Entergy

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GNRO-2012/00132

November 9, 2012

U.S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555-0001

SUBJECT: License Amendment Request for Revision of Technical Specification Allowable Value for Primary Containment and Drywell Isolation Instrumentation Function 3.c "RCIC Steam Supply Line Pressure – Low."
Grand Gulf Nuclear Station, Unit 1
Docket No. 50-416
License No. NPF-29

REFERENCE: NRC Administrative Letter 98-10, "Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety" dated December 29, 1989

Dear Sir or Madam:

In accordance with the provisions of Section 50.90 of Title 10 of the Code of Federal Regulations (10 CFR), Entergy Operations, Inc. is submitting a request for an amendment to the Technical Specifications (TS) for Grand Gulf Nuclear Station, Unit 1 (GGNS). The proposed amendment would revise the TS to support correction of a non-conservative technical specification allowable value.

- Attachment 1 provides an evaluation of the proposed changes.
- Attachment 2 provides the markup pages of existing TS to show the proposed changes.
- Attachment 3 provides revised (clean) TS pages.
- Attachment 4 provides calculation JC-Q1E31-N685-1 "RCIC Turbine Isolation on Low Inlet Steam Pressure"
- Attachment 5 provides JS09 Revision 1 "Grand Gulf Nuclear Station Instrument and Control Standard Methodology For The Generation Of Instrument Loop Uncertainty & Setpoint Calculations"

Entergy Operations, Inc. requests approval of the proposed license amendment by November 9, 2013 with the amendment being implemented within 90 days.

In accordance with 10 CFR 50.91 (a)(1), "Notice for Public Comment," the analysis about the issue of no significant hazards consideration using the standards in 10 CFR 50.92 is being provided to the Commission in accordance with the distribution requirements in 10 CFR 50.4. In accordance with 10 CFR 50.91 (b)(1), "State Consultation," a copy of this application and its reasoned analysis about no significant hazards considerations is being provided to the designated Mississippi Official.

This letter contains no new commitments.

If you have any questions or require additional information, please contact Jeffery A. Seiter at 601-437-2344.

I declare under penalty of perjury that the foregoing is true and correct. Executed on November 9, 2012.

Sincerely,

MP/jas

Attachments:
1. Evaluation of Proposed Changes
2. Proposed Technical Specification Changes (Mark-up)
3. Revised Technical Specification Changes (Clean Copy)
4. Calculation JC-Q1E31-N685-1 "RCIC Turbine Isolation on Low Inlet Steam Pressure"
5 JS09 Revision 1 "Grand Gulf Nuclear Station Instrument and Control Standard Methodology For The Generation Of Instrument Loop Uncertainty & Setpoint Calculations"

cc: (see next page)

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Attachment 1

GNRO-2012/00132

Evaluation of Proposed Changes

1.0 SUMMARY DESCRIPTION

This letter is a request to the Nuclear Regulatory Commission (NRC) to amend Facility Operating License NPF-29 for the Grand Gulf Nuclear Station (GGNS). The requested change affects Technical Specification (TS) Table 3.3.6.1-1 Allowable Value for Primary Containment and Drywell Isolation Instrumentation Function 3.c "Reactor Core Isolation Cooling (RCIC) Steam Supply Line Pressure – Low". This request is submitted pursuant to 10 CFR 50.90 to correct a non conservative TS and, consistent with the guidance of NRC Administrative Letter 98-10, "Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety", dated December 29, 1989 (reference 6.1).

TS Allowable Value for Primary Containment and Drywell Isolation Instrumentation Function 3.c "RCIC Steam Supply Line Pressure – Low" is changed from greater than or equal to (≥) 53 psig to greater than or equal to (≥) 57 psig.

As demonstrated in this submittal, the proposed change does not adversely impact safety and is required by NRC Administrative Letter 98-10, "Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety". Entergy Operations, Inc. requests approval of the proposed license amendment by November 9, 2013. Once approved, Entergy will implement the amendment within 90 days.

2.0 DETAILED DESCRIPTION

2.1 Proposed Changes

A recent revision of Calculation JC-Q1E31-N685-1 "RCIC Turbine Isolation on Low Inlet Steam Pressure" (reference 6.4) updated the methodology and assumptions used in the calculation. This revision resulted in a new calculated allowable value of ≥ 56.21 psig versus the current allowable value of ≥ 53 psig. The current setpoint of 60 psig as delineated in Function 3. of RCIC System Isolation in Technical Requirement Manual (TRM) Table 3.3.6.1-1 "Technical Specification Isolation Instrumentation Trip Setpoints and Response Times" remains conservative with a calculated setpoint of 56.73 psig. The non-conservative allowable value is required to be revised in accordance with NRC Administrative Letter 98-10.

2.2 Need for Changes

The discovery of a non-conservative allowable value requires a change to technical specifications. This change is required to ensure that the TS is sufficient to assure nuclear safety.

2.3 TSTF-493 Considerations

GGNS is aware of the NRC position to encourage TSTF-493 (Reference 6.3) adoption by requiring licensees to provide a determination for each instrumentation function proposed for revision, as to whether the function is a Limiting Safety System Setting (LSSS) that protects a safety limit. A review of the TSTF-493 traveler for this particular instrument function indicates that this function is not an LSSS that protects a safety limit. Attachment A to TSTF-493, Revision 4, entitled "Identification of Functions to be Annotated with TSTF-493 Footnotes," identifies those functions that are LSSS. Under the Attachment A listing for

NUREG-1434, "Boiling Water Reactor/6 Plants", Technical Specification Table 3.3.6.1-1 "Allowable Value for Primary Containment and Drywell Isolation Instrumentation" Function 3.c "Reactor Core Isolation Cooling (RCIC) Steam Supply Line Pressure – Low" is not listed as a LSSS. Since this function is not a LSSS no change to the TS is required with respect to this function.

3.0 TECHNICAL EVALUATION

3.1 RIS-2005-20 Revision 1

In NRC GL 91-18 and superseded by RIS-2005-20 Revision 1(reference 6.2), the NRC provided guidance for prompt corrective action to correct or resolve a degraded or non-conforming condition. In the case of non-conservative TS, this includes the evaluation of compensatory measures, such as administrative controls, in accordance with 10 CFR 50.59 and prompt actions to correct the TS. This section provides a description of the methodology used by Entergy to complete the evaluation for the requested TS allowable value change.

GGNS utilizes the methodology documented in JS-09 Rev. 1 "Methodology for the Generation of Instrument Loop Uncertainty & Setpoint Calculations." (reference 6.5) to calculate loop uncertainties and setpoints. This methodology is used coincident with the GE instrument setpoint methodology published in NEDC-31336. This method includes using the available uncertainty data along with the following general steps to generate an appropriate loop Allowable Value and Nominal Trip Setpoint.

- Calculate the Loop Uncertainty (LU) by computing the SRSS of the Loop Device Uncertainty (A_L), the Loop Calibration Uncertainty (C_L), the Process Measurement Uncertainty (PM), and the Primary Element Uncertainty (PE).
- Calculate the Loop Drift (D_L) by computing the SRSS of the Device Drift (DR), the Temperature Drift (TD), and the Radiation Drift (RD) for each loop instrument as applicable.
- Calculate the Total Loop Uncertainty (TLU) by summing the Loop Uncertainty, the Loop Drift and any applicable biases.
- For process variables that increase to the Analytical Limit (AL), calculate the loop Allowable Value (AV) by subtracting the Loop Uncertainty from the Analytical Limit. For process variables that decrease to the Analytical Limit, calculate the loop Allowable Value by summing the value of the Loop Uncertainty and the Analytical Limit.
- For process variables that increase to the Analytical Limit (AL), calculate the loop Nominal Trip Setpoint (NTSP) by subtracting the value of the Total Loop Uncertainty from the Analytical Limit. For process variables that decrease to the Analytical Limit, calculate the loop Nominal Trip Setpoint (NTSP) by summing the value of the Total Loop Uncertainty and the Analytical Limit.

Calculation JC-Q1E31-N685-1 "RCIC Turbine Isolation on Low Inlet Steam Pressure" (reference 6.4 and found in attachment 4) determines the instrument loop uncertainty, limiting allowable values and setpoints for instrument loops to isolate the RCIC Turbine on low inlet steam pressure to protect the turbine. The revision to the calculation did not result in a setpoint change, only the allowable value was required to be changed. The functionality of the associated instrumentation for the RCIC

Turbine Isolation on Low Inlet Steam Pressure setpoint are not in question since the actual plant setpoints are currently conservative with respect to the analytical limits. Therefore, the instrumentation can perform its specified TS safety function.

The TRM trip setpoint is not changed; therefore the system remains capable of performing its specified safety function in accordance with applicable design requirements and associated analyses. Since the system remains capable of performing its specified safety function, no compensatory measures are required. The condition report documenting the non-conservative technical specification is screened as operable degraded nonconforming (DNC) as required by GL-91-18 and this license application request (LAR) is submitted to request permission to revise technical specifications to eliminate the non-conservative allowable value.

4.0 REGULATORY SAFETY ANALYSIS

NRC GL 91-18 provides generic guidance to licensees on the type and time frame of any required corrective action for resolution of degraded and nonconforming conditions. As stated in the GL, whenever degraded or nonconforming conditions are discovered, 10 CFR Part 50, Appendix B, requires prompt corrective action to correct or resolve the condition. In the case of a deficient TS, this includes the evaluation of compensatory measures, such as administrative controls, in accordance with 10 CFR 50.59 and prompt actions to correct the TS. This request for license amendment provides the GGNS-specific actions to resolve the degraded or nonconforming condition. GGNS has determined that the proposed changes do not require any exemptions or relief from regulatory requirements, other than the TS, and do not affect conformance with any draft General Design Criteria differently than described in the GGNS UFSAR, as described below.

4.1 Applicable Regulatory Requirements/Criteria

Regulatory requirement 10 CFR 50.36, "Technical Specifications," provides the content required in a licensee's TS. Specifically, 10 CFR 50.36(c)(3) requires that the TS include surveillance requirements. The proposed TS allowable value (AV) change continues to support the requirements of 10 CFR 50.36(c)(3) to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation are met.

Calculation JC-Q1E31-N685-1 "RCIC Turbine Isolation on Low Inlet Steam Pressure" determines the instrument loop uncertainty, limiting allowable values and setpoints for instrument loops to isolate the RCIC Turbine on low inlet steam pressure to protect the turbine. This calculation documents the methodology and assumptions used for the calculation. The revision to the calculation did not result in a setpoint change; only the allowable value was required to be changed. This request for license amendment provides the GGNS specific calculation used to determine the setpoint and allowable value evaluation and provides a description of the methodology used by GGNS to complete the evaluation for the specific TS SR being revised.

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the

Commission's regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

4.2 No Significant Hazards Consideration

10 CFR 50.91(a)(1) requires that licensee requests for operating license amendments be accompanied by an evaluation of no significant hazard posed by issuance of the amendment. Entergy has evaluated this proposed amendment with respect to the criteria given in 10 CFR 50.92(c). The following is the evaluation required by 10 CFR 50.91(a)(1). Entergy is requesting an amendment of the Operating License for the Grand Gulf Nuclear Station (GGNS) to revise the Technical Specification (TS) Allowable Value (AV) for Primary Containment and Drywell Isolation Instrumentation Function 3.c "RCIC Steam Supply Line Pressure – Low".

Entergy has evaluated whether or not a significant hazards consideration is involved with the proposed amendment by focusing on the three standards set forth in 10 CFR 50.92, "Issuance of amendment," as discussed below:

1. **Does the proposed change involve a significant increase in the probability or consequences of an accident previously evaluated?**

   Response: No.

   The proposed TS allowable value change involves a change in the margin between the allowable value and the setpoint. The proposed TS change does not change the trip setpoint. The proposed TS change does not degrade the performance of, or increase the challenges to, any safety systems assumed to function in the accident analysis. The proposed TS change does not impact the usefulness of the SRs in evaluating the operability of required systems and components, or the way in which the surveillances are performed. In addition, the the trip setpoint for the associated TRM function is not considered an initiator of any analyzed accident, nor does a revision to the allowable value introduce any accident initiators. Therefore, the proposed change does not involve a significant increase in the probability of an accident previously evaluated.

   The consequences of a previously evaluated accident are not significantly increased. The proposed change does not affect the performance of any equipment credited to mitigate the radiological consequences of an accident. Evaluation of the proposed TS changes demonstrated that the availability of credited equipment is not significantly affected because of the reduction in margin between the allowable value and the trip setpoint.

   Therefore, the proposed change does not involve a significant increase in the probability or consequences of an accident previously evaluated.

2. **Does the proposed change create the possibility of a new or different kind of accident from any accident previously evaluated?**

   Response: No.

   The proposed TS change involves a change in the allowable value setting to correct a non-conservative value. The proposed TS change does not introduce any failure mechanisms of a different type than those previously evaluated, since there are no physical changes being made to the facility.

   No new or different equipment is being installed. No installed equipment is being operated in a different manner. As a result, no new failure modes are being introduced. The way surveillance tests are performed remains unchanged.

   Therefore, the proposed change does not create the possibility of a new or different kind of accident from any previously evaluated.

3. **Do the proposed changes involve a significant reduction in a margin of safety?**

   Response: No.

   The proposed TS change involves a change in the allowable value setting to correct a non-conservative value. The impact of the change on system availability is not significant, based on the frequency of the testing being unchanged, the existence of redundant systems and equipment, and overall system reliability. The proposed change does not significantly impact the condition or performance of structures, systems, and components relied upon for accident mitigation. The proposed change does not result in any hardware changes or in any changes to the analytical limits assumed in accident analyses. Existing operating margin between plant conditions and actual plant setpoints is not significantly reduced due to these changes. The proposed change does not impact any safety analysis assumptions or results.

   Therefore, the proposed change does not involve a significant reduction in a margin of safety.

Based on the responses to the above questions, GGNS concludes that the proposed amendment with respect to the TS AV change presents no significant hazards consideration under the standards set forth in 10 CFR 50.92(c) and, accordingly, a finding of "no significant hazards consideration" is justified.

4.3 Conclusion

In conclusion, based on the considerations discussed above, (1) there is reasonable assurance that the health and safety of the public will not be endangered by operation in the proposed manner, (2) such activities will be conducted in compliance with the Commissions regulations, and (3) the issuance of the amendment will not be inimical to the common defense and security or to the health and safety of the public.

5.0 ENVIRONMENTAL CONSIDERATION

The proposed change would change a requirement with respect to installation or use of a facility component located within the restricted area, as defined in 10 CFR 20, and would change an inspection or surveillance requirement. However, the proposed change does not involve (i) a significant hazards consideration, (ii) a significant change in the types or significant increase in the amounts of any effluent that may be released offsite, or (iii) a significant increase in individual or cumulative occupational radiation exposure. Accordingly, the proposed change meets the eligibility criterion for categorical exclusion set forth in 10 CFR 51.22(c)(9). Therefore, pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment need be prepared in connection with the proposed change.

6.0 REFERENCES

6.1 NRC Administrative Letter 98-10, "Dispositioning of Technical Specifications that are Insufficient to Assure Plant Safety" dated December 29, 1989

6.2 RIS-2005-20 Revision 1, Revision to NRC Inspection Manual Part 9900 Technical Guidance, "Operability Determinations & Functionality Assessments for Resolution of Degraded or Nonconforming Conditions Adverse to Quality or Safety" Dated April 16, 2008

6.3 Technical Specification Taskforce Traveler Improved Standard Technical Specifications Change Traveler, TSTF - 493, Revision 4, "Clarify Application of Setpoint Methodology for LSSS Functions.

6.4 Calculation JC-Q1E31-N685-1 "RCIC Turbine Isolation on Low Inlet Steam Pressure"

6.5 JS-09 Rev. 1 "Methodology for the Generation of Instrument Loop Uncertainty & Setpoint Calculations."

Attachment 2

GNRO-2012/00132

Proposed Technical Specification Changes (Mark-up)

Table 3.3.6.1-1 (page 3 of 5)
Primary Containment and Drywell Isolation Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS PER TRIP SYSTEM	CONDITIONS REFERENCED FROM REQUIRED ACTION C.1	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
3. Reactor Core Isolation Cooling (RCIC) System Isolation					
a. RCIC Steam Line Flow—High	1,2,3	1	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.3 SR 3.3.6.1.6 SR 3.3.6.1.7	≤ 64 inches water
b. RCIC Steam Line Flow Time Delay	1,2,3	1	F	SR 3.3.6.1.2 SR 3.3.6.1.4 SR 3.3.6.1.7	≥ 3 seconds and ≤ 7 seconds
c. RCIC Steam Supply Line Pressure—Low	1,2[(d)],3[(d)]	1	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.3 SR 3.3.6.1.6 SR 3.3.6.1.7	≥ ~~53~~ psig 57
d. RCIC Turbine Exhaust Diaphragm Pressure—High	1,2,3	2	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.3 SR 3.3.6.1.6 SR 3.3.6.1.7	≤ 20 psig
e. RCIC Equipment Room Ambient Temperature—High	1,2,3	1	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.5 SR 3.3.6.1.7	≤ 191°F
f. Main Steam Line Tunnel Ambient Temperature—High	1,2,3	1	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.5 SR 3.3.6.1.7	≤ 191°F
g. Main Steam Line Tunnel Temperature Timer	1,2,3	1	F	SR 3.3.6.1.2 SR 3.3.6.1.4 SR 3.3.6.1.7	≤ 30 minutes
h. RHR Equipment Room Ambient Temperature—High	1,2,3	1 per room	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.5 SR 3.3.6.1.7	≤ 171°F
i. RCIC/RHR Steam Line Flow - High	1,2,3	1	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.3 SR 3.3.6.1.6 SR 3.3.6.1.7	≤ 43 inches water

(continued)

(d) *Not required to be OPERABLE in MODE 2 or 3 with reactor steam dome pressure less than 150 psig during reactor startup.*

Attachment 3

GNRO-2012/00132

Revised Technical Specification Changes (Clean Copy)

Table 3.3.6.1-1 (page 3 of 5)
Primary Containment and Drywell Isolation Instrumentation

FUNCTION	APPLICABLE MODES OR OTHER SPECIFIED CONDITIONS	REQUIRED CHANNELS PER TRIP SYSTEM	CONDITIONS REFERENCED FROM REQUIRED ACTION C.1	SURVEILLANCE REQUIREMENTS	ALLOWABLE VALUE
3. Reactor Core Isolation Cooling (RCIC) System Isolation					
a. RCIC Steam Line Flow C High	1,2,3	1	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.3 SR 3.3.6.1.6 SR 3.3.6.1.7	≤ 64 inches water
b. RCIC Steam Line Flow Time Delay	1,2,3	1	F	SR 3.3.6.1.2 SR 3.3.6.1.4 SR 3.3.6.1.7	≥ 3 seconds and ≤ 7 seconds
c. RCIC Steam Supply Line Pressure C Low	1,2[(d)],3[(d)]	1	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.3 SR 3.3.6.1.6 SR 3.3.6.1.7	≥ 57 psig
d. RCIC Turbine Exhaust Diaphragm Pressure C High	1,2,3	2	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.3 SR 3.3.6.1.6 SR 3.3.6.1.7	≤ 20 psig
e. RCIC Equipment Room Ambient Temperature C High	1,2,3	1	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.5 SR 3.3.6.1.7	≤ 191EF
f. Main Steam Line Tunnel Ambient Temperature C High	1,2,3	1	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.5 SR 3.3.6.1.7	≤ 191EF
g. Main Steam Line Tunnel Temperature Timer	1,2,3	1	F	SR 3.3.6.1.2 SR 3.3.6.1.4 SR 3.3.6.1.7	≤ 30 minutes
h. RHR Equipment Room Ambient Temperature C High	1,2,3	1 per room	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.5 SR 3.3.6.1.7	≤ 171EF
i. RCIC/RHR Steam Line Flow – High	1,2,3	1	F	SR 3.3.6.1.1 SR 3.3.6.1.2 SR 3.3.6.1.3 SR 3.3.6.1.6 SR 3.3.6.1.7	≤ 43 inches water

(continued)

(d) Not required to be OPERABLE in MODE 2 or 3 with reactor steam dome pressure less than 150 psig during reactor startup.

Attachment 4

GNRO-2012/00132

Calculation JC-Q1E31-N685-1 "RCIC Turbine Isolation on Low Inlet Steam Pressure"

☐ ANO-1	☐ ANO-2	☒ GGNS	☐ IP-2	☐ IP-3	☐ PLP
☐ JAF	☐ PNPS	☐ RBS	☐ VY	☐ W3	
☐ NP-GGNS-3	☐ NP-RBS-3				

CALCULATION COVER PAGE	(1) **EC #** 39554	(2) **Page 1 of** 41

(3) Design Basis Calc. ☒ YES ☐ NO	(4) ☐ CALCULATION ☒ EC Markup
(5) **Calculation No:** JC-Q1E31-N685-1	(6) **Revision:** 001
(7) **Title:** Instrument Loop Uncertainty and Setpoint Determination for System E31 Loop N685 RCIC Turbine Isolation on Low Inlet Steam Pressure	(8) **Editorial** ☐ YES ☒ NO
(9) **System(s):** E31	(10) **Review Org (Department):** NPE (I&C Design)

(11) **Safety Class:**	(12) **Component/Equipment/Structure Type/Number:**	
☒ **Safety / Quality Related** ☐ **Augmented Quality Program** ☐ **Non-Safety Related**	1E31N085A,B	1E31N685A,B
(13) **Document Type:** J05.02		
(14) **Keywords (Description/Topical Codes):** setpoint, uncertainty, RCIC, turbine		

REVIEWS

(15) Name/Signature/Date	(16) Name/Signature/Date	(17) Name/Signature/Date
M. Coffaro Mary Coffaro / 11-1-12 See associated EC	Robin Smith / 11/1/12 See associated EC	Thomas W. Thornton 11/6/12 THOMAS W. THORNTON See associated EC
Responsible Engineer	☒ **Design Verifier** ☐ **Reviewer** ☒ Comments Attached	**Supervisor/Approval** ☐ Comments Attached

Revision	Record of Revision
0	Original Issue
1	EC-39554. Revised to incorporate GEXI2000-00134, GIN 96-02302, updated references and referenced information, calculated PM error in section 5.11.1. Revised and reformatted calculation to meet current requirements of JS09. Incorporated 24 month drift per JC-Q1111-09019. Added computation of ALT and AFT per TSTF-493.

CALCULATION SHEET

ENTERGY

CALCULATION NO. JC-Q1E31-N685-1 REV. 1

CALCULATION REFERENCE SHEET	CALCULATION NO: JC-Q1E31-N685-1 Rev 1

I. **EC MARKUPs INCORPORATED (N/A to NP calculations):** None

II Relationships:	Sht	Rev	Input Doc	Output Doc	Impact Y/N	Tracking No.
1. JS09	0	001	☑	☐	N	
2. J1250L	024A	001	☑	☐	N	
3. J1250L	024B	001	☑	☐	N	
4. 06-IC-1E31-Q-1016	-	107	☑	☐	N	
5. M1090A	0	019	☑	☐	N	
6. 22A3124	0	005	☑	☐	N	
7. 22A3735AA	0	004	☑	☐	N	
8. GIN96-02302	-	0	☑	☐	N	
9. GEXI2000-00134	-	0	☑	☐	N	
10. 460000047	0	300	☑	☐	N	
11. 460002635	0	300	☑	☐	N	
12. PERR91-6068	-	001	☑	☐	N	
13. A0012	0	015	☑	☐	N	
14. 184C4571	001	009	☑	☐	N	
15. 164C5150	001	018	☑	☐	N	
16. 169C8394	002	008	☑	☐	N	
17. 865E517	002	014	☑	☐	N	
18. NEDC31336	-	0	☑	☐	N	
19. E100.0	0	007	☑	☐	N	
20. 865E516	002	008	☑	☐	N	
21. 368X543BA	0	044	☑	☐	N	
22. 368X551BA	0	021	☑	☐	N	
23. FSK-I-9999-249-C	-	006	☑	☐	N	
24. FSK-S-1090A-082-C	0	009	☑	☐	N	
25. FSK-I-9999-152-C	-	009	☑	☐	N	
26. FSK-S-1090A-016-C	0	013	☑	☐	N	
27. FSK-S-1090A-017-C	0	015	☑	☐	N	
28. 06-IC-1E31-R-1016	-	103	☑	☐	N	
29. JC-Q1111-09019	0	000	☑	☐	N	
30. GGNS-NE-11-00011	0	000	☑	☐	N	

II Relationships:	Sht	Rev	Input Doc	Output Doc	Impact Y/N	Tracking No.
31. J1507A	0	001	☑	☐	N	
32. J0400	0	018	☑	☐	N	
33. J0401	0	014	☑	☐	N	
34. A0120	0	016	☑	☐	N	
35. A0014	0	009	☑	☐	N	
36. QP0399	-	013	☑	☐	N	
37. 460003606	0	300	☑	☐	N	

III. CROSS REFERENCES:

1. Asset Suite Equipment Data Base (EDB)
2. UFSAR, Section 5.4.6
3. Technical Specifications, Table 3.3.6.1-1
4. Technical Specifications, Table TR3.3.6.1-1
5. "Flow Measurement Engineering Handbook" by R.W.Miller, published by McGraw-Hill Book Company, 1983
6. ASME Steam Tables, Sixth Edition

IV. SOFTWARE USED:

Title: N/A Version/Release: ______ Disk/CD No. ______

V. DISK/CDS INCLUDED:

Title: N/A Version/Release ______ Disk/CD No. ______

VI. OTHER CHANGES:

Related references removed from the calculation:

EDP 32, ES-19, 368X533, API 90/1253, EAR E900158, 06-IC-1E31-R-0023, 460000944

TABLE OF CONTENTS

1.0 PURPOSE

The purpose of this calculation is to determine the instrument loop uncertainties, limiting allowable values and setpoints for instrument loops 1E31-N685A & B. The values generated by this calculation are in accordance with reference 3.1.1.

2.0 DESIGN REQUIREMENTS

Design Basis Description

The RCIC system is provided to assure adequate core cooling in the event of reactor isolation from its primary heat sink and the loss of feedwater flow to the reactor vessel without requiring actuation of any of the Emergency Core Cooling System equipment (Ref. 3.1.28).
The RCIC turbine is tripped and isolated from its steam supply when the supply pressure drops below that required for safe operation. 1E31-PT-N085 monitors the pressure in the RCIC steam supply line just downstream of its tap off the Main Steam Line and, through trip switch 1E31-PIS-N685, furnishes a trip signal on decreasing pressure to the RCIC steam isolation valve trip logic (Ref. 3.1.30, 3.1.28).

Design Basis Event (DBE)

Since the RCIC turbine is not required for any design basis accidents, the initiating event for RCIC steam supply isolation is low reactor steam pressure in the event of reactor isolation from its primary heat sink and the loss of feedwater flow to the reactor vessel. This event would cause the suppression pool to heat up, but would not change any of the environmental conditions in the drywell or the containment. Therefore, these instruments do not have to operate during accident conditions.

These instruments are classified as QF1 (Ref. 3.2.3). Therefore, this equipment is required to operate under SSE (Safe Shutdown Earthquake) conditions. However per Reference 3.1.1, seismic effects are not required to be considered for setpoint loops. Therefore seismic effects will not be considered for the subject loops.

Reference 3.1.32 identifies the design limit (AL) for the RCIC turbine low steam pressure as 50 psig. The Technical Specification Allowable Value (AV) is ≥ 53 psig (Ref. 3.2.1). The Technical Specification nominal trip setpoint (NTSP) is ≥ 60 psig (Ref. 3.2.2).

3.0 REFERENCES

3.1 Relationships

3.1.1 JS09, Instrumentation & Control Standard Safety Related Methodology For The Generation Of Instrument Loop Uncertainty & Setpoint Calculation

3.1.2 Loop Diagrams

J1250L-024A
J1250L-024B

3.1.3 GIN96-02302, Calculation Change Due To Replacement Of Power Supply By ER96-0514 Revision 0

3.1.4 M1090A, Piping & Instrumentation Diagram Leak Detection System

3.1.5 GEXI2000-00134, Statistical Variation Associated With Published Performance Variable

3.1.6 460003606, "Fluke" Fluke 45 Dual Display Digital Multimeter

3.1.7 NEDC31336, General Electric Instrument Setpoint Methodology

3.1.8 06-IC-1E31-R-1016, RCIC Steam Supply Low Pressure Calibration

3.1.9 460002635, "GE" Operations & Maintenance Instructions For Analog Trip System Qualified To IEEE 323-1971

3.1.10 460000047, Rosemount Inc. Trip/Calibration System

3.1.11 E100.0, Technical Specification For Environmental Safety Related Parameter

3.1.12 169C8394-002, Gage Pressure Transmitter

3.1.13 06-IC-1E31-Q-1016, RCIC Steam Supply Low Pressure Functional Test

3.1.14 368X543BA, Reactor Vessel & Level & Pressure Local Panel A

3.1.15 368X551BA, Main Steam Flow Local Panel A

3.1.16 865E516-002, Division 2 Residual Heat Removal Relay VB

3.1.17 865E517-002, Division 1 Low Pressure Core Spray & Residual Heat Removal Relay VB

3.1.18 164C5150-001, Purchased Part Trip Unit

3.1.19 184C4571-001, Purchased Part Power Supply

3.1.20 FSK-I-9999-249-C, 1E31-PDT-NO84 1E31-PT-N085A Instrument Tubing Run

3.1.21 FSK-S-1090A-082-C, DCB-27 St Fr DBA-24 Elb Ftg To PDTN084A

3.1.22 FSK-S-1090A-017-C, DCB-27 St Fr DBA-24 Elbow Ftg To Lek Detection Sys

3.1.23 FSK-I-9999-152-C, Instrument Tubing Runs Panel 1H22-P015

3.1.24 FSK-S-1090A-016-C, DCB-27 St Fr DBA-24 Elbow Ftg To Leak Detection Sys

3.1.25 QP0399, Panel 1H22P004

3.1.26 A0014, General Floor Plan Floor Plan At Elevation 185 & 189 Feet

3.1.27 A0012, General Floor Plan Floor Plan At Elevation 133 Feet 136 Feet 139 Feet 144 Feet & 148 Feet

3.1.28 22A3124, Reactor Core Isolation Cooling System

3.1.29 PERR91-6068, Rosemount 710DU

3.1.30 22A3735AA, Leak Detection System

3.1.31 JC-Q1111-09019, Drift Calculation for Rosemount Range Codes 5-8 Gage Pressure Transmitters

3.1.32 GGNS-NE-11-00011, RCIC Turbine Exhaust Vent Line Trip And Low Steam Pressure Trip And Isolation AL Bases For 24 Month Fuel Cycle

3.1.33 J1507A, Instrument Location Auxiliary Building & Containment Plan At Elevation 139 Feet 147 & 4 & 7 Inch

3.1.34 J0400, Control Room Panel Location

3.1.35 J0401, Upper Cable Spreading Room Panel Location

3.1.36 A0120, Control Building Control Room Floor Plan at Elevation 166 Feet

3.2 Cross References

3.2.1 Technical Specifications, Table 3.3.6.1-1

3.2.2 Technical Specifications, Table TR3.3.6.1-1

3.2.3 Asset Suite Equipment Data Base (EDB)

3.2.4 "Flow Measurement Engineering Handbook" by R.W.Miller, published by McGraw-Hill Book Company, 1983, pg.6-11

3.2.5 UFSAR Section 5.4.6

3.2.6 ASME Steam Tables, Sixth Edition

4.0 GIVEN

4.1 Instrument Loop Block Diagram

Transmitter	Trip Unit	Power	P&ID	Loop Diagram
1E31-PT-N085A,B	1E31-PIS-N685A,B	E21K702 (E21-PS2) E12K701 (E12-PS1)	3.1.4	3.1.2

4.2 Transmitter Environment (1E31-PT-N085A,B)

Description	Data	Reference
Tag Number	1E31-PT-N085A,B	
Instrument Location:		
Panel	1H22-P004, P015	3.1.2
Room	1A313	3.1.27, 3.1.33
Environmental Conditions:		
Normal:	Zone N-068	3.1.11
Temperature	60-105°F	3.1.11
Pressure	-1.0 to -0.1 in.wg.	3.1.11
Radiation (Gamma)	3.1E03 rads (40 yr TID)	3.1.11
	0.011 Rads/hr gamma	3.1.11
Humidity	20 to 90% RH	3.1.11
DBE or Accident:	N/A	Section 2.0
Seismic Conditions:	Not Required	Section 2.0
Surveillance Intervals:	24 months	3.2.1

4.3 Trip Unit Environment

Description	Data	Reference
Tag Number	1E31-PIS-N685A,B	
Instrument Location:		
Panel	1H13-P629, P618	3.1.2
Room	0C703/0C504	3.1.26, 3.1.34 – 3.1.36
Environmental Conditions:		
Normal:	Zone N-028	3.1.11
Temperature	69-90°F	3.1.11
Pressure	0.1 to 1.0 in wg.	3.1.11
Radiation (Gamma)	1.8E2 rads (40 yr TID)	3.1.11
	0.5 mRads/hr dose rate	
Humidity	20 to 50% RH	3.1.11
DBE or Accident:	Same as Normal	3.1.11
Surveillance Intervals	92 days	3.2.1

4.4 Transmitter Vendor Data

Description	Data	Reference
Tag Number	1E31-PT-N085A,B	
Manufacturer	Rosemount	3.1.12, 3.1.14, 3.1.15
Model	1152GP7N22T0280PB	3.1.12, 3.1.14, 3.1.15
URL	300 psig	3.1.9
Maximum span	0-300 psi	3.1.9
Minimum span	0-50 psi	3.1.9
Calibrated Span	200 psi	3.1.8
Accuracy:	± 0.25% span (3σ)	3.1.9, 3.1.5
Drift:	±1.346% Span for 30 months	3.1.31
Power Supply:	<0.005% span per volt (3σ)	3.1.9, 3.1.5
Temperature:	± 5.00% Span/100°F @ min span (3σ) ± 1.25% Span/100°F @ max span (3σ)	3.1.9, 3.1.5
Humidity:	Sealed unit - no effects	3.1.9
Radiation:	± 5.00% URL	3.1.9
Static Press:	N/A for gauge pressure transmitter	3.1.9
Overpressure:	< ± 3.00% URL per 2000 psi (3σ)	3.1.9, 3.1.5
Seismic:	± 0.25% URL for 3g peak	3.1.9
Output Range	4-20 madc	3.1.9
Process Head Correction:	1E31-PT-N085A = +2.4 psi 1E31-PT-N085B = +14.5 psi	3.1.8 3.1.8

4.5 Trip Unit Vendor Data

Description	Data	Reference
Tag Number	1E31-PIS-N685A,B	
Manufacturer	Rosemount	3.1.16 - 3.1.18
Model	510DU/710DU	3.1.16 - 3.1.18 Assumption 5.4
Repeatability:	± 0.2% span	3.1.10, Note 1
Drift:	N/A	Assumption 5.7
Input Range	4-20 madc	3.1.10

Note 1: Table 5 of reference 3.1.10 defines environmental conditions at the Trip Switch in terms of "operating condition" and "environment." Conditions in Zone N-028 are bounded by line 2 defined as "adverse operating conditions" and "normal environment" The corresponding line on Table 6 specifies repeatability under the defined conditions as ±0.2%. This repeatability is valid for six months operation. An allowance for power supply effects, temperature effects, humidity effects, drift and radiation effects are included in the repeatability.

4.6 Power Supplies

Power Supply Nominal	24.0 volts	Assumption 5.3
Power Supply Variations	23.0 - 28 vdc	Assumption 5.3

4.7 Instrument Tubing Run Data

Description	Data	Reference
Tag Number	1E31-PT-N085A; B	
Room	1A313	3.1.20, 3.1.21, 3.1.27
Normal Temp (N-068)	60-105°F	3.1.11
Accident Temp	N/A	Section 2.0
Vertical Rise (ft)	8' 3" (1E31-PT-N085A)	3.1.20, 3.1.21
	7' 6-3/4" (1E31-PT-N085B)	3.1.22, 3.1.23
Room	1A112	3.1.22 – 3.1.25, 3.1.27
Normal Temp (N-003)	65-150°F	3.1.11
Accident Temp	N/A	Section 2.0
Vertical Rise (ft)	12' 3-1/2" (1E31-PT-N085A)	3.1.21
	+21' 0" (1E31-PT-N085B)	3.1.22, 3.1.24

5.0 ASSUMPTIONS

5.1 All uncertainties given in vendor data specifications are assumed to be 2 sigma unless otherwise specified.

5.2 Per reference 3.1.1, the M&TE error is normally assumed to be equal to the reference accuracy of the transmitter. Per reference 3.1.8, a Fluke 45 (±0.040 ma, Ref. 3.1.6) and a pressure gauge (±0.5 psi) are used to calibrate the transmitters. The total M&TE error (MTE_{cal1}) for this device is the SRSS of the two. Converting the ma error to psi: (0.040 ma)(200 psi / 16 ma) = 0.5 psi. The SRSS of 0.5 and 0.5 is ±0.71 psi. The setting tolerance from reference 3.1.8 is ±0.04 ma, or ±0.5 psi. As the test equipment error is larger than the reference accuracy of the transmitter (±0.34 psi) and the setting tolerance, ±0.71 psi will be assumed for the M&TE error.

Per reference 3.1.13, a Rosemount readout assembly is used to calibrate the Rosemount trip units. Per reference 3.1.10, the accuracy of the readout assembly (MTE_{cal2}) is ±0.01 ma, which is equal to (0.01 ma)(200 psi/16 ma) = ±0.13 psi and the accuracy of the trip unit is ±0.20% span = 0.20%(200 psi) = ±0.40 psi. Reference 3.1.13 specifies a setting tolerance of ±0.04 ma = (0.04)(200/16) = 0.5 psi. The larger ±0.5 psi setting tolerance value will be assumed for the M&TE error.

5.3 A maximum value of 28 vdc and minimum of 23 vdc will be assumed for power supply variation, as this is the value provided in PPD 184C4571 for the 24 vdc power supplies (Ref. 3.1.19). This results in an assumed voltage variation of +4, -1 vdc. Per reference 3.1.3, the loop power supplies were replaced with a Vicor model VI-N53-IM DC-DC converter that has a maximum variation of 0.55%, which is bounded by the original power supply variation. For conservatism, ±4 vdc will be used in this calculation.

5.4 Since Rosemount 510DU model is obsolete, they may be replaced with 710DU models in the future (Ref. 3.1.29). The performance specifications for the 710DU is equal to or better than those of the 510DU.

5.5 Overpressure consists of pressure above the URL, in this case 300 psi (Section 4.4). Normally, the transmitter sees full RCS pressure, approximately 1150 psi. Therefore, the transmitter may see overpressure conditions prior to performing its trip function. Since overpressure is a non-linear effect, the full value will be used.

5.6 The radiation drift for the transmitters and trip units is assumed to be negligible because of the low normal dose rates. Per reference 3.1.7 section 2.6, there is no effect on transmitters below 0.1 Mrad.

5.7 The accuracy of the Rosemount trip units (±0.20% span) is valid for six months (Ref. 3.1.10). The trip units are calibrated every 115 days (Assumption 5.9). Therefore, drift is included in reference accuracy.

5.8 Harsh environments may affect the cabling by reducing insulation resistance. Since this loop does not have to work during accident conditions (Section 2.0), no cable degradation is expected and IR = ±0.0 psi.

5.9 A calibration interval of 30 months will be assumed for the transmitters, which is the nominal 24-month period, plus a 25% grace period (Ref. 3.2.1). A calibration interval of 115 days will be assumed for the trip units which is the nominal 92 day period, plus a 25% grace period (Ref. 3.2.1).

5.10 This loop does not employ a primary element separate from the pressure transmitter. Therefore, no additional errors due to inaccuracies in the primary element exist and PE = ±0.0 psi.

5.11 Three sources of process measurement error exist in this application: one due to the water filled tubing, one due to the location of the tap on the piping, and the other due to ambient pressure during accident conditions.

1. Process Measurement errors can arise from changes in density of water in sensing line (tubing) used to connect the transmitter to the process line. Since the error is in a definite direction, the PM error will be a bias term. Each tubing run is sufficiently different that maximum error will be calculated for each tubing run and the largest error used in the calculation.

   The method used will be to compare the calibrated static head correction to the static head conditions during the minimum and maximum environmental conditions. This is done by summing the heads due to each of the vertical lengths in different environments. The difference between these values will be the change due to actual plant conditions, which is the process measurement error desired.

   Head = Σ [vertical length * density]

   Process Measurement Error = Head (actual) – Head (calibrated)

   (Note that if the actual static head is higher than the calibrated head, the transmitter output will be higher than desired: a positive PM error).

   For N085B loop, the PM error will be determined for the minimum temperature and maximum pressure (1150 psig, Assumption 5.5) during normal conditions and the maximum temperature and minimum pressure (0 psig, conservatively) during normal conditions. For the N085A loop, because the transmitter is located above the penetration and the static head effect is reversed for the length of tubing between the penetration and the transmitter, the temperature/pressure extremes for that portion of tubing will be reversed as well. Per section 2.0, these loops are not required to operate during accident conditions. Section 4.7 lists the environments and vertical runs. The various water densities for these temperature and pressures can be found in reference 3.2.6. Note that:

$$\text{density (lb/ft}^3\text{) / 1728 = density (lb/in}^3\text{)}$$

Loop: N085A Calibration Process Head Correction: 2.4 psi (Ref. 3.1.8)				
Max Static Head Conditions				
Length	Temp	Press	Density	Head
-99 in	105°F	0 psig	61.93 lb/ft^3	-3.548 psi
147.5 in	65°F	1150 psig	62.57 lb/ft^3	5.341 psi
Maximum Static Head				+1.793 psi
Min Static Head Conditions				
Length	Temp	Press	Density	Head
-99 in	60°F	1150 psig	62.60 lb/ft^3	-3.586 psi
147.5 in	150°F	0 psig	61.19 lb/ft^3	5.223 psi
Minimum Static Head				+1.637 psi
Loop N085A		PM (max static head) =		-0.607 psi
		PM (min static head) =		-0.763 psi

Loop: N085B Calibration Process Head Correction: 14.5 psi (Ref. 3.1.8)				
Max Static Head Conditions				
Length	Temp	Press	Density	Head
90.75 in	60°F	1150 psig	62.60 lb/ft^3	3.288 psi
252 in	65°F	1150 psig	62.57 lb/ft^3	9.125 psi
Maximum Static Head				+12.413 psi
Min Static Head Conditions				
Length	Temp	Press	Density	Head
90.75 in	105°F	0 psig	61.93 lb/ft^3	3.252 psi
252 in	150°F	0 psig	61.19 lb/ft^3	8.924 psi
Minimum Static Head				+12.176 psi
Loop N085B		PM (max static head) =		-2.087 psi
		PM (min static head) =		-2.324 psi

Because this is a decreasing setpoint, negative bias errors need not be considered. Therefore, the PM error due to density variation is zero.

2. The loop employs elbow taps in the main steam line for pressure measurement points. The flow around the elbow causes a high pressure area on the outside of the elbow and a low pressure area on the inside, the square root of the difference being proportional to the flow (Ref. 3.2.4).

   1E31-PT-N085A taps off the outside of an elbow. This results in PT-N085A reading higher than actual system pressure, a positive bias error. 1E31-PT-N085B taps off the inside of the elbow. The effects are exactly the same, but results in 1E31-PT-N085B reading lower than system pressure, a negative bias error.

   1E31-PDT-N084 measures this differential pressure and generates a trip signal on high differential pressure corresponding to high steam flow, an indication of a steam line break. From reference 3.2.1, the allowable value for this trip is 64 inwc. Half of this is due to elevating the pressure at the outer tap, half due to the drop at the inner tap (Ref. 3.2.4).

Therefore, 1E31-PT-N085A will read from 0 to 32 inches high as flow varies from 0 to the allowable value. This must be treated as a positive bias error, since it always makes the reading high.

Similarly, 1E31-PT-N085B will read from 0 to 32 inches low as flow varies from 0 to the allowable value. This must be treated as a negative bias error. Since this will cause an early trip, no credit will be taken for it, and the worst case value will be used:

PM = +32 inches

= +1.16 psi

3. The final source of process error arises from the fact that 1E31-PT-N085 actually measures differential pressure between the process and local ambient pressure (psig). Since this loop does not have to work during accident conditions (Section 2.0), no significant variation in local ambient pressure is expected (Section 4.2), and no error will exist due to this effect.

6.0 METHODOLOGY

6.1 Device Uncertainties

For each module, the uncertainty terms applicable to this application will be specified and combined into the following module errors:

RA	-	reference accuracy
L	-	negative bias uncertainty
M	-	positive bias uncertainty
MTE	-	measurement and test equipment inaccuracies
D	-	drift

6.2 Loop Uncertainties

The random and bias components of:

PE	-	errors associated with the Primary Element
PM	-	errors in Process Measurement, and
IR	-	errors due to degradation in Insulation Resistance

will be quantified, the loop error equation given, and the device and loop uncertainties combined to produce:

A_L	-	SRSS of all device random uncertainties except drift
L_L	-	The sum of all negative bias uncertainties
M_L	-	The sum of all positive bias uncertainties
C_L	-	SRSS of all measurement and test equipment inaccuracies used for calibration.
D_L	-	SRSS of all drifts
LU	-	SRSS(A_L, C_L, PE, PM) $\pm$ IR - L_L + M_L

6.3 Total Loop Uncertainty

The total loop uncertainty will be calculated using the reference 3.1.1 equation:

$$TLU = LU + D_L$$

6.4 Allowable Value

The allowable value for the loop will be calculated using the reference 3.1.1 equation:

$$AV = AL \pm LU$$

6.5 Nominal Trip Setpoint

The nominal trip setpoint will be calculated using the reference 3.1.1 equation:

$$NTSP = AL \pm TLU$$

6.6 Spurious Trip Avoidance

The probability of a spurious trip during normal plant operation using the Tech Spec setpoint will be evaluated using the methodology of reference 3.1.1 and calculated loop errors. Per reference 3.1.1, a 95% probability of no spurious trip is acceptable.

6.7 LER Avoidance

The probability of exceeding the Tech Spec allowable value without a trip at the tech spec setpoint will be evaluated using the methodology of reference 3.1.1 and calculated loop errors. Per reference 3.1.1, a 90% probability of avoiding LERs is acceptable.

Note: When considering the probability of a spurious trip, any late actuation will be conservative. Similarly, when considering the probability of an LER, any early actuation will be conservative. This means that single sided distributions are appropriate for this evaluation. Per reference 3.1.1, a Z of 1.645 corresponds to a probability of 95%. Similarly, a Z of 1.28 corresponds to a probability of 90%.

6.8 Nomenclature

The nomenclature of reference 3.1.1, Section 1.6, will be used. Errors associated with the transmitter will be subscripted with a "1", errors associated with the trip unit will be subscripted with a "2", while loop errors will be subscripted with an "L". For example, D_1 would be the transmitter drift, D_2 would be the trip unit drift, and D_L would be the loop drift.

6.9 Worst Case Loop

The equipment and environments for each loop are identical; therefore, no worst case calculation is required.

7.0 CALCULATION

7.1 Transmitter Uncertainties

Using the vendor data from Section 4.4:

URL = 300 psig
SPAN = 200 psi

RA_I = ± 0.25% span (3σ)
= ± (2/3)*(0.0025)*(200) psi
= ± 0.34 psi

Temperature effect is specified at maximum and minimum span (Section 4.5). Maximum and minimum spans are 300 psi and 50 psi (Ref. 3.1.9). Using a linear interpolation between these values for the temperature effect at 200 psi:

$$\frac{(\text{Cal Sp} - \text{Min Sp})}{(\text{Max Sp} - \text{Min Sp})} = \frac{(\text{X} - \text{TE @ Min Sp})}{(\text{TE @ Max Sp} - \text{TE @ Min Sp})}$$

$$\frac{(200 - 50)}{(300 - 50)} = \frac{(X - 5.00)}{(1.25 - 5.00)}$$

$$150*(-3.75) = 250X - 1250$$

$$X = \frac{(150*(-3.75)) + 1250}{250}$$

$$X = 2.75$$

TE_I = ± 2.75% Span/100°F (3σ)
= ± (2/3)*(0.0275)*(200 psi)
= ± 3.67 psi/100°F

Temperature effect will be broken into TD (65-90°F per reference 3.1.1), TEN (90-105°F, the balance of the normal range from Section 4.2). Per Section 2.0, no accident conditions need to be addressed.

Therefore:

TD_I = (3.67)*(25/100)
= ± 0.92 psi

TEN_I = (3.67)*(15/100)
= ± 0.56 psi

Per reference 3.1.9, humidity has no effect on the sealed transmitter.

HE_I = ± 0.00 psi

Radiation Drift (normal)

RD_I = ± 0.00 psi Assumption 5.6

Per Section 4.6, the worst power supply variations are taken as ± 4.0 volts.

PS_I = ± 0.005% span / volt variation (3σ)
= ± (2/3)*(0.00005)*(200 psi)*(4 volts)
= ± 0.03 psi

Seismic Effect

SE_I = ± 0.00 psi Section 2.0

Overpressure Effect

OVP_I = ± 3.0% URL for 2000 psi (3σ) Assumption 5.5
= ± (2/3)*(0.03)*(300 psi)
= ± 6.00 psi

Drift

DR_I = ±1.346% Span for 30 months
= ± (0.01346)*(200 psi)
= ± 2.70 psi

Summarizing for the transmitter:

A_I = ± SRSS(RA_I, TEN_I, PS_I, SE_I, OVP_I)
= ± SRSS(0.34, 0.56, 0.03, 0.00, 6.00)
= ± 6.04 psi

L_I = + 0.0 psi
M_I = - 0.0 psi

C_I = ± 0.71 psi Assumption 5.2

D_I = ± SRSS(DR_I, TD_I)
= ± SRSS(2.70, 0.92) psi
= ± 2.86 psi

7.2 Trip Unit Uncertainties

Using the vendor values from Section 4.5:

Span	= 200 psi	
A_2	= ± 0.20% span = ± (0.0020)*(200 psi) = ± 0.40 psi	
L_2	= + 0.00 psi	
M_2	= - 0.00 psi	
C_2	= ± 0.50 psi	Assumption 5.2
D_2	= ± 0.00 psi	Assumption 5.7

7.3 Primary Element Accuracy

PE	= ±0.0 psi	Assumption 5.10

7.4 Process Measurement Accuracy

PM	= +1.16 psi	Assumption 5.11

7.5 Insulation Resistance Bias

IR	= 0.0 psi	Assumption 5.8

7.6 Loop Uncertainties

Using the equations from reference 3.1.1 and the values from above:

A_L = ± SRSS(A_1, A_2)
= ± SRSS(6.04, 0.40)
= ± 6.06 psi

L_L = L_1 + L_2 = -0.0 psi
M_L = M_1 + M_2 = +0.0 psi

C_L = ± SRSS(C_1, C_2)
= ± SRSS(0.71, 0.50)
= ± 0.87 psi

D_L $= \pm$ SRSS(D_1, D_2)
$= \pm$ SRSS(2.86, 0.00)
$= \pm$ 2.86 psi

LU_+ = + SRSS(A_L, C_L) + PM
= + SRSS(6.06, 0.87) + 1.16
= + 7.29 psi

7.7 Total Loop Uncertainty

TLU = LU_+ + D_L
=7.29 + 2.86
= + 10.15 psi

7.8 Allowable Value

AV = AL + LU_+
= 50 + 7.29
= 57.29 psig

The Technical Specification Allowable Value of ≥ 53.0 psig, is non-conservative with respect to the calculated AV value.

Based on the reference 3.1.1, section 7, statistical techniques may be considered to reduce margin. Because the setpoint is approached from only one direction and there is no increasing setpoint, the setpoint errors (LU) have a single side of interest and may be reduced by a factor of 1.645 / 2 to maintain a 95% probability of a trip.

LU'_+ = ((LU_+ - PM)*1.645 / 2) + PM.
= ((7.29– 1.16)* 0.8225) + 1.16
= 5.05 + 1.16
= + 6.21 psi

AV' = 50 + 6.21
= 56.21 psig

The calculated AV **does not** support the existing Technical Specification Allowable Value of ≥ 53.0 psig. Therefore a new technical specification allowable value of ≥ 57 psig is **recommended.**

7.9 Nominal Trip Setpoint

NTSP = AL + TLU
= 50 psig + 10.15 psi
= 60.15 psig

The Technical Specification NTSP of ≥ 60.0 psig, is non-conservative with respect to the calculated NTSP value.

Per Section 7 of reference 3.1.1, TLU may be reduced by using the single-sided distribution and SRSS (LU,D_L) methods. Therefore:

TLU′ = (1.645/2)(SRSS(LU_+, D_L))
= (0.8225)(SRSS((7.29 – 1.16), 2.86)) +1.16
= + 6.73 psig

Recalculating NTSP

NTSP′ = AL + TLU′
= 50 + 6.73
= 56.73 psig

The Technical Specification NTSP and plant setpoint of 60 psig is conservative with respect to the calculated value.

7.10 Spurious Trip Avoidance

Z = ABS(NTSP - X_T) / SRSS($Sigma_n$, $Sigma_i$) where:

$Sigma_i$	= (1/n)*(SRSS((LU'_+ - PM), D_L))+ PM	Ref. 3.1.1
n	= 2	Assumption 5.1
$Sigma_i$	= (1/2)*(SRSS((6.21 – 1.16), 2.86)) + 1.16	
	= 4.07	

Reference 3.2.5 notes that the RCIC turbine steam input pressure in the LP (Low Pressure) Condition cannot fall below 135 psig. Trips below this limit would not be considered spurious since there is no longer any need for the RCIC turbine.

X_T = 135 psi

The confidence of this X_T is high; therefore, the appropriate value of $Sigma_N$ is zero.

$Sigma_N$ = 0.00

Using the equations from reference 3.1.1 and the NTSP from Section 2.0:

Z = ABS(NTSP – X_T) / SRSS($Sigma_N$, $Sigma_i$) Ref. 3.1.1
Z = ABS(60 – 135) / SRSS(0.00, 4.07)
= 18.42

This is above the Section 6.6 minimum acceptable Z value of 1.645 for 95%.

7.11 LER Avoidance

Using the recommended AV of 57 psig from section 7.8:

Z = ABS(AV- NTSP) / 1/n*SRSS(A_L, C_L, D_L) Ref. 3.1.1
= ABS(57 – 60) / ½ SRSS(6.06, 0.87, 2.86)
= 0.88

This is below the Section 6.7 minimum acceptable Z value of 1.28 for 90%.

7.12 As-Left Tolerance

Note: For the purposes of calculating ALT, the actual MTE values, MTE_{1cal} and MTE_{2cal}, are used.

ALT_T – Transmitter TSTF-493 Calculation

MTE_{1cal} = ± 0.71 psi Assumption 5.2

ALT_T = ± SRSS (RA_1, MTE_{1cal})

= ± SRSS (0.34, 0.71) psi

= ± 0.79 psi

Converting to loop current:

ALT_T = ± (0.79 psi/200 psi)*16 mA

= ± 0.06 mA

ALT_{Tcal} – Transmitter As-Left Tolerance for Calibration Procedures

In field calibration procedures, use only the Reference Accuracy (RA) for establishing the Transmitter ALT.

ALT_{Tcal} = RA_1 = ±0.34 psi

Converting to loop current:

ALT_{Tcal} = ± (0.34 psi/200 psi) * 16 mA

= ± 0.03 mA

The current calibration setting tolerance for the transmitter is ± 0.04 mA, which is conservative to the TSTF-493 required value. Because of perceived difficulty in calibration to the derived value, the current ALT is retained.

ALT_{Tcal} = ± 0.04 mA

ALT_{TU} – Trip Unit TSTF-493 Calculation

MTE_{2cal} = ± 0.13 psi Assumption 5.2

ALT_{TU} = ± SRSS (A_2, MTE_{2cal})

= ± SRSS (0.40, 0.13)

= ± 0.42 psi

Converting to loop current:

ALT_{TU} = ± (0.42 psi/200 psi) * 16 mA
= ±0.03 mA

ALT_{TUcal} – Trip Unit for Calibration Procedures

In field calibration procedures, use only the Reference Accuracy (RA) for establishing the Trip Unit ALT.

ALT_{TUcal} = A_2
= ± 0.40 psi

Converting to loop current:

ALT_{TUcal} = ± (0.40 psi/200 psi) * 16 mA
= ± 0.03 mA

7.13 As-Found Tolerance (AFT)

AFT_T – Transmitter TSTF-493 Calculation

For calculating AFT_T, the actual MTE value is used:

AFT_T = ± SRSS (RA_1, MTE_{1cal}, D_1) psi
= ± SRSS (0.34, 0.71, 2.86) psi
= ± 2.97 psi

Converting to loop current:

AFT_T = ± (2.97 psi/200 psi) * 16 mA
= ± 0.24 mA

AFT_{Tcal} – Transmitter As-Found Parameter for Field Procedures

Defining AFT_{Tcal}, the value used in calibration procedures for monitoring performance:
Surveillance Interval = 30 Months
DR_1 = ±2.70 psi
AFT_{Tcal} = DR_1
= ±2.70 psi
= ± (2.70 psi/200 psi) * 16 mA
= ± 0.22 mA

AFT_{TU} – Trip Unit TSTF-493 Calculation

The surveillance period for the trip units is 115 days.

Using vendor data,

AFT_{TU} = ± SRSS (A_2, MTE_{2cal}, D_2)
= ± SRSS (0.40, 0.13, 0) psi
= ± 0.42 psi

Converting to loop current:

AFT_{TU} = ± (0.42 psi/200 psi) * 16 mA
= ± 0.03 mA

AFT_{TUcal} – Trip Unit As-Found Parameter for Field Procedures

Surveillance Interval = 115 Days
D_2 = ±0.00 psi
Because there is no drift value for the trip unit, AFT_{TUcal} will be set equal to AFT_{TU}.
AFT_{TUcal} = AFT_{TU}
= ±0.42psi
= ± (0.42 psi/200psi) * 16 mA
= ± 0.03 mA

7.14 Loop Tolerances

ALT_L – As-Left Loop Tolerance

ALT_L = ± SRSS (ALT_{Tcal}, ALT_{TUcal})
= ± SRSS (0.34, 0.40) psi
= ± 0.52 psi
= ± (0.52 psi/200 psi) * 16 mA
= ± 0.04 mA

AFT_L – As-Found Loop Tolerance

AFT_L = ±SRSS (AFT_{Tcal}, AFT_{TUcal})
= ±SRSS (2.70, 0.42) psi
= ± 2.73 psi
= ± (2.73 psi/200 psi) * 16 mA
= ± 0.22 mA

8.0 CONCLUSION

The Technical Specification allowable value is non conservative with respect to the calculated values. The Technical Specification NTSP is conservative with respect to the calculated values. Using the recommended AV yields unfavorable LER avoidance.

SUMMARY OF RESULTS		
SYSTEM		E31
LOOP NUMBERS		N685A,B
TOTAL LOOP UNCERTAINTY		+6.73 psi
LOOP UNCERTAINTY		+ 6.21 psi
DRIFT ALLOWANCE		± 2.86 psi
M&TE		± 0.87 psi
	SPECIFIED (psig)	CALCULATED (psig)
Design Limit	50	-
Allowable Value	≥ 53 ≥ 57**	56.21
Nominal Trip Setpoint	≥ 60	56.73

** Recommended value

Summary of Calibration Tolerances	
Transmitter As-Left Tolerance TSTF-493 (ALT_T)	±0.06 mA
Transmitter ALT Cal (ALT_{Tcal})	±0.04 mA
Trip Unit As-Left Tolerance TSTF-493 (ALT_{TU})	±0.03 mA
Trip Unit ALT Cal (ALT_{TUcal})	±0.03 mA
Transmitter AFT TSTF-493 (AFT_T)	±0.24 mA
Transmitter AFT Cal (AFT_{Tcal})	±0.22 mA
Trip Unit AFT TSTF-493 (AFT_{TU})	±0.03 mA
Trip Unit AFT Cal (AFT_{TUcal})	±0.03 mA
As-Left Loop Tolerance (ALT_L)	±0.52 psi
As-Left Loop Tolerance (ALT_L)	±0.04 mA
As-Found Loop Tolerance (AFT_L)	±2.73 psi
As-Found Loop Tolerance (AFT_L)	±0.22 mA

Sheet 1 of 1

DESIGN VERIFICATION COVER PAGE

☐ ANO-1	☐ ANO-2	☐ IP-2	☐ IP-3	☐ JAF	☐ PLP
☐ PNPS	☐ VY	☒ GGNS	☐ RBS	☐ W3	☐ NP

Document No. JC-Q1E31-N685-1	Revision No. 1	Page 1 of 4

Title: Instrument Loop Uncertainty and Setpoint Determination for System E31 Loop N685 RCIC Turbine Isolation on Low Inlet Steam Pressure

☒ Quality Related ☐ Augmented Quality Related

DV Method: ☒ Design Review ☐ Alternate Calculation ☐ Qualification Testing

VERIFICATION REQUIRED	DISCIPLINE	VERIFICATION COMPLETE AND COMMENTS RESOLVED (DV print, sign, and date)
☐	Electrical	
☐	Mechanical	
☒	Instrument and Control	Robin Smith [signature] 11/1/12
☐	Civil/Structural	
☐	Nuclear	
☐		
☐		

Originator:	Mary Coffaro [signature] 11-1-12 Print/Sign/Date After Comments Have Been Resolved

ATTACHMENT 9.6 **DESIGN VERIFICATION CHECKLIST**

Sheet 1 of 3

IDENTIFICATION:				DISCIPLINE:
Document Title:	Instrument Loop Uncertainty and Setpoint Determination for System E31 Loop N685 RCIC Turbine Isolation on Low Inlet Steam Pressure			☐ Civil/Structural ☐ Electrical ☒ I & C ☐ Mechanical ☐ Nuclear ☐ Other
Doc. No.:	JC-Q1E31-N685-1	Rev. 1	QA Cat.: SR	
Verifier:	Robin Smith Print	See AS for signature Sign	______ Date	
Manager authorization for supervisor performing Verification. ☒ N/A	______ Print	______ Sign	______ Date	
METHOD OF VERIFICATION: Design Review ☒	Alternate Calculations ☐		Qualification Test ☐	

The following basic questions are addressed as applicable, during the performance of any design verification. [ANSI N45.2.11 – 1974] [NP] [QAPD, Part II, Section 3] [NQA-1-1994, Part II, BR 3, Supplement 3s-1].

NOTE The reviewer can use the "Comments/Continuation sheet" at the end for entering any comment/resolution along with the appropriate question number. Additional items with new question numbers can also be entered.

1. Design Inputs – Were the inputs correctly selected and incorporated into the design?

   (Design inputs include design bases, plant operational conditions, performance requirements, regulatory requirements and commitments, codes, standards, field data, etc. All information used as design inputs should have been reviewed and approved by the responsible design organization, as applicable.

   All inputs need to be retrievable or excerpts of documents used should be attached.

   See site specific design input procedures for guidance in identifying inputs.)

   Yes ☒ No ☐ N/A ☐

2. Assumptions – Are assumptions necessary to perform the design activity adequately described and reasonable? Where necessary, are assumptions identified for subsequent re-verification when the detailed activities are completed? *Are the latest applicable revisions of design documents utilized?*

   Yes ☒ No ☐ N/A ☐

3. Quality Assurance – Are the appropriate quality and quality assurance requirements specified?

   Yes ☒ No ☐ N/A ☐

ATTACHMENT 9.6 **DESIGN VERIFICATION CHECKLIST**

Sheet 2 of 3

4. Codes, Standards and Regulatory Requirements – Are the applicable codes, standards and regulatory requirements, including issue and addenda properly identified and are their requirements for design met?
Yes ☒ No ☐ N/A ☐

5. Construction and Operating Experience – Have applicable construction and operating experience been considered?
Yes ☐ No ☐ N/A ☒

6. Interfaces – Have the design interface requirements been satisfied and documented?
Yes ☐ No ☐ N/A ☒

7. Methods – Was an appropriate design or analytical (for calculations) method used?
Yes ☒ No ☐ N/A ☐

8. Design Outputs – Is the output reasonable compared to the inputs?
Yes ☒ No ☐ N/A ☐

9. Parts, Equipment and Processes – Are the specified parts, equipment, and processes suitable for the required application?
Yes ☐ No ☐ N/A ☒

10. Materials Compatibility – Are the specified materials compatible with each other and the design environmental conditions to which the material will be exposed?
Yes ☐ No ☐ N/A ☒

11. Maintenance requirements – Have adequate maintenance features and requirements been specified?
Yes ☐ No ☐ N/A ☒

12. Accessibility for Maintenance – Are accessibility and other design provisions adequate for performance of needed maintenance and repair?
Yes ☐ No ☐ N/A ☒

13. Accessibility for In-service Inspection – Has adequate accessibility been provided to perform the in-service inspection expected to be required during the plant life?
Yes ☐ No ☐ N/A ☒

14. Radiation Exposure – Has the design properly considered radiation exposure to the public and plant personnel?
Yes ☐ No ☐ N/A ☒

15. Acceptance Criteria – Are the acceptance criteria incorporated in the design documents sufficient to allow verification that design requirements have been satisfactorily accomplished?
Yes ☒ No ☐ N/A ☐

16. Test Requirements – Have adequate pre-operational and subsequent periodic test requirements been appropriately specified?
Yes ☐ No ☐ N/A ☒

ATTACHMENT 9.6 **DESIGN VERIFICATION CHECKLIST**

Sheet 3 of 3

17. Handling, Storage, Cleaning and Shipping – Are adequate handling, storage, cleaning and shipping requirements specified?
Yes ☐ No ☐ N/A ☒

18. Identification Requirements – Are adequate identification requirements specified?
Yes ☐ No ☐ N/A ☒

19. Records and Documentation – Are requirements for record preparation, review, approval, retention, etc., adequately specified? Are all documents prepared in a clear legible manner suitable for microfilming and/or other documentation storage method? Have all impacted documents been identified for update as necessary?
Yes ☒ No ☐ N/A ☐

20. Software Quality Assurance- ENN sites: For a calculation that utilized software applications (e.g., GOTHIC, SYMCORD), was it properly verified and validated in accordance with EN- IT-104 or previous site SQA Program?
ENS sites: This is an EN-IT-104 task. However, per ENS-DC-126, for exempt software, was it verified in the calculation?
Yes ☐ No ☐ N/A ☒

21. Has adverse impact on peripheral components and systems, outside the boundary of the document being verified, been considered?
Yes ☐ No ☐ N/A ☒

<u>Comments / Continuation Sheet</u>

Question #	Comments	Resolution	Initial/Date
1	Density-related PM error should be determined in Assumption 5.14 for normal conditions.	Incorporated. (This section moved to 5.11).	RS / 9-14-12

Entergy

ATTACHMENT 9.10
SHEET 1 OF 1

ENGINEERING CHANGE COMMENT FORM

Comment No.	Reviewer	Department / Discipline / Program	Comment	Comment Date	Resolution	Date Resolved
			Owner's Review Comments to JC-Q1E31-N685-1 (EC 39554)			
			General Issues			
1	R. Hannigan	EXCEL Services Corp.	Section 2: There is no basis reference for the Design Basis Events statement listed in Section 2. Need to add a cross-reference for this. Should also check accident analyses and confirm the events credited. That whole paragraph under "Design Basis Event (DBE)" is confusing and poorly written. I realize it may be out of Enercon's scope but it would be nice to rework it. Paragraph under "Design Basis Event (DBE)" -- What value does the 2nd sentence provide? It appears that the 2nd sentence is supposed to be the justification for the next sentence stating that these instruments do not have to operate under accident conditions but it isn't clear. Again, this may be out of Enercon's scope.	8/10/12	The subject paragraph was not affected by this revision of the calculation and is not required to be updated. The 2nd sentence of the paragraph is basically stating that the suppression pool heatup caused by RCIC operation has an insignificant affect on the surrounding environment.	09/26/12

Comment No.	Reviewer	Department / Discipline / Program	Comment	Comment Date	Resolution	Date Resolved
Owner's Review Comments to JC-Q1E31-N685-1 (EC 39554)						
2	R. Hannigan	EXCEL Services Corp.	Section 2.0 – 2nd paragraph under Design Basis Events – prior to using terms QF1 and SSE consider defining them. Also, is this paragraph supposed to be under the "Design Basis Event (DBE)" heading or is it a separate subject, i.e. "Seismic Requirements"? I realize that may change based on new direction from 8/16/2 telecon.	8/10/12	Defined SSE. At GGNS SE in normally addressed under DBE.	09/26/12
3	R. Hannigan	EXCEL Services Corp.	Section 2.0 – last paragraph – if the 50 psig Design Limit is going to be used to replace the previous Analytical then it should be clearly stated in this section. If so then for the remainder of the calculation you should use the term Design Limit or "DL". Also, for this section consider not listing the previous AV & NTSP but rather state that this revision will establish new AV & NTSP in association with the 24 Month Project. We know that there are going to be AV and possibly NTSP changes so might as well state it here. Also, is this paragraph still a sub-part under the heading "Design Basis Event (DBE)" or should there should be a new heading?	8/10/12	Added (AL) after design limit. This is an adequate method of noting this. This calculation is consistent with GGNS setpoint calculation format. Generally AL and technical specification values are identified after DBE.	09/26/12

Comment No.	Reviewer	Department / Discipline / Program	Comment	Comment Date	Resolution	Date Resolved
Owner's Review Comments to JC-Q1E31-N685-1 (EC 39554)						
4	R. Hannigan	EXCEL Services Corp.	Reference 3.1.9 – need to correct to 460002635.	8/10/12	Changed reference 460000944 to 460002635.	09/26/12
5	R. Hannigan	EXCEL Services Corp.	Section 4.2 – The TID rad dose for Zone N-068 has been changed in E100.0 Rev. 7 to 3.1E3 Rads. The dose rate has been changed in E100.0 Rev. 7 to 0.011 Rad/hr.	8/10/12	Incorporated.	09/26/12
6	R. Hannigan	EXCEL Services Corp.	Section 4.3 – The temperature for Zone N-028 has been changed in E100.0 Rev. 7 to 69 – 90F.	8/10/12	Incorporated.	09/26/12
7	R. Hannigan	EXCEL Services Corp.	Section 4.4 – Process Head Correction referenced in this section differs from that in Ref 3.1.8 (surv test 06-IC-1E31-R-1016). The head correction for 1E31-PT-N085A & B is +2.1/+13.3 psi in surv test vs. +2.4/+14.5 psi in calc.	8/10/12	The process head stated in the calculation agrees with reference 3.1.8. No change required.	09/26/12
8	R. Hannigan	EXCEL Services Corp.	Section 4.4 – Need to redo Rosemount transmitter uncertainties based on new direction regarding 2σ/3σ values. This should help knock down the Overpressure Uncertainty.	8/10/12	Incorporated the new guidelines concerning Rosemount transmitter confidence levels into the calculation.	09/26/12

Comment No.	Reviewer	Department / Discipline / Program	Comment	Comment Date	Resolution	Date Resolved
			Owner's Review Comments to JC-Q1E31-N685-1 (EC 39554)			
9	R. Hannigan	EXCEL Services Corp.	Section 4.7 – When referring to the transmitters be consistent with the tag name – if you are going to express it as 1E31-PT-N085A & B then use the same tag id throughout the step and the rest of the calc. Same for trip units – be consistent with tag names.	8/10/12	Revised tag numbers in section 4.7.	09/26/12
10	R. Hannigan	EXCEL Services Corp.	Section 5.1– Modify/remove as per new direction regarding Rosemount transmitter uncertainty.	8/10/12	Incorporated based on new guidelines.	09/26/12
11	R. Hannigan	EXCEL Services Corp.	Section 5.3 – Why are you using the ±4 volts if both power supplies have been replaced with the better converters?	8/10/12	Any gains in using different values for power supply effect is negligible since the total power supply effect is 0.03 psi currently.	09/26/12
12	R. Hannigan	EXCEL Services Corp.	Section 5.14 – When you are computing the Max & Min Static Head Conditions it appears as though you have sensing lines that are seeing 0 psig in one section and 1150 psig in an adjacent connected section. That isn't possible. Do you really mean to do that?	8/10/12	This technique is applied to the A loop only because the transmitter is located above the penetration as explained in section 5.14.1. (This section moved to 5.11).	09/26/12

Comment No.	Reviewer	Department / Discipline / Program	Comment	Comment Date	Resolution	Date Resolved
Owner's Review Comments to JC-Q1E31-N685-1 (EC 39554)						
13	R. Hannigan	EXCEL Services Corp.	Section 5.14 – For the loop N085A & B PM value at the bottom of the table explain how you derived those values from the table and exactly what these values mean – it isn't clear. I figured it out but you might want to just add how you came up with the value.	8/10/12	This is explained in section 5.14.1 in the paragraph preceding the actual calculations. This is an adequate method of presenting this material. (This section moved to 5.11).	09/26/12
14	R. Hannigan	EXCEL Services Corp.	Section 7.1 – The TD_1 temperature effect should be 60F to 90F – not 65F to 90F. This will affect TD1, D1, and DL computations.	8/10/12	JS09 section 3.2.3 (65F – 90F).	09/26/12
15	R. Hannigan	EXCEL Services Corp.	Section 7.1 – Need to redo Rosemount transmitter uncertainties based on new direction regarding $2\sigma/3\sigma$ values. This should help knock down the Overpressure Uncertainty.	8/10/12	Incorporated the new guidelines concerning Rosemount transmitter confidence levels into the calculation.	09/26/12
16	R. Hannigan	EXCEL Services Corp.	Section 7.1 – Delete seismic from A1 computation per new direction.	8/10/12	Incorporated the new guidelines concerning SE into the calculation.	09/26/12

Comment No.	Reviewer	Department / Discipline / Program	Comment	Comment Date	Resolution	Date Resolved
Owner's Review Comments to JC-Q1E31-N685-1 (EC 39554)						
17	R. Hannigan	EXCEL Services Corp.	Section 7.8 – If we adopt the Design Limit then replace AL with DL. Also, should we change the approach to go from saying that the AV is non-conservative to saying that we are establishing a new AV in association with the 24 Month Project? This may be outside your scope or direction – if so disregard.	8/10/12	See response to item 3.	09/26/12
18	R. Hannigan	EXCEL Services Corp.	Section 7.9 – If we adopt the Design Limit then replace AL with DL.	8/10/12	See response to item 3.	09/26/12
19	R. Hannigan	EXCEL Services Corp.	Section 7.10 – In the sentence starting with "Reference 3.2.5 notes…" define term "LP" before using it.	8/10/12	Incorporated.	09/26/12
20	R. Hannigan	EXCEL Services Corp.	Section 8.0 – The AV will definitely be exceeded although you may be ok with the NTSP. Would it be better to say in this section that new AV and NTSP values are being generated to support the 24 Month Projec?	8/10/12	GGNS to determine. Left as is.	09/26/12

Attachment 5

GNRO-2012/00132

JS09 Revision 1 "Grand Gulf Nuclear Station Instrument and Control Standard Methodology For The Generation Of Instrument Loop Uncertainty & Setpoint Calculations"

SECTION 1: PURPOSE

The purpose of this engineering standard is to provide the user with the basic terminology and methodology to be employed in the generation of instrument loop uncertainty and setpoint calculations at GGNS. This standard, when used in conjunction with ~~Desktop Procedure EDP-032~~ EN-DC-200, will promote uniformity in instrument loop uncertainty and setpoint calculations generated by Design Engineering.

SECTION 2: SCOPE and ORGANIZATION

This standard is based on ISA RP67.04 Part II, 1994, - Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation and NEDC 31336P-A, 1996, - General Electric Instrument Setpoint Methodology.

The topical areas listed below are discussed in the following sections of this document:

- Terminology to be used in the generation of instrument loop uncertainty and setpoint calculations (Section 3)
- Methodology to be used in the generation of setpoint calculations for Nuclear Safety-Related Instrumentation which are addressed in the GGNS Technical Specifications (Section 4)
- Methodology to be used in the generation of setpoint calculations for Nuclear Safety-Related Instrumentation which do not form a part of the GGNS Technical Specifications (Section 5)
- Methodology to be used in the generation of general instrument indication uncertainty calculations (Section 6)
- Methods to be used to increase calculated margins (Section 7)
- Methodology for determining the probability of Spurious Trips and the probability of occurrence of events which would result in Licensee Event Reports (Appendix A)
- Analytical techniques for determining possible measurement uncertainty effects due to specific process variations (Appendix B)
- Analytical techniques for determining possible measurement uncertainty due to degraded loop insulation resistance (Appendix C)

Repeatability

Repeatability is defined as the closeness of agreement among a number of consecutive measurements of the output for the same value of the input under the same operating conditions approaching from the same direction, for full range transverses. [Ref. 8.2]

3.2.3 Temperature Effects - TE

Temperature Effects are defined as the changes in the input/output relationship of a device due to fluctuations in the ambient temperature to which the device is exposed.

This effect may only be assumed to be applicable for temperature variations outside the assumed normal calibration temperature range of 65°F to 90°F (i.e. from the minimum expected ambient temperature to 65°F or from 90°F up to the maximum expected ambient temperature). The effects of temperature variations within the calibration temperature band must be addressed under Temperature Drift effects (See Section 3.2.12). [Ref. 8.3]

3.2.4 Humidity Effects - HE

Humidity Effects are defined as the changes in the input/output relationship of a device due to fluctuations in the ambient humidity levels to which the device is exposed. [Ref. 8.3]

3.2.5 Seismic Effects - SE

Seismic Effects are defined as the changes in the input/output relationship of a device due to the effects of seismic vibrations during or after a seismic event. [Ref. 8.3] Consideration of seismic effects is not required in Grand Gulf setpoint or indication uncertainty calculations. A Safe Shutdown Earthquake (SSE) occurring concurrently with a Design Basis Event (DBE) is not considered credible. [Ref. 8.7] If an SSE or OBE were to occur, the plant is required to promptly shutdown. [Ref. 8.11] Prior to re-start, affected transmitters must be re-calibrated. [Ref. 8.7] Seismic Effect errors for seismic events below the OBE threshold are considered insignificant because the OBE threshold is very low (0.075g).

3.2.6 Radiation Effects - RE

Radiation Effects are defined as the changes in the input/output relationship of a device due to radiation exposure considering both the dose rate and total dose. [Ref. 8.3]

3.2.7 Power Supply Effects - PS

Power Supply Effects are defined as the changes in the input/output relationship of a device due to fluctuations in the power supply feeding the device. Voltage and/or frequency fluctuations may result in Power Supply Effects. [Ref. 8.1]

3.2.8 Static Pressure Effect - SPE

Static Pressure Effect is defined as the uncertainty introduced in differential pressure instruments which are calibrated at a static pressure that is different from the normal operating pressure. SPE may affect both the span and zero of the instrument.

3.2.9 Overpressure Effects - OVP

Overpressure Effects are defined as the changes in the input/output relationship of a pressure sensing device after exposure to process pressure in excess of its specified Upper Range Limit.

3.2.10 Device Drift - DR

Drift is defined as an undesired change in output over a period of time where change is unrelated to the input, environment or load. [Ref 8.1] Uncertainty due to drift is dependent on the calibration frequency of the device. Drift values can be based on published vendor specifications or the values can be determined based on statistical analysis of as-found/as-left calibration data per ECH-NE-08-00015 and EPRI TR-103335 rev 1.

3.2.11 Radiation Drift - RD

Radiation Drift is defined as the time dependant change in the input/output relationship of a device that can be directly related to radiation exposure.

3.2.12 Temperature Drift - TD

Temperature Drift is defined as the change in the input/output relationship of a device due to ambient temperature swings over a calibration period.

Temperature Drift effects may be assumed to be applicable only over the expected range of temperature during calibration (typically 65°F to 90°F). The possible uncertainty due to temperature variations outside this range is addressed under Temperature Effects. (See Section 3.2.3) [Ref. 8.3]

3.2.13 Measurement and Test Equipment Effects - MTE

Measurement and Test Equipment Effects are defined as those uncertainties introduced into a device as a result of the uncertainties associated with the equipment used to calibrate the device. MTE values can be based on published specifications of the test equipment. When confirmed to be conservative MTE can be also set equal to either the reference accuracy or the tolerance specified in the calibration procedure (whichever is larger).

3.3 Loop Specific Random Uncertainty Terms

3.3.1 Loop Device Uncertainty - A_L

The Loop Device Uncertainty is defined as the square root sum of the squares (SRSS) of all the individual Device Uncertainty terms for a given instrument loop. [Ref. 8.3]

3.3.2 Loop Calibration Uncertainty - C_L

The Loop Calibration Uncertainty is defined as the SRSS of all the Measurement and Test Equipment effects that may be incurred during calibration of each of the devices in a given loop. [Ref. 8.3]

3.3.3 Loop Drift - D_L

The Loop Drift is defined as the SRSS of the all the drift terms for each of the loop devices. The Loop Drift includes (as applicable) allowances for Device Drift, Temperature Drift, and Radiation Drift for each device in the loop. [Ref. 8.3]

3.3.4 Process Measurement Uncertainty - PM

Process Measurement Uncertainties are those uncertainties that may be introduced in an instrument loop due to limitations in modeling the physical system; or more commonly, those uncertainties introduced in an instrument loop due to fluctuations in the process for which the loop instrumentation cannot automatically compensate. (see Appendix B) For the Reactor water level setpoint calculations, the density changes in the reactor vessel do not need to be considered when calculating PM error. Per NEDC 31336, only the density changes in the reference and variable legs need to be considered.

Engineering Change Mark-up Continuation Sheet			
Before View ☐	EC #:39605		Page 5 of 7
DOC #: JS09		SHT # 0	REV 1

4.6 Spurious Trip and LER Avoidance Analysis

A Spurious Trip and LER Avoidance Analysis must be performed as described in Appendix A to demonstrate the acceptability of the setpoint margins. These analyses must be performed for the setpoint that is employed in the field. These analyses are not required for calculated setpoints that are not to be implemented in the field.

4.7 Calculation of As-Left Tolerance – ALT [Ref. 8.9]

For the purposes of calculating the ALT, actual (published) MTE values are used instead of using the assumption that MTE = RA. (Section 4.1.2)

$$ALT = \pm SRSS\ (RA, MTE)$$

Since a smaller ALT is more conservative it is acceptable to ignore MTE and simplify the equation.

$$ALT = RA$$

4.8 Calculation of As-Found Tolerance – AFT [Ref. 8.9]

For the purposes of calculating the AFT, the actual (published) MTE value is used instead of the assumption that MTE = RA.

$$AFT = \pm SRSS\ (RA, MTE, DR)$$

Drift values determined by statistical analysis of historical as-found/as-left calibration data is actually a combination of RA, MTE and DR because there is no deterministic method to separate these individual components. The AFT equation can therefore be simplified when statistically derived drift values are utilized.

$$AFT = \pm DR$$

4.9 As-Left Loop Tolerance and As-Found Loop Tolerance [Ref. 8.9]

The equation for As-Left Loop Tolerance would be:

$$ALT_L = \pm SRSS\ (ALT_{1cal}, ALT_{2cal}, \ldots, ALT_{Xcal})$$

The equation for As-Found Loop Tolerance would be:

$$AFT_L = \pm SRSS\ (AFT_{1cal}, AFT_{2cal}, \ldots, AFT_{Xcal})$$

6.3 Calculation of Total Loop Uncertainty – TLU

$$TLU = \sqrt{RLU^2 + RI^2} + Bias$$

SECTION 7: METHODS FOR INCREASING CALCULATED MARGINS

Calculations generated using the methodology presented in this standard may, due to the in-depth treatment of the uncertainty terms, generate setpoint and instrument uncertainty estimates which are more conservative than previously calculated values.

If in the generation of setpoints and loop Allowable Values, a large difference is noted between the existing and calculated values, various techniques should be considered to isolate and possibly reduce these differences if appropriate.

In certain cases, the following may be valid techniques to reduce calculated uncertainty terms:

7.1 Review the environmental limits to reduce them as necessary to reflect only the specific event requirements for which the device is required to function.

7.2 Review the value used for Insulation Resistance Effects to ensure that it is not overly conservative

7.3 Review the Measurement & Test Equipment values used in the calculation as a term to be reduced, especially if the M&TE values have been assumed to be equal to the Reference Accuracy of the individual loop devices.

7.4 A Single-sided Distribution approach to the uncertainty may be considered, depending on the application. This approach may not be applicable to all setpoints due to the possible impact on operational margins or other system setpoints. Note, if this approach is employed, all data should be normalized for Single-Sided Distribution. With the 2σ data applied to Single-Sided Distribution, the accuracy will exceed the 95% confidence level. (See Reference 8.3)

7.5 The Total Loop Uncertainty may be reduced using the square root sum of the squares approach to combine the Loop Uncertainty and the Loop Drift. Generally, this approach should be avoided since it minimizes the margin between the loop Allowable Value and the Nominal Trip Setpoint. Values calculated using this approach should be reviewed to ensure adequate margin exists between the Nominal Trip Setpoint and the Allowable Value.

7.6 Drift values determined by statistical analysis of historical as-found/as-left calibration data is actually a combination of RA, MTE and DR because there is no deterministic method to separate these individual components. If additional NTSP margin is required, this can be credited and the RA and MTE values can be set equal to zero.

SECTION 8: REFERENCES

8.1 ISA RP67.04, Part II, 1994, Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation

8.2 Process Measurement - Instrument Engineers' Handbook Revised Edition
Bela G. Liptak & Kristzta Venczel, 1982 - Chilton Book Co., Radnor Pennsylvania

8.3 NEDC-31336P-A, 1996, General Electric Instrument Setpoint Methodology
W.H. Cooley, JR., J.L. Leong, M.A. Smith, S. Wolf, - General Electric Co.

8.4 CRANE Technical Paper No. 410 - Flow of Fluids through Valves, Fittings and Pipe
CRANE Engineering Division, 1985 - Crane Co.

8.5 Nuclear Plant Engineering Desk Top Procedure EDP-032 Rev. 1 - Instrument Loop Uncertainty and Setpoint Calculations

8.6 USNRC Regulatory Guide 1.105 Rev. 1 - Instrument Setpoints

8.7 EC-39605, Revise Standard JS-09 Methodology

8.8 EN-DC-200, Revision 0, I&C Uncertainties / Setpoint Calculations & Determinations

8.9 TSTF-493, Revision 4, Technical Specifications Task Force Traveler - Clarify Application of Setpoint Methodology for LSSS Functions

8.10 ECH-NE-08-00015, Revision 0, Drift Analysis Design Guide

8.11 05-S-02-VI-3, Revision 107, Earthquake Off-Normal Event Procedure

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GRAND GULF NUCLEAR STATION

INSTRUMENTATION AND CONTROL STANDARD

METHODOLOGY FOR THE GENERATION OF INSTRUMENT LOOP UNCERTAINTY & SETPOINT CALCULATIONS

- SAFETY RELATED -

GRAND GULF NUCLEAR STATION

NUCLEAR PLANT ENGINEERING

REVIEW AND APPROVAL SHEET

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Signatures certify that the above standard was originated, verified, reviewed or waived and approved as noted below:

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PAGE REVISION STATUS

PAGE N0.	REVISION	PAGE NO.	REVISION
01	1	17	1
02	1	18	1
03	1	19	1
04	1	20	1
05	1	21	1
06	1	22	1
07	1	23	1
08	1	24	1
09	1	25	1
10	1	26	1
11	1	27	1
12	1	28	1
13	1	29	1
14	1	30	1
15	1	31	1
16	1	32	1

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APPENDIX / ATTACHMENT REVISION STATUS

APPENDIX NO.	REVISION	ATTACHMENT NO.	REVISION
A	1	1	1
B	1		
C	0		
D	0		

TABLE OF CONTENTS

APPENDICES

SECTION 1: PURPOSE

The purpose of this engineering standard is to provide the user with the basic terminology and methodology to be employed in the generation of instrument loop uncertainty and setpoint calculations at GGNS. This standard, when used in conjunction with Desktop Procedure EDP-032, will promote uniformity in instrument loop uncertainty and setpoint calculations generated by Design Engineering.

SECTION 2: SCOPE and ORGANIZATION

This standard is based on ISA RP67.04 Part II, 1994, - Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation and NEDC 31336P-A, 1996, - General Electric Instrument Setpoint Methodology.

The topical areas listed below are discussed in the following sections of this document:

- Terminology to be used in the generation of instrument loop uncertainty and setpoint calculations (Section 3)
- Methodology to be used in the generation of setpoint calculations for Nuclear Safety-Related Instrumentation which are addressed in the GGNS Technical Specifications (Section 4)
- Methodology to be used in the generation of setpoint calculations for Nuclear Safety-Related Instrumentation which do not form a part of the GGNS Technical Specifications (Section 5)
- Methodology to be used in the generation of general instrument indication uncertainty calculations (Section 6)
- Methods to be used to increase calculated margins (Section 7)
- Methodology for determining the probability of Spurious Trips and the probability of occurrence of events which would result in Licensee Event Reports (Appendix A)
- Analytical techniques for determining possible measurement uncertainty effects due to specific process variations (Appendix B)
- Analytical techniques for determining possible measurement uncertainty due to degraded loop insulation resistance (Appendix C)

SECTION 3: DEFINITIONS and TERMINOLOGY

3.1 General Terminology

3.1.1 Allowable Value - AV

A limiting value that the trip setpoint may have when tested periodically, beyond which appropriate action shall be taken. [Ref. 8.1]

3.1.2 Analytical Limit - AL

The value of the sensed process variable established as part of the safety analysis prior to or at the point that a desired action is to be initiated to prevent the safety process variable from reaching the associated Licensing Safety Limit. [Ref. 8.3]

3.1.3 Abnormally Distributed Uncertainty - F

A term used to denote uncertainties that do not have a normal distribution. This type of uncertainty is treated as a bias against both the positive and negative components of a module's uncertainty [Ref. 8.1]

3.1.4 Bias

A Bias is a component of uncertainty that consistently has the same algebraic sign, and is expressed as an estimated limit of error. [Ref. 8.1]

Positive Bias - M

A Positive Bias is a known error in process measurement that consistently has a known positive value with respect to the process variable.

Negative Bias - L

A Negative Bias is a known error in process measurement that consistently has a known negative value with respect to the process variable.

Bias terms should only be accounted for if the bias acts in a conservative direction with respect to the calculated variable.

3.1.5 Design Basis Event - DBE

The limiting abnormal transient or an accident which is analyzed using the analytical limit value for the setpoint to determine the bounding value of a process variable. [Ref. 8.3]

3.1.6 Licensee Event Report - LER

A report which must be filed with the NRC by the utility when a Tech. Spec. limit is known to be exceeded, as required by 10CFR50.73. [Ref. 8.3]

3.1.7 Licensing Safety Limit - LSL

The limit on a safety process variable that is established by licensing requirements to provide conservative protection for the integrity of physical barriers that guard against uncontrolled release of radioactivity. [Ref. 8.3]

3.1.8 Limiting Normal Operating Transient - X_T

The most severe transient event affecting a process variable during normal operation for which trip initiation is to be avoided. [Ref. 8.3]

3.1.9 Process Limit - PL

The Process Limit is the limiting process value (maximum or minimum) required for proper system operation. (e.g. pump net positive suction head and min. flow requirements may be loop Process Limits)

3.1.10 Span

Span is defined as the algebraic difference between the upper and lower values of a calibrated range. [Ref. 8.1]

3.1.11 Trip Environment

The environment that exists up to and including the time when the instrument channel performs its initial safety (trip) function during an event. [Ref. 8.3]

3.1.12 Upper Range Limit - URL

Upper Range Limit is defined as the maximum value of the process variable that a device can accurately measure. [Ref. 8.2]

3.2 Device Specific Random Uncertainty Terms

3.2.1 Device Uncertainty - A_X

The Device Uncertainty is defined as the square root sum of the squares (SRSS) of all the applicable individual components of uncertainty associated with a given device. (i.e. the SRSS of the uncertainty effects listed in Sections 3.2.2 - 3.2.9) [Ref. 8.3]

3.2.2 Reference Accuracy - RA

Reference Accuracy (or Accuracy Rating) is a number or quantity that defines a limit that errors will not exceed when a device is used under specified operating conditions. Reference accuracy includes, as applicable, the combined effects of: deadband, hysteresis, linearity and/or repeatability. [Ref. 8.2]

Deadband

Deadband is defined as the range through which an input can be varied without initiating an observable response at the output (usually expressed in percent of span). [Ref. 8.2]

Hysteresis

Hysteresis is defined as that property of an element evidenced by the dependence of the value of the output, for a given excursion of the input, upon the history of prior excursions and the direction of the current transverse. [Ref. 8.2]

Linearity

Linearity is defined as the maximum deviation of the calibration curve (average of the upscale and downscale readings) from a straight line which is so positioned as to minimize the maximum deviation. [Ref. 8.2]

Repeatability

Repeatability is defined as the closeness of agreement among a number of consecutive measurements of the output for the same value of the input under the same operating conditions approaching from the same direction, for full range transverses. [Ref. 8.2]

3.2.3 Temperature Effects - TE

Temperature Effects are defined as the changes in the input/output relationship of a device due to fluctuations in the ambient temperature to which the device is exposed.

This effect may only be assumed to be applicable for temperature variations outside the assumed normal calibration temperature range of 65°F to 90°F (i.e. from the minimum expected ambient temperature to 65°F or from 90°F up to the maximum expected ambient temperature). The effects of temperature variations within the calibration temperature band must be addressed under Temperature Drift effects (See Section 3.2.12). [Ref. 8.3]

3.2.4 Humidity Effects - HE

Humidity Effects are defined as the changes in the input/output relationship of a device due to fluctuations in the ambient humidity levels to which the device is exposed. [Ref. 8.3]

3.2.5 Seismic Effects - SE

Seismic Effects are defined as the changes in the input/output relationship of a device due to the effects of seismic vibrations during or after a seismic event. [Ref. 8.3]

3.2.6 Radiation Effects - RE

Radiation Effects are defined as the changes in the input/output relationship of a device due to radiation exposure considering both the dose rate and total dose. [Ref. 8.3]

3.2.7 Power Supply Effects - PS

Power Supply Effects are defined as the changes in the input/output relationship of a device due to fluctuations in the power supply feeding the device. Voltage and/or frequency fluctuations may result in Power Supply Effects. [Ref. 8.1]

3.2.8 Static Pressure Effect - SPE

Static Pressure Effect is defined as the uncertainty introduced in differential pressure instruments which are calibrated at a static pressure that is different from the normal operating pressure. SPE may affect both the span and zero of the instrument.

3.2.9 Overpressure Effects - OVP

Overpressure Effects are defined as the changes in the input/output relationship of a pressure sensing device after exposure to process pressure in excess of its specified Upper Range Limit.

3.2.10 Device Drift - DR

An undesired change in output over a period of time where change is unrelated to the input, environment or load. [Ref. 8.1]
Uncertainty due to drift is dependent on the calibration frequency of the device.

3.2.11 Radiation Drift - RD

Radiation Drift is defined as the time dependant change in the input/output relationship of a device that can be directly related to radiation exposure.

3.2.12 Temperature Drift - TD

Temperature Drift is defined as the change in the input/output relationship of a device due to ambient temperature swings over a calibration period.

Temperature Drift effects may be assumed to be applicable only over the expected range of temperature during calibration (typically 65°F to 90°F). The possible uncertainty due to temperature variations outside this range is addressed under Temperature Effects. (See Section 3.2.3) [Ref. 8.3]

3.2.13 Measurement and Test Equipment Effects - MTE

Measurement and Test Equipment Effects are defined as those uncertainties introduced into a device as a result of the uncertainties associated with the equipment used to calibrate the device.

3.3 Loop Specific Random Uncertainty Terms

3.3.1 Loop Device Uncertainty - A_L

The Loop Device Uncertainty is defined as the square root sum of the squares (SRSS) of all the individual Device Uncertainty terms for a given instrument loop. [Ref. 8.3]

3.3.2 Loop Calibration Uncertainty - C_L

The Loop Calibration Uncertainty is defined as the SRSS of all the Measurement and Test Equipment effects that may be incurred during calibration of each of the devices in a given loop. [Ref. 8.3]

3.3.3 Loop Drift - D_L

The Loop Drift is defined as the SRSS of the all the drift terms for each of the loop devices. The Loop Drift includes (as applicable) allowances for Device Drift, Temperature Drift, and Radiation Drift for each device in the loop. [Ref. 8.3]

3.3.4 Process Measurement Uncertainty - PM

Process Measurement Uncertainties are those uncertainties that may be introduced in an instrument loop due to limitations in modeling the physical system; or more commonly, those uncertainties introduced in an instrument loop due to fluctuations in the process for which the loop instrumentation cannot automatically compensate. (See Appendix B)

3.3.5 Primary Element Uncertainty - PE

Primary Element Uncertainty is defined as the uncertainty introduced in an instrument loop due to the uncertainties associated with the loop's primary measuring device. Primary Element Uncertainty applies to the uncertainty associated with flow elements, elbow taps, and similar devices which may not typically be considered instruments.

3.3.6 Insulation Resistance Effects - IR

Insulation Resistance Effects are defined as those uncertainties introduced in an instrument loop due to changes in the insulation resistance properties of the cables, penetrations, splices and terminations within the loop. Insulation Resistance Effects may be bias type errors as opposed to random uncertainties depending on the type of instrument loop under consideration. (See Appendix C)

SECTION 4: SAFETY RELATED SETPOINT CALCULATIONS (Tech. Spec.)

As stated in Regulatory Guide 1.105, the accuracy of instrument setpoints should be equal to or better than the accuracy assumed in the safety analysis. Therefore, Safety Related Setpoint Calculations employ normal distribution uncertainty data specified to at least 2 standard deviations (2σ), or 95% confidence level.

To ensure the calculated setpoint and associated calculated margins are capable of accommodating the worst case uncertainty, the trip environment for the postulated design basis event should be determined. Once these worst case environmental effects have been determined, the appropriate uncertainty values can be included in the calculation to account for any environmental effects to the instrumentation or the process variable.

Using the available uncertainty data, the following general steps (outlined in Sections 4.1 - 4.5) should be used to generate an appropriate loop Allowable Value and Nominal Trip Setpoint.

- Calculate the Loop Uncertainty (LU) by computing the SRSS of the Loop Device Uncertainty (A_L), the Loop Calibration Uncertainty (C_L), the Process Measurement Uncertainty (PM), the Primary Element Uncertainty (PE), and the loop Insulation Resistance Effects (IR).

- Calculate the Loop Drift (D_L) by computing the SRSS of the Device Drift (DR), the Temperature Drift (TD), and the Radiation Drift (RD) for each loop instrument as applicable.

- Calculate the Total Loop Uncertainty (TLU) by summing the Loop Uncertainty and the Loop Drift.

- For process variables that increase to the Analytical Limit (AL), calculate the loop Allowable Value (AV) by subtracting the Loop Uncertainty from the Analytical Limit. For process variables that decrease to the Analytical Limit, calculate the loop Allowable Value by summing the value of the Loop Uncertainty and the Analytical Limit.

- For process variables that increase to the Analytical Limit (AL), calculate the loop Nominal Trip Setpoint (NTSP) by subtracting the value of the Total Loop Uncertainty from the Analytical Limit. For process variables that decrease to the Analytical Limit, calculate the loop Nominal Trip Setpoint by summing the value of the Total Loop Uncertainty and the Analytical Limit.

Once the loop Allowable Value and Nominal Trip Setpoint have been established, Spurious Trip and LER Avoidance analysis must be performed as described in Section 4.6 for the field setpoint. These analyses will demonstrate the adequacy of the margins associated with the setpoint.

4.1 Calculation of Loop Uncertainty - LU

The Loop Uncertainty (LU), which defines the margin between the loop Analytical Limit and Allowable Value, is given by the equation:

$$LU = \pm\sqrt{(A_L)^2 + (C_L)^2 + (PM)^2 + (PE)^2 + (IR)^2}$$

Where the variables A_L, C_L, PM, PE, and IR are determined as follows:

4.1.1 Loop Device Uncertainty - A_L

For a loop consisting of instruments A, B, C, ... X, the loop device uncertainty is given by the equation:

$$A_L = \pm\sqrt{(A_A)^2 + (A_B)^2 + (A_C)^2 + ... + (A_X)^2}$$

Where each of the individual device uncertainties A_A, A_B, A_C, ... A_X are formed from the SRSS of the components of uncertainty listed in Sections 3.2.2 - 3.2.9 (as applicable).

$$A_X = \pm\sqrt{(RA_X)^2 + (TE_X)^2 + (HE_X)^2 + (SE_X)^2 + (RE_X)^2 + (PS_X)^2 + (SPE_X)^2 + (OVP_X)^2}$$

Where:

RA_X = Reference Accuracy of device X

TE_X = Temperature Effects for device X

HE_X = Humidity Effects for device X

SE_X = Seismic Effects for device X

RE_X = Radiation Effects for device X

PS_X = Power Supply Effects for device X

SPE_X = Static Pressure Effects for device X

OVP_X = Overpressure Effects for device X

4.1.2 Loop Calibration Uncertainty - C_L

For a loop consisting of instruments A, B, C, ... X, the loop calibration uncertainty is given by the equation:

$$C_L = \pm\sqrt{(MTE_A)^2 + (MTE_B)^2 + (MTE_C)^2 + \ldots + (MTE_X)^2}$$

Where:

MTE_A = SRSS of the measurement and test equipment effects incurred during calibration of instrument A

MTE_B = SRSS of the measurement and test equipment effects incurred during calibration of instrument B

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MTE_X = SRSS of the measurement and test equipment effects incurred during calibration of instrument X

Since the uncertainties associated with specific pieces of field measurement/test equipment are often difficult to obtain, an alternate (and typically more conservative) approach may be used to determine the Loop Calibration Uncertainty.

This alternate approach is based on the assumption that the Measurement and Test Equipment effects associated with each loop device are equal to the Reference Accuracy of that device (i.e. $MTE_X = RA_X$). Thus, the Loop Calibration Uncertainty may be expressed as:

$$C_L = \pm\sqrt{(RA_A)^2 + (RA_B)^2 + (RA_C)^2 + \ldots + (RA_X)^2}$$

4.1.3 Process Measurement Uncertainty - PM

Any loop uncertainty that may be attributable to effects similar to those described in Appendix B must be determined by appropriate analytical techniques and accounted for under Process Measurement Uncertainty.

4.1.4 Primary Element Uncertainty - PE

If the instrument loop has a device which is essential to the measurement of the process variable, other than those devices previously addressed in the calculation of the Loop Device Uncertainty (A_L), the base uncertainty associated with this device must be determined and accounted for under Primary Element Uncertainty.

4.1.5 Insulation Resistance Effects - IR

If the instrument loop cable, penetrations, splices or terminal blocks may be exposed to harsh environments at any time before the instrumentation is to perform its trip function, the possible effects of degraded insulation resistance must be determined as in Appendix C and accounted for under Insulation Resistance Effects.

Note, the basic equation for the Loop Uncertainty (given below) assumes all the variables in the equation are random in nature and are specified to two standard deviations (2σ).

Basic Loop Uncertainty Equation:

$$LU = \pm\sqrt{(A_L)^2 + (C_L)^2 + (PM)^2 + (PE)^2 + (IR)^2}$$

If some or all of the variables are known to a higher level of confidence (e.g. three standard deviations, 3σ), the basic equation may be modified to produce a Loop Uncertainty normalized to two standard deviations (if desired) by dividing each variable by its associated standard deviation (n) and then multiplying the total equation by 2 as shown below. [Ref. 8.3]

$$LU = \pm 2\sqrt{\left(\frac{A_L}{n}\right)^2 + \left(\frac{C_L}{n}\right)^2 + \left(\frac{PM}{n}\right)^2 + \left(\frac{PE}{n}\right)^2 + \left(\frac{IR}{n}\right)^2}$$

If one or more of the variables is known to be a conservative Bias as opposed to a random uncertainty, those variables should not be included under the radical and must simply be added to, or subtracted from, the SRSS of the remaining variables to form the Loop Uncertainty.

4.2 Calculation of Loop Drift - D_L

For a loop consisting of instruments A, B, C, ... X, the loop drift is given by the equation:

$$D_L = \pm\sqrt{(DR_A)^2 + (TD_A)^2 + (RD_A)^2 + ... + (DR_X)^2 + (TD_X)^2 + (RD_X)^2}$$

Where:

DR_A = the Device Drift associated with instrument A

TD_A = the Temperature Drift Effect for instrument A

RD_A = the Radiation Drift Effect for instrument A

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DR_X = the Device Drift associated with instrument X

TD_X = the Temperature Drift Effect for instrument X

RD_X = the Radiation Drift Effect for instrument X

Since the Device Drift (DR) is directly related to the length of the calibration period, it may be necessary to scale the vendor supplied drift specification to accommodate the calibration interval.

Conservatively, this may be accomplished by multiplying the given drift specification by the ratio of the desired calibration interval to the supplied drift specification interval. Device Drift should only be scaled when the supplied drift specification interval is less than the calibration interval.

The Device Drift for all applicable loop instruments must be valid (scaled if necessary) for the maximum calibration interval allowed by the GGNS Technical Specifications.

4.3 Calculation of Total Loop Uncertainty - TLU

The Total Loop Uncertainty (TLU), which defines the margin between the loop Analytical Limit and the Nominal Trip Setpoint, is given by the equation:

$$TLU = LU + D_L$$

4.4 Calculation of Loop Allowable Value - AV

Using the existing documented Analytical Limit and the Loop Uncertainty calculated as shown in Section 4.1:

The loop Allowable Value for a process variable that <u>increases</u> to the Analytical Limit is given by the equation:

$$AV = AL - |LU|$$

And, the loop Allowable Value for a process variable that <u>decreases</u> to the Analytical Limit is given by the equation:

$$AV = AL + |LU|$$

4.5 Calculation of Loop Nominal Trip Setpoint - NTSP

Using the existing documented Analytical Limit and the Total Loop Uncertainty calculated as shown in Section 4.3:

The loop Nominal Trip Setpoint for a process variable that <u>increases</u> to the Analytical limit is given by the equation:

$$NTSP = AL - |TLU|$$

And, the loop Nominal Trip Setpoint for a process variable that <u>decreases</u> to the Analytical Limit is given by the equation:

$$NTSP = AL + |TLU|$$

4.6 Spurious Trip and LER Avoidance Analysis

A Spurious Trip and LER Avoidance Analysis must be performed as described in Appendix A to demonstrate the acceptability of the setpoint margins. These analyses must be performed for the setpoint that is employed in the field. These analyses are not required for calculated setpoints that are not to be implemented in the field.

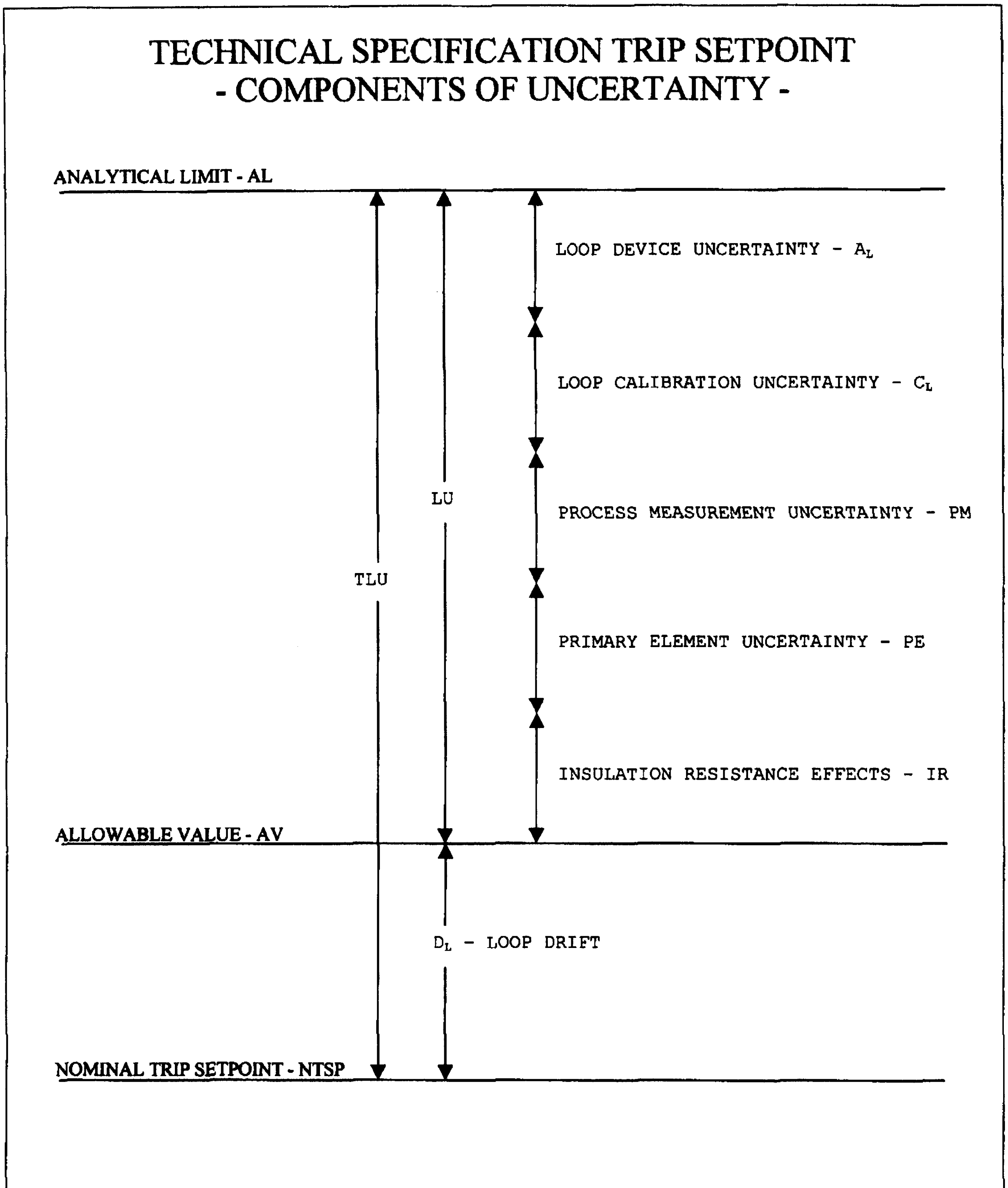

FIGURE 1: Tech. Spec. Trip Setpoint Uncertainty Breakdown

SECTION 5: SAFETY RELATED SETPOINT CALCULATIONS (Non-Tech Spec.)

As with the methodology presented in Section 4, Non-Tech. Spec. setpoint calculations employ normal distribution uncertainty data specified to at least 2 standard deviations (2σ) which are applicable to the worst case environmental conditions assumed for the trip environment.

Non-Tech. Spec. setpoint calculations, however, differ in methodology from Tech. Spec. setpoint calculations in that no Analytical Limit is applicable and thus no Allowable Value can be computed. Non-Tech. Spec. setpoint calculations simply add to (or subtract from) the associated Process Limit the value of the Total Loop Uncertainty to determine the Nominal Trip Setpoint.

The following general steps (outlined in Sections 5.1 - 5.4) should be used to generate an appropriate Nominal Trip Setpoint for Non-Tech. Spec. variables.

- Calculate the Loop Uncertainty (LU) by computing the SRSS of the Loop Device Uncertainty (A_L), the Loop Calibration Uncertainty (C_L), the Process Measurement Uncertainty (PM), the Primary Element Uncertainty (PE), and the loop Insulation Resistance Effects (IR).

- Calculate the Loop Drift (D_L) by computing the SRSS of the Device Drift (DR), the Temperature Drift (TD), and the Radiation Drift (RD) for each loop instrument as applicable.

- Calculate the Total Loop Uncertainty (TLU) by summing the Loop Uncertainty and the Loop Drift.

- For process variables that increase to the Process Limit (PL), calculate the Loop Nominal Trip Setpoint (NTSP) by subtracting the value of the Total Loop Uncertainty from the Process Limit. For process variables that decrease to the Process Limit, calculate the Loop Nominal Trip Setpoint by summing the value of the Total Loop Uncertainty and the Process Limit.

Once the Nominal Trip Setpoint has been established a Spurious Trip analysis as described in Section 5.5 must be performed for the field setpoint. This analysis will demonstrate the adequacy of the margin associated with the setpoint.

5.1 Calculation of Loop Uncertainty - LU

The Loop Uncertainty (LU) is defined by the equation:

$$LU = \pm\sqrt{(A_L)^2 + (C_L)^2 + (PM)^2 + (PE)^2 + (IR)^2}$$

Where the variables A_L, C_L, PM, PE, and IR are determined as follows:

5.1.1 Loop Device Uncertainty - A_L

For a loop consisting of instruments A, B, C, ... X, the loop device uncertainty is given by the equation:

$$A_L = \pm\sqrt{(A_A)^2 + (A_B)^2 + (A_C)^2 + \ldots + (A_X)^2}$$

Where each of the individual device uncertainties A_A, A_B, A_C, ... A_X are formed from the SRSS of the components of uncertainty listed in Sections 3.2.2 - 3.2.9 (as applicable).

$$A_X = \pm\sqrt{(RA_X)^2 + (TE_X)^2 + (HE_X)^2 + (SE_X)^2 + (RE_X)^2 + (PS_X)^2 + (SPE_X)^2 + (OVP_X)^2}$$

Where:

RA_X = Reference Accuracy of device X

TE_X = Temperature Effects for device X

HE_X = Humidity Effects for device X

SE_X = Seismic Effects for device X

RE_X = Radiation Effects for device X

PS_X = Power Supply Effects for device X

SPE_X = Static Pressure Effects for device X

OVP_X = Overpressure Effects for device X

5.1.2 Loop Calibration Uncertainty - C_L

For a loop consisting of instruments A, B, C, ... X, the loop calibration uncertainty is given by the equation:

$$C_L = \pm\sqrt{(MTE_A)^2 + (MTE_B)^2 + (MTE_C)^2 + \ldots + (MTE_X)^2}$$

Where:

MTE_A = SRSS of the measurement and test equipment effects incurred during calibration of instrument A

MTE_B = SRSS of the measurement and test equipment effects incurred during calibration of instrument B

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MTE_X = SRSS of the measurement and test equipment effects incurred during calibration of instrument X

Since the uncertainties associated with specific pieces of field measurement/test equipment are often difficult to obtain, an alternate (and typically more conservative) approach may be used to determine the Loop Calibration Uncertainty.

This alternate approach is based on the assumption that the Measurement and Test Equipment effects associated with each loop device are equal to the Reference Accuracy of that device (i.e. $MTE_X = RA_X$). Thus, the Loop Calibration Uncertainty may be expressed as:

$$C_L = \pm\sqrt{(RA_A)^2 + (RA_B)^2 + (RA_C)^2 + \ldots + (RA_X)^2}$$

5.1.3 Process Measurement Uncertainty - PM

Any loop uncertainty that may be attributable to effects similar to those described in Appendix B must be determined by appropriate analytical techniques and accounted for under Process Measurement Uncertainty.

5.1.4 Primary Element Uncertainty - PE

If the instrument loop has a device which is essential to the measurement of the process variable, other than those devices previously addressed in the calculation of the Loop Device Uncertainty (A_L), the base uncertainty associated with this device must be determined and accounted for under Primary Element Uncertainty.

5.1.5 Insulation Resistance Effects - IR

If the instrument loop cable, penetrations, splices or terminal blocks may be exposed to harsh environments at any time before the instrumentation is to perform its trip function, the possible effects of degraded insulation resistance must be determined as in Appendix C and accounted for under Insulation Resistance Effects.

Note, the basic equation for the Loop Uncertainty (given below) assumes all the variables in the equation are random in nature and are specified to two standard deviations (2σ).

Basic Loop Uncertainty Equation:

$$LU = \pm\sqrt{(A_L)^2 + (C_L)^2 + (PM)^2 + (PE)^2 + (IR)^2}$$

If some or all of the variables are known to a higher level of confidence (e.g. three standard deviations, 3σ), the basic equation may be modified to produce a Loop Uncertainty normalized to two standard deviations (if desired) by dividing each variable by its associated standard deviation (n) and then multiplying the total equation by 2 as shown below. [Ref. 8.3]

$$LU = \pm 2\sqrt{\left(\frac{A_L}{n}\right)^2 + \left(\frac{C_L}{n}\right)^2 + \left(\frac{PM}{n}\right)^2 + \left(\frac{PE}{n}\right)^2 + \left(\frac{IR}{n}\right)^2}$$

If one or more of the variables is known to be a <u>conservative</u> Bias as opposed to a random uncertainty, those variables should not be included under the radical and must simply be added to, or subtracted from, the SRSS of the remaining variables to form the Loop Uncertainty.

5.2 Calculation of Loop Drift - D_L

For a loop consisting of instruments A, B, C, ... X, the loop drift is given by the equation:

$$D_L = \pm\sqrt{(DR_A)^2 + (TD_A)^2 + (RD_A)^2 + \ldots + (DR_X)^2 + (TD_X)^2 + (RD_X)^2}$$

Where:

DR_A = the Device Drift associated with instrument A

TD_A = the Temperature Drift Effect for instrument A

RD_A = the Radiation Drift Effect for instrument A

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DR_X = the Device Drift associated with instrument X

TD_X = the Temperature Drift Effect for instrument X

RD_X = the Radiation Drift Effect for instrument X

Since the Device Drift (DR) is directly related to the length of the calibration period, it may be necessary to scale the vendor supplied drift specification to accommodate the calibration interval.

Conservatively, this may be accomplished by multiplying the given drift specification by the ratio of the desired calibration interval to the supplied drift specification interval. Device Drift should only be scaled when the supplied drift specification interval is less than the calibration interval.

The Device Drift for all applicable loop instruments must be valid (scaled if necessary) for the maximum calibration interval allowed for the instrument loop.

5.3 Calculation of Total Loop Uncertainty - TLU

The Total Loop Uncertainty (TLU), which defines the margin between the loop Process Limit and the Nominal Trip Setpoint, is given by the equation:

$$TLU = LU + D_L$$

5.4 Calculation of Loop Nominal Trip Setpoint - NTSP

Using the Process Limit derived from existing documentation and the Total Loop Uncertainty calculated as shown in Section 5.3:

The loop Nominal Trip Setpoint for a process variable that increases to the Process Limit is given by the equation:

$$NTSP = PL - |TLU|$$

And, the loop Nominal Trip Setpoint for a process variable that decreases to the Process Limit is given by the equation:

$$NTSP = PL + |TLU|$$

5.5 Spurious Trip Analysis

A Spurious Trip Analysis must be performed as described in Appendix A to demonstrate the acceptability of the setpoint margins. This analysis must be performed for the setpoint that is employed in the field; but is not required for calculated setpoints that are not to be implemented in the field.

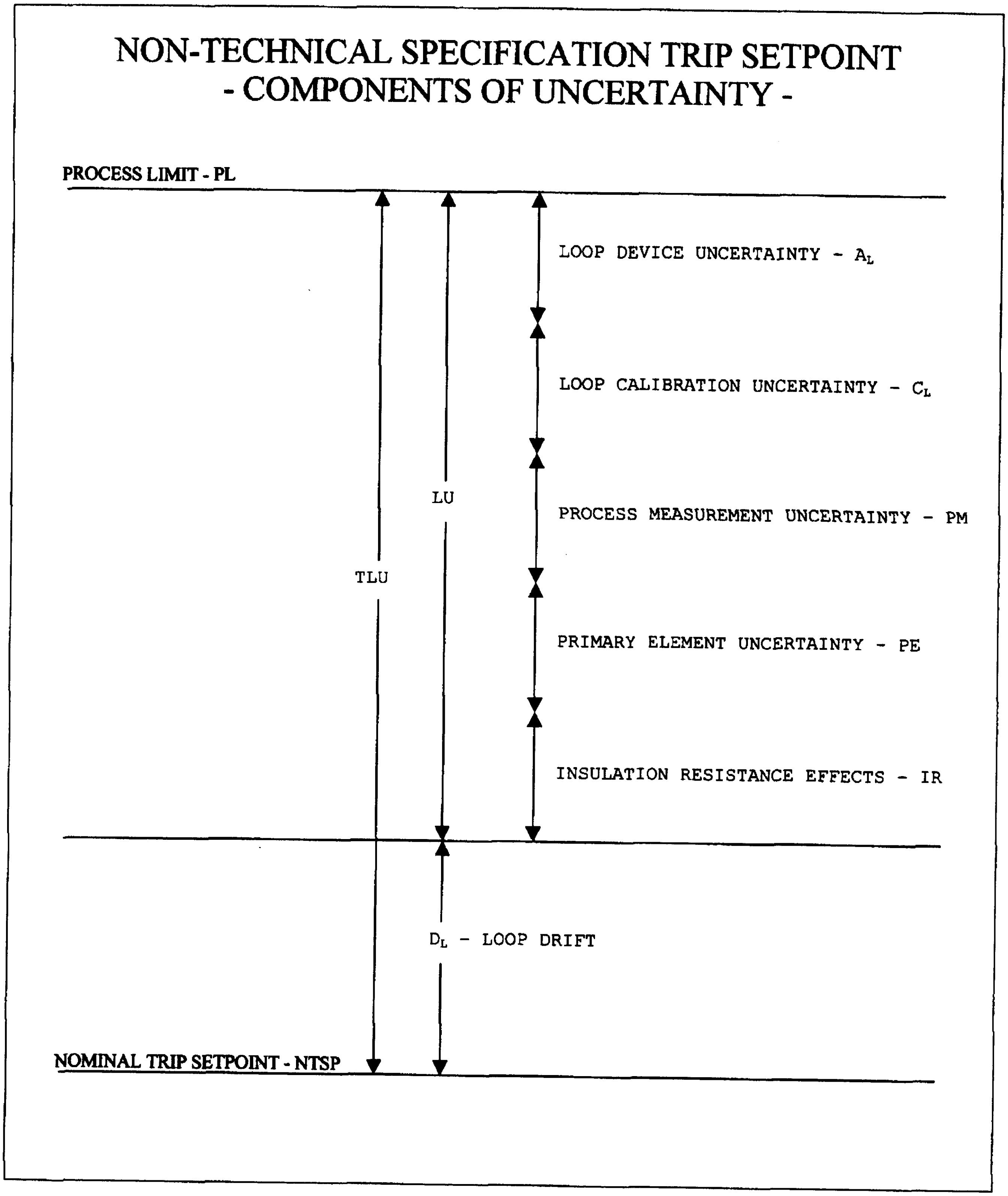

FIGURE 2: Non-Tech. Spec. Trip Setpoint Uncertainty Breakdown

SECTION 6: INSTRUMENT INDICATION UNCERTAINTY CALCULATIONS

As with the methodologies presented in Sections 4 & 5, Instrument Indication Uncertainty Calculations employ normal distribution uncertainty data specified to at least 2 standard deviations (2σ) which are applicable to the worst case environmental conditions postulated for the instrument location. For instrumentation used to monitor Reg. Guide 1.97 variables, the worst case environmental effects specific to the instrument location associated with the Design Basis Accident are to be used in the calculation.

Indication Uncertainty Calculations differ in methodology from setpoint calculations in that the Loop Drift is not calculated separately from the Loop Uncertainty. Instead the Loop Drift is included with the other random uncertainty components under the radical to form the Total Random Loop Uncertainty (RLU).

Another important difference between indication uncertainty calculations and setpoint calculations is that indication uncertainty calculations must address the man-machine interface associated with the indicator. For indicators with linear scales, this possible source of uncertainty is assigned a value equal to 1/2 the value of the indicator's minor scale division. This allowance accounts for the effects of parallax and the mental interpolation required of the operator and is termed the 'Readability of the Indicator' (RI).

For loops using indicators with non-linear scales (i.e. square-law or log scales) the RI term should be calculated based on decades or other appropriate ranges rather than process units to alleviate the inequity between the size of the minor divisions at the upper an lower extremes of the indicator's scale. Note, 'Readability' is not applicable for recorders and digital readout devices.

The following general steps (outlined in Sections 6.1 - 6.3) should be used to determine the worst case instrument indication uncertainty for a given loop:

- Calculate the Readability term (RI) by taking 1/2 the value of the indicator's minor scale division (or another appropriate value estimated for indicators with non-linear scales).

- Calculate the Random Loop Uncertainty (RLU) by computing the SRSS of the Loop Device Uncertainty (A_L), the Loop Calibration Uncertainty (C_L), the Loop Drift (D_L), the Process Measurement Uncertainty (PM), the Primary Element Uncertainty (PE), and the loop Insulation Resistance Effects (IR).

- Calculate the Total Loop Uncertainty (TLU) by combining the Random Loop Uncertainty, Readability and any conservative bias terms.

6.1 Calculation of Readability - RI

For indicators with linear scales the 'Readability' of the Indicator is:

RI = ± ½ (minor indicator scale division)

6.2 Calculation of Random Loop Uncertainty - RLU

The Random Loop Uncertainty (RLU) is defined by the equation:

$$RLU = \pm\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PM)^2 + (PE)^2 + (IR)^2}$$

Where the variables A_L, C_L, D_L, PM, PE, and IR are determined as follows:

6.2.1 Loop Device Uncertainty - A_L

For a loop consisting of instruments A, B, C, ... X, the loop device uncertainty is given by the equation:

$$A_L = \pm\sqrt{(A_A)^2 + (A_B)^2 + (A_C)^2 + \ldots + (A_X)^2}$$

Where each of the individual device uncertainties A_A, A_B, A_C, ... A_X are formed from the SRSS of the components of uncertainty listed in Sections 3.2.2 - 3.2.9 (as applicable).

$$A_X = \pm\sqrt{(RA_X)^2 + (TE_X)^2 + (HE_X)^2 + (SE_X)^2 + (RE_X)^2 + (PS_X)^2 + (SPE_X)^2 + (OVP_X)^2}$$

Where:
RA_X = Reference Accuracy of device X
TE_X = Temperature Effects for device X
HE_X = Humidity Effects for device X
SE_X = Seismic Effects for device X
RE_X = Radiation Effects for device X
PS_X = Power Supply Effects for device X
SPE_X = Static Pressure Effects for device X
OVP_X = Overpressure Effects for device X

6.2.2 Loop Calibration Uncertainty - C_L

For a loop consisting of instruments A, B, C, ... X, the loop calibration uncertainty is given by the equation:

$$C_L = \pm\sqrt{(MTE_A)^2 + (MTE_B)^2 + (MTE_C)^2 + \ldots + (MTE_X)^2}$$

Where:

MTE_A = SRSS of the measurement and test equipment effects incurred during calibration of instrument A

MTE_B = SRSS of the measurement and test equipment effects incurred during calibration of instrument B

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MTE_X = SRSS of the measurement and test equipment effects incurred during calibration of instrument X

Since the uncertainties associated with specific pieces of field measurement/test equipment are often difficult to obtain, an alternate (and typically more conservative) approach may be used to determine the Loop Calibration Uncertainty.

This alternate approach is based on the assumption that the Measurement and Test Equipment effects associated with each loop device are equal to the Reference Accuracy of that device (i.e. $MTE_X = RA_X$). Thus, the Loop Calibration Uncertainty may be expressed as:

$$C_L = \pm\sqrt{(RA_A)^2 + (RA_B)^2 + (RA_C)^2 + \ldots + (RA_X)^2}$$

6.2.3 Calculation of Loop Drift - D_L

For a loop consisting of instruments A, B, C, ... X, the loop drift is given by the equation:

$$D_L = \pm\sqrt{(DR_A)^2 + (TD_A)^2 + (RD_A)^2 + \ldots + (DR_X)^2 + (TD_X)^2 + (RD_X)^2}$$

Where:

DR_A = the Device Drift associated with instrument A

TD_A = the Temperature Drift Effect for instrument A

RD_A = the Radiation Drift Effect for instrument A

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DR_X = the Device Drift associated with instrument X

TD_X = the Temperature Drift Effect for instrument X

RD_X = the Radiation Drift Effect for instrument X

Since the Device Drift (DR) is directly related to the length of the calibration period, it may be necessary to scale the vendor supplied drift specification to accommodate the calibration interval.

Conservatively, this may be accomplished by multiplying the given drift specification by the ratio of the desired calibration interval to the supplied drift specification interval. Device Drift should only be scaled when the supplied drift specification interval is less than the calibration interval.

6.2.4 Process Measurement Uncertainty - PM

Any loop uncertainty that may be attributable to effects similar to those described in Appendix B must be accounted for under Process Measurement Uncertainty.

6.2.5 Primary Element Uncertainty - PE

If the instrument loop has a device which is essential to the measurement of the process variable, other than those devices previously addressed in the calculation of the Loop Device Uncertainty (A_L), the base uncertainty associated with this device must be accounted for under Primary Element Uncertainty.

6.2.6 Insulation Resistance Effects - IR

If the instrument loop cable, penetrations, splices or terminal blocks may be exposed to harsh environments at any time before the instrumentation is to perform its trip function, the possible effects of degraded insulation resistance must be determined as in Appendix C and accounted for under Insulation Resistance Effects.

Note, the basic equation for the Random Loop Uncertainty (given below) assumes all the variables in the equation are random in nature and are specified to two standard deviations (2σ).

Basic Random Loop Uncertainty Equation:

$$RLU = \pm\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PM)^2 + (PE)^2 + (IR)^2}$$

If some or all of the variables are known to a higher level of confidence (e.g. three standard deviations, 3σ), the basic equation may be modified to produce a Random Loop Uncertainty normalized to two standard deviations (if desired) by dividing each variable by its associated standard deviation (n) and then multiplying the total equation by 2 as shown below. [Ref. 8.3]

$$RLU = \pm 2\sqrt{\left(\frac{A_L}{n}\right)^2 + \left(\frac{C_L}{n}\right)^2 + \left(\frac{D_L}{n}\right)^2 + \left(\frac{PM}{n}\right)^2 + \left(\frac{PE}{n}\right)^2 + \left(\frac{IR}{n}\right)^2}$$

6.3 Calculation of Total Loop Uncertainty – TLU

$$TLU = RLU + RI + Bias$$

SECTION 7: METHODS FOR INCREASING CALCULATED MARGINS

Calculations generated using the methodology presented in this standard may, due to the in-depth treatment of the uncertainty terms, generate setpoint and instrument uncertainty estimates which are more conservative than previously calculated values.

If in the generation of setpoints and loop Allowable Values, a large difference is noted between the existing and calculated values, various techniques should be considered to isolate and possibly reduce these differences if appropriate.

In certain cases, the following may be valid techniques to reduce calculated uncertainty terms:

7.1 Review the environmental limits to reduce them as necessary to reflect only the specific event requirements for which the device is required to function.

7.2 Review the value used for Insulation Resistance Effects to ensure that it is not overly conservative

7.3 Review the Measurement & Test Equipment values used in the calculation as a term to be reduced, especially if the M&TE values have been assumed to be equal to the Reference Accuracy of the individual loop devices.

7.4 A Single-sided Distribution approach to the uncertainty may be considered, depending on the application. This approach may not be applicable to all setpoints due to the possible impact on operational margins or other system setpoints. Note, if this approach is employed, all data should be normalized for Single-Sided Distribution. With the 2σ data applied to Single-Sided Distribution, the accuracy will exceed the 95% confidence level. (See Reference 8.3)

7.5 The Total Loop Uncertainty may be reduced using the square root sum of the squares approach to combine the Loop Uncertainty and the Loop Drift. Generally, this approach should be avoided since it minimizes the margin between the loop Allowable Value and the Nominal Trip Setpoint. Values calculated using this approach should be reviewed to ensure adequate margin exists between the Nominal Trip Setpoint and the Allowable Value.

SECTION 8: REFERENCES

8.1 ISA RP67.04, Part II, 1994, Methodologies for the Determination of Setpoints for Nuclear Safety-Related Instrumentation

8.2 Process Measurement - Instrument Engineers' Handbook Revised Edition Bela G. Liptak & Kristzta Venczel, 1982 - Chilton Book Co., Radnor Pennsylvania

8.3 NEDC-31336P-A, 1996, General Electric Instrument Setpoint Methodology W.H. Cooley, JR., J.L. Leong, M.A. Smith, S. Wolf, - General Electric Co.

8.4 CRANE Technical Paper No. 410 - Flow of Fluids through Valves, Fittings and Pipe CRANE Engineering Division, 1985 - Crane Co.

8.5 Nuclear Plant Engineering Desk Top Procedure EDP-032 Rev. 1 - Instrument Loop Uncertainty and Setpoint Calculations

8.6 USNRC Regulatory Guide 1.105 Rev. 1 - Instrument Setpoints

APPENDIX A

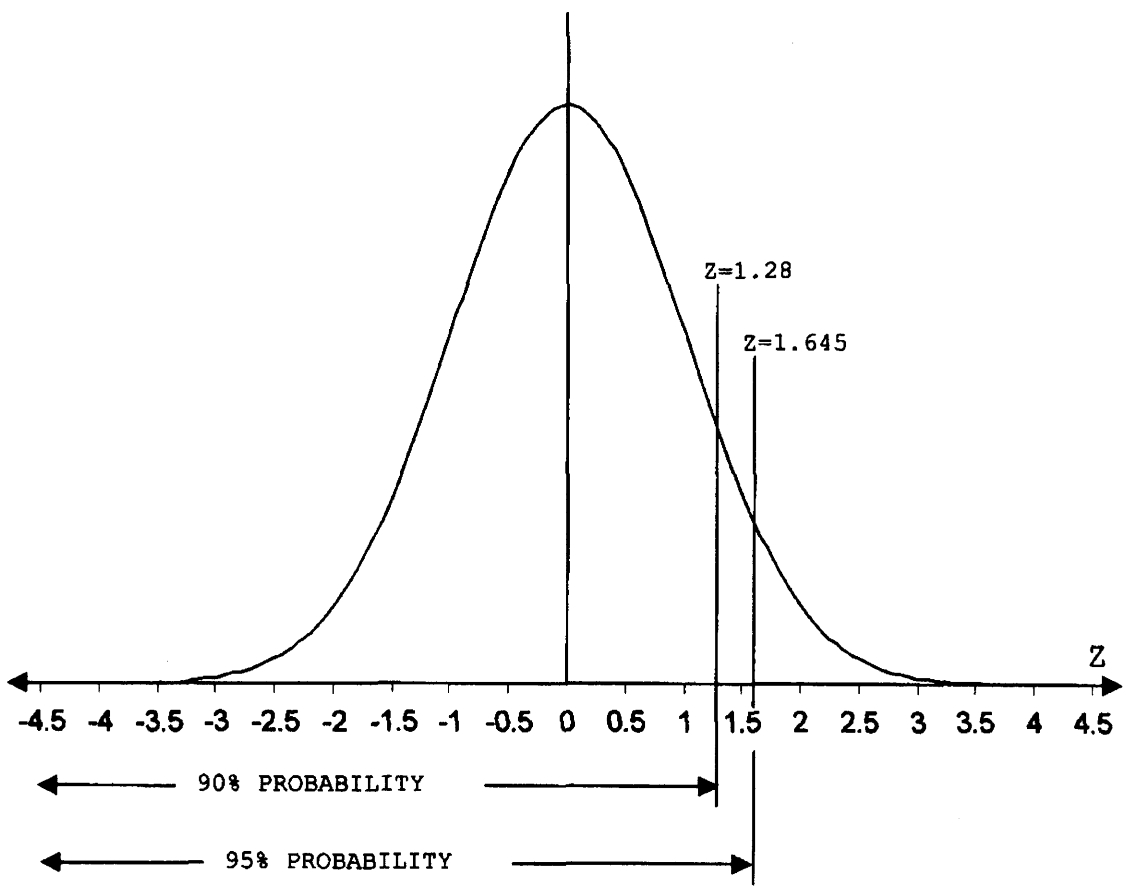
SPURIOUS TRIP AND LER AVOIDANCE ANALYSIS

INTRODUCTION

The Spurious Trip and Licensee Event Report (LER) Avoidance analysis techniques that follow are used to demonstrate the acceptability of field setpoints with respect to specific operating margins. These techniques and the associated terminology are referenced from NEDC 31336P-A, 1996, General Electric Instrument Setpoint Methodology.

In both the Spurious Trip and LER Avoidance analysis, the probability that the margin of interest will not be exceeded is determined by the area under the normal standard deviation curve from $-\infty$ to Z, where Z is derived by dividing the magnitude of each respective margin by the appropriate standard deviation.

The standard normal distribution curve is shown below with the minimum "Z" values for 90% and 95% probability, the acceptance criteria for LER Avoidance and Spurious Trip Avoidance respectively.



1.0 SPURIOUS TRIP ANALYSIS

Spurious Trip analysis is performed to demonstrate the acceptability of the margin between a Nominal Trip Setpoint and the value of the limiting process transient variation associated with the setpoint. If the setpoint is acceptable, there should be at least a 95% probability that this margin will not be exceeded and no spurious trip will occur.

The probability of avoiding spurious trips for a single channel is determined by calculating a value "Z" as shown below. This Z value is then used to determine the area under the standard normal distribution curve from $-\infty$ to Z using standard statistical tables. Note, any $Z \geq 1.645$ will meet the acceptance criteria of 95% spurious trip avoidance.

A Spurious Trip analysis should be performed for all field setpoints validated by calculation and may be performed for calculated setpoints that are not to be employed in the field.

$$Z_{\Delta} = \frac{|NTSP - X_T|}{\sqrt{(\sigma_n)^2 + (\sigma_i)^2}}$$

Discussion of Variables:

NTSP - Nominal Trip Setpoint

X_T - Limiting Operating Transient Variation

$X_T = X_o + T + T_c$, if the process variable increases to the Analytical Limit

$X_T = X_o - T - T_c$, if the process variable decreases to the Analytical Limit

Where:

X_o = maximum or minimum steady state operating value

T = magnitude of the limiting transient variation

T_c = modeling bias or uncertainty

The limiting operating transient (X_T) is typically calculated as shown; however, this value may be specifically noted in the system operating instruction. Unless justification is provided, the value of X_T should not be closer to the operating limit than the setpoint.

The steady state operating value (X_o) may be determined from the system operating instructions, Technical Specifications, design specifications or similar documentation.

The limiting transient variation (T) is typically the margin between the steady state operating value and the process setpoint, but the limiting variation may be related to some other operating limit/restriction invoked by the system operating instructions or the Technical Specification.

The modeling bias or uncertainty (T_C) is typically zero when using existing documented operating restrictions. This term is used to add any margin for uncertainty when specifying the limiting transient variation based on engineering judgement.

σ_N - The standard deviation associated with the limiting operating transient (σ_N), is equal to zero when the limiting operating transient is based on existing documented operating restrictions. This term is used to account for any deviation associated with the limiting operating transient when the limiting transient is based on engineering judgement.

σ_i - The standard deviation associated with the loop uncertainty, denoted σ_i, is calculated as shown below:

$$\sigma_i = \frac{1}{n}\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2 + (PM)^2 + (PE)^2}$$

Where:

n = number of standard deviations used in expressing the individual components of uncertainty

A_L = Loop Device Uncertainty

C_L = Loop Calibration Uncertainty

D_L = Loop Drift

PM = Process Measurement Uncertainty

PE = Primary Element Uncertainty

2.0 LER AVOIDANCE ANALYSIS

LER Avoidance analysis is performed to demonstrate the acceptability of the margin between a loop Allowable Value and Nominal Trip Setpoint. If the setpoint is acceptable, there should be at least a 90% probability that this margin will not be exceeded.

The probability of LER avoidance for a single channel is determined by calculating a value "Z" as shown below. This Z value is then used to determine the area under the standard normal distribution curve from -∞ to Z. Note, any Z ≥ 1.28 will meet the acceptance criteria of 90% LER avoidance.

An LER Avoidance analysis should be performed for each field setpoint/allowable value validated by calculation and may be performed for calculated values that are not to be employed in the field.

$$Z = \frac{|AV - NTSP|}{\frac{1}{n}\sqrt{(A_L)^2 + (C_L)^2 + (D_L)^2}}$$

Where:

AV = Allowable Value

NTSP = Nominal Trip Setpoint

A_L = Loop Device Uncertainty

C_L = Loop Calibration Uncertainty

D_L = Loop Drift

n = number of standard deviations used in specifying the individual components of uncertainty

APPENDIX B

PROCESS MEASUREMENT UNCERTAINTIES

INTRODUCTION

Process measurement uncertainties are: those uncertainties which may be introduced in an instrument loop due to limitations in modeling the physical system; or more commonly, those uncertainties introduced in an instrument loop due to fluctuations in the process for which the loop instrumentation can not automatically compensate.

Note, this Appendix is not intended to be an exhaustive discussion of Process Measurement Uncertainty but rather is intended only to present specific analysis techniques used to address common uncertainties associated with process measurement.

1.0 FLOW MEASUREMENT UNCERTAINTY - (FLUID DENSITY EFFECTS)

In systems that use differential pressure transmitters to detect flow, measurement uncertainty may be introduced by density changes in the process fluid. Such variations in fluid density are generally the result of temperature transients in the system.

As shown in the equations below, a change in the density of the process fluid will result in a variation of the sensed variable (DP) if the flow rate is constant. Therefore, the flow derived from the pressure measurement will not be a true representation of the actual flow.

$$Q = K(A)\sqrt{\frac{DP}{Density}} \quad \text{(volumetric flow rate)}$$

$$W = K(A)\sqrt{DP(Density)} \quad \text{(mass flow rate)}$$

Where:

Q = Volumetric flow rate

W = Mass flow rate

A = Cross sectional area of the pipe

K = Constant

DP = Differential pressure measured across the orifice plate

Density = Density of the process fluid

By assuming Q, the volumetric flow rate of the system, remains constant between a base calibration condition (Density 1) and some final condition (Density 2) the measurement uncertainty due to fluid density changes may be derived as follows:

$$Q2 = Q1$$

$$K(A)\sqrt{\frac{DP2}{Density2}} = K(A)\sqrt{\frac{DP1}{Density1}}$$

$$\frac{DP2}{Density2} = \frac{DP1}{Density1}$$

Since density is the inverse of specific volume (SV), the results above may be expressed as*:

$$\frac{DP2}{DP1} = \frac{SV1}{SV2}$$

Clearly, if the specific volume of the process fluid changes between condition 1 and condition 2, the differential pressure will also change. This change in differential pressure (ΔDP) is given by:

$$\Delta DP = DP2 - DP1$$

* Since the density of water is given in the ASME Steam Tables in terms of specific volume, relating DP to specific volume is generally more convenient than relating DP to density.

By expressing DP2 in terms of DP1 and substituting, the DP uncertainty can be expressed as:

$$\Delta DP = DP1\left[\left(\frac{SV1}{SV2}\right)-1\right]$$

Where:

DP1 = Differential pressure sensed at calibration temperature (T1)
SV1 = Specific volume of the process fluid at calibration temperature (T1)
SV2 = Specific volume of the process fluid at any arbitrary temperature (T2)

NOTE:

- If SV2 > SV1 (T2 > T1): the indicated flow is less than the actual flow
- If SV2 < SV1 (T2 < T1): the indicated flow is greater than the actual flow
- If DP1 is maximized, the uncertainty is maximized.

Although the results above are applicable only to volumetric flow rate; the same methodology may also be used to determine mass flow rate density effects.

2.0 LEVEL MEASUREMENT UNCERTAINTIES - (FLUID DENSITY EFFECTS)

When differential pressure transmitters are used to measure liquid level, changes in the density of the liquid within the vessel and/or the transmitter reference leg fluid may result in process measurement uncertainty. The following discussion addresses both open vessel and closed vessel level measurement uncertainties attributable to density variations in the process.

2.1 Open Vessel Liquid Level Measurement

For measurement of liquid level in an open vessel, no reference leg considerations are applicable since both the vessel and pressure transmitter are vented to the atmosphere. Therefore, the only density variation to be considered is that of the liquid within the vessel.

The equation below shows the relationship between the density of the liquid within the vessel and the pressure sensed by the transmitter in an open system.

$$P = H_V \times SG_V$$

OR

$$P = H_V \times \left[\frac{\textit{density of the liquid in the vessel}}{\textit{density of water at ref. conditions.}}\right]$$

Where:

P = Pressure sensed by the transmitter (in inches of water)
H_V = Height of the liquid in the vessel measured from the transmitter tap(in inches)
SG_V = Specific gravity of the liquid within the vessel

By using the inverse relationship between density and specific volume (SV), the pressure at the transmitter may also be expressed as:

$$P = H_V \times \left[\frac{\textit{SV of water at ref. conditions}}{\textit{SV of the liquid in the vessel}}\right]$$

From the equations derived for 'P', the pressure sensed at the transmitter, the error (ΔP) resulting from density variations in the process liquid can be calculated as shown below:

$$\Delta P = H_V \left(SG_{V2} - SG_{V1} \right)$$

OR

$$\Delta P = H_V \left(\frac{SV_{W3}}{SV_{V2}} - \frac{SV_{W3}}{SV_{V1}} \right)$$

Where:

H_V = Height of the liquid in the vessel measured from the transmitter tap (in inches)

SG_{V1} = Specific gravity of the process liquid at calibration temperature (T1)

SG_{V2} = Specific gravity of the process liquid at any arbitrary temperature (T2)

SV_{V1} = Specific volume of the process liquid at calibration temperature (T1)

SV_{V2} = Specific volume of the process liquid at any arbitrary temperature (T2)

SV_{W3} = Specific volume of water at some reference temperature (T3)

If the process liquid is **water** and the reference temperature (T3) is the temperature at calibration (T1), the equations above may be reduced to the form shown below:

$$\Delta P = H_V \left[\frac{SV_{V1}}{SV_{V2}} - 1 \right]$$

NOTE:

- If $SV_{V2} > SV_{V1}$ (T2 > T1): the indicated level is less than the actual level
- If $SV_{V2} < SV_{V1}$ (T2 < T1): the indicated level is greater than the actual level

2.2 Closed Vessel Liquid Level Measurement (low pressure system)

For measurement of liquid level in a closed vessel, the density variations in the transmitter reference leg fluid must be considered in conjunction with the density variations of the liquid within the vessel.

If the transmitter reference leg is dry (i.e. pressurized only by the gaseous volume above the liquid in the vessel) and the vessel is at a relatively low temperature and pressure, the only significant density variation due to temperature transients will be in the vessel liquid. The density variations of the gaseous volume and thus the pressure variations in the reference leg under low pressure conditions are generally negligible. Therefore, the level measurement uncertainty due to density variations would be calculated as if the vessel were vented.

However, if the transmitter reference leg is wet (i.e. pressurized by a column of liquid), both the density variations of the vessel liquid and the reference leg liquid could contribute to process measurement uncertainty.

The equations below show the relationship between the density of the process liquid, the density of the reference leg liquid and the differential pressure sensed by the transmitter in a low pressure closed vessel system.

$$DP = (H_R \times SG_R) - (H_V \times SG_V)$$

OR

$$DP = H_R \left[\frac{Density_R}{Density_W} \right] - H_V \left[\frac{Density_V}{Density_W} \right]$$

Where:

DP	=	Differential pressure sensed by the transmitter (in "WC)
H_R	=	Height of the liquid in the reference leg measured from the transmitter tap (in inches)
H_V	=	Height of the liquid in the vessel measured from the transmitter tap (in inches)
SG_R	=	Specific gravity of the liquid within the reference leg
SG_V	=	Specific gravity of the liquid within the vessel
$Density_R$	=	Density of the liquid within the reference leg
$Density_V$	=	Density of the liquid within the vesse
$Density_W$	=	Density of water at some reference condition

By using the inverse relationship between density and specific volume (SV), the differential pressure may also be expressed as:

$$DP = H_R\left(\frac{SV_W}{SV_R}\right) - H_V\left(\frac{SV_W}{SV_V}\right)$$

From the equations derived for 'DP', the differential pressure sensed at the transmitter, the error (ΔDP) introduced in the low pressure closed vessel system as a result of density variations can be calculated as shown below:

$$\Delta DP = H_R(SG_{R2} - SG_{R1}) - H_V(SG_{V4} - SG_{V3})$$

OR

$$\Delta DP = H_R\left[\frac{SV_{W5}}{SV_{R2}} - \frac{SV_{W5}}{SV_{R1}}\right] - H_V\left[\frac{SV_{W5}}{SV_{V4}} - \frac{SV_{W5}}{SV_{V3}}\right]$$

Where:

H_R = Height of the liquid in the reference leg measured from the transmitter tap (in inches)

H_V = Height of the liquid in the vessel measured from the transmitter tap (in inches)

SG_{R1} = Specific gravity of the reference leg liquid at calibration temperature (T1)

SG_{R2} = Specific gravity of the reference leg liquid at any arbitrary temperature (T2)

SG_{V3} = Specific gravity of the vessel liquid at calibration temperature (T3)

SG_{V4} = Specific gravity of the vessel liquid at any arbitrary temperature (T4)

SV_{R1} = Specific volume of the reference leg liquid at calibration temperature (T1

SV_{R2} = Specific volume of the reference leg liquid at any arbitrary temperature (T2)

SV_{V3} = Specific volume of the process liquid at calibration temperature (T3)

SV_{V4} = Specific volume of the process liquid at any arbitrary temperature (T4)

SV_{W5} = Specific volume of water at some reference temperature (T5)

The preceding equations can be somewhat confusing since the reference leg liquid and the liquid within the vessel are not necessarily at the same temperature or density at any moment.

However, assuming the reference leg liquid and the liquid within the vessel are **water** and the reference temperature (T5) is equal to the temperature of the reference leg liquid at the time of calibration (T1), the equations may be reduced to:

$$\Delta DP = H_R\left[\frac{SV_{R1}}{SV_{R2}} - 1\right] - H_V\left[\frac{SV_{R1}}{SV_{V4}} - \frac{SV_{R1}}{SV_{V3}}\right]$$

Closed vessel high pressure systems differ from low pressure closed vessel systems in that the density variations of the vapor region above the vessel liquid must also be considered to determine the total measurement uncertainty. A detailed discussion of this type of system is not included here but is presented in Reference 8.1 for a steam/water system.
The defining equation for this type of measurement is:

$$DP = (H_R \times SG_R) - (H_V \times SG_V) - (H_{VAP} \times SG_{VAP})$$

Where:

DP	=	Differential pressure sensed by the transmitter (in "WC)
H_R	=	Height of the liquid in the reference leg measured from the transmitter tap (in inches)
H_V	=	Height of the liquid in the vessel measured from the transmitter tap (in inches)
H_{VAP}	=	Height of the vapor region above the vessel liquid (in inches)
SG_R	=	Specific gravity of the liquid within the reference leg
SG_V	=	Specific gravity of the liquid within the vessel
SG_{VAP}	=	Specific gravity of the vapor above the vessel liquid

APPENDIX C

INSULATION RESISTANCE EFFECTS

INTRODUCTION

Cables, splices, connectors, terminal blocks, and penetrations may experience a reduction in insulation resistance under conditions of high humidity and temperature associated with a high-energy line break (HELB). This reduction in insulation resistance causes an increase in leakage currents from individual conductors to ground, and from one conductor to another.

Normally, leakage currents are negligibly small, and may be compensated for during calibration. However, under accident conditions, leakage currents may increase causing a significant uncertainty in measurement. This type of signal uncertainty, known as Insulation Resistance Effects (IR), is of great concern for instrument channels with logarithmic signals, and may be of concern for circuits with sensitive, low level, signals (e.g. current transmitters, resistive temperature devices, thermocouples, etc.).

1.0 INSULATION RESISTANCE TEST DATA

LOCA simulation qualification test reports may be referenced for cable insulation resistance data. The insulation resistance data taken during LOCA simulation testing are conservative with respect to all postulated accident conditions, and are usually based on leakage currents for various cable types and measurement configurations.

Since test report data will generally be given for a test cable of much shorter length than the field cable of interest, it is necessary to determine the "ohms-foot" value of the insulation resistance. This factor allows the insulation resistance for a particular length of field cable to be determined.

The "ohms-foot" value is obtained by multiplying the value of insulation resistance measured for the sample cable by the length of the sample cable. The resistance of varying lengths of field cable is then determined by dividing the ohms-foot value by the length of the field cable.

2.0 IR EFFECTS FOR A CURRENT SOURCE LOOP (General Example)

The model shown below represents a typical transmitter loop with potential leakage current paths associated with the cables, cable splices and a penetration. This model and the analysis techniques that follow are intended as a guide and can be modified to determine the insulation resistance effect for loops with different physical configurations.

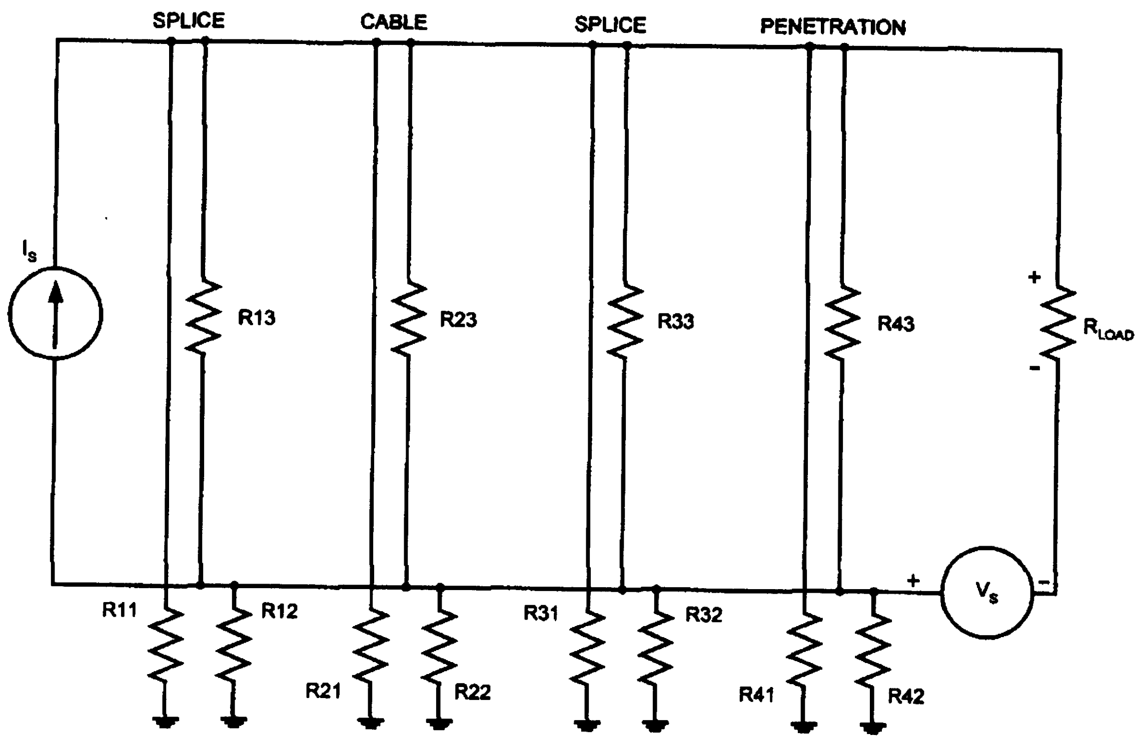


Figure C-1

Where:

I_S = Transmitter output, current source

V_S = Loop power supply, voltage source

R_{X1} = Leakage current resistance path from conductor 1 to ground

R_{X2} = Leakage current resistance path from conductor 2 to ground

R_{X3} = Leakage current resistance path from conductor 1 to conductor 2

R_{Load} = Load resistance

Note: R_{X1}, R_{X2}, and R_{X3} should be referenced from LOCA simulation qualification test reports as described in the previous section.

In general, the leakage resistance paths shown in Figure C-1 can be grouped into three different types: paths between conductor 1 and conductor 2, paths from conductor 1 to ground, and paths from conductor 2 to ground. If these distinctions are made, the original model may be reduced by combining like resistance paths using the equations shown below to form the equivalent model shown in Figure C-2.

Combining all paths from conductor 1 to ground:

$$\frac{1}{R_{C1}} = \frac{1}{R_{11}} + \frac{1}{R_{21}} + \frac{1}{R_{31}} + \frac{1}{R_{41}}$$

Combining all paths from conductor 2 to ground:

$$\frac{1}{R_{C2}} = \frac{1}{R_{12}} + \frac{1}{R_{22}} + \frac{1}{R_{32}} + \frac{1}{R_{42}}$$

Combining all conductor - to - conductor resistances:

$$\frac{1}{R_{CC}} = \frac{1}{R_{13}} + \frac{1}{R_{23}} + \frac{1}{R_{33}} + \frac{1}{R_{43}}$$

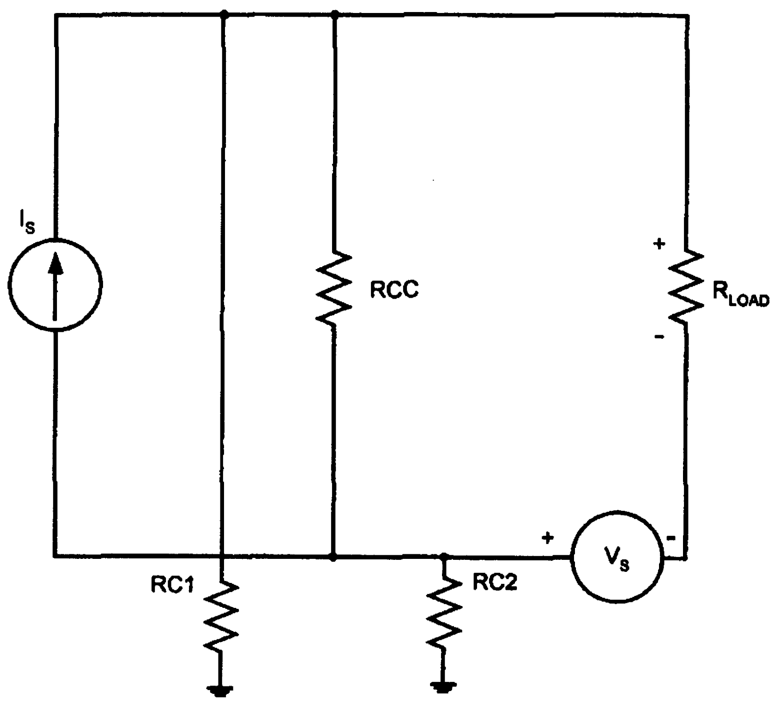


Figure C-2

Again, the circuit of Figure C-2 can be reduced to further simplify the model by using the equation below to yield the equivalent circuit of Figure C-3.

Combining the potential leakage current path resistances:

$$\frac{1}{R_{LEAKAGE}} = \frac{1}{R_{CC}} + \frac{1}{R_{C1} + R_{C2}}$$

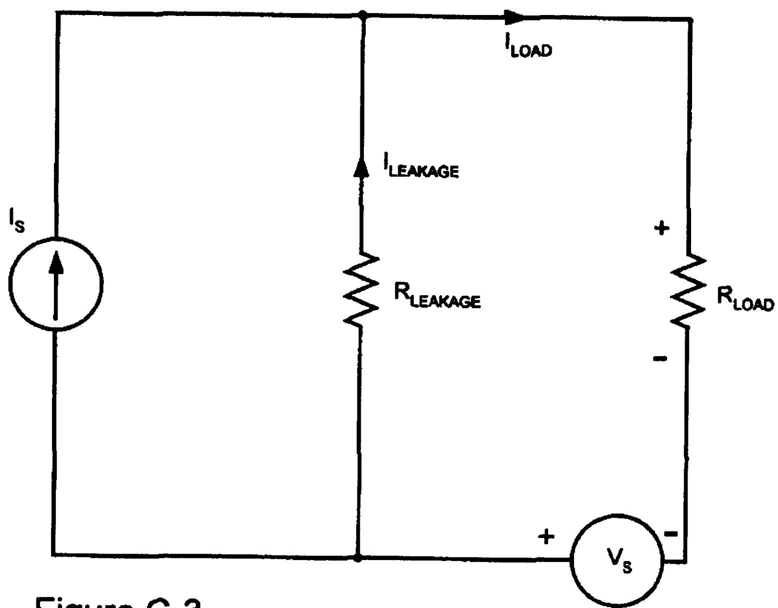


Figure C-3

Ideally, if no leakage resistance paths existed, the source current (I_S) and the current delivered to the load (I_{Load}) would be equivalent. However, due to the postulated degradation of the insulation resistance, the leakage resistance is no longer so great that leakage current is negligible. As the leakage resistance decreases the leakage current (or IR effect) becomes greater. To relate this effect to loop uncertainty, the leakage current must be determined using the following equations from basic circuit analysis.

From Figure C-3, the source current is the difference between the current delivered to the load and the leakage current:

$$I_S = I_{LOAD} - I_{LEAKAGE}$$

OR

$$I_{LEAKAGE} + I_S = I_{LOAD}$$

Also from Figure C-3, the source voltage is given by:

$$V_S = I_{LEAKAGE}(R_{LEAKAGE}) + I_{LOAD}(R_{LOAD})$$

Or equivalently:

$$I_{LEAKAGE} = \frac{V_S - I_{LOAD}(R_{LOAD})}{R_{LEAKAGE}}$$

Substituting for I_{Load} and solving for $I_{Leakage}$:

$$I_{LEAKGE} = \frac{V_S - (I_{LEAKAGE} + I_S)R_{LOAD}}{R_{LEAKAGE}}$$

$$I_{LEAKGE}(R_{LEAKAGE} + R_{LOAD}) = V_S - I_S(R_{LOAD})$$

Therefore, the leakage current is given by:

$$I_{LEAKAGE} = \frac{V_S - I_S(R_{LOAD})}{R_{LEAKAGE} + R_{LOAD}}$$

And the leakage resistance in percent of span, or IR Effect is:

$$I_{LEAKAGE}(\%SPAN) = \frac{I_{LEAKAGE}}{I_{S\max} - I_{S\min}}(100\%)$$

The equations above lead to the following general conclusions regarding insulation resistance effects for current loops:

- The IR effect for a transmitter (current) loop is a positive **bias** with respect to the loop current.
- The IR effect increases with increased source (power supply) voltage.
- The IR effect increases with decreased source (transmitter) current.
- The IR effect increases with decreased load resistance.

APPENDIX D

ACRONYMS AND ABBREVIATIONS

ACRONYMS AND ABBREVIATIONS

AL	–	Analytical Limit
A_L	–	Loop Device Uncertainty
AV	–	Allowable Value
A_X	–	Individual Device Uncertainty
C_L	–	Loop Calibration Uncertainty
DBE	–	Design Basis Event
D_L	–	Loop Drift
DR	–	Device Drift
F	–	Arbitrarily Distributed Loop Uncertainties
HE	–	Humidity Effects
HELB	–	High Energy Line Break
IR	–	Insulation Resistance Effects
ISA	–	Instrument Society of America
L	–	Bias in the Negative Direction
LER	–	Licensee Event Report
LSL	–	Licensing Safety Limit
LU	–	Loop Uncertainty
M	–	Bias in the Positive Direction
MTE	–	Measurement and Test Equipment Effects
NTSP	–	Nominal Trip Setpoint
n	–	Number of Standard Deviations
OVP	–	Overpressure Effects
PAM	–	Post Accident Monitoring

PE	–	Primary Element Uncertainty
PL	–	Process Limit
PM	–	Process Measurement Uncertainty
PS	–	Power Supply Effects
RA	–	Reference Accuracy
RD	–	Radiation Drift
RE	–	Radiation Effects
RI	–	Readability of Indicator
RLU	–	Random Loop Uncertainty
SE	–	Seismic Effects
SPE	–	Static Pressure Effects
SRSS	–	Square Root Sum of the Squares
SSE	–	Safe Shutdown Earthquake
T	–	Magnitude of the Limiting Transient Variation
T_C	–	Modeling Bias or Uncertainty
TE	–	Temperature Effects
TD	–	Temperature Drift Effects
TLU	–	Total Loop Uncertainty
URL	–	Upper Range Limit
X_o	–	Max. or Min. Steady State Loop Operating Value
X_T	–	Magnitude of the Limiting Operating Transient

Facility:	Grand Gulf Nuclear Station

I. SIGNATURES

Preparer:	Floyd J Brown	Floyd J. Brown	1/6/2000
	Signature	Name (print)	Date
Reviewer:	[signature]	TIMOTHY M BRYANT	1/6/00
	Signature	Name (print)	Date

II. OVERVIEW

Document Evaluated: (Include document number, revision, and title)

GGNS-JS-09, Rev. 1 – Methodology for the Generation of Instrument Loop Uncertainty & Setpoint Calculations

Brief Description of the Proposed Change:

General revision and incorporate SCN 98-0001

III. 50.59 SCREENING

TECHNICAL SPECIFICATION SCREENING

Does the proposed Change represent a change to:

Operating License	☐ Yes ☒ No	If yes, process a change per 10CFR50.90 and obtain NRC approval prior to implementing the Change.
Technical Specifications	☐ Yes ☒ No	If yes, process a change per 10CFR50.90 and obtain NRC approval prior to implementing the Change.
NRC Orders (ANO only)	☐ Yes ☐ No ☒ N/A	If yes, process a change per 10CFR50.90 and obtain NRC approval prior to implementing the Change.

SAR SCREENING

Does the proposed Change represent a change to the facility or procedure which alters information, operation, function or ability to perform the function of a system, structure or component described in the SAR (site-specific documents)**?**

TS Bases section	☐ Yes ☒ No	If yes, perform a 50.59 Evaluation.
UFSAR (including pending changes)	☐ Yes ☒ No	If yes, perform a 50.59 Evaluation.
TRM	☐ Yes ☒ No	If yes, perform a 50.59 Evaluation.

ATTACHMENT: 1
TO: GGNS-JS-09 Rev 1
PAGE: 1 OF 3

Core Operating Limits Report	☐	Yes	If yes, perform a 50.59 Evaluation.
	☒	No	
Fire Hazards Analysis (Included in RBS' USAR)	☐	Yes	If yes, perform a 50.59 Evaluation.
	☒	No	
	☐	N/A	
NRC SERs	☐	Yes	If yes, perform a 50.59 Evaluation. (See Section 5.1.19.)
	☒	No	
Does the proposed Change involve a test or experiment not described in the SAR?	☐	Yes	If yes, perform a 50.59 Evaluation.
	☒	No	
Does the proposed Change result in any potential impact to equipment or facilities utilized for Ventilated Storage Cask activities?	☐	Yes	If yes, perform a 72.48 Review.
	☒	No	
	☐	N/A	

ADDITIONAL SCREENING

Does the proposed Change represent a change to:

Quality Assurance Program Manual	☐	Yes	If yes, notify the quality department and ensure a 50.54 Evaluation is performed.
	☒	No	
Emergency Plan	☐	Yes	If yes, notify the emergency planning department and ensure a 50.54 Evaluation is performed.
	☒	No	

BASIS: [A brief written response providing the basis for answering the questions must be provided. Adequate basis must be provided within the Screening such that a third-party reviewer can reach the same conclusions. Simply stating that the change does not affect TS or the SAR is not an acceptable basis. Also discuss the methodology for performing the LBD search. State the location of relevant licensing document information and explain the scope of the review such as electronic search criteria used (e.g., key words) or the general extent of manual searches per Section 5.1.18.6.]

Standard GGNS-JS-09 presents the methodology for the generation of instrument loop uncertainty and setpoint calculations. This standard is intended to promote uniformity in instrument calculations performed at GGNS, and is based on accepted industry standards.

JS-09 is not specifically addressed in the Technical Specifications or the SAR. The changes made in Revision 1 of JS-09 will not invalidate the general descriptions of setpoint / allowable value development contained in the Tech. Spec. Bases.

Electronic search keywords: setpoint methodology, JS-09

Documents searched: UFSAR, Technical Specifications, TRM

IV. ENVIRONMENTAL EVALUATION APPLICABILITY REVIEW

If any of the following questions is answered "YES", then an Environmental Evaluation must be performed.

Will the Change being evaluated:

YES	NO	
☐	☒	Disturb land that is beyond that initially disturbed during construction (i.e., new construction of buildings, creation or removal of ponds, or other terrestrial impact)?
☐	☒	Increase thermal discharges to the river, lake or atmosphere?
☐	☒	Increase concentration or quantity of chemicals discharged to the atmosphere, ground water, or surface water?
☐	☒	Increase quantity of chemicals to cooling lake or atmosphere through discharge canal or tower?
☐	☒	Modify the design or operation of cooling tower that will change flow characteristics?
☐	☒	Install any new transmission lines leading offsite?
☐	☒	Change the design or operation of the intake or discharge structures?
☐	☒	Discharges any chemicals new or different from that previously discharged?
☐	☒	Potentially cause a spill or unevaluated discharge that may effect neighboring soils, surface water or ground water?
☐	☒	Involve burying or placement of any solid wastes in the site area that may effect runoff, surface water or ground water?
☐	☒	Involve incineration or disposal of any potentially hazardous materials on the site?
☐	☒	Result in a change to non-radiological effluents or licensed reactor power level?
☐	☒	Potentially change the type or increase the amount of non-radiological air emissions from the site?

Date: 1/7/00

To: Mr. J. E. Venable, GGNS General Manager, Plant Operations

From: A. D. Barfield, Manager, Design Engineering

Subject: Engineering Issuance of Standard GGNS-JS-09, Revision 1, for Use

Title Methodology for the Generation of Instrument Loop Uncertainty & Setpoint Calculations

Engineering is issuing the subject Standard for use at GGNS.

__X__ The subject specification/standard was not issued for review. Therefore, if this issuance impacts any procedure, requires re-training, or effects materials, contact Engineering.

_____ The subject specification/standard was previously issued for review. All comments have been incorporated. Plant review indicated no material impacts, retraining, or procedure revisions are required.

_____ The subject specification/standard was previously issued for review. All comments have been incorporated. Plant review indicated material impacts, retraining, or procedure revisions are required. See the attached completed Advance Change Notification Department Response.

It should be noted that a master reproducible copy of this document is being transmitted to Plant Staff Document Control so that members of your staff will be able to obtain controlled copies.

FJB: ADBarfield

Attachment

pc: E. D. Harris, w/a (M&E/Engineering), w/a
J. C. Roberts (BADM/QP), w/o
C. D. Stafford (G-ADM1-OPS), w/a
D. P. Wiles (U2WHSE/MATL), w/a
Configuration. Management (ESC), w/a
File (applicable), w/a
File (NPE), w/o

FORM 015- 9/1/1999

Date: 1/6/2000

To: Ms. K. M. Bilbro, Document Control Supervisor

From: M. L. Humphries, Group Supervisor, Electrical / I&C

Subject: File Documentation

DOCUMENT NAME AND NUMBER

DCP: ______________________ **CALC:** ______________

MCP: ______________________ **CN:** ______________

OTHER: **GGNS-JS-09, Rev. 1**

Documents are attached and forwarded for inclusion in the appropriate subject file.

M. L. Humphries 1-6-2000

Group Supervisor /Date

Total number of pages including this sheet 3 **.**

FORM035-9/2/1999

ENGINEERING PROGRAMS APPLICABILITY REVIEW/ACCOUNTABILITY RECORD

Document Evaluated GGNS-JS-09 Rev. 1 Supplement N/A

Brief Description of Change General revision and incorporate SCN 98/0001

	N/A	NO	YES	N/R
ALARA (if YES, refer to NPEAP 311) Does document install or modify a component: 1) where radiation exposure to plant personnel (> 2.5 mrem/hr) can occur either during normal or outage conditions, or during manipulation of an SSC following an accident; 2) involve work inside the fluid boundary of a radioactive system; 3) require a modification of shielding; or 4) is there a potential for Cobalt reduction in systems communicating with the Reactor Vessel? Note: Records of plant radiological conditions during various operational modes are maintained by the GGNS Health Physics department.	■	☐	☐	☐
SEISMIC QUALIFICATION (if YES, refer to NPEAP 314) Does document delete or modify seismically qualified equipment; install new safety related or post accident monitoring equipment, or affect equipment which interacts with seismically qualified equipment in a manner which could affect the performance capabilities or seismic/dynamic characteristics?	☐	■	☐	☐
FIRE PROTECTION (if YES, refer to NPEAP 317) Does document involve or affect combustibles, fire protection equipment, obstructions to fire suppression/detection features, penetrations/ space separators, or structural steel fireproofing, raceway fire barrier enclosures (Thermo-Lag/Kaowool), cable tray covers or Pre-Fire Plans; add or remove safety related equipment?	■	☐	☐	☐
SAFE SHUTDOWN (if YES, refer to NPEAP 317) Does document involve equipment listed in FPP-1, described on safe shutdown P&ID drawings, or involve any of the following systems; B21, E12, P41, P75, T46, T51, X77, Y47, C61, M71, Z77, or systems which support these systems; address a change to equipment in an area containing redundant safe shutdown components; involve non-safe shutdown circuits that share power supplies, signal sources or enclosures with safe shutdown circuits; or affect the function of 8 hour emergency lighting?	■	☐	☐	☐
HUMAN FACTORS (if YES, refer to NPEAP 333) Does document include a change to control room labeling or annunciator wording which differs from, or is not listed in Appendix A of ES-17; or modifies display equipment on control room panels or control room operator controls?	☐	■	☐	☐
HYDROGEN CONTROL (if YES, refer to NPEAP 336) Does document address a change to equipment or structures in the containment or drywell?	☐	■	☐	☐
ASME SECTION XI (if YES, refer to NPEAP 337) Does document add or delete any safety related pressure boundary welds, components, or component supports; affect the performance or testing of a safety related pump or safety related valve; or the function or function classification of any pump or valve as stated in GGNS-M-189.3?	☐	■	☐	☐
ENVIRONMENTAL QUALIFICATION (if YES, refer to NPEAP 803) Does document add EQ equipment; remove, replace, change the function of, change the power supply of or alter any EQ equipment; result in a change or potential change to local environmental conditions (e.g., heat load, cooling source or radiation source) during normal, abnormal or post accident operations including changes to HELB barriers (e.g. doors); add, change or alter safety related equipment located inside a line break area/containment which share common power supplies or circuit breakers with EQ equipment; or alter a system required to detect/mitigate a LOCA or HELB?	☐	■	☐	☐
EROSION/CORROSION - MIC (if YES, refer to NPEAP 903) Does the document affect any aspect of a water/steam system (e.g., flow path geometry, material, flow rate, duration, chemistry, new weld location, temperature, pressure, or steam quality); or affect the piping component wall thickness (e.g., welding overlay, different pipe schedule, eroded areas, etc.) for elbow, tee, reducer, piping, pump, tank, or valve within the piping system (not to include pipe supports); or add external weight to the piping system (such as lead shielding or larger actuator); or make any changes to the drawings listed in Attachment 1 to NPEAP 903?	■	☐	☐	☐

Justification: Revision 1 of JS-09 is a general revision and incorporates SCN 98/0001. These changes consist of minor methodology revisions, editorial changes and updates to references. The revision does not impact the original design inputs.

Responsible Engineer: [signature] Date: 1/6/2000

Group Supervisor: [signature] Date: 1/6/2000

Form 330.2, Rev. 4

DESIGN VERIFICATION RECORD

Document Number: JS-09 Revision: 1

METHOD

Verification methods to be used:

X Design Review
Qualification Testing
Alternate Calculations

DOCUMENT(S) REVIEWED: (Attach Additional Sheet(s), if needed)

Document Number	Revision	Document Title
NEDC-31336P-A	1996	GE setpoint methodology
ISA RP67.04, Part II	1994	ISA setpoint methodology
EDP-032	1	Setpoint/uncertainty desktop procedure
USNRC RG 1.105	1	NRC instrument setpoint reg guide
JS-09	0	

SUMMARY OF REVIEW: (Attach Additional Sheet(s), if needed)

A review was done to verify the accuracy of the information presented in JS-09 rev 1. A review was done to ensure that all procedural requirements were met. JS-09 rev 1 is acceptable for issuance. The methodology for generating instrument uncertainty and setpoint calculations is adequately explained.

Design Verification Completed By: [signature] Date: 1/6/00

Engineering Supervisor: [signature] Date: 1/6/2000