ste)^2 + (FF\_ste)^2 + (SP\_ste)^2]^{1/2})^2 + (SF\_rte)^2 \}^{1/2} + EA + \text{Bias}$$
$$= \{ (2.54)^2 + (0.42)^2 + [(0.31)^2 + (0.31)^2] + [(0.59)^2 + (1.13)^2 + (0.60)^2] + (0.5)^2 \}^{1/2} + (0) + (0) = \{ 9.0552 \}^{1/2} = 3.0092 = 3.01 \text{ \% Flow Span}$$

The above-computed Z' term has been reduced from that shown in the current Tech Specs, owing to the elimination of the thermal nonrepeatability bias previously assumed for originally installed Barton 764 feedwater flow transmitters.

$$R' = \{ (SF\_rd + SF\_rca)^2 + (FF\_rd + FF\_rca)^2 + (SP\_rd + SP\_rca)^2 \}^{1/2}$$
$$= \{ (1.0 + 0.5)^2 + (1.0 + 0.5)^2 + (1.2 + 0.6)^2 \}^{1/2}$$
$$= \{ (2.25) + (2.25) + (3.24) \}^{1/2} = \{ 7.74 \}^{1/2} = 2.782 \text{ \% Flow Span}$$

Using a 122.94% Span (versus the original plant design of 120% Span), which incorporates steam/feedwater flow conversion values based upon the current 5.0 MPPH/4.067 MPPH maximum/100% flow ratio, a worst-case allowable value (designated by AV_1') can be computed for SGR only operation. However, for PUR/SGR operation at the maximum 5.0 MPPH/4.24 MPPH flow ratio, PUR/SGR rescaling will result in a 117.93% Rated Flow span and a corresponding PUR/SGR allowable value AV_2'.

AV_1' = { TS + [R'/100%Span] x 122.94 % Rated Flow }
= 40.0 + 0.0278 x 122.94 = 40.0 + 3.417 = 43.417 % Rated Flow

TABLE 3-11 (Cont'd)
STEAM/FEEDWATER FLOW MISMATCH
Summary of CSA and Five-Column Tech Spec Terms

$$AV_2' = \{ TS + [R'/100\%Span] \times 117.93 \ \% \text{ Rated Flow} \}$$
$$= 40.0 + 0.0278 \times 117.93 = 40.0 + 3.278 = 43.278 \ \% \text{ Rated Flow}$$

The above-computed AV' values are comparable to the current Tech Spec AV of 43.1% full steam flow at RTP; the current AV should be used owing to its slightly smaller value. The current Tech Spec TA = TA' should also be used, as specified above. The above-computed Z' and S' values are applicable for PUR/SGR and/or SGR only operation, given the conservative conversion factors/uncertainty components employed. A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	20.0 % Span	20.0 % Span
Z Term	3.41 % Span	3.01 % Span
Sensor Error (S)	Per current Note 6	Per new Note 6 (see below)
Trip Setpoint (TS)	$\leq$ 40.0 % Steam Flow at RTP	$\leq$ 40.0 % Steam Flow at RTP
Allowable Value (AV)	$\leq$ 43.1 % Steam Flow at RTP	$\leq$ 43.1 % Steam Flow at RTP

Post-PUR/SGR Note 6: The sensor error (in % Span of Steam Flow) is: 1.1% for steam flow; 1.8% for feedwater flow; and 2.4% for steam pressure.

TABLE 3-12A
CONTAINMENT PRESSURE - HIGH-1 & HIGH-2
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [\ (PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2\ ]^{1/2}$$

$$= [\ (0.00)^2 + (0.00)^2 + (0.71 + 1.00)^2 + (0.50)^2 + (0.00)^2 + (0.50 + 0.71)^2 + (0.50)^2 + (0.50 + 1.00)^2 + (0.50)^2 + (0.50 + 0.50)^2\ ]^{1/2}$$

$= 2.89 \sim= 2.9$ % Span [Reference 2.9.j & Reference 2.8 (WCAP Table 3-12)]

Note that above CSA′ computation includes a 1.0% Span sensor drift uncertainty (versus the 1.25% Span value assumed in References 2.8 and 2.9.j), based upon subsequent review of As-Found/As-Left drift data and for consistency with the "transmitter allowable drift [TAD]" value defined per current channel scaling calculations.

TS = 3.0 psig [Reference 2.13.a (UFAPPD, Table 2.18)]

SAL′ = 5.0 psig [Reference 2.13.a (UFAPPD, Table 2.18)]

TA′ = { (SAL′ - TS) / 55.0 psig Span } x 100 % Span = 3.64 % Span

Margin = TA′ - CSA′ = 0.74 % Span

S′ = { (SD) + (SCA) } = { (1.00) + (0.5) } = 1.50 % Span

$$Z' = (A')^{1/2} + EA = \{ (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA$$

$$= \{ 0^2 + 0^2 + 0^2 + (0.50)^2 + (0.50)^2 \}^{1/2} + 0.00 = 0.71 \text{ \% Span}$$

R′ = T′ is the lesser of:

T_1' = { RD + RCA } = { (1.0) + (0.5) } = 1.50 % Span

T_2' = TA′ - S′ - Z′ = 3.64 - 1.50 - 0.71 = 1.43 % Span

AV′ = { TS + [R′/100%Span] x 55 psig } = 3.79 psig

The computed AV′ is greater than the current Tech Spec AV of 3.6 psig. Therefore, AV′ = AV = 3.6 psig will be retained for PUR/SGR operation. A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	2.7 % Span	3.64 % Span
Z Term	0.71 % Span	0.71 % Span
Sensor Error (S)	1.5 % Span	1.5 % Span
Trip Setpoint (TS)	$\leq$ 3.0 psig	$\leq$ 3.0 psig
Allowable Value (AV)	$\leq$ 3.6 psig	$\leq$ 3.6 psig

TABLE 3-12B
CONTAINMENT PRESSURE - HIGH-3
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2}$$

$$= [(0.00)^2 + (0.00)^2 + (0.71 + 1.00)^2 + (0.50)^2 + (0.00)^2 + (0.50 + 0.71)^2 + (0.50)^2 + (0.50 + 1.00)^2 + (0.50)^2 + (0.50 + 0.50)^2]^{1/2}$$

$$= 2.89 \sim= 2.9 \text{ \% Span}$$ [Reference 2.9.j & Reference 2.8 (WCAP Table 3-12)]

As per Table 3-12A, a 1.0% Span sensor drift uncertainty (versus the 1.25% Span value assumed in References 2.8 and 2.9.j) was used.

TS = 10.0 psig [Reference 2.13.a (UFAPPD, Table 2.18)]

SAL′ = 12.0 psig [Reference 2.13.a (UFAPPD, Table 2.18)]

$$TA' = \{ (SAL' - TS) / 55.0 \text{ psig Span} \} \times 100 \text{ \% Span} = 3.64 \text{ \% Span}$$

$$\text{Margin} = TA' - CSA' = 0.74 \text{ \% Span}$$

$$S' = \{ (SD) + (SCA) \} = \{ (1.00) + (0.5) \} = 1.50 \text{ \% Span}$$

$$Z' = (A')^{1/2} + EA = \{ (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA$$
$$= \{ 0^2 + 0^2 + 0^2 + (0.50)^2 + (0.50)^2 \}^{1/2} + 0.00 = 0.71 \text{ \% Span}$$

R′ = T′ is the lesser of:

$$T_1' = \{ RD + RCA \} = \{ (1.0) + (0.5) \} = 1.50 \text{ \% Span}$$
$$T_2' = TA' - S' - Z' = 3.64 - 1.50 - 0.71 = 1.43 \text{ \% Span}$$

$$AV' = \{ TS + [R'/100\%\text{Span}] \times 55 \text{ psig} \}$$
$$= 10.79 \text{ psig} \sim= 10.8 \text{ psig}$$

The above-computed AV′ is comparable to that originally specified by FCQL-355 (with its round off to 11.0 psig). Given the slightly larger PUR/SGR SAL′ value, the continued use of AV′ = AV = 11.0 psig is justified. A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	3.6 % Span	3.64 % Span
Z Term	0.71 % Span	0.71 % Span
Sensor Error (S)	1.5 % Span	1.5 % Span
Trip Setpoint (TS)	$\leq$ 10.0 psig	$\leq$ 10.0 psig
Allowable Value (AV)	$\leq$ 11.0 psig	$\leq$ 11.0 psig

TABLE 3-13
PRESSURIZER PRESSURE - LOW, SAFETY INJECTION
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2} + EA_{Temp} + EA_{Rad}$$

$$= [(0.00)^2 + (0.00)^2 + (0.71 + 1.00)^2 + (1.44)^2 + (0.00)^2 + (0.50 + 0.71)^2 + (0.25)^2 + (0.50 + 1.00)^2 + (0.50)^2 + (0.50 + 0.50)^2]^{1/2} + (8.00) + (0.95)$$

= 12.11 % Span [Reference 2.9.c & Reference 2.8 (WCAP Table 3-13)]

TS = 1850 psig [Reference 2.13.a (UFAPPD, Table 2.18)]

SAL = 1700 psig [Reference 2.13.a (UFAPPD, Table 2.18); Specifies a value of 1699.6 psig]

TA = { (TS - SAL) / 800 psig Span } x 100 % Span = 18.75 % Span

Margin = TA - CSA' = 6.64 % Span

S' = { (SD) + (SCA) } = { (1.0) + (0.5) } = 1.50 % Span

$$Z' = (A')^{1/2} + EA$$

$$= \{ (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA_{Temp} + EA_{Rad}$$

$$= \{ 0^2 + 0^2 + 0^2 + (1.44)^2 + (0.50)^2 \}^{1/2} + (8.00) + (0.95) = 10.472 \text{ \% Span}$$

R' = T' is the lesser of:

T_1' = { RD + RCA } = { (1.0) + (0.5) } = 1.50 % Span

T_2' = TA' - S' - Z' = 18.75 - 1.50 - 10.47 = 6.78 % Span

AV' = { TS - [R'/100%Span] x 800 psig } = 1838 psig

The above-computed AV' is comparable to the original 1836 psig value specified by FCQL-355 (with current Tech Spec requirements based upon a T = 1.8 %Span and a CSA of 16.1 %Span); however, the computed value was selected for post-PUR/SGR operation. A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	18.8 % Span	18.75 % Span
Z Term	14.41 % Span	10.47 % Span
Sensor Error (S)	1.5 % Span	1.5 % Span
Trip Setpoint (TS)	≥ 1850 psig	≥ 1850 psig
Allowable Value (AV)	≥ 1836 psig	≥ 1838 psig

TABLE 3-14

STEAMLINE DIFFERENTIAL PRESSURE - HIGH

Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein (as modified as noted below), the following values were computed for post-PUR/SGR Tech Spec terms for this trip function. This trip function must account for sensor and rack components from two different channels, for the physical comparison of the differential pressure between two steam lines; CSA, S, and R terms have been modified accordingly to represent these two ['A' and 'B'] channels.

$$CSA' = [\ (PMA_A)^2 + (PEA_A)^2 + (SMTE_A + SD_A)^2 + (STE_A)^2 + (SPE_A)^2 + (SCA_A + SMTE_A)^2 + (SRA_A)^2 + (RMTE_A + RD_A)^2 + (RCA_A + RMTE_A)^2 + (RTE)^2 + (PMA_B)^2 + (PEA_B)^2 + (SMTE_B + SD_B)^2 + (STE_B)^2 + (SPE_B)^2 + (SCA_B + SMTE_B)^2 + (SRA_B)^2 + (RMTE_B + RD_B)^2 + (RCA_B + RMTE_B)^2\ ]^{1/2} + EA$$

$$= [\ (0.00)^2 + (0.00)^2 + (0.71 + 1.50)^2 + (0.50)^2 + (0.00)^2 + (0.50 + 0.71)^2 + (0.50)^2 + (0.50 + 1.00)^2 + (0.50 + 0.50)^2 + (0.50)^2 + (0.00)^2 + (0.00)^2 + (0.71 + 1.50)^2 + (0.50)^2 + (0.00)^2 + (0.50 + 0.71)^2 + (0.50)^2 + (0.50 + 1.00)^2 + (0.50 + 0.50)^2\ ]^{1/2} + (0.00)$$

$= 4.52\ \%\ \text{Span}$ [Reference 2.9.f & Reference 2.8 (WCAP Table 3-14)]

TS = 100 psi [Reference 2.13.a (UFAPPD, Table 2.18)]

SAL = 165 psi [Reference 2.13.a (UFAPPD, Table 2.18)]

$TA = \{\ (\ SAL - TS\ )\ /\ 1300\ \text{psig Span}\ \} \times 100\ \%\ \text{Span} = 5.00\ \%\ \text{Span}$

$\text{Margin} = TA - CSA' = 0.48\ \%\ \text{Span}$

S', Z', and R' terms have been computed as follows, using the original FCQL-355 methodology, except for elimination of the Barton 763 thermal nonrepeatability bias (since the transmitters will not see excessive temperature exposures based upon their installation in the Reactor Auxiliary Building).

Individual transmitters A & B were evaluated separately (by $S_A = SD_A + SCA_A = 1.0 + 0.5 = 1.5$ %Span and, similarly, $S_B = SD_B + SCA_B = 1.5$ %Span), consistent with the current Tech Spec total S term of 3.0 %Span. Owing to the slightly larger sensor drift (of 1.5 %Span) assumed in PUR/SGR uncertainty analysis, a corresponding total S' term would become 4.0 %Span. Alternately, a SRSS combination of total S error could be computed per the following:

$$S' = \{\ (SD_A + SCA_A)^2 + (SD_B + SCA_B)^2\ \}^{1/2} = \{\ (1.5 + 0.5)^2 + (1.5 + 0.5)^2\ \}^{1/2}$$

$$= \{\ (4.0) + (4.0)\ \}^{1/2} = 2.828\ \%\ \text{Span} \sim= 3.0\ \%\ \text{Span}$$

Since this computation justifies a value closer to the original Tech Spec S term, the continued use of S' = S = 3.0 % Span will apply; for operability evaluation purposes, each transmitter will be limited to a 1.5 %Span error (in keeping with the original Tech Spec values).

$$Z' = (A')^{1/2} + \text{Biases} = \{\ (PMA)^2 + (PEA)^2 + (SPE)^2 + (\text{Total STE})^2 + (RTE)^2\ \}^{1/2} + EA + \text{Bias}$$

$$= \{\ (PMA)^2 + (PEA)^2 + (SPE)^2 + (\ [(STE_A)^2 + (STE_B)^2]^{1/2}\ )^2 + (RTE)^2\ \}^{1/2} + EA + \text{Bias}$$

$$= \{\ 0^2 + 0^2 + 0^2 + (\ [(0.5)^2 + (0.5)^2]^{1/2}\ )^2 + (0.50)^2\ \}^{1/2} + (0) + (0)$$

$$= \{\ (0.71)^2 + (0.50)^2\ \}^{1/2} + (0) + (0) = 0.866\ \%\ \text{Span}$$

TABLE 3-14 (Cont'd)
STEAMLINE DIFFERENTIAL PRESSURE - HIGH
Summary of CSA and Five-Column Tech Spec Terms

$$R' = \{ (RD_A + RCA_A)^2 + (RD_B + RCA_B)^2 \}^{1/2} = \{ (1.0 + 0.5)^2 + (1.0 + 0.5)^2 \}^{1/2}$$
$$= \{ (2.25) + (2.25) \}^{1/2} = 2.121 \text{ \% Span}$$

$$AV' = \{ TS + [R'/100\%Span] \times 1300 \text{ psig} \} = 127.56 \text{ psi}$$

The above-computed AV' is comparable to the current (127.4 psi) Tech Spec value; therefore, AV' = AV = 127.4 psi will be conservatively retained for PUR/SGR operation. Z' has been reduced as noted above by eliminating the previously-assumed transmitter nonrepeatability bias.

A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	5.0 % Span	5.0 % Span
Z Term	1.47 % Span	0.87 % Span
Sensor Error (S)	3.0 % Span	3.0 % Span
Trip Setpoint (TS)	≤ 100 psi	≤ 100 psi
Allowable Value (AV)	≤ 127.4 psi	≤ 127.4 psi

TABLE 3-15
NEGATIVE STEAMLINE PRESSURE RATE - HIGH
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function. All sensor-related uncertainty components have been set to zero, owing to the use of a rate (derivative) function to eliminate steady-state measurement errors. Therefore, this trip function must account only for rack components to accomplish the rate of change measurement.

$$CSA' = [(PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2} + EA$$

$$= [0^2 + 0^2 + (0 + 0)^2 + 0^2 + 0^2 + (0 + 0)^2 + 0^2 + (0.50 + 1.00)^2 + (0.50)^2 + (0.50 + 0.50)^2]^{1/2} + 0.00$$

$= 1.87$ % Span [Reference 2.9.e & Reference 2.8 (WCAP Table 3-15)]

TS = 100 psi [Reference 2.2 and Reference 2.3]

This function is not credited in the Safety Analysis [per Reference 2.13.a (UFAPPD, Table 2.18) and Reference 2.3 (FCQL-355)]; therefore, an SAL value has not been assigned to this function. Since the current Tech Spec TA value of 2.3 % Span exists, TA' will also be set at 2.3 % Span. A margin of 0.43 % Span [2.30 - 1.87] exists between the current Tech Spec trip setpoint [TS] and total allowance [TA].

No sensor-related uncertainties are applicable, as noted above.

$S' = \{ (SD) + (SCA) \} = \{ (0.0) + (0.0) \} = 0.00$ % Span

$Z' = (A')^{1/2} + EA = \{ (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA$

$= \{ 0^2 + 0^2 + 0^2 + 0^2 + (0.50)^2 \}^{1/2} + (0.0) = 0.50$ % Span

R' = T' is the lesser of:

$T_1' = \{ RD + RCA \} = \{ (1.0) + (0.5) \} = 1.50$ % Span

$T_2' = TA' - S' - Z' = 2.30 - 0.00 - 0.50 = 1.80$ % Span

$AV' = \{ TS + [R'/100\%Span] \times 1300 \text{ psig} \} = 119.5$ psi

The above-computed AV' is slightly less than that originally specified by FCQL-355 (with an actual T = 1.75 %Span); however, the computed value was selected for post-PUR/SGR operation. A comparison of current and post-PUR/SGR values are summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	2.3 % Span	2.3 % Span
Z Term	0.5 % Span	0.5 % Span
Sensor Error (S)	0.0 % Span	0.0 % Span
Trip Setpoint (TS)	$\leq$ 100 psi	$\leq$ 100 psi
Allowable Value (AV)	$\leq$ 122.8 psi	$\leq$ 119.5 psi

TABLE 3-16
TAVG - LOW, LOW (ESFAS P-12 INTERLOCK)
Summary of CSA and Five-Column Tech Spec Terms

Post-PUR/SGR values for the CSA' and AV' terms are discussed per the following. Uncertainty components applicable for post-PUR/SGR operation have been developed within Reference 2.9.m [CN-SSO-99-32, Rev. 0], and have been further summarized within Table 3-16 of Reference 2.8.

CSA' = 3.2% of ΔT span [Ref. 2.9.m, Page 22 & Ref. 2.8 (Table 3-16)]

This CSA' consists of: the SRSS of random uncertainties, associated with RCS N-R RTDs, R/E conversion within the process racks, and other process rack uncertainties; and the additive PMA biases associated with RCS Hot and Cold Leg streaming allowances, as well as the total R/E non-linearity uncertainty for linear approximation of the RTD [R vs. T] curve.

Owing to the operational flexibility required for startup and shutdown evolutions, the P-12 Permissive value has been retained within the same tolerance as that specified in current Tech Specs. Therefore, for completeness, post-PUR/SGR Tech Spec trip setpoint and allowable value can be summarized as follows:

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	N/A	N/A
Z Term	N/A	N/A
Sensor Error (S)	N/A	N/A
Trip Setpoint (TS)	≥ 553.0 °F	≥ 553.0 °F
Allowable Value (AV)	≥ 549.3 °F	≥ 549.3 °F

TABLE 3-17
STEAMLINE PRESSURE - LOW
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein, the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(PMA)^2 + (PEA)^2 + (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2} + EA$$

$$= [(0.00)^2 + (0.00)^2 + (0.71 + 1.50)^2 + (0.50)^2 + (0.00)^2 + (0.50 + 0.71)^2 + (0.50)^2 + (0.50 + 1.00)^2 + (0.50)^2 + (0.50 + 0.50)^2]^{1/2} + (0.00)$$

$= 3.21$ % Span [Reference 2.9.e & Reference 2.8 (WCAP Table 3-17)]

TS = 601 psig [Reference 2.13.a (UFAPPD, Table 2.18)]

SAL' = 542.2 psig [Reference 2.9.e, Page 19 ("No EA for M&E Analysis")]

Note that Reference 2.13.a (UFAPPD, Table 2.18) specifies original Reference 2.10.a & 2.10.b uncertainty estimate of 370.9 psig (based upon the 370.5-psig SAL specified in FCQL-355). The 370.9-psig value assumes an environmental allowance (if pressure transmitters are located in steam tunnel). These transmitters are located outside the MS Tunnel [in the Reactor Auxiliary Building Elev. 261'], and will not be exposed to harsh environmental conditions for a Main Steam Line Break or Feedwater Line Break.

$$TA' = \{ (TS - SAL') / 1300 \text{ psig Span} \} \times 100 \text{ \% Span} = 4.52 \text{ \% Span}$$

$$\text{Margin} = TA - CSA' = 1.31 \text{ \% Span}$$

$$S' = \{ (SD) + (SCA) \} = \{ (1.50) + (0.50) \} = 2.00 \text{ \% Span}$$

$$Z' = (A')^{1/2} + EA$$

$$= \{ (PMA)^2 + (PEA)^2 + (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA$$

$$= \{ 0^2 + 0^2 + 0^2 + (0.50)^2 + (0.50)^2 \}^{1/2} + (0.0) = 0.71 \text{ \% Span}$$

R' = T' is the lesser of:

$$T_1' = \{ RD + RCA \} = \{ (1.0) + (0.5) \} = 1.50 \text{ \% Span}$$

$$T_2' = TA' - S' - Z' = 4.52 - 2.00 - 0.71 = 1.81 \text{ \% Span}$$

$$AV' = \{ TS - [R'/100\%\text{Span}] \times 1300 \text{ psig} \} = 581.5 \text{ psig}$$

The above-computed AV' is somewhat less than that originally specified by FCQL-355 (owing to T = 1.8 %Span). Given the above-noted elimination of the harsh environment [EA] uncertainty, the above-computed values for CSA', TA', and Z' are also correspondingly reduced.

A comparison of current and post-PUR/SGR values are summarized as follows:

TABLE 3-17 (Cont'd)
STEAMLINE PRESSURE - LOW
Summary of CSA and Five-Column Tech Spec Terms

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	17.7 % Span	4.52 % Span
Z Term	14.81 % Span	0.71 % Span
Sensor Error (S)	1.5 % Span	2.0 % Span
Trip Setpoint (TS)	$\geq$ 601 psig	$\geq$ 601 psig
Allowable Value (AV)	$\geq$ 578.3 psig	$\geq$ 581.5 psig

TABLE 3-18A
SG WATER LEVEL - HIGH-HIGH, BARTON 764 XMTRS
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein (as modified below), the following values were computed for post-PUR/SGR Tech Spec terms for this trip function.

$$CSA' = [(SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2} + EA_{RefLeg} + EA_{HELB} + PMA_{RefLegTemp} + PMA_{Pressure} + PMA_{Subcool} + PMA_{FluidVelocity} + PMA_{MidPlateDP}$$

$$= [(0.50 + 1.50)^2 + (0.50)^2 + (0.63)^2 + (0.50 + 0.50)^2 + (0.50)^2 + (0.08 + 1.00)^2 + (0.50)^2 + (0.50 + 0.08)^2]^{1/2} + (0.00) + (0.00) + (1.20) + (1.50) + (0.00) + (4.40) + (0.00)$$

$= 9.87$ % Span [Reference 2.9.a and Reference 2.8 (WCAP Table 3-18a)]

As noted per Table 3-10A, the above CSA′ computation includes: a 1.5% Span sensor drift uncertainty (versus the 2.0% Span value originally assumed in References 2.8 and 2.9.a); and conservatively chosen Biases which reflect worst-case values.

TS′ = 78.0 % level [Reference 2.13.a (UFAPPD, Table 2.18)]

SAL′ = 100.0 % level [Reference 2.13.a (UFAPPD, Table 2.18)]

TA′ = { (SAL′ - TS′) / 100 % level } x 100 % Span = 22.0 % Span

Margin = TA′ - CSA′ = 12.13 % Span

S′ = { (SD) + (SCA) } = { (1.50) + (0.50) } = 2.00 % Span

$$Z' = (A')^{1/2} + \text{Biases}$$

$$= \{ (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA_{RefLeg} + EA_{HELB} + PMA_{RefLegTemp} + PMA_{Pressure} + PMA_{Subcool} + PMA_{FluidVelocity} + PMA_{MidPlateDP}$$

$$= \{ (0.63)^2 + (0.50)^2 + (0.50)^2 \}^{1/2} + (0.00) + (0.00) + (1.20) + (1.50) + (0.00) + (4.40) + (0.00) = 8.05 \text{ \% Span}$$

<u>NOTE:</u> Since a slightly larger Z′ value of 9.63 % Span was computed per Table 3-18B herein (for the Tobar transmitters used for this same application), this larger value should be used for all Barton and Tobar transmitters (as it conservatively reduces the overall total allowance used in operability determinations).

R′ = T′ is the lesser of:

T_1' = { RD + RCA } = { (1.0) + (0.5) } = 1.50 % Span

T_2' = TA′ - S′ - Z′ = 22.00 - 2.00 - 9.63 = 10.37 % Span

AV′ = { TS′ + [R′/100%Span] x 100 % Level } = 79.5 % Level

Since the above-noted trip setpoint corresponds to a requirement for the Model Δ75 replacement steam generators [RSGs], the current Tech Spec values (associated with the Model D-4 SGs) are not directly comparable. The summary which follows (for current and post-PUR/SGR values) has been provided for completeness only:

TABLE 3-18A (Cont'd)
SG WATER LEVEL - HIGH-HIGH, BARTON 764 XMTRS
Summary of CSA and Five-Column Tech Spec Terms

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	15.0 % Span	22.0 % Span
Z Term	11.25 % Span	9.63 % Span
Sensor Error (S)	2.97 % Span	2.0 % Span
Trip Setpoint (TS)	≤ 82.4 % level span	≤ 78.0 % level span
Allowable Value (AV)	≤ 84.2 % level span	≤ 79.5 % level span

TABLE 3-18B
SG WATER LEVEL - HIGH-HIGH, TOBAR 32DP1 XMTRS
Summary of CSA and Five-Column Tech Spec Terms

Based upon the equations shown per Table 1-2 herein (as modified below), the following values were computed for post-PUR/SGR Tech Spec terms for this trip function (including the additional uncertainty term for the Tobar Model 32DP1 sensor bias).

$$\begin{aligned} CSA' &= [\ (SMTE + SD)^2 + (STE)^2 + (SPE)^2 + (SCA + SMTE)^2 + (SRA)^2 + \\ &\quad (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2\ ]^{1/2} + EA_{RefLeg} + EA_{HELB} + \\ &\quad PMA_{RefLegTemp} + PMA_{Pressure} + PMA_{Subcool} + PMA_{FluidVelocity} + PMA_{MidPlateDP} + PMA_{Sensor} \\ &= [\ (0.50 + 1.50)^2 + (0.50)^2 + (0.63)^2 + (0.50 + 0.50)^2 + (0.50)^2 + \\ &\quad (0.08 + 1.00)^2 + (0.50)^2 + (0.50 + 0.08)^2\ ]^{1/2} + (0.00) + (0.00) + \\ &\quad (1.20) + (1.50) + (0.00) + (4.40) + (0.00) + (1.58) \\ &= 11.45\ \%\ Span \end{aligned}$$

[Reference 2.4.d (SGR updated) and Reference 2.9.a]

As noted per Table 3-10A, the above CSA' computation includes: a 1.5% Span sensor drift uncertainty (versus the 2.0% Span value originally assumed in References 2.8 and 2.9.a); and conservatively chosen Biases which reflect worst-case values.

TS' = 78.0 % level [Reference 2.13.a (UFAPPD, Table 2.18)]

SAL' = 100.0 % level [Reference 2.13.a (UFAPPD, Table 2.18)]

TA' = { (SAL' - TS') / 100 % level } x 100 % Span = 22.0 % Span

Margin = TA' - CSA' = 10.55 % Span

S' = { (SD) + (SCA) } = { (1.50) + (0.50) } = 2.00 % Span

$$\begin{aligned} Z' &= (A')^{1/2} + Biases \\ &= \{ (SPE)^2 + (STE)^2 + (RTE)^2 \}^{1/2} + EA_{RefLeg} + EA_{HELB} + PMA_{RefLegTemp} + \\ &\quad PMA_{Pressure} + PMA_{Subcool} + PMA_{FluidVelocity} + PMA_{MidPlateDP} + PMA_{Sensor} \\ &= \{ (0.63)^2 + (0.50)^2 + (0.50)^2 \}^{1/2} + (0.00) + (0.00) + (1.20) + \\ &\quad (1.50) + (0.00) + (4.40) + (0.00) + (1.58) \quad = \quad 9.63\ \%\ Span \end{aligned}$$

R' = T' is the lesser of:

T_1' = { RD + RCA } = { (1.0) + (0.5) } = 1.50 % Span

T_2' = TA' - S' - Z' = 22.00 - 2.00 - 9.63 = 10.37 % Span

AV' = { TS' + [R'/100%Span] x 100 % Level } = 79.5 % Level

Since the above-noted trip setpoint corresponds to a requirement for the Model Δ75 replacement steam generators [RSGs], the current Tech Spec values (associated with the Model D-4 SGs) are not directly comparable.

The summary which follows (for current and post-PUR/SGR values) has been provided for completeness only, and is consistent with the values computed in Table 3-18A:

TABLE 3-18B (Cont'd)

SG WATER LEVEL - HIGH-HIGH, TOBAR 32DP1 XMTRS

Summary of CSA and Five-Column Tech Spec Terms

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	15.0 % Span	22.0 % Span
Z Term	11.25 % Span	9.63 % Span
Sensor Error (S)	2.97 % Span	2.0 % Span
Trip Setpoint (TS)	≤ 82.4 % level span	≤ 78.0 % level span
Allowable Value (AV)	≤ 84.2 % level span	≤ 79.5 % level span

TABLE 3-19
REACTOR COOLANT PUMP UNDERVOLTAGE - LOW
Summary of CSA and Five-Column Tech Spec Terms

Reference 2.4.i [HNP Electrical Calculation E2-0010] documents the basis for current Tech Spec Trip Setpoint (TS) and Allowable Value (AV) of ≥ 5148 volts and ≥ 4920 volts, respectively.

Reference 2.9.k [CN-SSO-99-17, Rev. 1] evaluated the uncertainties for this function, and confirmed that positive margin exists with the resultant CSA' of 10.29% of span. The Reference 2.9.k evaluation was based upon current MST-E0074 surveillance testing and acceptance criterion. (Note that this CSA' value was unchanged from the original CSA per Reference 2.3 [FCQL-355].) Furthermore, it was noted that this trip function is not credited within current SPC accident safety analyses.

Since no PUR/SGR hardware changes are proposed for this function, no changes to the current "five-column" Tech Spec values have been made herein.

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	14.0 % Span	14.0 % Span
Z Term	1.3 % Span	1.3 % Span
Sensor Error (S)	0.0 % Span	0.0 % Span
Trip Setpoint (TS)	≥ 5148 volts	≥ 5148 volts
Allowable Value (AV)	≥ 4920 volts	≥ 4920 volts

TABLE 3-20
REACTOR COOLANT PUMP UNDERFREQUENCY - LOW
Summary of CSA and Five-Column Tech Spec Terms

Reference 2.4.j [HNP Electrical Calculation E2-0011] documents the basis for current Tech Spec Trip Setpoint (TS) and Allowable Value (AV) of ≥ 57.5 Hz and ≥ 57.3 Hz, respectively.

Reference 2.9.k [CN-SSO-99-17, Rev. 1] evaluated the uncertainties for this function, and confirmed that positive margin exists with the resultant CSA' of 1.81% of span. The Reference 2.9.k evaluation was based upon current MST-E0073 surveillance testing and acceptance criterion.

Since no PUR/SGR hardware changes are proposed for this function, no changes to the current "five-column" Tech Spec values have been made herein.

Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	5.0 % Span	5.0 % Span
Z Term	3.0 % Span	3.0 % Span
Sensor Error (S)	0.0 % Span	0.0 % Span
Trip Setpoint (TS)	≥ 57.5 Hz	≥ 57.5 Hz
Allowable Value (AV)	≥ 57.3 Hz	≥ 57.3 Hz

TABLE 3-21
LOW FLUID OIL PRESSURE, TURBINE TRIP
Summary of CSA and Five-Column Tech Spec Terms

Refer to Reference 2.4.g [Calculation HNP-I/INST-1055], Pages 5 through 9 for the basis for current Tech Spec Trip Setpoint (TS) and Allowable Value (AV) of $\geq$ 1000 psig and $\geq$ 950 psig, respectively. Since no PUR/SGR hardware changes are proposed for this function, no changes to these current Tech Spec have been made herein.

Reference 2.4.g evaluated the acceptability of a 50-psig tolerance below the nominal setpoint as representative of the greater of either: a statistically calculated 44.78 psig [as-found/as-left] drift allowance; or a $\pm$ 28 psig MST 'allowable range' (e.g., calibration accuracy setting). (Data Sheet (2 [of 4]) from MST-I0260 [typical] reflects current calibration practices and as-found acceptance criterion.)

TABLE 3-22
TURBINE THROTTLE VALVE CLOSURE, TURBINE TRIP
Summary of CSA and Five-Column Tech Spec Terms

Refer to Reference 2.4.f [Calculation HNP-I/INST-1054] for the basis for current Tech Spec Trip Setpoint (TS) and Allowable Value (AV) of ≥ 1% open and ≥ 1% open, respectively. Since no PUR/SGR hardware changes are proposed for this function, no changes to these current Tech Spec have been made herein.

Reference 2.4.f evaluated the acceptability of the current MST implementation, in relation to the original Tech Spec TS and AV. (Data Sheets (2 and 3 [of 5]) from MST-I0263 [typical] reflect current calibration practices and as-found acceptance criterion.) These practices/criterion can be summarized as follows, given the physical configuration and practicality of surveillance measurements:

- The current "≥ 1% open" TS is actually calibrated as 4.76% open [(0.75-inches / 15.76-inches) x 100%], owing to the 0.75-inch setpoint measurement over a total stroke of the 15.76-inch valve actuator stem.
- This allows for variations between 'as-found' and 'as-left' settings (historically found to be within ± 0.45-inches or ± 2.86% open) and additional margin [beyond the analytical limit (allowable value)].
- A + 0.25-inch allowable range [i.e., from 0.75 to 1.00 inches] is maintained for the calibration/surveillance process. This allowable range corresponds to a ±1.59% open tolerance [(0.25 / 15.76) x 100%].

TABLE 3-23
RWST LEVEL - LOW-LOW
Summary of CSA and Five-Column Tech Spec Terms

Reference 2.4.h [Calculation EQS-2] provides the RWST Low-Low Level setpoint requirement, to start switchover from RWST supply to the containment sump. This switchover setpoint is defined as 23.4% level by the current Tech Spec Trip Setpoint (TS). Reference 2.4.h also notes an historical 2.41% of span instrument error (as originally provided by Westinghouse Project Letter CQL8673, using the same methodology as contained in Reference 2.3 [FCQL-355]), which is enveloped by the 3.0% of span allowance provided by the current Tech Spec Allowable Value (AV) of 20.4% level.

Reference 2.4.c [Calculation HNP-I/INST-1030] provides a computation of EOP indication accounting for the total of all channel uncertainty components (i.e., from the level transmitter through the process racks and MCB indicator).

For consistency with other uncertainty computations performed for post-PUR/SGR operation, CSA' has been computed herein using the Table 1-2 equation/terms. This result is also reconciled in relation to existing plant documentation. LT-990 & LT-992 are Barton Model 752 transmitters, and LT-991 & LT-993 are Rosemount Model 1153DP transmitters; therefore two different sets of uncertainties have been shown for the installed transmitters, with a reference/explanation for values chosen herein:

Uncertainty Parameter	Uncertainty (w/Barton Xmtr)	Uncertainty (w/Rosemount Xmtr)	Reference(s) / Notes
PMA	1.21	1.21	See Note 1 (below)
PEA	0.00	0.00	Not Applicable to level measurement
SRA	0.31	0.25	INST-1030, Sect. 5.1A.1 and 5.1B.1
SCA	0.50	0.50	INST-1030, Sect. 5.1A.10 & 5.1.B.10
SMTE	0.71	0.71	INST-1030, Sect. 5.1A.9 and 5.1.B.9; See Note 2 (below)
STE	1.44	1.89	INST-1030, Sect. 5.1A.3 and 5.1B.3
SPE	0.00	0.00	INST-1030, Sect. 5.1A.5 and 5.1B.5
SD	1.25	1.01	INST-1030, Sect. 5.1A.2 and 5.1B.2; See Note 3 (below)
EA	0.00	0.00	Not Applicable (INST-1030,Sect.4.5)
SEISMIC	0.00	0.00	Not Applicable (INST-1030,Sect.4.13)
RCA	0.50	0.50	Typical value per Ref. 2.9.x CNs
RMTE	0.50	0.50	Typical value per Ref. 2.9.x CNs
RTE	0.50	0.50	INST-1030, 5.4.3
RD	1.00	1.00	INST-1030, 5.4.2

Note 1: INST-1030, Section 5.5.1 states that: increasing density affects level with negative uncertainty (i.e., a resultant higher level), and decreasing density effects level

TABLE 3-23 (Cont'd)
RWST LEVEL - LOW-LOW
Summary of CSA and Five-Column Tech Spec Terms

with positive uncertainty (i.e., a resultant lower level). INST-1030 Positive and Negative Uncertainties of -1.21% and +0.34% were calculated. Consistent with the conservative assumption made within INST-1030, ±1.21 was selected as a random uncertainty component for CSA' computation herein, since the assumed higher level will result in an additional measurement uncertainty with respect to the decreasing Low-Low level setpoint. This density effect is treated as a random uncertainty in INST-1030, because of the unknown direction of the change in temperature and/or concentration (and resultant density change).

Note 2: Sensor MTEin and MTEout uncertainty components specified in INST-1030 are shown as a corresponding SRSS value.

Note 3: Based upon comparison of "as-left" and subsequent "as-found" MST calibration data and the MST allowable transmitter drift, this value has been reduced to a realistic value of 1.25% of span for the purposes of this CSA' computation (in lieu of that assumed by INST-1030, Section 5.1A.2).

$$\begin{aligned}
CSA'_{Barton} &= [(PMA)^2 + (SMTE + SD)^2 + (STE)^2 + (SCA + SMTE)^2 + \\
&\quad (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2} \\
&= [(1.21)^2 + (0.71 + 1.25)^2 + (1.44)^2 + (0.50 + 0.71)^2 + \\
&\quad (0.31)^2 + (0.5 + 1.0)^2 + (0.5)^2 + (0.5 + 0.5)^2]^{1/2} \\
&= 3.523 \text{ \% of span}
\end{aligned}$$

$$\begin{aligned}
CSA'_{Rosemount} &= [(PMA)^2 + (SMTE + SD)^2 + (STE)^2 + (SCA + SMTE)^2 + \\
&\quad (SRA)^2 + (RMTE + RD)^2 + (RTE)^2 + (RCA + RMTE)^2]^{1/2} \\
&= [(1.21)^2 + (0.71 + 1.01)^2 + (1.89)^2 + (0.50 + 0.71)^2 + \\
&\quad (0.25)^2 + (0.5 + 1.0)^2 + (0.5)^2 + (0.5 + 0.5)^2]^{1/2} \\
&= 3.606 \text{ \% of span}
\end{aligned}$$

For subsequent discussions, the larger uncertainty of 3.606% span will be further evaluated for its effects to the subject ESFAS trip function.

(3.606% span/100%) x (416.3 Inches WC [Xmtr Span, per INST-1030, Sect.4.9]) x (1-Ft/12-In) = 1.251-Ft of trip channel uncertainty, based upon CSA'. This is slightly larger than the 1.04-Ft measurement error assumed in Calculation EQS-2 (based upon the originally calculated Westinghouse instrument error value of 2.41% Span).

Since Calculation EQS-2 further calculated a 1.74-Ft (or equivalent 20,000 gallons) margin above the required switchover requirement with the current trip setpoint value, the small reduction [1.04 - 1.251 Ft = -0.211 Ft or -2.532 Inches] in this available margin will be negligible relative to the TS and AV.

Since no PUR/SGR hardware changes are proposed for this function, no changes to the current Tech Spec TS and AV appear warranted, based upon the above discussion.

TABLE 3-24
6.9 KV E-BUS UNDERVOLTAGE - PRIMARY, LOOP
Summary of CSA and Five-Column Tech Spec Terms

Reference 2.4.1 [HNP Electrical Calculation 0054-JRG] documents the basis for current Tech Spec Trip Setpoint (TS) of $\geq$ 4830 volts (with a $\leq$ 1.0 second time delay) and an Allowable Value (AV) of $\geq$ 4692 volts (with a $\leq$ 1.5 second time delay). Furthermore, Reference 2.4.1 evaluated the acceptability for current calibration practices and as-found acceptance criterion as contained within MST-E0075.

Since no PUR/SGR hardware changes are proposed for this function, no changes to these current Tech Spec have been made herein.

TABLE 3-25
6.9 KV E-BUS UNDERVOLTAGE - SECONDARY, LOOP
Summary of CSA and Five-Column Tech Spec Terms

Reference 2.4.k [HNP Electrical Calculation E2-0005.09] documents the basis for current Tech Spec Trip Setpoint (TS) of $\geq$ 6420 volts (with a $\leq$ 16.0 second time delay with Safety Injection, or with a $\leq$ 54.0 second time delay without Safety Injection) and an Allowable Value (AV) of $\geq$ 6392 volts (with a $\leq$ 18.0 second time delay with Safety Injection, or with a $\leq$ 60.0 second time delay without Safety Injection). Furthermore, Reference 2.4.k evaluated the acceptability for current calibration practices and as-found acceptance criterion as contained within MST-E0045.

Since no PUR/SGR hardware changes are proposed for this function, no changes to these current Tech Spec have been made herein.

TABLE 3-26
RTS P-6 INTERLOCK
Summary of CSA and Five-Column Tech Spec Terms

Table 3-3 computations herein summarize uncertainties associated with the RTS trip function for the NIS Intermediate Range channels. In addition, an RTS P-6 Interlock is included as Tech Spec Table 2.2-1, Item 19.a. Its current (and post-PUR/SGR) Tech Spec Trip Setpoint [TS] is $\geq 1.0 \times 10^{-10}$ amp.

As noted in Table 3-3 herein, no PUR/SGR hardware changes are proposed for the Intermediate Range channels; channels will be scaled commensurate for the increased RTP (consistent with the detectors' increased output).

The detector output span will continue to vary from 1×10^{-11} to 1×10^{-3} amp (corresponding to 0 to 120% RTP), with the following NIS IR rack transfer function: $\text{Voltage} = 1.25[\log_{10}(\text{Input Current}) + 11]$ or $\text{Input Current} = 10^{(0.8\text{Voltage} - 11)}$.

Setpoints are conservatively established (at relatively lower settings) during the start-up evolutions, commensurate with other known operating parameters.

Furthermore, current maintenance surveillance/calibration practices and acceptance criterion have proven acceptable to satisfy the current Tech Spec requirements.

Therefore, the post-PUR/SGR Tech Spec Allowable Value [AV'] should remain unchanged from the original HNP Tech Spec requirements, at $\geq 6.0 \times 10^{-11}$ amp. This justification precludes the need for methodology, terminology, and values specified on Page 28 of Ref. 2.9.h. (Note that R' should approach the [current] AV, when drift is included with the rack calibration tolerance [RCA', as defined on Page 26 of Ref. 2.9.h].)

In conclusion, no changes to the current "five-column" Tech Spec term values (associated with this permissive function) have been made herein.

TABLE 3-27
RTS P-7, P-10, AND P-13 INTERLOCKS
Summary of CSA and Five-Column Tech Spec Terms

Computations within Tables 3-1A, 3-1B, 3-2A, and 3-2B herein summarize various channel uncertainties associated with the RTS trip functions for the NIS Power Range channels. In addition, RTS Interlocks P-7, P-10, and P-13 (included as Tech Spec Table 2.2-1, Items 19.b(1), 19.b(2), 19.d, and 19.e) assure that plant start-up/ shutdown evolutions are controlled commensurate with permissible power level indications (from either the NIS Power Range or the First Stage Turbine Impulse Chamber Pressure channels). These interlocks currently monitor plant operations around a nominal trip setpoint of 10% of RTP; a post-PUR/SGR Tech Spec Trip Setpoint [TS] based upon 10% RTP remains applicable. (These RTS Interlocks functionally perform either Blocks or Permissives associated with subsequent automatic protection/control actions. For example, the RTS P-7 Block (with inputs from either P-10 NIS or P-13 turbine impulse pressure) is based upon a ≤ 10% RTP condition; the RTS P-10 Permissive (also generated from NIS channels) is based upon a ≥ 10% RTP condition.)

As noted in Table 3-1A through 3-2B for the NIS Power Range channels, <u>no</u> PUR/SGR hardware changes are proposed for these channels; channels will be scaled commensurate for the increased RTP (consistent with the detectors' increased output).

Although not discussed within a specific computation within this calculation, Turbine Impulse Chamber Pressure channels will also not undergo PUR/SGR-related hardware changes (except for scaling completed for slightly higher uprated RSG and turbine impulse pressures); turbine impulse chamber pressure P-13 input (to P-7) should be equivalent [for TS' and AV'] to the RTS input(s) received from NIS channels, since the subject RTS Interlocks for turbine impulse chamber pressure and NIS channels have the same functional requirements.

NIS setpoints are conservatively established (at relatively lower settings) for protection/control purposes during the start-up evolutions, commensurate with other known operating parameters. Similarly, Turbine Impulse Chamber Pressure channels are initially scaled for conservatively expected power levels, and then re-normalized (if required) for that fuel cycle's operation. Plant power ascension procedural controls assure that manual operator actions are based on the most conservative indication of reactor power (e.g., ΔT, NIS, RCS flow, calorimetric) or turbine load (e.g., impulse chamber pressure, MWe output).

Furthermore, current maintenance surveillance/calibration practices and acceptance criterion have proven acceptable to satisfy the current Tech Spec requirements.

Note that R' was maintained per Table 3-1A herein, at 1.75% span [or 2.1% RTP]. Therefore, the post-PUR/SGR Tech Spec Allowable Value [AV'] should remain <u>unchanged</u> from the original HNP Tech Spec requirements, at the nominal 10.0 ± 2.1% of RTP (with its inequality based upon the specific [Block or Permissive] trip function requirement, in a direction commensurate with its corresponding TS). This justification precludes the need for methodology, terminology, and values specified on Pages 32-33 of Ref. 2.9.g (given that "five-column" AV [and AV'] include rack drift in addition to the rack calibration tolerance [RCA', as defined on Page 20 of Ref. 2.9.g].)

In conclusion, <u>no</u> changes to the current "five-column" Tech Spec term values (associated with this permissive function) have been made herein.

TABLE 3-28
RTS P-8 INTERLOCK
Summary of CSA and Five-Column Tech Spec Terms

The RTS Interlock P-8 (included as Tech Spec Table 2.2-1, Item 19.c) assures that plant start-up/shutdown evolutions are controlled commensurate with permissible power level indication from the NIS Power Range channels. This interlock currently monitors plant operations around a nominal trip setpoint [TS] of $\leq$ 49% of RTP, with an Allowable Value [AV] of $\leq$ 51.1% of RTP.

Utilizing the same justifications as that provided within Table 3-27 herein (which support the maintenance of R' at 1.75% span [or 2.1% RTP]), a post-PUR/SGR Tech Spec Trip Setpoint [TS'] of $\leq$ 49% RTP, and an Allowable Value [AV'] $\leq$ 51.1% of RTP, remain applicable. This rationale precludes the need for methodology, terminology, and values specified on Page 31 of Ref. 2.9.g (given that "five-column" AV [and AV'] include rack drift in addition to the rack calibration tolerance [RCA', as defined on Page 20 of Ref. 2.9.g].)

In conclusion, no changes to the current "five-column" Tech Spec term values (associated with this permissive function) have been made herein.

TABLE 3-29
ESFAS P-11 / Not P-11 INTERLOCK
Summary of CSA and Five-Column Tech Spec Terms

Tables 3-7A, 3-7B, and 3-13 herein summarize uncertainties associated with RTS/ESFAS trip functions associated with Pressurizer Pressure channels. In addition, ESFAS P-11 and Not P-11 Interlocks are included within Tech Spec Table 3.3-4, Item 10.a. The P-11 interlock currently monitors plant operations around a nominal trip setpoint [TS] of ≥ 2000 psig, with an Allowable Value [AV] of ≥ 1986 psig. The Not P-11 interlock currently monitors plant operations around a nominal trip setpoint [TS] of ≤ 2000 psig, with an Allowable Value [AV] of ≤ 2014 psig.

Utilizing the same R′ value of 1.50% of span (or 12.0 psig) determined from the above-noted Table 3-7A, 3-7B, and 3-13 summaries: a post-PUR/SGR Tech Spec Trip Setpoint [TS′] for the P-11 Interlock of ≥ 2000 psig, and an Allowable Value [AV′] ≥ 1988 psig, would apply; and a post-PUR/SGR Tech Spec Trip Setpoint [TS′] for the Not P-11 Interlock of ≤ 2000 psig, and an Allowable Value [AV′] ≤ 2012 psig, would apply. This R′ term includes rack drift in addition to the rack calibration tolerance, consistent with other Pressurizer Pressure computations documented herein.

Therefore, for completeness, post-PUR/SGR Tech Spec trip setpoint and allowable value can be summarized as follows:

P-11 INTERLOCK:		
Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	N/A	N/A
Z Term	N/A	N/A
Sensor Error (S)	N/A	N/A
Trip Setpoint (TS)	≥ 2000 psig	≥ 2000 psig
Allowable Value (AV)	≥ 1986 psig	≥ 1988 psig

NOT P-11 INTERLOCK:		
Tech Spec Term	Current Tech Spec Value	Post-PUR/SGR Value
Total Allowance (TA)	N/A	N/A
Z Term	N/A	N/A
Sensor Error (S)	N/A	N/A
Trip Setpoint (TS)	≤ 2000 psig	≤ 2000 psig
Allowable Value (AV)	≤ 2014 psig	≤ 2012 psig

TABLE 4-1

Calc. No. HNP-I/INST-1010
Rev. 0
Page 85

TABLE 2.2-1

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

	FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
1.	Manual Reactor Trip	N.A.	N.A.	N.A.	N.A.	N.A.
2.	Power Range, Neutron Flux					
	a. High Setpoint	7.5	4.56	0	≤ 109% of RTP**	≤ 111.1% of RTP**
	b. Low Setpoint	8.3	4.56	0	≤ 25% of RTP**	≤ 27.1% of RTP**
3.	Power Range, Neutron Flux, High Positive Rate	~~1.6~~ 2.5	~~0.5~~ 0.83	0	≤ 5% of RTP** with a time constant ≥ 2 seconds	≤ 6.3% of RTP** with a time constant ≥ 2 seconds
4.	Power Range, Neutron Flux, High Negative Rate	~~1.6~~	~~0.5~~	0	≤ 5% of RTP** with a time constant ≥ 2 seconds	≤ 6.3% of RTP** with a time constant ≥ 2 seconds
5.	Intermediate Range, Neutron Flux	17.0	8.41	0	≤ 25% of RTP**	≤ 30.9% of RTP**
6.	Source Range, Neutron Flux	17.0	10.01	0	≤ 10^5 cps	≤ 1.4 x 10^5 cps
7.	Overtemperature ΔT	9.0 ~~8.7~~	7.31 ~~6.02~~	Note 5	See Note 1	See Note 2
8.	Overpower ΔT	4.0 ~~4.7~~	2.32 ~~1.50~~	~~1.9~~ 1.3	See Note 3	See Note 4
9.	Pressurizer Pressure-Low	5.0	1.52 ~~2.21~~	1.5	≥ 1960 psig	≥ ~~1946~~ 1948 psig
10.	Pressurizer Pressure-High	7.5	~~5.01~~	~~0.5~~ 1.5	≤ 2385 psig	≤ ~~2399~~ 2397 psig
11.	Pressurizer Water Level-High	8.0	3.42 ~~2.18~~	~~1.5~~ 1.75	≤ 92% of instrument span	≤ ~~93.0~~% of instrument span 93.5

**RTP = RATED THERMAL POWER

TABLE 4-1

Calc. No. HNP-I/INST-1010
Rev. 0
Page 86

TABLE 2.2-1 (continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
12. Reactor Coolant Flow-Low	~~2.9~~ 4.58	1.98	0.6	≥ 90.5% of loop full indicated flow	≥ 89.5% of loop full indicated flow
13. Steam Generator Water Level Low-Low	~~19.2~~ 25.0	~~14.06~~ 16.85	~~2.97~~ 2.0	≥ ~~38.5~~ 25.0% of narrow range instrument span	≥ ~~36.5~~ 23.5% of narrow range instrument span
14. Steam Generator Water Level - Low	~~19.2~~ 8.9	~~2.23~~ 5.35	~~2.97~~ 2.0	≥ ~~38.5~~ 25.0% of narrow range instrument span	≥ ~~36.5~~ 23.5% of narrow range instrument span
Coincident With Steam/Feedwater Flow Mismatch	20.0	~~3.41~~ 3.01	Note 6	≤ 40% of full steam flow at RTP**	≤ 43.1% of full steam flow at RTP**
15. Undervoltage - Reactor Coolant Pumps	14.0	1.3	0.0	≥ 5148 volts	≥ 4920 volts
16. Underfrequency - Reactor Coolant Pumps	5.0	3.0	0.0	≥ 57.5 Hz	≥ 57.3 Hz
17. Turbine Trip					
a. Low Fluid Oil Pressure	N.A.	N.A.	N.A.	≥ 1000 psig	≥ 950 psig
b. Turbine Throttle Valve Closure	N.A.	N.A.	N.A.	≥ 1% open	≥ 1% open
18. Safety Injection Input from ESF	N.A.	N.A.	N.A.	N.A.	N.A.

**RTP = RATED THERMAL POWER

TABLE 4-1
Calc. No. HNP-I/INST-1010
Rev. 0
Page 87

TABLE 2.2-1 (Continued)

REACTOR TRIP SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
19. Reactor Trip System Interlocks					
a. Intermediate Range Neutron Flux, P-6	N.A.	N.A.	N.A.	$\geq 1 \times 10^{-10}$ amp	$\geq 6 \times 10^{-11}$ amp
b. Low Power Reactor Trips Block, P-7					
1) P-10 input	N.A.	N.A.	N.A.	$\leq$10% of RTP**	$\leq$12.1% of RTP**
2) P-13 input	N.A.	N.A.	N.A.	<10% RTP** Turbine Impulse Pressure Equivalent	<12.1% RTP** Turbine Impulse Pressure Equivalent
c. Power Range Neutron Flux, P-8	N.A.	N.A.	N.A.	$\leq$49% of RTP**	$\leq$51.1% of RTP**
d. Power Range Neutron Flux, P-10	N.A.	N.A.	N.A	$\geq$10% of RTP**	$\geq$7.9% of RTP**
e. Turbine Impulse Chamber Pressure, P-13	N.A.	N.A.	N.A.	<10% RTP** Turbine Impulse Pressure Equivalent	<12.1% RTP** Turbine Impulse Pressure Equivalent
20. Reactor Trip Breakers	N.A.	N.A.	N.A	N.A.	N.A.
21. Automatic Trip and Interlock Logic	N.A.	N.A.	N.A.	N.A.	N.A.
22. Reactor Trip Bypass Breakers	N.A.	N.A.	N.A.	N.A.	N.A.

**RTP = RATED THERMAL POWER

TABLE 4-1
Calc. No. HNP-I/INST-1010
Rev. 0
Page 88

TABLE 2.2-1 (Continued)
TABLE NOTATIONS

NOTE 1: OVERTEMPERATURE ΔT

$$\Delta T \frac{(1 + \tau_1 S)}{(1 + \tau_2 S)} \left(\frac{1}{1 + \tau_3 S}\right) \leq \Delta T_o \left\{K_1 - K_2 \frac{(1 + \tau_4 S)}{(1 + \tau_5 S)} \left[T \left(\frac{1}{1 + \tau_6 S}\right) - T'\right] + K_3(P - P') - f_1(\Delta I)\right\}$$

Where: ΔT = Measured ΔT by RTD Instrumentation;

$\frac{1 + \tau_1 S}{1 + \tau_2 S}$ = Lead-lag compensator on measured ΔT;

τ_1, τ_2 = Time constants utilized in lead-lag compensator for ΔT, τ_1 = $\boxed{8}$ 0 s, τ_2 = $\boxed{3}$ 0 s;

$\frac{1}{1 + \tau_3 S}$ = Lag compensator on measured ΔT;

τ_3 = Time constants utilized in the lag compensator for ΔT, τ_3 = $\boxed{0}$ 4 s;

ΔT_o = Indicated ΔT at RATED THERMAL POWER;

K_1 = ~~1.17~~; 1.185

K_2 = 0.0224/°F;

$\frac{1 + \tau_4 S}{1 + \tau_5 S}$ = The function generated by the lead-lag compensator for T_{avg} dynamic compensation;

τ_4, τ_5 = Time constants utilized in the lead-lag compensator for T_{avg}, τ_4 = $\boxed{28}$ 22 s, τ_5 = 4 s;

TABLE 4-1
Calc. No. HNP-I/INST-1010
Rev. 0
Page 89

TABLE 2.2-1 (Continued)
TABLE NOTATIONS

NOTE 1: (Continued)

T	=	Average temperature, °F;
$\frac{1}{1 + \tau_6 S}$	=	Lag compensator on measured T_{avg};
τ_6	=	Time constant utilized in the measured T_{avg} lag compensator, τ_6 = 0 s;
T′	~~=~~ ≤	~~580.8°F (Nominal~~ Reference T_{avg} at RATED THERMAL POWER~~);~~ (≤ 588.8°F);
K_3	=	~~0.001072~~ 0.0012/psig;
P	=	Pressurizer pressure, psig;
P′	=	2235 psig (Nominal RCS operating pressure);
S	=	Laplace transform operator, s^{-1};

and f_1 (ΔI) is a function of the indicated difference between top and bottom detectors of the power-range neutron ion chambers; with gains to be selected based on measured instrument response during plant startup tests such that:

(1) For $q_t - q_b$ between -21.6% and +12.0%, f_1 (ΔI) = 0, where q_t and q_b are percent RATED THERMAL POWER in the top and bottom halves of the core respectively, and $q_t + q_b$ is total THERMAL POWER in percent of RATED THERMAL POWER;

(2) For each percent that the magnitude of $q_t - q_b$ exceeds -21.6%, the ΔT Trip Setpoint shall be automatically reduced by ~~2.36~~ 1.75% of its value at RATED THERMAL POWER; and

(3) For each percent that the magnitude of $q_t - q_b$ exceeds + 12.0%, the ΔT Trip Setpoint shall be automatically reduced by ~~1.57~~ 1.50% of its value at RATED THERMAL POWER.

NOTE 2: The channel's maximum Trip Setpoint shall not exceed its computed Trip Setpoint by more than ~~2.1% ΔT span.~~ 1.4% of ΔT span for ΔT input; 2.0% of ΔT span for Tavg input; 0.4% of ΔT span for pressurizer pressure input; and 0.7% of ΔT span for ΔI input.

TABLE 4-1

Calc. No. HNP-I/INST-1010
Rev. 0
Page 90

TABLE 2.2-1 (Continued)

TABLE NOTATIONS

NOTE 3: OVERPOWER ΔT

$$\Delta T \frac{(1 + \tau_1 S)}{(1 + \tau_2 S)} \left(\frac{1}{1 + \tau_3 S}\right) \leq \Delta T_o \left\{K_4 - K_5 \left(\frac{\tau_7 S}{1 + \tau_7 S}\right) \left(\frac{1}{1 + \tau_6 S}\right) T - K_6 \left[T \left(\frac{1}{1 + \tau_6 S}\right) - T''\right] - f_2(\Delta I)\right\}$$

Where:

ΔT	=	As defined in Note 1,
$\frac{1 + \tau_1 S}{1 + \tau_2 S}$	=	As defined in Note 1,
τ_1, τ_2	=	As defined in Note 1,
$\frac{1}{1 + \tau_3 s}$	=	As defined in Note 1,
τ_3	=	As defined in Note 1,
ΔT_o	=	As defined in Note 1,
K_4	=	$\boxed{\cancel{1.079}}$, 1.12
K_5	=	0.02/°F for increasing average temperature and 0 for decreasing average temperature,
$\frac{\tau_7 S}{1 + \tau_7 S}$	=	The function generated by the rate-lag compensator for T_{avg} dynamic compensation,
τ_7	=	Time constants utilized in the rate-lag compensator for T_{avg}, τ_7 = $\boxed{\cancel{10}}$ 13 s,
$\frac{1}{1 + \tau_6 S}$	=	As defined in Note 1,
τ_6	=	As defined in Note 1,

TABLE 4-1

Calc. No. HNP-I/INST-1010
Rev. 0
Page 91

TABLE 2.2-1 (Continued)

TABLE NOTATIONS

NOTE 3: (Continued)

K_6 = 0.002/°F for T > T" and K_6 = 0 for T ≤ T".

T = As defined in Note 1.

T" = ~~Indicated~~ Reference T_{avg} at RATED THERMAL POWER ~~(Calibration temperature for ΔT instrumentation, ≤ 580.8~~ (≤ 588.8 °F).

S = As defined in Note 1, and

$f_2(\Delta I)$ = 0 for all ΔI.

NOTE 4: The channel's maximum Trip Setpoint shall not exceed its computed Trip Setpoint by more than ~~2.3% ΔT span.~~ 1.4% of ΔT span for ΔT input and 0.2% of ΔT span for Tavg input.

~~NOTE 5: The sensor error for temperature is 1.9 and 1.1 for pressure.~~

~~NOTE 6: The sensor error for steam flow is 0.9, for feed flow is 1.5, and for steam pressure is 0.75.~~

NOTE 5: The sensor error is: 1.3% of ΔT span for ΔT/Tavg temperature measurements; and 1.0% of ΔT span for pressurizer pressure measurements.

NOTE 6: The sensor error (in % Span of Steam Flow) is: 1.1% for steam flow; 1.8% for feedwater flow; and 2.4% for steam pressure.

TABLE 4-2
Calc. No. HNP-I/INST-1010
Rev. 0
Page 92

TABLE 3.3-4

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
1. Safety Injection (Reactor Trip, Feedwater Isolation, Control Room Isolation, Start Diesel Generators, Containment Ventilation Isolation, Phase A Containment Isolation, Start Auxiliary Feedwater System Motor-Driven Pumps, Start Containment Fan Coolers, Start Emergency Service Water Pumps, Start Emergency Service Water Booster Pumps)					
a. Manual Initiation	N.A.	N.A.	N.A.	N.A.	N.A.
b. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	N.A.
c. Containment Pressure--High-1	~~2.7~~ 3.64	0.71	1.5	≤ 3.0 psig	≤ 3.6 psig
d. Pressurizer Pressure--Low	~~18.8~~ 18.75	~~14.41~~ 10.47	1.5	≥ 1850 psig	≥ ~~1836~~ 1838 psig
e. Steam Line Pressure--Low	~~17.7~~ 4.52	~~14.81~~ 0.71	~~1.5~~ 2.0	≥ 601 psig	≥ ~~578.3~~ 581.5 psig*
2. Containment Spray					
a. Manual Initiation	N.A.	N.A.	N.A.	N.A.	N.A.
b. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	N.A.
c. Containment Pressure--High-3	~~3.6~~ 3.64	0.71	1.5	≤ 10.0 psig	≤ 11.0 psig

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
3. Containment Isolation					
a. Phase "A" Isolation					
1) Manual Initiation	N.A.	N.A.	N.A.	N.A.	N.A.
2) Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	N.A.
3) Safety Injection	See Item 1. above for all Safety Injection Trip Setpoints and Allowable Values.				
b. Phase "B" Isolation					
1) Manual Containment Spray Initiation	N.A.	N.A.	N.A.	N.A.	N.A.
2) Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	N.A.
3) Containment Pressure--High-3	See Item 2.c. above for Containment Pressure High-3 Trip Setpoints and Allowable Values.				
c. Containment Ventilation Isolation					
1) Manual Containment Spray Initiation	N.A.	N.A.	N.A.	N.A.	N.A.
2) Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	N.A.

TABLE 4-2

Calc. No. HNP-I/INST-1010

Rev. 0

Page 94

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
3. Containment Isolation (Continued)					
3) Safety Injection	See Item 1. above for all Safety Injection Trip Setpoints and Allowable Values.				
4) Containment Radioactivity					
a) Area Monitors (both preentry and normal purges)	See Table 3.3-6, Item 1a, for trip setpoint.				
b) Airborne Gaseous Radioactivity					
(1) RCS Leak Detection (normal purge)	See Table 3.3-6, Item 1b1, for trip setpoint.				
(2) Preentry Purge Detector	See Table 3.3-6, Item 1b2, for trip setpoint.				
c) Airborne Particulate Radioactivity					
(1) RCS Leak Detection (normal purge)	See Table 3.3-6, Item 1C1, for trip setpoint.				
(2) Preentry Purge Detector	See Table 3.3-6, Item 1C2, for trip setpoint.				
5) Manual Phase "A" Isolation	N.A.	N.A.	N.A.	N.A.	N.A.

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
4. Main Steam Line Isolation					
a. Manual Initiation	N.A.	N.A.	N.A.	N.A.	N.A.
b. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	N.A.
c. Containment Pressure--High-2	$\boxed{2.7}$ 3.64	0.71	1.5	≤3.0 psig	≤3.6 psig
d. Steam Line Pressure--Low	See Item 1.e. above for Steam Line Pressure--Low Trip Setpoints and Allowable Values.				
e. Negative Steam Line Pressure Rate--High	2.3	0.5	0	≤ 100 psi#	≤ ~~122.8~~ 119.5 psi#**
5. Turbine Trip and Feedwater Isolation					
a. Automatic Actuation Logic Actuation Relays	N.A.	N.A.	N.A.	N.A.	N.A.

TABLE 4-2

Calc. No. HNP-I/INST-1010
Rev. 0
Page 96

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
5. Turbine Trip and Feedwater Isolation (Continued)					
b. Steam Generator Water Level--High-High (P-14)	~~15.0~~ 22.0	~~11.25~~ 9.63	~~2.97~~ 2.0	≤ ~~82.4~~ 78.0% of narrow range instrument span.	≤ ~~84.2~~ 79.5% of narrow range instrument span.
c. Safety Injection	See Item 1. above for Safety Injection Trip Setpoints and Allowable Values.				
6. Auxiliary Feedwater					
a. Manual Initiation	N.A.	N.A.	N.A.	N.A.	N.A.
b. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	N.A.
c. Steam Generator Water Level--Low-Low	~~19.2~~ 25.0	~~14.06~~ 16.85	~~2.97~~ 2.0	≥ ~~38.5~~ 25.0% of narrow range instrument span.	≥ ~~36.5~~ 23.5% of narrow range instrument span.
d. Safety Injection Start Motor-Driven Pumps	See Item 1. above for all Safety Injection Trip Setpoints and Allowable Values.				
e. Loss-of-Offsite Power Start Motor-Driven Pumps and Turbine-Driven Pump	See Item 9. below for all Loss-of-Offsite Trip Setpoint and Allowable Values.				
f. Trip of All Main Feedwater Pumps Start Motor-Driven Pumps	N.A.	N.A.	N.A.	N.A.	N.A.

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
6. Auxiliary Feedwater (Continued)					
g. Steam Line Differential Pressure--High	5.0	~~1.47~~ 0.87	3.0	≤ 100psi	≤ 127.4 psi
Coincident With Main Steam Line Isolation (Causes AFW Isolation)	See Item 4. above for Main Steam Line Isolation Trip Setpoints and Allowable Values.				
7. Safety Injection Switchover to Containment Sump					
a. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	N.A.
b. RWST Level--Low-Low	N.A.	N.A.	N.A.	≥ 23.4%	≥ 20.4%
Coincident With Safety Injection	See Item 1. above for all Safety Injection Trip Setpoints and Allowable Values.				
8. Containment Spray Switchover to Containment Sump					
a. Automatic Actuation Logic and Actuation Relays	N.A.	N.A.	N.A.	N.A.	N.A.
b. RWST--Low-Low	See Item 7.b. above for all RWST--Low-Low Trip Setpoints and Allowable Values.				
Coincident With Containment Spray	See Item 2. above for all Containment Spray Trip Setpoints and Allowable Values.				

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
9. Loss-of-Offsite Power					
a. 6.9 kV Emergency Bus Undervoltage--Primary	N.A.	N.A.	N.A.	$\geq$ 4830 volts with a $\leq$ 1.0 second time delay.	$\geq$ 4692 volts with a time delay $\leq$ 1.5 seconds
b. 6.9 kV Emergency Bus Undervoltage--Secondary	N.A.	N.A.	N.A.	$\geq$ 6420 volts with a $\leq$ 16 second time delay (with Safety Injection).	$\geq$ 6392 volts with a time delay $\leq$ 18 seconds (with Safety Injection).
				$\geq$ 6420 volts with a $\leq$ 54.0 second time delay (without Safety Injection).	$\geq$ 6392 volts with a $\leq$ 60 second time delay (without Safety Injection).
10. Engineered Safety Features Actuation System Interlocks					
a. Pressurizer Pressure, P-11	N.A.	N.A.	N.A.	$\geq$ 2000 psig	1988 $\geq$ ~~1986~~ psig
Not P-11	N.A.	N.A.	N.A.	$\leq$ 2000 psig	$\leq$ ~~2014~~ psig 2012
b. Low-Low T_{avg}, P-12	N.A.	N.A.	N.A.	$\geq$ 553°F	$\geq$ 549.3°F

TABLE 4-2

Calc. No. HNP-I/INST-1010
Rev. 0
Page 99

TABLE 3.3-4 (Continued)

ENGINEERED SAFETY FEATURES ACTUATION SYSTEM INSTRUMENTATION TRIP SETPOINTS

FUNCTIONAL UNIT	TOTAL ALLOWANCE (TA)	Z	SENSOR ERROR (S)	TRIP SETPOINT	ALLOWABLE VALUE
10. Engineered Safety Features Actuation System Interlocks (Continued)					
c. Reactor Trip, P-4	N.A.	N.A.	N.A.	N.A.	N.A.
d. Steam Generator Water Level, P-14	See Item 5.b above for all Steam Generator Water Level Trip Setpoints and Allowable Values.				

TABLE 3.3-4 (Continued)

TABLE NOTATIONS

* Time constants utilized in the lead-lag controller for Steam Line Pressure-Low are $\tau_1 \geq 50$ seconds and $\tau_2 \leq 5$ seconds. CHANNEL CALIBRATION shall ensure that these time constants are adjusted to these values.

** The time constant utilized in the rate-lag controller for Steam Line Pressure-Negative Rate--High is ≥ 50 seconds. CHANNEL CALIBRATION shall ensure that this time constant is adjusted to this value.

\# The indicated values are the effective, cumulative, rate-compensated pressure drops as seen by the comparator.

TABLE 4-2

Calc. No. HNP-I/INST-1010
Rev. 0
Page 100

TABLE 4-3
SUMMARY OF RTS/ESFAS "FIVE-COLUMN" TERMS FOR POST-PUR/SGR OPERATION

Table 2.2-1		INST-1010 Table	Current "Five-Column" Tech Spec Terms					Post-PUR/SGR "Five-Column" Tech Spec Terms				
Item	Functional Item		Total Allowance (TA)	Z Term	Sensor Error (S)	Trip Setpoint (TS)	Allowable Value (AV)	Total Allowance (TA)	Z Term	Sensor Error (S)	Trip Setpoint (TS)	Allowable Value (AV)
2.a	Power Range, Neutron Flux - High Setpoint	3-1A	7.5	4.56	0.0	≤ 109.0% of RTP	≤ 111.1% of RTP	7.5	4.56	0.0	≤ 109.0% of RTP	≤ 111.1% of RTP
2.b	Power Range, Neutron Flux - Low Setpoint	3-1B	8.3	4.56	0.0	≤ 25% of RTP	≤ 27.1% of RTP	8.3	4.56	0.0	≤ 25% of RTP	≤ 27.1% of RTP
3	Power Range, Neutron Flux - High Positive Rate	3-2B	1.6	0.5	0.0	≤ 5% of RTP with a time constant of ≥ 2 seconds	≤ 6.3% of RTP with a time constant of ≥ 2 seconds	2.5	0.83	0.0	≤ 5% of RTP with a time constant of ≥ 2 seconds	≤ 6.3% of RTP with a time constant of ≥ 2 seconds
4	Power Range, Neutron Flux - High Negative Rate	3-2A	1.6	0.5	0.0	≤ 5% of RTP with a time constant of ≥ 2 seconds	≤ 6.3% of RTP with a time constant of ≥ 2 seconds	2.5	0.83	0.0	≤ 5% of RTP with a time constant of ≥ 2 seconds	≤ 6.3% of RTP with a time constant of ≥ 2 seconds
5	Intermediate Range, Neutron Flux	3-3	17.0	8.41	0.0	≤ 25% of RTP	≤ 30.9% of RTP	17.0	8.41	0.0	≤ 25% of RTP	≤ 30.9% of RTP
6	Source Range, Neutron Flux	3-4	17.0	10.01	0.0	≤ 10^5 cps	≤ 1.4 x 10^5 cps	17.0	10.01	0.0	≤ 10^5 cps	≤ 1.4 x 10^5 cps
7	Overtemperature ΔT	3-5	8.7	6.02	Note 5	Note 1	Note 2	9.0	7.31	See Note 5	See Note 1	See Note 2
8	Overpower ΔT	3-6	4.7	1.50	1.9	Note 3	Note 4	4.0	2.32	1.3	See Note 3	See Note 4
9	Pressurizer Pressure - Low, Reactor Trip	3-7A	5.0	2.21	1.5	≥ 1960 psig	≥ 1946 psig	5.0	1.52	1.5	≥ 1960 psig	≥ 1948 psig
10	Pressurizer Pressure - High, Reactor Trip	3-7B	7.5	5.01	0.5	≤ 2385 psig	≤ 2399 psig	7.5	1.52	1.5	≤ 2385 psig	≤ 2397 psig
11	Pressurizer Water Level - High	3-8	8.0	2.18	1.5	≤ 92% of instrument span	≤ 93.8% of instrument span	8.0	3.42	1.75	≤ 92% of instrument span	≤ 93.5% of instrument span
12	Reactor Coolant Flow - Low	3-9	2.9	1.98	0.6	≥ 90.5% of loop full indicated flow	≥ 89.5% of loop full indicated flow	4.58	1.98	0.6	≥ 90.5% of loop full indicated flow	≥ 89.5% of loop full indicated flow
13	SG Water Level, Low-Low (FW Line Break)	3-10A	19.2	14.06	2.97	≥ 38.5% of narrow range instrument span	≥ 36.5% of narrow range instrument span	25.0	16.85	2.0	≥ 25% of narrow range instrument span	≥ 23.5% of narrow range instrument span
13	SG Water Level, Low-Low (Loss of Normal FW)	3-10B	19.2	14.06	2.97	≥ 38.5% of narrow range instrument span	≥ 36.5% of narrow range instrument span	25.0	16.85	2.0	≥ 25% of narrow range instrument span	≥ 23.5% of narrow range instrument span

TABLE 4-3
SUMMARY OF RTS/ESFAS "FIVE-COLUMN" TERMS FOR POST-PUR/SGR OPERATION

Table 2.2-1		INST-1010 Table	Current "Five-Column" Tech Spec Terms					Post-PUR/SGR "Five-Column" Tech Spec Terms				
Item	Functional Item		Total Allowance (TA)	Z Term	Sensor Error (S)	Trip Setpoint (TS)	Allowable Value (AV)	Total Allowance (TA)	Z Term	Sensor Error (S)	Trip Setpoint (TS)	Allowable Value (AV)
14	Steam Generator Water Level, Low	3-10C	19.2	2.23	2.97	≥ 38.5% of narrow range instrument span	≥ 36.5% of narrow range instrument span	8.9	5.35	2.0	≥ 25% of narrow range instrument span	≥ 23.5% of narrow range instrument span
14	Steam / Feedwater Flow Mismatch	3-11	20.0	3.41	Note 6	≤ 40% of full steam flow at RTP	≤ 43.1% of full steam flow at RTP	20.0	3.01	See Note 6	≤ 40% of full steam flow at RTP	≤ 43.1% of full steam flow at RTP
15	Reactor Coolant Pump Undervoltage - Low	3-19	14.0	1.3	0.0	≥ 5148 volts	≥ 4920 volts	14.0	1.3	0.0	≥ 5148 volts	≥ 4920 volts
16	Reactor Coolant Pump Underfrequency - Low	3-20	5.0	3.0	0.0	≥ 57.5 Hz	≥ 57.3 Hz	5.0	3.0	0.0	≥ 57.5 Hz	≥ 57.3 Hz
17.a	Low Fluid Oil Pressure, Turbine Trip	3-21	N/A	N/A	N/A	≥ 1000 psig	≥ 950 psig	N/A	N/A	N/A	≥ 1000 psig	≥ 950 psig
17.b	Turbine Throttle Valve Closure, Turbine Trip	3-22	N/A	N/A	N/A	≥ 1% open	≥ 1% open	N/A	N/A	N/A	≥ 1% open	≥ 1% open
19.a	P-6, Intermediate Range Neutron Flux	3-26	N/A	N/A	N/A	≥ 1 x 10^{-10} amp	≥ 6 x 10^{-11} amp	N/A	N/A	N/A	≥ 1 x 10^{-10} amp	≥ 6 x 10^{-11} amp
19.b(1)	P-7, Low Power Reactor Trip Block (from P-10 input)	3-27	N/A	N/A	N/A	≤ 10% of RTP	≤ 12.1% of RTP	N/A	N/A	N/A	≤ 10% of RTP	≤ 12.1% of RTP
19.b(2)	P-7, Low Power Reactor Trip Block (from P-13 input)	3-27	N/A	N/A	N/A	≤ 10% of RTP Turbine Impulse Pressure Equivalent	≤ 12.1% of RTP Turbine Impulse Pressure Equivalent	N/A	N/A	N/A	≤ 10% of RTP Turbine Impulse Pressure Equivalent	≤ 12.1% of RTP Turbine Impulse Pressure Equivalent
19.c	P-8, Power Range Neutron Flux	3-28	N/A	N/A	N/A	≤ 49% of RTP	≤ 51.1% of RTP	N/A	N/A	N/A	≤ 49% of RTP	≤ 51.1% of RTP
19.d	P-10, Power Range Neutron Flux	3-27	N/A	N/A	N/A	≥ 10% of RTP	≥ 7.9% of RTP	N/A	N/A	N/A	≥ 10% of RTP	≥ 7.9% of RTP
19.e	P-13, Turbine Impulse Chamber Pressure	3-27	N/A	N/A	N/A	≤ 10% of RTP Turbine Impulse Pressure Equivalent	≤ 12.1% of RTP Turbine Impulse Pressure Equivalent	N/A	N/A	N/A	≤ 10% of RTP Turbine Impulse Pressure Equivalent	≤ 12.1% of RTP Turbine Impulse Pressure Equivalent

Notes: See Tech Spec mark-up (INST-1010, Table 4-1)

TABLE 4-3

SUMMARY OF RTS/ESFAS "FIVE-COLUMN" TERMS FOR POST-PUR/SGR OPERATION

Table 3.3-4		INST-1010 Table	Current "Five-Column" Tech Spec Terms					Post-PUR/SGR "Five-Column" Tech Spec Terms				
Item	Functional Item		Total Allowance (TA)	Z Term	Sensor Error (S)	Trip Setpoint (TS)	Allowable Value (AV)	Total Allowance (TA)	Z Term	Sensor Error (S)	Trip Setpoint (TS)	Allowable Value (AV)
1.c	Containment Pressure - High-1	3-12A	2.7	0.71	1.5	≤ 3.0 psig	≤ 3.6 psig	3.64	0.71	1.5	≤ 3.0 psig	≤ 3.6 psig
4.c	Containment Pressure - High-2	3-12A	2.7	0.71	1.5	≤ 3.0 psig	≤ 3.6 psig	3.64	0.71	1.5	≤ 3.0 psig	≤ 3.6 psig
2.c	Containment Pressure - High-3	3-12B	3.6	0.71	1.5	≤ 10.0 psig	≤ 11.0 psig	3.64	0.71	1.5	≤ 10.0 psig	≤ 11.0 psig
1.d	Pressurizer Pressure - Low, Safety Injection	3-13	18.8	14.41	1.5	≥ 1850 psig	≥ 1836 psig	18.75	10.47	1.5	≥ 1850 psig	≥ 1838 psig
6.g	Steamline Differential Pressure - High	3-14	5.0	1.47	3.0	≤ 100 psi	≤ 127.4 psi	5.0	0.87	3.0	≤ 100 psi	≤ 127.4 psi
4.e	Negative Steamline Pressure Rate - High	3-15	2.3	0.50	0.0	≤ 100 psi	≤ 122.8 psi	2.3	0.5	0.0	≤ 100 psi	≤ 119.5 psi
1.e	Steamline Pressure - Low	3-17	17.7	14.81	1.5	≥ 601 psig	≥ 578.3 psig	4.52	0.71	2.0	≥ 601 psig	≥ 581.5 psig
5.b	SG Water Level - High-High, Barton 764 Xmtrs	3-18A	15.0	11.25	2.97	≤ 82.4% of narrow range instrument span	≤ 84.2% of narrow range instrument span	22.0	9.63	2.0	≤ 78.0% of narrow range instrument span	≤ 79.5% of narrow range instrument span
5.b	SG Water Level - High-High, Tobar 32DP1 Xmtrs	3-18B	15.0	11.25	2.97	≤ 82.4% of narrow range instrument span	≤ 84.2% of narrow range instrument span	22.0	9.63	2.0	≤ 78.0% of narrow range instrument span	≤ 79.5% of narrow range instrument span
6.c	SG Water Level, Low-Low	3-10A	19.2	14.06	2.97	≥ 38.5% of narrow range instrument span	≥ 36.5% of narrow range instrument span	25.0	16.85	2.0	≥ 25.0% of narrow range instrument span	≥ 23.5% of narrow range instrument span
7.b	RWST Level - Low	3-23	N/A	N/A	N/A	≥ 23.4%	≥ 20.4%	N/A	N/A	N/A	≥ 23.4%	≥ 20.4%
9.a	6.9 KV E-Bus Undervoltage - Primary, LOOP	3-24	N/A	N/A	N/A	≥ 4830 volts with a ≤ 1.0 second time delay	≥ 4692 volts with a time delay ≤ 1.5 seconds	N/A	N/A	N/A	≥ 4830 volts with a ≤ 1.0 second time delay	≥ 4692 volts with a time delay ≤ 1.5 seconds
9.b	6.9 KV E-Bus Undervoltage - Secondary, LOOP	3-25	N/A	N/A	N/A	≥ 6420 volts with a ≤ 16 second time delay (with Safety Injection) ≥ 6420 volts with a ≤ 54.0 second time delay (without Safety Injection)	≥ 6392 volts with a time delay ≤ 18 seconds (with Safety Injection) ≥ 6392 volts with a ≤ 60 second time delay (without Safety Injection)	N/A	N/A	N/A	≥ 6420 volts with a ≤ 16 second time delay (with Safety Injection) ≥ 6420 volts with a ≤ 54.0 second time delay (without Safety Injection)	≥ 6392 volts with a time delay ≤ 18 seconds (with Safety Injection) ≥ 6392 volts with a ≤ 60 second time delay (without Safety Injection)
10.a	P-11, Pressurizer Pressure	3-29	N/A	N/A	N/A	≥ 2000 psig	≥ 1986 psig	N/A	N/A	N/A	≥ 2000 psig	≥ 1988 psig
10.a	NOT P-11, Pressurizer Pressure	3-29	N/A	N/A	N/A	≤ 2000 psig	≤ 2014 psig	N/A	N/A	N/A	≤ 2000 psig	≤ 2012 psig
10.b	P-12, Low-Low Tavg	3-16	N/A	N/A	N/A	≥ 553.0 °F	≥ 549.3 °F	N/A	N/A	N/A	≥ 553.0 °F	≥ 549.3 °F

ATTACHMENT 2
Sheet 1 of 2
Record of Lead Review

Design Calculation HNP-I / INST-1010 **Revision** 0

The signature below of the Lead Reviewer records that:
- the review indicated below has been performed by the Lead Reviewer;
- appropriate reviews were performed and errors/deficiencies (for all reviews performed) have been resolved and these records are included in the design package;
- the review was performed in accordance with EGR-NGGC-0003.

☒ **Design Verification Review** ☐ **Engineering Review** ☐ **Owner's Review**
- ☒ Design Review
- ☐ Alternate Calculation
- ☐ Qualification Testing

☐ **Special Engineering Review** ______

☐ YES ☒ N/A **Other Records are attached.**

Clyde R. Fletcher [signature] I&C 8/31/00

Lead Reviewer **(print/sign)** **Discipline** **Date**

Item No.	Deficiency	Resolution
1)	Calculation Title should reflect current and uprated power with SG Replacement.	Modified Calculation Title as suggested.
2)	Ref. 2.9.a should read "BH/99-067". Ref. 2.4.L should read "0054-JRG".	Corrected typos as suggested.
3)	Add reference to CQL-98-052 [Calc Note OPES(98)-025].	Added [Reference 2.10.h] as suggested.
4)	Section 4.0, 1st para.: Delete reference to "2-column" Tech Spec terms comparison.	Deleted text as suggested.
5)	Table 1-1: Add RCSA term, and delete SRA term for FCQL-355 'A' & 'Z' definitions.	Corrected as suggested.
6)	Table 2-3, Tech Spec Items 5b & 10b: Trip Setpoint should read "$\leq$" (vs. "$\geq$").	Corrected as suggested.
7)	Table 3-0: Add cross-reference to Westinghouse CNs or CP&L calculations.	Added Table Column "W Calc or Other HNP Calc Ref(s)", as suggested.
8)	Table 3-8: SPE term in CSA' should be 0.5; Resultant CSA', Margin, Z', & T_2' should be 5.26, 2.75, 3.416, & 2.83, respectively.	Corrected equations and results, as suggested.
9)	Table 3-9: 0.13 Calorimetric Bias was specified in WCAP-15249, Table 3-21 as a PMA.	CN-SSO-99-33 [Ref. 2.9.n], WCAP-12340 [Rev.1], & INST-1011 confirms Bias treatment.

ATTACHMENT 2
Sheet 2 of 2
Record of Lead Review

Design Calculation HNP-I / INST-1010 **Revision** 0

Item No.	Deficiency	Resolution
10)	Tables 3-10A: Add basis for excluding Cable IR degradation bias.	Added explanation in Table 3-10A, as suggested. Need for this bias not required for Table 3-10B.
11)	Tables 3-10A, 10B, 10C, 18A, & 18B: Reduce Sensor Drift to a more realistic (but conservative) value.	SD reduced to 1.5% span for all Tables. Justification added to use historical drift data as basis for reduction.
12)	Tables 3-10A & 3-10B: Confirm applicability of [Table 3-10B] LONF results for terms TA', Z', & S' as bounding for [Table 3-10A] FLB requirements.	Applicability of Table 3-10A TA' and Z' values within Table 3-10B are consistent with the current licensing basis (as delineated within the current Tech Specs).
13)	Table 3-11: AV' calculation should be based upon 122.642% Span [vs. 120% as shown]. If current 5.0 MPPH flow range is retained, then AV' calculation should be based upon 117% [and not 120% or 122.642%].	AV' results were revised to state results in terms of [worst-case] RSG only and PUR/SGR Spans, given the use of (maximum) conversion factors/uncertainties. Use of current Tech Spec AV of ≤ 43.1% and change to Z' = 3.01 are discussed. [Note that use of originally assumed 116.55% will similarly result in the continued use of current ≤ 43.1% AV.]
14)	Tables 3-18A & 3-18B: For conservatism, use [Table 3-18B] Z' term of 9.63 (which includes 1.58 bias for Tobar transmitters) for Table 3-18A (Barton) results.	Note was added following computation of Z' term in Table 3-18A; Table 3-18A summary comparison was also updated to show Z' = 9.63.
15)	Table 3-17: Add further CN reference to "No EA for M&E Analysis" for SAL' of 542.2 psig.	Page 19 of Ref. 2.9.e was added within reference. [Also see Table 2-3, Note (7).]
16)	Section 3.3: Clarify "high (or 95%, as applicable) confidence level".	Reworded to include applicability of 95% confidence levels only for "power/flow calorimetric functions" only for 95% confidence. Assumption 3.2.5 reworded to "generally" specify high confidence level, unless noted otherwise.
17)	Documentation for Concurrent Engineering Review by HESS, as required, should be included in Attachment Section.	HESS Review Documentation [Engineering Review] added within Attachment A2. LEF & TOC changed accordingly.
18)	Miscellaneous Typos/General Comments identified per markup (transmitted separately).	Remaining comments dispositioned/resolved, as required.

ATTACHMENT 3
Sheet 1 of 3
Record of Concurrent Review

Design Calculation HNP-I / INST-1010 **Revision** 0

☐ **Design Verification Review** ☐ **Engineering Review** ☐ **Owner's Review**
☐ Design Review
☐ Alternate Calculation
☐ Qualification Testing

☒ **Special Engineering Review** HESS Plant Review

Larry F. Costello / Larry F. Costello — I&C/Electrical — 8/31/00
Concurrent Reviewer **(print/sign)** — **Discipline** — **Date**

Item No.	Deficiency	Resolution
---	See Attached Generic MPS Comment Sheet [2 pages].	Comments dispositioned/resolved, as required (per attached Comment Sheets).

FORM EGR-NGGC-0003-3-5
This form is a QA Record when completed and included with a completed design package. Owner's Reviews may be processed as stand alone QA records when Owner's Review is completed.

ATTACHMENT 3
Sheet 2 of 3
Record of Concurrent Review

Generic Major Projects Comment Sheet

Document Name/No.: HNP-I/INST-1010, Rev. 0 **Project ID:** SGR/PUR

Reviewed by: Larry Costello **Organization/Discipline:** HESS/I&C

Review Package: (Circle one) 30% 70% 100% Other ____________

Item No.	Comment	Resolution
1	Page 8, Sect 3.2.3, states that dependent uncertainty components are treated as a bias. They are algebraically added; however, I consider a bias a term that is added to the total result; i.e., PMA terms.	Parenthetical phrase "(i.e., a Bias term)" deleted from Assumption 3.2.3, for clarity.
2	Page 9, Sect 3.2.10, It is not an assumption that the pressure gauges used for transmitter calibrations are temperature compensated.	Assumption 3.2.10 reworded to state that temperature compensated pressure gauges are used at HNP.
3	Page 8, Sect. 3.2.6, states that "although sensor drift has been determined to be independent of time" per NSAL-97-01, I do not believe that CP&L or the industry necessarily concur with this statement.	Assumption 3.2.6 revised to remove stated conclusion of Reference 2.11.c, as suggested.
4	Page 16, The CSA' equation is missing the squared term for A'.	CSA' is correct as written [A' is a sum of squares, as shown].
5	Page 16, Recommend adding "to **conservatively** maintain minimum tolerances on S' and R'..."	Added wording, as suggested.
6	Page 31, Need to correct the math for the T_2' Calc; the TA' value is 1.60% span. This effects the AV' calc.	Table 3-2B was revised to: restate the SAL as N/A; and clarify selection of 2.5% for consistency with Table 3-2A.
7	Page 40, Where is the new "Note 6" that is referenced at bottom of page?	New "Note 6" for OPΔT eliminated from text and Tech Spec mark-up. S term included directly in Tech Spec Table 2.2-1 (without additional Note).
8	Page 49, Provide the basis for using the 1.5% drift value; i.e., calibration history of the transmitters.	Explanation added for 1.5% transmitter drift within Tables 3-10A thru 3-10C and 3-18A & 3-18B.
9	Page 49, Might note that the "worst case" values for the bias terms were conservatively selected over the full instrument span.	Clarifying note added to Summary Tables as part of resolution to Comment 8 (above).

ATTACHMENT 3
Sheet 3 of 3
Record of Concurrent Review

Item No.	Comment	Resolution
10	Page 54, Why does the calc still reflect a full scale steam flow of 5.2 mpph? I thought it was determined that we would be staying with a 5.0 mpph full scale flow.	Calc reworded/clarified to address flow ranges w.r.t. the current (5.0 MPPH) span. Inclusion of multiple ranges provides flexibility of final design implementation [Rosemount or Barton; SGR only or PUR/SGR], per conservative treatment of flow conversions used and to retention of 43.1% AV. (Also see Lead DV Comment 13 resolution.)
11	Page 57, delete the extra "given the" in para above the table.	Deleted wording, as suggested.
12	Page 62, AV' = AV = 127.4 will **conservatively** be retained....".	Added wording, as suggested.
13	Page 62, Provide a brief explanation of why S' = 0.	Table 3-15 was revised to add wording to first paragraph and to new paragraph before S' computation.
14	Page 74, Need to explain/reconcile the difference in the density effects between the Westinghouse calc and HNP-I/INST-1030.	Table 3-23, Uncertainty Parameters Note 1 was clarified by deleting first sentence. Original wording was not clear (as Westinghouse did not perform a PUR/SGR CN for this trip function [RWST Low-Low Level]).
15	Page 76, Provide more thorough basis for changing the drift value; i.e., the 30 month max surveillance frequency is wrong. Transmitters are calibrated every RFO.	Table 3-23, Uncertainty Parameters Note 3 was clarified by deletion of 30-month INST-1030 assumption. A parenthetical reference to INST-1030, Section 5.1A.2 was retained within Note 3.
17	Page 79, Add "for this permissive" after "changes" in last sentence.	Added wording, as suggested.
18	Page 80, Add "for this permissive" after "changes" in last sentence.	Added wording, as suggested.
19	Clarify basis for OTΔT and OPΔT allowable Tech Spec sensor error associated with RTD measurements. Relate this sensor error value and normalization process to current acceptance criterion/ plant practices contained within EST-104 and/or EPT-156.	Clarification was provided within Tables 3-5 & 3-6 to address the following: • $S'_{temperature}$ terminology [used to describe RTD sensor errors contained in Westinghouse CN] was clarified to clearly explain that Westinghouse CN assumptions were based upon a channel that was already normalized. Paragraph at top of Page 39, in Table 3-5 [OTΔT], was augmented to specify INST-1049/EST-104 acceptance criterion for RTD calibration accuracy and drift, as well as to define a corresponding PUR/SGR Tech Spec sensor error term of 1.3% ΔT span. • Rack drift component within Allowable Value [per $R'_{\Delta T}$] was confirmed against current plant practices/ acceptance criterion [i..e, relative to EPT-156 criterion on need to renormalize (-1 to +3% ΔT tolerance is used by EPT-156; -1% selected as the applicable conservative tolerance, given that +3% will effect an earlier trip)].

Calculation Indexing Table

Calculation No. HNP-I/INST-1010
Page No. A3-1
Revision 0

Type of Document	Document Number or Tag Number	Document Title	Basis for Cross Reference
Technical Specifications	Table 2.2-1; Bases 2.2	Reactor Trip System Instrumentation Trip Setpoints	TS Compliance
	Table 3.3-4; Bases 3/4.3.1 & 3/4.3.2	Engineered Safety Features Actuation System Instrumentation Trip Setpoints	
FSAR Sections	1.8	Conformance to: RG 1.105 Rev. 1	Consistency with Chapter 15 safety analyses assumptions and licensing commitments
	7.1.1	Identification of Safety Related System	
	7.2	Reactor Trip System	
	7.3	Engineered Safety Features System	
	15.0.6	Trip Points and Time Delays to Trip Assumed in Accident Analyses *	* - Various Sections of Chapter 15 discuss analyses which rely on the RTS/ESFAS Trip functions (subject to this calculation); Table 15.0.6-2 lists these functions and the analyses using these functions.
	15.0.7	Instrumentation Drift and Calorimetric Errors - Power Range Neutron Flux	
	15.0.8	Plant Systems and Components Available for Mitigation of Accident Effects	
POM Procedures **		<u>Applicable Function:</u>	Calibration and Surveillance Procedures for TS compliance
	MST-I0003 thru MST-I0006; MST-I0236 thru MST-I0239	Containment Pressure	
	MST-I0007 thru MST-I0015; MST-I0125 thru MST-I0133	Main Steam Pressure	
	MST-I0016 thru MST-I0021; MST-I0134 thru MST-I0139	Main Steam/Feedwater Flow Mismatch	** - Procedure References does not include Time Response Testing for these Instrument Functions.
	MST-I0023 thru MST-I0036; MST-I0143 thru MST-I0151, and MST-I0175 thru MST-I0177	SG N-R Level	

Calculation Indexing Table

Calculation No. HNP-I/INST-1010
Page No. A3-2
Revision 0

Type of Document	Document Number or Tag Number	Document Title	Basis for Cross Reference
POM Procedures ** (Cont'd)		Applicable Function:	Calibration and Surveillance Procedures for TS compliance
	MST-I0037 thru MST-I0039; MST-I0140 thru MST-I0142	RCS Delta T/Tavg	
	MST-I0268 thru MST-I0270	Lo-Lo Tavg P-12 Interlock	
	MST-I0040 thru MST-I0043; MST-I0204 thru MST-I0207	RWST Level	
	MST-I0044 thru MST-I0047; and MST-I0070; MST-I0163 thru MST-I0166	NIS Power Range	
	MST-I0048 and MST-I0049; MST-I0167 and MST-I0168	NIS Intermediate Range	
	MST-I0050 and MST-I0051; MST-I0169 and MST-I0170	NIS Source Range	
	MST-I0052 thru MST-I0054; MST-I0208 thru MST-I0210	Pressurizer Level	
	MST-I0055 thru MST-I0063; MST-I0152 thru MST-I0160	Reactor Coolant Flow	
	MST-I0067 thru MST-I0068	First Stage Turbine Impulse Pressure	
	MST-I0119 thru MST-I0121; MST-I0122 thru MST-I0124	Pressurizer Pressure	
	MST-I0260 thru MST-I0262	T-G Low Fluid Pressure	
	MST-I0263 thru MST-I0266	T-G Throttle Valve Closure	

Calculation Indexing Table

Calculation No. HNP-I/INST-1010
Page No. A3-3
Revision 0

Type of Document	Document Number or Tag Number	Document Title	Basis for Cross Reference
POM Procedures ** (Cont'd)		Applicable Function:	Calibration and Surveillance Procedures for TS compliance
	MST-E0073	RCP Bus Underfrequency	
	MST-E0074	RCP Bus Undervoltage	
	MST-E0045 and MST-E0075	6.9KV E-Bus Undervoltage	
POM Procedures	EPT-008	Intermediate and Power Range Detector Setpoint Determination	Additional Calibration/Surveillance Procedures for Channel Normalization or other Scaling
	EPT-009	Intermediate Range Detector Setpoint Verification	
	EPT-156	Reactor Coolant System ΔT Scaling at 100% Reactor Power	
Design Basis Documents	DBD-301	Reactor Control and Protection System	RTS/ESFAS Design Criteria
	DBD-313	Time Response	
	DBD-314	Plant Parameters Document ***	*** - PUR/SGR-project related UFAPPD will be incorporated into DBD-314
Design Basis/ Plant Parameters Document	Attachment to HNP-F/NFSA-0034	Harris Nuclear Plant SGR/ PUR Uprate Fuel Analysis Plant Parameters Document (UFAPPD)	RTS/ESFAS Design Reference for PUR/SGR Implementation included in UFAPPD Tables 2-2 and 2-18
NGG Procedure	EGR-NGGC-0153	Engineering Instrument Setpoints	NGG standard for instrument uncertainties
Vendor Document	WCAP-15249	Westinghouse Protection System Setpoint Methodology ... (for Uprate to 2912.4 MWT-NSSS Power and Replacement Steam Generators)	Westinghouse methodology to support TS compliance and FSAR commitments; "Five-Column" Terms and Bases still applicable to HNP Tech Spec.

Calculation Indexing Table

Calculation No. HNP-I/INST-1010
Page No. A3-6
Revision 0

Type of Document	Document Number or Tag Number	Document Title	Basis for Cross Reference
Wiring/Interconnection or Other Configuration Drawings	2166-B-0508	Setpoint Document ****	**** - Setpoint Document & Instrument List are shown as historical references; Setpoint data is now currently controlled within the HNP engineering database system (EDBS), per ENP-023.
	2166-B-0432	Instrument List ****	
	EMDRAC 1364-001328	Westinghouse Process Block Diagrams	
	EMDRAC 1364-000864 thru 878	Westinghouse Protection System Functional Diagrams	
	2166-S-0302 Sheets 2, 7, 8, 20, 23, and 24	Medium Voltage Relay Settings	
	EMDRAC 1364-002795 S01	E.H. Fluid System & Lube Oil Diagram	
	EMDRAC 1364-003319	Wiring Diagram: Pedestal - Governor	
	2165-S-0553 S03	Simplified Flow Diagram-DEH Control System	
	EMDRAC 1364-002724	Wiring Diagram: Terminal Box D- HP Turbine	