Exelon Generation
4300 Winfield Road
Warrenville, IL 60555

www.exeloncorp.com

Exelon Nuclear

RS-03-229

December 5, 2003

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

Dresden Nuclear Power Station, Units 2 and 3
Facility Operating License Nos. DPR-19 and DPR-25
NRC Docket Nos. 50-237 and 50-249

Quad Cities Nuclear Power Station, Units 1 and 2
Facility Operating License Nos. DPR-29 and DPR-30
NRC Docket Nos. 50-254 and 50-265

Subject: Additional Information Regarding License Amendment Request for Main Steam Line Low Pressure Isolation Setpoint

Reference: Letter from P. R. Simpson (Exelon Generation Company, LLC) to U. S. NRC, "Request for Amendment to Technical Specifications for Main Steam Line Low Pressure Isolation Function," dated March 28, 2003

In the referenced letter, Exelon Generation Company, LLC (EGC) requested a change to the Facility Operating Licenses listed above regarding the Technical Specifications (TS) for Main Steam Line (MSL) Low Pressure Isolation Function. The proposed change revises the allowable value for the MSL Pressure – Low Function of the Primary Containment Isolation System (PCIS) Instrumentation at Dresden Nuclear Power Station (DNPS), Units 2 and 3, and Quad Cities Nuclear Power Station (QCNPS), Units 1 and 2.

On December 4, 2003, the NRC requested additional information to support review of the referenced letter. The attachments to this letter provide the requested information. Attachments 1 and 2 do not contain General Electric Company (GE) report GENE-0000-0010-4202-01, "Engineering Evaluation of Impact on Transient and Safety Analyses of Reducing the Low Pressure Isolation Setpoint Analytical Limit to 785 psig – Dresden Units 2 & 3 and Quad Cities Units 1 & 2." This document contains proprietary information and was provided to the NRC in the referenced letter.

EGC has reviewed the information supporting a finding of no significant hazards consideration that was previously submitted to the NRC in Attachment 1 of the referenced letter. The bases for concluding that the proposed TS changes do not involve a significant hazards consideration are not affected by the supplemental information provided in Attachments 1 and 2 of this submittal.

A001

Should you have any questions concerning this letter, please contact Mr. Thomas G. Roddey at (630) 657-2811.

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 5th day of December 2003.

Respectfully,

Patrick R. Simpson

Patrick R. Simpson
Manager – Licensing

Attachments: Attachment 1: NED-I-EIC-0097, Revision 5, " Main Steam Line Low Pressure Setpoint Error Analysis, " Dresden Nuclear Power Station

Attachment 2: NED-I-EIC-0033, Revision 4, "Main Steam Line Low Pressure Setpoint Error Analysis," Quad Cities Nuclear Power Station

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Dresden Nuclear Power Station
NRC Senior Resident Inspector – Quad Cities Nuclear Power Station
Illinois Emergency Management Agency — Division of Nuclear Safety

ATTACHMENT 1

NED-I-EIC-0097, Revision 5
Main Steam Line Low Pressure Setpoint Error Analysis
Dresden Nuclear Power Station

Exelon Nuclear

CC-AA-309-1001
Revision 0

ATTACHMENT 1
Design Analysis Cover Sheet

Last Page No. 28

Analysis No.	NED-I-EIC-0097	Revision	5
EC/ECR No.		Revision	
Title:	Main Steam Line Low Pressure Isolation Switch Setpoint Error Analysis		

		Component(s)	
Station(s)	Dresden		
Unit No.:	Units 2 & 3	PS 2-0261-30A	PS 3-0261-30A
Discipline	I	PS 2-0261-30B	PS 3-0261-30B
Description Code/ Keyword	I03 / Setpoint	PS 2-0261-30C	PS 3-0261-30C
Safety Class	Safety Related	PS 2-0261-30D	PS 3-0261-30D
System Code	0261 (MS)		
Structure			

CONTROLLED DOCUMENT REFERENCES

Document No.	From/To	Document No.	From/To

Is this Design Analysis Safeguards?	Yes ☐	No ☒	
Does this Design Analysis Contain Unverified Assumptions?	Yes ☐	No ☒	ATI/AR#
Is a Supplemental Review Required?	Yes ☐	No ☒	If yes, complete Attachment 3

	Print Name	Sign Name	Date
Preparer	Joseph R. Basak	Joseph R. Basak	2/14/03
Reviewer	Dale R. Eaman	Dale Eaman	2-14-03

Method of Review ☒ Detailed Review ☐ Alternate Calculations ☐ Testing

Review Notes:

	Print Name	Sign Name	Date
Approver	Stephen V. Tutich	Stephen V Tutich	2/18/03

(For External Analyses Only)

	Print Name	Sign Name	Date
~~Exelon Reviewer~~			
Approver			

Description of Revision (list affected pages for partials):

Revision 5 determines the calculated setpoint, field calibration setpoint, and allowable value for the Main Steam Line Low Pressure Isolation function based on a reduced Analytical Limit of 785 psig. This revision also incorporates format changes in accordance with CC-AA-309; however, the section headings and numbering from the previous revision are maintained. Changes are identified by revision bar.

THIS DESIGN ANALYSIS SUPERCEDES: NED-I-EIC-0097 Revision 4

DESIGN ANALYSIS NO. NED-I-EIC-0097 **REV:** 04 **PAGE NO.** 2

Revision Summary (including EC's incorporated): This revision completely re-formats the calculation per CC-AA-309, Rev.1, and NES-G-14, Rev. 1. Therefore, no revision bars were used. All attachments were deleted. In addition, it incorporates DCR 990359 (EC 13754), and makes changes to both analyzed M&TE and error values to improve operating margin. Incorporate EC 337551 per R. Brown 6/14/02

Electronic Calculation Data Files: WORD97/0097r4.doc/ 190,464 BYTES/ 06-14-02/ 10:23AM
(Program Name, Version, File Name extension/size/date/hour/min)

Design impact review completed? [ ] Yes [X] N/A, Per EC#: 337551
(If yes, attach impact review sheet)

Prepared by: Christopher Wiegand / [signature] / 6-14-2002
Print Sign Date

Reviewed by: DALE EAMAN / [signature] / 06-14-02
Print Sign Date

Method of Review: [X] Detailed [ ] Alternate [ ] Test

This Design Analysis supersedes: ____________ **in its entirety.**

Supplemental Review Required? [ ] Yes [X] No
[ ] Additional Review [ ] Special Review Team
Additional Reviewer or Special Review Team Leader: ______ / ______ / ______
Print Sign Date
Special Review Team: (N/A for Additional Review)
Reviewers: 1) ______ / ______ / ______ 2) ______ / ______ / ______
Print Sign Date Print Sign Date
3) ______ / ______ / ______ 4) ______ / ______ / ______
Print Sign Date Print Sign Date
Supplemental Review Results:

QA COPY MADE

Approved by: STEVE TUTICH / [signature] / 6/14/02
Print Sign Date

External Design Analysis Review (Attachment 3 Attached)
Reviewed by: ______ / ______ / ______
Print Sign Date
Approved by: ______ / ______ / ______
Print Sign Date

Do any ASSUMPTIONS / ENGINEERING JUDGEMENTS require later verification? [ ] Yes [X] No
Tracked By: AT#, EC# etc.) ______

DESIGN ANALYSIS NO. NED-I-EIC-0097 **REV:** 3 **PAGE NO.** 3

Revision Summary (including EC's incorporated): This revision was made to analyze an increased calibration interval per extended AOT/STI submittal. Deleted Attachment A. Added Attachment C. Revision bars are shown only where content changes, not for re-formatting or re-numbering. Pages revised are: 3, 4, 6–10, 12–20, 22.

Electronic Calculation Data Files:
(Program Name, Version, File Name extension/size/date/hour/min)

Design impact review completed? [ ] Yes [ ] N/A, Per EC#: ______________
(If yes, attach impact review sheet)

Prepared by: J.D. Lee (S&L) / ______________ / 11/12/98
Print / Sign / Date

Reviewed by: A. C. Go (S&L) / ______________ / 11/12/98
Print / Sign / Date

Method of Review: [X] Detailed [ ] Alternate [ ] Test
This Design Analysis supersedes: ____________ **in its entirety.**

Supplemental Review Required? [ ] Yes [X] No
[ ] Additional Review [ ] Special Review Team
Additional Reviewer or Special Review Team Leader: ______ / ______ / ______
Print / Sign / Date
Special Review Team (N/A for Additional Review)
Reviewers: (1) ______ / ______ / ______ (2) ______ / ______ / ______
Print / Sign / Date Print / Sign / Date
(3) ______ / ______ / ______ (4) ______ / ______ / ______
Print / Sign / Date Print / Sign / Date
Supplemental Review Results:

Approved by: ______________ / ______________ / ______________
Print / Sign / Date

External Design Analysis Review (Attachment 3 Attached)
Reviewed by: ______________ / ______________ / ______________
Print / Sign / Date
Approved by:
______________ / ______________ / ______________
Print / Sign / Date

Do any ASSUMPTIONS / ENGINEERING JUDGEMENTS require later verification? [ ] Yes [X] No
Tracked By: AT#, EC# etc.) ______________

DESIGN ANALYSIS NO. NED-I-EIC-0097 **REV:** 2 **PAGE NO.** 4

Revision Summary (including EC's incorporated): This revision determines a new setpoint value based on the new Tech Spec Upgrade LCO. Calculation also includes all errors associated with increasing the surveillance period to quarterly intervals and includes the addition of the Beta Model 320 to the approved M&TE equipment list.

Electronic Calculation Data Files:
(Program Name, Version, File Name extension/size/date/hour/min)

Design impact review completed? [ ] Yes [ ] N/A, Per EC#:________
(If yes, attach impact review sheet)

Prepared by: R. W. Ellen / ________ / 9/15/95
Print Sign Date

Reviewed by: W. D. Crumpacker / ________ / 9/15/95
Print Sign Date

Method of Review: [X] Detailed [ ] Alternate [ ] Test

This Design Analysis supersedes: ________ **in its entirety.**

Supplemental Review Required? [ ] Yes [X] No
[ ] Additional Review [ ] Special Review Team
Additional Reviewer or Special Review Team Leader: ________ / ________ / ________
Print Sign Date
Special Review Team (N/A for Additional Review):
Reviewers: 1) ________ / ________ / ________ 2) ________ / ________ / ________
Print Sign Date Print Sign Date
3) ________ / ________ / ________ 4) ________ / ________ / ________
Print Sign Date Print Sign Date
Supplemental Review Results:

Approved by: ________ / ________ / ________
Print Sign Date

External Design Analysis Review (Attachment 3 Attached)
Reviewed by: ________ / ________ / ________
Print Sign Date
Approved by: ________ / ________ / ________
Print Sign Date

Do any ASSUMPTIONS / ENGINEERING JUDGEMENTS require later verification? [ ] Yes [X] No
Tracked By: AT#, EC# etc.) ________

DESIGN ANALYSIS NO. **NED-I-EIC-0097** **REV: 01** **PAGE NO. 5**

Revision Summary (including EC's incorporated): This revision computes a new setpoint with a larger setting tolerance to decrease the necessity for frequent calibrations while ensuring a positive margin, per Dresden IMD request. Clarified Assumption 16.

Electronic Calculation Data Files:
(Program Name, Version, File Name extension/size/date/hour/min)

Design impact review completed? [ ] Yes [ ] N/A, Per EC#:________
(If yes, attach impact review sheet)

Prepared by: E. A. Kaczmarski / ____________ / 3/5/93
Print Sign Date

Reviewed by: M. S. Banogon / ____________ / 3/8/93
Print Sign Date

Method of Review: [X] Detailed [ ] Alternate [ ] Test

This Design Analysis supersedes: ________ **in its entirety.**

Supplemental Review Required? [ ] Yes [X] No
[ ] Additional Review [ ] Special Review Team
Additional Reviewer or Special Review Team Leader: ____ / ____ / ____
Print Sign Date
Special Review Team: (N/A for Additional Review)
Reviewers: 1) ____ / ____ / ____ 2) ____ / ____ / ____
Print Sign Date Print Sign Date
3) ____ / ____ / ____ 4) ____ / ____ / ____
Print Sign Date Print Sign Date
Supplemental Review Results:

Approved by: ____________ / ____________ / ____________
Print Sign Date

External Design Analysis Review (Attachment 3 Attached)
Reviewed by: ____________ / ____________ / ____________
Print Sign Date **Approved by:**
____________ / ____________ / ____________
Print Sign Date

Do any ASSUMPTIONS / ENGINEERING JUDGEMENTS require later verification? [ ] Yes [X] No
Tracked By: AT#, EC# etc.)____________

REVISION SUMMARY

CALCULATION NO. **NED-I-EIC-0097**

REV: 0 **PAGE NO. 6**

REVISION SUMMARY:

Revision 0, Initial Issue.

Electronic Calculation Data Files:
(Program Name, Version, File Name extension/size/date/hour/min)

Prepared By: E. A. Kaczmarski (Print/Sign/Initial) 9/3/92 Date

Reviewed By: M.S. Banogon (Print/Sign/Initial) 9/30/92 Date

Type of Review: [X] **Detailed** [ ] **Alternate** [ ] **Test** [ ] **Repetitive Calculation**

Supplemental Review Required: [ ] Yes [ ] No
Supervisor:

Do any ASSUMPTIONS / ENGINEERING JUDGMENTS required later verification? [ ] **Yes** [ ] **No**
Tracked By: (AT#, etc.)________________

Exelon Nuclear

CC-AA-309-1001
Revision 0

DESIGN ANALYSIS TABLE OF CONTENTS

ANALYSIS NO. NED-I-EIC-0097	REV. NO. 5	PAGE NO. 7

1.0 Purpose / Objective

The purpose of this calculation is to derive the total error and determine the calculated setpoint, field calibration setpoint, and Technical Specification Allowable Value (Table 3.3.6.1-1, Function 1.b) for the Units 2 and 3 instrumentation loops that perform the Main Steam Line Low Pressure Group I Isolation. The setpoint determination will be evaluated for a quarterly calibration interval and a reduction in the Analytical Limit following the implementation of Extended Power Uprate.

The analysis has evaluated the impact of the time of operation for this function and determined that the environment remains mild for the purposes of instrument accuracy for the period of operation. Therefore, only normal operating environmental conditions are considered.

Finally, this calculation computes Expanded Tolerance (administrative internal as found limit) for the above switches as necessary to support surveillance activities.

This calculation applies to Dresden Instrument Surveillance (DIS) Procedures DIS 0250-02, Main Steam Line Low Pressure Isolation Switch Calibration (Reactor Mode Switch in Run Mode) and DIS 0250-12, Main Steam Line Low Pressure Isolation Switch Calibration (Reactor Mode Switch NOT in Run Mode) for each of the following instruments:

PS-2(3)-0261-30A
PS-2(3)-0261-30B
PS-2(3)-0261-30C
PS-2(3)-0261-30D

2.0 Methodology and Acceptance Criteria

2.1 Basic Methodology

The methodology used for this calculation is that presented in NES-EIC-20.04, "Analysis of Instrument Channel Setpoint Error and Instrument Loop Accuracy", (Ref. 5.1.2). See also Section 3.0 for assumptions and engineering judgement issues.

2.2 Classification Level

Because this is a Tech Spec loop, the Total Error (Z) is evaluated in conformance with a Level 1 Setpoint as defined in Reference 5.1.2, Appendix D, Graded Approach to Determination of Instrument Channel Uncertainty. As a Level 1, this means that the random errors (σ) to a 2σ value are combined via SRSS, and the non-random errors (Σe) are added. The total error is the sum of the random and non-random errors.

$$TE = 2\sigma + \Sigma e$$

2.3 Clarifications to NES-EIC-20.04

2.3.1 Other Environmental Effects

Temperature, ambient pressure and humidity errors, when available from the manufacturer, were evaluated with respect to the conditions specified in the Dresden EQ zones. The EQ zone requirements for each instrument are obtained from the Exelon passport Component Data Sheet location data, Component Classification Binder, and the Dresden EQ Zone maps (Ref. 5.6.1, 5.4.1, & 5.4.3). If these errors are not provided, the EQ zone conditions are analyzed to determine if they are within the manufacturers specified operating conditions. If the environmental conditions are bounded, these error effects are considered to be included in the manufacturer's reference accuracy specification.

2.3.2 Seismic

Seismic effects associated with instrumentation at or below those classified as an OBE are considered negligible. Where the seismic event, which itself is considered a single event from a Licensing viewpoint, is greater than an OBE, then the instrumentation shall be re-calibrated prior to Station operation and therefore are not required to be evaluated in this uncertainty calculation.

2.4 Calculated Setpoint

A calculated setpoint will be determined utilizing the following equations based on Appendix C of Reference 5.1.2 where applicable:

$$SP = AL + (Z + MAR) \quad \text{[lower limit]}$$

where
- SP: is the calculated setpoint
- AL: is the Analytical Limit
- Z: is the total error for the device including all estimated effects
- MAR: is a selected margin used to provide additional conservatism

Note 1: The names of the terms in the generic equations shown above may be modified in accordance with specific device designations.

2.5 Allowable Value

An allowable value will be determined utilizing the following equations based on Appendix C of Reference 5.1.2 as applicable:

$$AV \geq SPc - |Zav^+| \quad \text{[lower limit]}$$
$$AV \leq SPc + |Zav^-| \quad \text{[upper limit]}$$

where
AV: is the allowable value
SPc: is the calculated setpoint
Zav^+, Zav^-: is the total error (positive, negative) for the device during calibration

Note 1: The names of the terms in the generic equations shown above may be modified in accordance with specific loop designations.

Note 2: The errors that are included for the determination of the allowable values (Zav) are only those applicable during calibration. Thus, only errors during normal conditions are included.

Note 3: The Zav is equivalent to the DTI term. See discussion of DTI term below.

2.6 Calibration Tolerance (ST)

The calibration tolerance (or Setting Tolerance, ST) is assumed to describe the limits of the as-left component outputs. For a random error, this corresponds to 100% of the population and can be statistically represented by a 3σ value. Per Reference 5.1.2, the "Setting Tolerance" (ST) is defined as a random error that is due to procedural allowances given to the technician performing the calibration and can be expressed as a 1σ, 2σ, or 3σ value. $ST_{3\sigma}$ = calibration tolerance or setting tolerance.

2.7 Expanded Tolerances (ET)

Expanded tolerances are determined for the device as follows, in keeping with the intent of Reference 5.1.2, Appendix C. See also Reference 5.1.8.

a. $ET = 0.7*(|Zav| - ST) + ST$
b. If any of the tolerances determined using the equation above results in an expanded tolerance (ET) value that is less than the setting tolerance (ST), then ET = ST is specified.

The expanded tolerance is specified as an acceptable tolerance for as-found values. It is expected that the calibration setting tolerance still be utilized as the as-left tolerance.

2.8 Drift Tolerance Interval (DTI)

The Drift Tolerance Interval based on vendor specifications (DTIv) is based upon reference accuracy, calibration error (CAL), setting tolerance (ST) and drift (D). For these switches, the reference accuracy consists only of the Repeatability (RPT) term. The DTIv is used in the determination of the Allowable Values and Extended Tolerances. A formal drift analysis has not been performed for this application of the Barksdale B2T-M12SS-TC pressure switch to derive DTIc. Therefore, DTIv will be used.

2.9 Decimal Precision

Decimal precision is limited to three decimal places. The final results are rounded to the number of decimal places appropriate for the calibration procedure. Error standard deviations or sigma (σ) values are noted in brackets [ ] following the value.

2.10 Acceptance Criteria

The acceptance criteria for this calculation is such that the calibration setpoints associated with the subject instrument loops are set such that they are bounded by the calculated setpoint.

There are no acceptance criteria for the allowable value determination. The allowable value is calculated in accordance with the methodology and the results are provided for use.

The expanded tolerances are determined in accordance with Section 2.6 and are acceptable if the result is greater than or equal to the applicable setting tolerance and do not result in a violation of an applicable limit.

3.0 Assumptions / Engineering Judgments

3.1 Published instrument vendor specifications are considered to be based on sufficiently large samples so that the probability and confidence level meets the 2σ criteria, unless stated otherwise by the vendor.

3.2 For normal error analysis, normal vibrations and seismic effects are considered negligible or capable of being calibrated out in accordance with Appendix I of Reference 5.1.2.

3.3 Head corrections have been evaluated and incorporated in this calculation. Tap and mounting elevations were obtained from separate walkdowns (Reference 5.1.3), or from station drawings (Reference 5.3.3). Head corrections obtained from drawings have not considered installation tolerances. The head correction listed in the DIS procedure has been used for instruments that could not be verified by a walkdown, or where insufficient drawing information was available. Where DIS and walkdown head corrections are available, calculations used head corrections derived from walkdown data. Density corrections have been incorporated into the specific instrument head correction using the minimum ambient temperature for instrument calibration.

3.4 Evaluation of M&TE errors is based on the assumption that the test equipment listed in Section 4 is used. Use of test equipment less accurate than that listed in Section 4 will require evaluation of the effect on the calculation results.

3.5 Per the P&ID drawings (References 5.3.4.1 & 5.3.4.2) the pressure switches tap off of the main steam lines upstream of the Main Turbine Stop valves. The process is saturated steam. The sample lines go up from the steam taps, run horizontally, and drop to the instrument location (References 5.3.3.1 through 5.3.3.4). In the portion of the sample line that drops to the instrument location, steam condenses to form a subcooled water column. As discussed in Section 3.3 above, allowance is made for this head of water. Process measurement errors for normal operating conditions are considered to be accounted for in the establishment of the existing setpoint. Therefore, Process Error is considered to be zero.

4.0 Design Input

4.1 Instrument Channel Configuration - The instrument loop consists of a pressure switch.

4.2 The instrument loop is calibrated quarterly per Reference 5.6.3.

4.3 Loop Element Data - Barksdale Model B2T-M12SS-TC Pressure Switch (Ref 5.6.1)

From Reference 5.7.1

Adjustable Range: 77 psig to 1200 psig (Increasing)
50 psig to 1173 psig (Decreasing)

Reference Accuracy: ± 0.5% Span

Temperature Range: -65 to 165°F (Max. recommended range of pressure media & ambient temperature)

4.4 Local Service Environments

Per References 5.1.3, 5.1.4, 5.3.3, and 5.6.1, the pressure switches are located in panels 2252(3)-1A, in the Turbine Building. The operating conditions that are evaluated are summarized below are based on the above references and References 5.4.2 and 5.4.3.

Panel	2252-1A	2253-1A
Elevation	Between 535'-4" and 536'-8"	
EQ Zone	EQ Zone 30	
	Normal Operating Conditions	Accident Conditions
Ambient Temperature	65°F – 120°F	N/A
Ambient Pressure	14.7 psia	N/A
Humidity	20 to 90% RH	N/A
Radiation	<1.0 x 10^4 RADS (40 years)	N/A

Switch Location: Turbine Bldg. Panel 2252(3)-1A, EQ. Zone 30 (Reference 5.1.3)

PS-2-261-30A	Mounting Elev.	536'8"
PS-3-261-30A	Mounting Elev.	536'6"
PS-2(3)-261-30B	Mounting Elev.	536'6"
PS-2-261-30C	Mounting Elev.	536'7"
PS-3-261-30C	Mounting Elev.	535'4"
PS-2(3)-261-30D	Mounting Elev.	535'4"

4.5 Calibration Procedure Data

Dresden Instrument Calibration Procedure DIS 0250-02 (Ref. 5.2.1) provides the historical information below.

Field Calibration Setpoint (SPf)	Sw. Opens @ 850 psig (Decr.) – includes 5 psig head
Setting Tolerance (ST)	± 10 psig **
Surveillance Interval (SI)	3 months [Ref. 5.6.3 & 5.6.4]
Late Factor (LF)	25% of Calibration Frequency [Ref. 5.6.5]

** Revision 4 of this calculation (NED-I-EIC-0097)

4.6 Analytical Limit (AL)

From Reference 5.5.2, the Analytical Limit for this function is 785 psig.

4.7 M&TE

Based on discussion with Instrument Maintenance department personnel, the normal M&TE used in the calibration of the subject pressure switches is the Honeywell Loveland 2020 System Calibrator with a Fluke 700 series pressure module.

References 5.2.1 and 5.2.2 include three options of M&TE for the calibration of the pressure switches, the Honeywell Loveland 2020 with a Fluke 700 series pressure module (either 1000 or 1500 psig ranges) and the Beta 320.

4.8 M&TE Accurracies

Per reference 5.1.2 equation C.6, RAMTE is the M&TE reference accuracy. Per reference 5.5.1:

Beta 320 (0 –1000 psig)

RAMTE = 1.004988
TEMTE = 0
REMTE = 0 (already included in RAMTE value)

Honeywell Loveland 2020 with Fluke pressure module (0-1500 psig)

RAMTE = 0.388104
TEMTE = 0
REMTE = 0 (already included in RAMTE value)

Honeywell Loveland 2020 with Fluke pressure module (0-1000 psig)

RAMTE = 0.269258
TEMTE = 0
REMTE = 0 (already included in RAMTE value)

The Beta 320 value will be used in calculations because it is the less accurate of the two instruments even though the Honeywell Loveland is the M&TE primarily used in this calibration.

RAMTE = 1.005 (rounded up from 1.004988)

Calibration Standard Errors: In accordance with Reference 5.6.6, the standards used to calibrate the M&TE either meet the 4:1 ratio or the M&TE calibration acceptance tolerance is reduced enough to ensure that the effect of STD is negligible.

STD (from reference 5.1.2) = 0

4.9 Drift Specification

Per Reference 5.1.2, Appendix A, drift is assigned as ±1.0% of Span per refueling interval, up to 30 months. Per Reference 5.6.3, the trip unit calibration interval is 3 months and per Reference 5.1.6 the late factor is 25% of calibration interval.

4.10 Setting Tolerance (ST)

As shown in step 4.5 the current setting tolerance is +/- 10 psig. This existing setting tolerance (ST) will be retained.

4.11 Allowable Value (AV)

See Section 6.5.4.

4.12 Normal Operating Throttle Pressure

From Reference 5.5.2, normal operating throttle pressure post EPU is approximately 912 psig.

5.0 References

5.1 METHODOLOGY

5.1.1 ANSI/ISA-S67.04-1994, Setpoints for Nuclear Safety-Related Instrumentation.

5.1.2 NES-EIC-20.04, "Analysis of Instrument Channel Setpoint Error and Instrument Loop Accuracy", Revision 3.

5.1.3 Sargent & Lundy, Main Steam Line Low Pressure Switch Sensing Line Walkdown Drawings, Unit 3, page 1 of 4, dated 10/10/91 and Unit 2, page 1 of 3, dated 1/4/90.

5.1.4 ABB Impell Letter 0591-632-001, Dated July 8, 1992; transmitting "Dresden Head Correction Data Collection Information".

5.1.5 Deleted.

5.1.6 Technical Specification Surveillance Requirement SR 3.0.2, Amendment # 194/188.

5.1.7 ASME Steam tables, 4th Edition.

5.1.8 ComEd document DG99-001245, Improved Technical Specifications (ITS) and 24 month Technical Specifications Project Technical Plan, Revision 2, April 28, 2000

5.2 PROCEDURES

5.2.1 DIS 0250-02, Revision 17, Main Steam Line Low Pressure Isolation Switch Calibration (Reactor Mode Switch in Run Position)

5.2.2 DIS 0250-12, Revision 5, "Main Steam Line Low Pressure Isolation Switch Calibration (Reactor Mode Switch NOT in Run Position)."

5.2.3 CC-AA-309, "Control of Design Analyses", Rev. 003

5.3 DRAWINGS

5.3.1 Dresden Schematic Drawings

5.3.1.1	12E-2501, Sheet 1, Revision AU
5.3.1.2	12E-2501, Sheet 2, Revision AU
5.3.1.3	12E-3501, Sheet 1, Revision AR
5.3.1.4	12E-3501, Sheet 2, Revision AP

5.3.2 Dresden Wiring Diagram Drawings

5.3.2.1	12E-2747A, Revision BJ	12E-3747A, Revision BG
5.3.2.2	12E-2747C, Revision BE	12E-3747C, Revision BF
5.3.2.3	12E-2749A, Revision BP	12E-3749A, Revision BJ
5.3.2.4	12E-2749C, Revision BE	12E-3749C, Revision BA

5.3.3 Dresden Instrument Installation Drawings

5.3.3.1 M-310, Sheet 23, Revision B
5.3.3.2 M-310, Sheet 230, Revision B
5.3.3.3 M-310, Sheet 232, Revision B
5.3.3.4 M-494, Sheet 23, Revision 000

5.3.4 Dresden P&ID Drawings

5.3.4.1 M-12, Sheet 2, Revision ABB
5.3.4.2 M-345, Sheet 2, Revision PV

5.4 ENVIRONMENTAL PARAMETERS

5.4.1 Component Classification Binder # CC-DR017

5.4.2 UFSAR, Section 9.4, Air conditioning, Heating, Cooling, AND Ventilation Systems, Revision 4

5.4.3 Calculation DRE01-0041, Rev. 0, Updated EQ Zone Parameter Tables following Implementation of Extended Power Uprate.

5.5 OTHER EVALUATIONS / CALCULATIONS

5.5.1 DRE98-0047, Rev. 1, Dresden Station Measurement and Test Equipment (M&TE) Accuracy Calculation

5.5.2 GE Nuclear Energy, GENE-0000-0010-4202-01P R0, Class III, January 2003, "Engineering Evaluation of Impact on Transient and Safety Analyses of Reducing the Low Pressure Isolation Setpoint Analytical Limit to 785 psig Dresden Units 2 & 3 and Quad Cities Units 1 & 2"

5.5.3 GE Nuclear Energy, SIL 130, March 31, 1975, "Main Steam Line Low Pressure Isolation Limit Change"

5.6 OTHER STATION DOCUMENTS

5.6.1 Exelon Passport Records

PS 2-261-30A	Rev 004	PS 3-261-30A	Rev 005
PS 2-261-30B	Rev 004	PS 3-261-30B	Rev 005
PS 2-261-30C	Rev 004	PS 3-261-30C	Rev 005
PS 2-261-30D	Rev 004	PS 3-261-30D	Rev 005

5.6.2 Dresden Technical Specification Upgrade, Table 3.2.A-1, Isolation Actuation Requirements, Item 3.c, page 3/4.2-3, Unit 2 – Amendment No. 175 dated 10/01/99 and Unit 3 – Amendment No. 171 dated 10/01/99. (Historical Record)

5.6.3 Dresden Technical Specification Table 3.3.6.1-1, Function 1.b, Amendment # 194/188.

5.6.4 Dresden Technical Specification Surveillance Requirement SR 3.3.6.1.4, Amendment # 194/188.

5.6.5 Dresden Technical Specification Surveillance Requirement SR 3.0.1 Amendment # 194/188.

5.6.6 ComEd Memorandum Doc. ID # 5795530, Calibration Standard Error (STD) analysis in the instrument setpoint and loop accuracy calculations.

5.7 VENDOR DOCUMENTS

5.7.1 Barksdale Bulletin No. 870420-C, 1990

6.0 Calculation / Numerical Analysis

6.1 RANDOM ERROR

6.1.1 Process Error (PE)

From Engineering Judgement 3.5,
PE = 0

6.1.2 Trip Point Repeatability (RPT)

Repeatability (±0.5% of Span) and switch span (50 to 1173 psig) are given in Section 4.3 for this decreasing setpoint. This is a 2σ value. For a span of 1123 psig the accuracy is:

RPT = (±0.5% of span) (span)
= (.005)(1173 psig - 50 psig)
= 5.615 psig [2σ]

Converting to 1σ,
RPT = (5.615/2)
= 2.8075 psig [1σ]

Rounded to 2.808 psig

6.1.3 Drift Error (σD)

Per Section 4.9, drift is assigned as ±1.0% of Span per refueling interval, up to 30 months. Per Section 4.9, the trip unit calibration interval is 3 months and the late factor is 25% of calibration frequency. Therefore,

σD = ± 1.0% * Span
σD = ± 1.0% * (1173 psig – 50 psig) [4.3]
σD = ± 11.23 psig [2σ]

Converting to 1σ
$\sigma D_{1\sigma}$ = (± 11.23 psi) / 2
$\sigma D_{1\sigma}$ = ± 11.23 / 2
$\sigma D_{1\sigma}$ = ± 5.615 psi [1σ]

6.1.4 Calibration Error (CAL)

$CAL = \pm [(RAMTE + TEMTE)^2 + REMTE^2 + STD^2]^{1/2}$
(equation C6 from reference 5.1.2)

Where:

RAMTE = 1.005 psig (Section 4.8)
TEMTE = 0.000 psig (Section 4.8)

REMTE = 0.000 psig (Section 4.8)
STD = 0.000 psig (Section 4.8)

Therefore:

CAL = ±1.005 psig [1σ]

6.1.5 Setting Tolerance (ST)

Per Section 4.5, the existing Setting Tolerance is,

ST = ±10 psig [3σ]

Per Reference 5.1.2, Appendix A, Setting Tolerance is considered to be a 3σ Term. Converting to 1σ:

$ST_{1\sigma} = ST / 3$

$ST_{1\sigma} = \pm 10 \text{ psig} / 3$

$ST_{1\sigma} = \pm 3.333$ [1σ]

6.1.6 Random Input Error (IN)

This is the first and only module. Therefore, there is no random input error.

IN = 0 psig

6.1.7 Determination of Total Random Error (σ)

Utilizing Equation C9 from Reference 5.1.2, total random error is,

$$\sigma = \pm [(PE)^2 + (RPT)^2 + (\sigma D_{1\sigma})^2 + (CAL)^2 + (ST_{1\sigma})^2 + (IN)^2]^{1/2}$$

$$= \pm [(0)^2 + (2.808 \text{ psig})^2 + (5.615 \text{ psig})^2 + (1.005 \text{ psig})^2 + (3.333 \text{ psig})^2 + (0)^2]^{1/2}$$

$$\sigma = \pm 7.179 \text{ psig}$$ [1σ]

6.2 NON RANDOM ERRORS

6.2.1 Humidity Error (eHn)

There are no humidity errors described in the Vendor's specification for the pressure switch. These errors are included in instrument reference accuracy or are negligible.

Therefore,

eHn = 0

6.2.2 Temperature Error (eTn)

The Vendor's specification for the pressure switch gives the maximum recommended range of pressure media & ambient temperature as -65 to 165°F (Step 4.3). The normal operating ambient temperature at the switch location is 65°F to 120°F (Step 4.4), which is within the manufacturer's reference conditions for accuracy. Therefore,

$$eTn = 0$$

6.2.3 Radiation Error (eRn)

There are no radiation errors described in the Vendor's specification for the pressure switch. These errors are considered to be negligible (Appendix I of Reference 5.1.2). Periodic calibration will compensate for any accumulated error. Therefore,

$$eRn = 0$$

6.2.4 Seismic Error (eSn)

Seismic events are not considered under normal operating conditions (Appendix I of Reference 5.1.2 and Section 2.3.2). Therefore,

$$eSn = 0$$

6.2.5 Static Pressure Offset (eSPn)

There are no static pressure offset errors described in the Vendor's specification for the pressure switch. Therefore,

$$eSPn = 0$$

6.2.6 Pressure Error (ePn)

There are no ambient pressure errors described in the Vendor's specification for the pressure switch. These errors are considered to be included in instrument reference accuracy. Note, however, that a head correction is applicable to the instrument's location and that head correction is addressed later in this calculation.

$$ePn = 0$$

6.2.7 eIRn Insulation resistance (eIRn)

Current leakage through insulation is not applicable to these pressure switches, these are simply contacts and this error is not applicable.

$$eIRn = 0$$

6.2.8 Margin (MARn)

For this portion of the calculation, no additional margin is added for conservatism.

$$MARn = 0$$

6.2.9 Power Supply Effects (eVn)

There is no power supply required to operate this instrument, Therefore,

$$eVn = 0$$

6.2.10 Total Non-Random Error (Σe)

Utilizing Equation C9 from Reference 5.1.2, total non-random error is,

$$\Sigma e = \pm [eHn + eTn + eRn + eSn + eSPn + ePn + eIRn + MARn + eVn]$$
$$\Sigma e = \pm [0 + 0 + 0 + 0 + 0 + 0 + 0 + 0 + 0]$$
$$\Sigma e = \pm 0 \text{ psig}$$

6.3 TOTAL ERROR (TEn or Z)

From Section 2.2, total error for normal conditions is,

$$TEn = Z = \pm 2\sigma + \Sigma e \quad [2.2]$$

Where:

$\sigma = \pm 7.179$ psig [6.1.7]
$\Sigma e = \pm 0$ psig [6.2.10]

$$TEn = Z = \pm 2 (7.179 \text{ psig}) + 0 \text{ psig}$$
$$TEn = Z = \pm 14.358 \text{ psig}$$

6.4 INSTRUMENT HEAD CORRECTION (h_{WD})

6.4.1 Walkdown Head Correction

Reference 5.1.3 provides the following data for determination of required head correction.

Instrument # PS-2-261-	**30A**	**30B**	**30C**	**30D**
Mounting Elevation:	536'8"	536'6"	536'7"	535'4"
Penetration Elevation:	541'3"	541'3"	541'3"	541'3"
Process Tap Elevation:	544'6"	544'6"	544'6"	544'6"
Instrument # PS-3-261-	**30A**	**30B**	**30C**	**30D**
Mounting Elevation:	536'6"	536'6"	535'4"	535'4"
Penetration Elevation:	545'0"	545'0"	545'0"	545'0"
Process Tap Elevation:	544'5¼"	544'5¼"	544'5¼"	544'5¼"

6.4.2 Determination of Head Correction

With process tap and instrument mounting in the same environmental location, Walkdown Head Correction (h_{WD}) is determined as follows,

h_{WD} = {(Process Elev – Mounting Elev)(ρ @ 65°F; 1200 psig)}

Per Reference 5.1.7, the density of water (ρ) at 65°F and 1200 psig is 62.5778#/ft^3

Process Tap Elev –Mounting Elev Unit 2

PS-2-261-30A	7'8"	= 92"
PS-2-261-30B	8'0"	= 96"
PS-2-261-30C	7'11"	= 95"
PS-2-261-30D	9'2"	= 110"

Unit 3

PS-3-261-30A, B	7'11¼"	= 95¼"
PS-3-261-30C, D	9'1¼"	= 109¼"

The biggest worst-case distance between process tap location, and mounting elevation location occurs with Instrument # PS-2-261-30D, Therefore, for conservatism, worst-case distances will be used to determine walkdown Head Correction.

Instrument # PS-2-261-30D

Process Elev – Mounting Elev = 544'6" – 535'4" = 110"

h_{WD} = {(110")(62.5778 #/ft^3)(ft^3/1728 in^3)}

= 3.984 psig

For conservatism, this is rounded up to 5 psig. Therefore,

h_{WD} = eP = 5 psig

6.5 SETPOINT ANALYSIS

6.5.1 Analytical Limit (AL)

From Section 4.6,

AL = 785 psig

6.5.2 Analytical Limit with Head Correction (ALc)

Per Section 6.4.2 h_{WD} = 5 psig, Therefore, using AL = 785 psig from Section 6.5.1;

Instrument # PS-2(3)-261-30A, -30B, -30C, -30D

$$AL_C = AL + h_{WD}$$
$$= 785\ \text{psig} + 5\ \text{psig}$$
$$= 790\ \text{psig}$$

6.5.3 Setpoint Calculation, SPc (including Head Correction)

The calculated setpoint (SPc) is determined from the Analytical Limit (AL) and the total error as follows for a decreasing setpoint.

From Section 4.5, the exiting actual instrument (calibrated) setpoint (SPa) = 850 psig.

From Section 6.3, total error (TEn) = ± 14.358 psig.

From Section 6.5.1, Analytical Limit (AL) = 785 psig

From Section 2.4 and Reference 5.1.2, a margin is calculated as 0.5% of span for additional conservatism. The span is 1123 psig (50 to 1173 psig) per Section 4.3. Thus,

MAR = 0.5% * 1123 psig = 5.615 psig

From Section 2.4 and Appendix C of Reference 5.1.2 provides the instructions for calculating an Allowable Value for a decreasing setpoint as:

SPc = AL + TEn + MAR
SPc = 785 psig + 14.358 psig + 5.615 psig
SPc = 804.973 psig (w/o head correction)

Adding the 5 psig Head Correction, h_{WD} from Section 6.4.2, to SPc:

SPc = 804.973 psig + 5 psig
SPc_{HD} = 809.973 psig (w/ head correction)

Based on the calculated setpoint, a conservative calibration setpoint (SPf and SPf_{HC}) will be established as follows (The calibration setpoint SPf_{HC} is conservative with respect to the calculated setpoint SPc_{HD}, provides additional margin to the AV, but does not affect the Expanded Tolerance):

SPf = 810 psig decreasing (without head correction)
SPf_{HC} = 815 psig decreasing (w/ head correction)

6.5.4 Determination of Allowable Value, AV (including Head Correction)

Appendix C of Reference 5.1.2 and Section 2.5 provides the instructions for calculating an Allowable Value for a decreasing setpoint as:

AV = SP – applicable uncertainty

Where:

AV = Allowable Value

SP = Calculated Trip Setpoint (SPc)

applicable uncertainty = a value calculated from the errors and uncertainties that have been determined to affect the trip setpoint at the time of the as found measurement.

As described in Reference 5.1.8, the applicable uncertainty is referred to as the drift tolerance interval (DTI_V). In addition, per Section 2.8, the DTI_V is determined from the combination of Reference Accuracy or Repeatability (RPT), Drift (σD), Setting Tolerance (ST) and Calibration Error (CAL). From Section 6.1 of this calculation, the values of these terms are as follows:

RPT(1σ)	= ±2.808 psig	[6.1.2]
CAL(1σ)	= ±1.005 psig	[6.1.4]
σD(1σ)	= ±5.615 psig	[6.1.3]
ST(1σ)	= ±3.333 psig	[6.1.5]

Per Section 6.1 of this calculation, all four terms used in determining the DTI_V are considered as random terms. Thus, the DTI_V is calculated as follows:

Units 2 and 3

$DTI_V(1\sigma) = \pm[(RPT(1\sigma))^2 + (CAL(1\sigma))^2 + (\sigma D(1\sigma))^2 + (ST(1\sigma))^2]^{1/2}$

$DTI_V(1\sigma) = \pm[(2.808 \text{ psig})^2 + (1.005 \text{ psig})^2 + (5.615 \text{ psig})^2 + (3.333 \text{ psig})^2]^{1/2}$

$DTI_V(1\sigma) = \pm 7.179$ psig [1σ]

$DTI_V(2\sigma) = \pm 2(DTI_V(1\sigma))$
$= \pm 2(7.179 \text{ psig})$
$= \pm 14.358$ psig [2σ]

Therefore, the AV is calculated as follows:

AV $\geq SPc - DTI_V$
AV $\geq$ 804.973 psig – 14.358 psig
AV $\geq$ 790.615 psig

AV $\geq$ 791 psig (rounded for conservatism)

The terms included in the AV determinations above are treated in the same way as they are in the setpoint determination. Therefore, adequate margin exists between the Analytical Limit and the Allowable Value, and no check calculation is required.

Adding Head Correction:

AVc = 791 psig + 5 psig [Section 6.4.2]
AVc = 796 psig (w/ head correction)

6.5.5 Determination of Expanded Tolerance, ET [Administrative As Found Limit] (including Head Correction)

From Section 6.1 and 6.5.4:

$ST(3\sigma) = \pm 10$ psig [6.1]
$ST(2\sigma) = \pm 2(ST(3\sigma)/3)$
$= \pm 2(10/3 \text{ psig})$
$= \pm 6.667$ psig [2σ]
$DTI_V(2\sigma) = \pm 14.358$ psig [2σ]

Per Reference 5.1.8, the Expanded Tolerance for these switches is determined as follows:

$$ET = \pm[0.7 \times (DTI_V(2\sigma) - ST(2\sigma))] + ST(2\sigma)$$
$$= \pm[0.7 \times (14.358 \text{ psig} - 6.667 \text{ psig})] + 6.667 \text{ psig}$$
$$= \pm 12.051 \text{ psig}$$

$$= \pm 12 \text{ psig (rounded for conservatism)}$$

In order to evaluate the computed ET value, two comparisons are made. First the expanded tolerance must exceed the 3σ value of the setting tolerance.

ET (12 psig) > ST (10 psig) [pass]

Secondly, the calculated setpoint, minus the expanded tolerance, must not be less than any applicable limit. The only limit of concern here is the Allowable Value.

$(SPf_{HC} - ET) > AVc$

where:

SPf_{HC} = 815 psig [6.5.3]
ET = 12 psig

AVc = 796 psig [6.5.4]
(815 psig - 12 psig) > 796 psig

803 psig > 796 psig [pass]

Therefore, the computed expanded tolerance is acceptable with respect to the setting tolerance and the ET limit does exceed the Allowable Value. Therefore,

ET = ±12 psig (2σ)

6.5.6 Margin to Normal Operating Throttle Pressure (NOTP)

A Comparison is made between SPf and the normal process pressure. For conservatism, the ~~terms are added algebraically instead of using square root sum of the squares. From 4.12,~~ normal operating throttle pressure (NOTP) post EPU is approximately 912 psig.

SPf + ST + TEn < NOTP
810 psig + 10 psi + 14.358 < 912 psig [Sections 6.5.3, 6.1.5, 6.3, 4.12]
834.358 psig < 912 psig [pass]

GE SIL 130 (Reference 5.5.3) recommends that the nominal setpoint (SPf) be approximately 100 psi less than the turbine inlet pressure and 25 psi above the AL. The proposed setpoint (810 psig) still meets this generic guidance (approx. 100 psi less than 912 psig and 25 psi above 785 psig). Note, post EPU the other numeric values of SIL 130 are no longer applicable to Dresden.

(FINAL)

7.0 Summary and Conclusions

The results summarized below are determined based on a reduction in the Analytical Limit from 825 psig to 785 psig. A License Amendment is required prior to implementation of the revised setpoint requirements.

The results summarized below are applicable for normal operating and anticipated *transient conditions when calibrated with the M&TE specified in Sections 4.7 & 4.8.*

Acceptance Criteria

The acceptance criteria associated with the setpoint are met since the field calibration setpoints are set such that they are bounded by the calculated setpoint and provide margin to the normal operating throttle pressure.

There are no acceptance criteria for the Allowable Value determination. A License Amendment to incorporate the revised Allowable Value into the Technical Specifications is required prior to implementation of the revised field calibration setpoint.

The acceptance criteria associated with the expanded tolerance are met since the expanded tolerance is greater than or equal to the applicable setting tolerance and does not result in violation of an applicable limit.

Calibration Summary

The calibration information used to support the results of this calculation is defined below. In addition, the calibration values and expanded tolerances are identified.

EPN	Parameter	Process Units	Head Corrected Units
2(3)-0261-30A 2(3)-0261-30B 2(3)-0261-30C 2(3)-0261-30D	Analytical Limit (AL)	785 psig	790 psig
	Calculated Allowable Value (AV)	≥ 791 psig	≥ 796 psig
	Calculated Setpoint (SPc)	≥ 804.973 psig	≥ 809.973 psig
	Field Calibration Setpoint Value (SPf)	810 psig	815 psig

Calibration Frequency and Tolerances		
Surveillance Interval	**Setting Tolerance**	**Expanded Tolerance**
3 months	± 10 psig	± 12 psig

Note: An amendment to Dresden Technical Specifications to incorporate the specified Allowable Value is required prior to implementation of the Field Calibration Setpoint.

ATTACHMENT 2

NED-I-EIC-0033, Revision 4
Main Steam Line Low Pressure Setpoint Error Analysis
Quad Cities Nuclear Power Station

Exelon Nuclear

FP8

ATTACHMENT 1
Design Analysis Cover Sheet

CC-AA-309-1001
Revision 0

Last Page No. 24

Analysis No. NED-I-EIC-0033 **Revision** 004
EC/ECR No. NA **Revision** NA
Title: Main Steam Line Low Pressure Setpoint Error Analysis

		Component(s)	
Station(s)	Quad Cities		
Unit No.:	Units 1 & 2	PS 1-0261-30A	PS 2-0261-30A
Discipline	I	PS 1-0261-30B	PS 2-0261-30B
Description Code/ Keyword	I03 / Setpoint	PS 1-0261-30C	PS 2-0261-30C
Safety Class	Safety Related	PS 1-0261-30D	PS 2-0261-30D
System Code	0261		
Structure			

CONTROLLED DOCUMENT REFERENCES

Document No.	From/To	Document No.	From/To
QDC-0261-I-0813			

Is this Design Analysis Safeguards? Yes ☐ No ☒
Does this Design Analysis Contain Unverified Assumptions? Yes ☐ No ☒ ATI/AR#
Is a Supplemental Review Required? Yes ☐ No ☒ If yes, complete Attachment 3

	Print Name	Sign Name	Date
Preparer	Joseph R. Basak	Joseph R. Basak	1/31/03
Reviewer	Brian Edmark	Brian Edmark	1/31/03

Method of Review ☒ Detailed Review ☐ Alternate Calculations ☐ Testing
Review Notes:

	Print Name	Sign Name	Date
Approver	JOE P. TAFT	[signature]	2/20/03

(For External Analyses Only)

	Print Name	Sign Name	Date
Exelon Reviewer		N/A	
Approver	Joseph P. Taft	N/A	

Description of Revision (list affected pages for partials):

Revision 4 determines the calculated setpoint, field calibration setpoint, and allowable value for the Main Steam Line Low Pressure Isolation function based on a reduced Analytical Limit of 785 psig. This revision also incorporates DCR 990502 and format changes in accordance with CC-AA-309; however, the section headings and numbering from the previous revision are maintained. Changes are identified by revision bar.

THIS DESIGN ANALYSIS SUPERCEDES: DCR # 990502 (EC # 30838) AND NED-I-EIC-0033 Revision 003

ATTACHMENT 1
General Review Questions
Page 1 of 1

DESIGN ANALYSIS NO. NED-I-EIC-0233 **REV:** 4

		Yes	No	N/A
1.	Does the design analysis conform to design requirements?	☒	☐	☐
2.	Does the design analysis conform to applicable codes, standards, and regulatory requirements?	☒	☐	☐
3.	Have applicable design and safety limits been identified?	☒	☐	☐
4.	Is the analysis method appropriate?	☒	☐	☐
5.	Are the methods used and recommendations given conservative relative to the design and safety limits?	☒	☐	☐
6.	Are assumptions/Engineering Judgments explained and appropriate?	☒	☐	☐
7.	Have appropriately verified Computer Program and versions been identified, when applicable?	☐	☐	☒
8.	Does the Computer Program conform with the NRC SER or similar document when applicable?	☐	☐	☒
9.	Has the input been correctly incorporated into the design analysis?	☒	☐	☐
10.	Has the input been reviewed by all cognizant design authorities?	☒	☐	☐
11.	Are the analysis outputs and conclusions reasonable compared to the inputs and assumptions?	☒	☐	☐
12.	Are the recommendations/results/conclusions reasonable based on previous experience?	☒	☐	☐
13.	Has a verification of the design analysis been performed by alternate methods?	☐	☒	☐
14.	Has all input data been used correctly and is it traceable?	☒	☐	☐
15.	Has the effect on plant drawings, procedures, databases, and/or plant simulator been addressed?	☒	☐	☐
16.	Has the effect on other systems been addressed?	☐	☐	☒
17.	Have any changes in other controlled documents (e.g. UFSAR, Technical Specifications, COLR, etc.) been identified and tracked?	☒	☐	☐
18.	When applicable, are the analysis results consistent with the proposed license amendment?	☒	☐	☐
19.	Have other documents that have used the calculation as input been reviewed and revised as appropriate?	☐	☐	☒

BJE 1/30/03

Exelon Nuclear

DESIGN ANALYSIS TABLE OF CONTENTS

ANALYSIS NO. NED-I-EIC-0033	REV. NO. 4	PAGE NO. 2
SECTION:	PAGE NO.	SUB-PAGE NO.

1.0 PURPOSE/OBJECTIVE

The purpose of this calculation is to determine the calculated setpoint, Allowable Value, field calibration setpoint, and expanded tolerance for the instrumentation loops that perform the Main Steam Line Low Pressure Group I Isolation function. These instrument loops initiate a Group I Isolation (MSIV closure) in the event of low Main Steam Line (MSL) pressure with the Mode Switch in the RUN position. This is a MSL Break Detection function.

This calculation evaluates the instrument loops associated with pressure switches PS 1(2)-0261-30A, B, C, & D. This evaluation will determine errors associated with normal operating environmental conditions and station selected measurement and test equipment, to ensure compliance with the Quad Cities Technical Specifications. Per Reference 5.19, the switches are required to mitigate the effects of a Main Steam Line Break (MSLB). Because this event does not create a harsh environment for these switches, this calculation evaluates normal plant operating conditions, only.

Determination of total error, calculated setpoint, field calibration setpoint, Allowable Value and Expanded Tolerances is in accordance with References 5.2 and 5.13. This evaluation utilizes a historical drift analysis provided by Reference 5.12. The setpoint determination will be evaluated for a quarterly calibration interval and a reduction in the Analytical Limit following the implementation of Extended Power Uprate. The current Analytical Limit (AL) for the Main Steam Line Low Pressure Isolation is 825 psig (Reference 5.16); however, this calculation determines the setpoint requirements based on a reduced Analytical Limit of 785 psig (Reference 5.21).

2.0 METHODOLOGY AND ACCEPTANCE CRITERIA

This calculation is to evaluate instrument loop errors, during normal operating environmental conditions, using specific maintenance and test equipment (M&TE) selected by Quad Cities Instrument Maintenance (IM) Department, to ensure Tech. Spec. compliance. This calculation applies to Quad Cities Instrument Surveillance (QCIS) Procedure No. 200-15, Main Steam Line Low Pressure Calibration and Functional Test, for each of the following instruments:

- PS 1(2)-0261-30A
- PS 1(2)-0261-30B
- PS 1(2)-0261-30C
- PS 1(2)-0261-30D

2.1 As-Found and As-Left data were analyzed in Reference 5.12 to determine the drift tolerance interval in accordance with Reference 5.13 and Appendix J to Reference 5.2. Instrument drift is evaluated as follows:

- The vendor drift specification (DTIv) is based upon reference accuracy (RA), calibration error (CAL), setting tolerance (ST) and drift (D).
- The calculated drift specification (DTIc) is the calculated drift based on historical As-Found/As-Left data.
- The larger of the two values (DTIv or DTIc) is used in determination of the difference between the Analytical Limit and the Nominal Trip Setpoint.

Historical drift data from Reference 5.12 will be used for the applicable terms included in the uncertainty analysis, in accordance with NES-EIC-20.04, Rev. 1, Appendix J, Section 2.7.

This is a Level 1 Graded Approach Method, and all terms will be expressed in terms of the final desired deviation level of 2σ.

2.2 The calibration tolerance is assumed to describe the limits of the as-left component outputs. For a random error, this corresponds to 100% of the population and can be statistically represented by a 3σ value. Per Reference 5.2, the "Setting Tolerance" (ST) is defined as a random error that is due to procedural allowances given to the technician performing the calibration. For this calculation:

ST = (Calibration Tolerance)* 2 / 3 [2σ]

2.3 The acceptance criteria for this calculation is such that the calibration setpoints associated with the subject instrument loops are bounded by the calculated setpoint.

There are no acceptance criteria for the Allowable Value determination. The Allowable Value is calculated in accordance with the methodology and the results are provided for use.

The expanded tolerances are determined in accordance with Reference 5.13 and are acceptable if the result is greater than or equal to the applicable setting tolerance and do not result in a violation of an applicable limit.

2.4 Derivation of setpoints and Allowable Values for use in the Improved Technical Specification Project was performed in accordance with the methodology of References 5.2 and 5.13, utilizing the drift tolerance intervals for nominal calibration intervals of 3 months. The current surveillance interval is 3 months (Reference 5.17).

2.5 Expanded tolerances will be computed for each switch, based on the methodology within Reference 5.13.

3.0 ASSUMPTIONS/ENGINEERING JUDGEMENTS

3.1 Published instrument and M&TE vendor performance specifications are considered to be 2σ values unless specific information is available to indicate otherwise. The least Significant Digit (LSD) for digital indications is assumed to be a 2σ value.

3.2 Temperature, humidity and pressure errors have been incorporated when provided by the manufacturer. Otherwise, these errors are assumed to be included in the manufacturer's reference accuracy specification.

3.3 The only temperature induced M&TE errors that were evaluated were those specified by the manufacturer for a specific model number. This methodology used the most conservative error evaluation by considering the full range of ambient temperature change as specified for the applicable EQ zone.

3.4 Radiation induced errors associated with normal environments have been incorporated when provided by the manufacturer. Otherwise, these errors are assumed to be small and capable of being adjusted out each time the instrument is calibrated.

3.5 Instrument sensing lines are assumed to be cold and dead-ended. As such, process fluid temperature in contact with the instrument is assumed to be ambient temperature.

3.6 It is assumed that the M&TE listed in Section 9.0 is calibrated to required manufacturer's recommendations and within the manufacturer's required environmental conditions. Temperature related errors are based on the difference between the manufacturer's specific calibration temperature and the worst case temperature at the device is used.

3.7 Based on Assumption 3.6, it is assumed that the calibration standard accuracy error of primary calibration equipment is negligible with respect to other error terms.

3.8 Evaluation of M&TE errors is based on the assumption that the test equipment listed in Section 9.0 is used. Use of test equipment less accurate than that listed will require evaluation of the effect on calculation results.

3.9 Deleted

3.10 For events at or below an OBE, seismic effects on instrumentation are considered negligible, unless specific Equipment Qualification testing provides results to the contrary. Where the seismic event, which itself is considered the single event from a Licensing viewpoint, is greater than an OBE, then the instrument shall be recalibrated prior to Station operation. Therefore, seismic effects are not evaluated in this uncertainty calculation.

3.11 Deleted

4.0 DESIGN INPUTS

4.1 Reference 5.12 states that the bounding 115-day drift tolerance interval for the Barksdale Model B2T-A12SS/B2T-M12SS-TC pressure switch has been determined to be a random ±16.8 psig, with no bias term. This drift was conservatively treated as time dependent and the random portion is conservatively treated as normally distributed. The random term is considered to be a 2σ value.

4.2 Only normal environmental conditions have been considered unless specifically identified. Temperature, radiation and humidity errors, when available from the manufacturer, were evaluated with respect to the normal conditions specified in the Quad Cities EQ zones. Instrument location was obtained from the CECo Instrument Database (EWCS) (Reference 5.6). Locations were then correlated to EQ zones and application environments were determined using the Quad Cities Enviornmental Zone Maps (Reference 5.10.a and 5.10.b). Seismic Effects are not included in this evaluation, as discussed in Section 3.10.

4.3 Head corrections have been evaluated and incorporated in this calculation. Elevations were obtained from separate walkdowns or station drawings. Head corrections obtained from drawings have not considered installation tolerances. Density corrections have been incorporated using the most limiting temperature for the area of concern.

4.4 Instrument reference accuracy is obtained from published manufacturer's specifications (Reference 5.4).

4.5 Deleted

4.6 Deleted

4.7 Calibration Tolerance was obtained from the associated QCIS calibration data sheet.

4.8 Deleted

4.9 The Analytical Limit (AL) for the Main Steam Line Low Pressure Isolation is 785 psig per Reference 5.21 (previously 825 psig per Reference 5.16). This is the process requirement and does not include calibration requirements, i.e., head correction.

4.10 The minimum temperature experienced by the switches and instrument tubing routed throughout the Turbine Building is 65°F (Reference 5.15).

4.11 Per Reference 5.17, the switches are calibrated on a 3-month calibration cycle.

4.12 Per Attachment B, Druck Incorporated has indicated that the temperature effect of the Druck DPI 601 (±0.006% of reading/°F) applies up to a maximum temperature of 122°F.

5.0 REFERENCES

5.1 ANSI/ISA-S67.04-1988, Setpoints for Nuclear Safety Related Instrumentation.

5.2 NES EIC-20.04 Revision 3, Analysis of Instrument Channel Setpoint Error and Instrument Loop Accuracy

5.3 Quad Cities Instrument Surveillance Procedures for Main Steam Line Low Pressure Calibration and Functional Test:

Unit 1 Division I	QCIS 0200-15 Revision 011
Unit 1 Division II	QCIS 0200-59 Revision 001
Unit 2 Division I	QCIS 0200-60, Revision 001
Unit 2 Division II	QCIS 0200-61, Revision 001

5.4 Barksdale Bulletin No. S870420-N, 1997, (VETI Binder C0007, Barksdale Pressure Switches).

5.5 Deleted

5.6 Quad Cities Passport Data Records

PS 1-0261-30A, Revision 003	PS 2-0261-30A, Revision 002
PS 1-0261-30B, Revision 003	PS 2-0261-30B, Revision 002
PS 1-0261-30C, Revision 002	PS 2-0261-30C, Revision 002
PS 1-0261-30D, Revision 002	PS 2-0261-30D, Revision 002

5.7 NED-I-EIC-0255, Measurement and Test Equipment (M&TE) Accuracy Calculation for Use with Commonwealth Edison Company Boiling Water Reactors, Rev. 0, April 14, 1994

5.8 Deleted

5.9 ABB Impell Letter 0591-449-001, (Dated 3-20-91); Head Correction Determination

5.10 Quad Cities Environmental Zone Maps

a. M-4A, Sheet 1, "Environmental Zone Map (Basement Floor Plan) Elevation 554'-0" Figure 1," Revision E
b. M-4A, Sheet 3, "Environmental Zone Map (Mezzanine Floor Plan) Elevation 623'-0" Figure 3," Revision D

5.11 ABB Impell Letter 0059-80012-001, (Dated 06-23-93), Head Correction Determination

5.12 Quad Cities Calculation QDC-0261-I-0813, "Instrument Drift Analysis for Barksdale Model B2T-A12SS/B2T-M12SS-TC [PS-1(2)-0261-30A,B,C,D]," Rev. 0, dated 11/8/99

5.13 ComEd Document No. DG99-001245, Improved Technical Specifications (ITS) and 24-Month Technical Specifications Project Technical Plan, Revision 2, April 28, 2000

5.14 Quad Cities Drawings

a. M-100, "Main Steam Piping Plan and Sections," Rev. N
b. M-101, "Main Steam Piping Plan and Sections," Rev. M
c. 4E-1503A, "Schematic Diagram PCI System Panel 901-15 Trip Logic and Condenser," Rev. AM
d. 4E-1503B, "Schematic Diagram PCI System Panel 901-17 Trip Logic and Condenser," Rev. AU
e. 4E-2503A, Sheet 1, "Schematic Diagram PCI System Panel 902-15 Trip Logic and Condenser," Rev. AD
f. 4E-2503A, Sheet 2, "Schematic Diagram PCI System Panel 902-15 Trip Logic and Condenser," Rev. AE
g. 4E-2503B, Sheet 1, "Schematic Diagram PCI System Panel 902-17 Trip Logic," Rev. AE
h. 4E-2503B, Sheet 2, "Schematic Diagram PCI System Panel 902-17 Trip Logic," Rev. AK

5.15 Quad Cities Station UFSAR, Section 9.4.4.1, Turbine Building Area Ventilation System, Design Basis, Rev. 5

5.16 NDIT NFM0000026, Seq. 00, "Expanded List of Analytical Limits for Specified Instrument Functions," dated 1/31/00 (HISTORICAL REFERENCE)

5.17 Quad Cities 1 and 2 Technical Specifications through Amendment No. 210/204, Table 3.3.6.1-1 Primary Containment Isolation Instrumentation

5.18 Crane's Flow of Fluids Through Valves, Fittings and Pipe Technical Paper No. 410, 1988

5.19 Specification 13524-103-N001, "Environmental Qualification Specification for Electrical Equipment in Response to IE Bulletin 79-01B/10CFR50.49 for Quad Cities Nuclear Power Station, Units 1 and 2," Rev. 0

5.20 ComEd letter, Document Number DG00-000175, "Use Of ComEd Default Drift Values For Instrument Drift Effects," from Thomas B. Thorsell, dated 2/15/2000

5.21 GENE-000-0010-4202-01P R0, Class III, January 2003, GE Nuclear Energy "Engineering Evaluation of Impact on Transient and safety Analyses of Reducing the Low Pressure Isolation Setpoint Analytical Limit to 785 psig Dresden Units 2 & 3 and Quad Cities Units 1 & 2"

6.0 INSTRUMENT CHANNEL CONFIGURATION

6.1 There are four instrument channels per unit, each consisting of a single pressure switch. Applicable EPN's include the following:

PS 1(2)-0261-30A
PS 1(2)-0261-30B
PS 1(2)-0261-30C
PS 1(2)-0261-30D

5.13 ComEd Document No. DG99-001245, Improved Technical Specifications (ITS) and 24-Month Technical Specifications Project Technical Plan, Revision 2, April 28, 2000

5.14 Quad Cities Drawings

a. M-100, "Main Steam Piping Plan and Sections," Rev. N
b. M-101, "Main Steam Piping Plan and Sections," Rev. M
c. 4E-1503A, "Schematic Diagram PCI System Panel 901-15 Trip Logic and Condenser," Rev. AM
d. 4E-1503B, "Schematic Diagram PCI System Panel 901-17 Trip Logic and Condenser," Rev. AU
e. 4E-2503A, Sheet 1, "Schematic Diagram PCI System Panel 902-15 Trip Logic and Condenser," Rev. AD
f. 4E-2503A, Sheet 2, "Schematic Diagram PCI System Panel 902-15 Trip Logic and Condenser," Rev. AE
g. 4E-2503B, Sheet 1, "Schematic Diagram PCI System Panel 902-17 Trip Logic," Rev. AE
h. 4E-2503B, Sheet 2, "Schematic Diagram PCI System Panel 902-17 Trip Logic," Rev. AK

5.15 Quad Cities Station UFSAR, Section 9.4.4.1, Turbine Building Area Ventilation System, Design Basis, Rev. 5

5.16 NDIT NFM0000026, Seq. 00, "Expanded List of Analytical Limits for Specified Instrument Functions," dated 1/31/00 (HISTORICAL REFERENCE)

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5.19 Specification 13524-103-N001, "Environmental Qualification Specification for Electrical Equipment in Response to IE Bulletin 79-01B/10CFR50.49 for Quad Cities Nuclear Power Station, Units 1 and 2," Rev. 0

5.20 ComEd letter, Document Number DG00-000175, "Use Of ComEd Default Drift Values For Instrument Drift Effects," from Thomas B. Thorsell, dated 2/15/2000

5.21 GENE-000-0010-4202-01 R0, GE Nuclear Energy "Engineering Evaluation of Impact on Transient and safety Analyses of Reducing the Low Pressure Isolation Setpoint Analytical Limit to 785 psig Dresden Units 2 & 3 and Quad Cities Units 1 & 2"

6.0 INSTRUMENT CHANNEL CONFIGURATION

6.1 There are four instrument channels per unit, each consisting of a single pressure switch. Applicable EPN's include the following:

PS 1(2)-0261-30A
PS 1(2)-0261-30B
PS 1(2)-0261-30C
PS 1(2)-0261-30D

7.0 PROCESS PARAMETERS

7.1 The Instrument Loop provides a Group I Isolation upon sensing low MSL pressure while the Mode Switch is in the RUN position. The switches sense MSL pressure via instrument tubing, filled with water. Per References 5.6, 5.10.b, 5.14.a and 5.14.b, tubing is routed from the process connection in the Steam Tunnel (EQ Zone 25) to instrument racks 2251-1 (Unit 1) and 2-2252-1 (Unit 2) (EQ Zone 26). Because the instrument tubing is static, the fill water temperature is assumed to be at ambient temperature (Section 3.5). The following process parameters exist:

Temperature	65 - 120°F (Section 4.10 and Reference 5.10.b)
Process	Water
Pressure	804 psig (low pressure setpoint form Section 13) to 912 psig (normal MSL pressure per Reference 5.21)

8.0 LOOP ELEMENT DATA

8.1 PS 1-0261-30C and PS 1-0261-30D: Barksdale Model B2T-M12SS-TC (Reference 5.6)

PS 1(2)-0261-30A, PS 1(2)-0261-30B, PS 2-0261-30C and
PS 2-0261-30D: Barksdale Model B2T-A12SS Pressure Switch (Reference 5.6)

From Reference 5.4 and Attachment A:

Adjustable Range:	77-1200 psig (Inc.) 50-1173 psig (Dec.)
Reference Accuracy:	±0.5% of Adjustable Range
Temperature Range:	-65 to 165°F (Max. recommended range of pressure media & ambient temperature)

8.2 Environmental Data for Switch Location

Switch Location	Unit 1(2) Turbine Bldg., 611'6" Elev. Panel 2251-1 (Unit 1 and 2-2252-1 (Unit 2) (Reference 5.6)

From Design Input 4.2, Environmental Zone 26, Normal Operating Conditions, and Sect. 5.10.

Temperature	120°F
Pressure	14.7 PSIA
Radiation	<1.0 x 10^4 Rads (40-Year TID)
Relative Humidity	20 - 90%

9.0 CALIBRATION INSTRUMENT DATA

The following Maintenance and Test Equipment (M&TE) is specified in Reference 5.3. M&TE specifications are obtained from Reference 5.7:

MTE_1 (Analog Pressure Gauge)

Manufacturer	Heise	
Model	CMM	
Range	0-1000 psig	
Calibrated Accuracy (CA)	± 2.0 psig	[2σ]
Minor Division (MD)	1.0 psig	
Temperature Effect (TE)	±(0.1% of Range/5°F) Referenced to 73°F	[2σ]

MTE_2 (Digital Pressure Indicator)

Manufacturer	Druck	
Model	DPI-601	
Range	0-1000 psig	
Reference Accuracy (RA)	±(0.30% of Range)	[2σ]
Indication Accuracy (IA)	±(0.006% of Range)	[2σ]
Resolution (RES)	0.1 psig	
Temperature Effect (TE)	±(0.006% of Reading/°F) 32 to 122°F (per Section 4.12), referenced to 73°F	[2σ]

10.0 CALIBRATION PROCEDURE DATA

Per the Reference 5.3 calibration procedures, the current instrument calibration requirements are as follows:

Instrument Setpoint:	Switch opens @ 854 psig dec. (includes a 6 psig head correction)
Allowable Range:	+-4 psig

During calibration, setpoint of instrument can be verified either by monitoring the switch contacts or by alarm annunciation.

11.0 CALCULATION

From Ref. 5.2, Equation C9, the Total Error (Z) is equal to the sum of the Total Random and Total Non-Random Errors (Note: The switch has an analog input and a discrete output. Therefore, it is classified as a bistable module.)

Equation 11.0:

$$Z = \pm[\sigma_{PE}^2 + \sigma_{RA}^2 + \sigma_D^2 + CAL^2 + ST^2 + \sigma_{IN}^2]^{1/2} \pm [eSP + eP + eV + eT + eH + eR + eS + eIR + MAR]$$

Where all random errors are of the same confidence level and:

Z	=	Accuracy Represented by the Total Uncertainty
σ	=	Random Error
e	=	Bias Error
PE	=	Process Error
RA	=	Reference Accuracy
D	=	Drift
CAL	=	Calibration Error
ST	=	Setting Tolerance
IN	=	Random Input Error(s)
eSP	=	Static Pressure Error
eP	=	Pressure Error
eV	=	Power Supply Error
eT	=	Temperature Error
eH	=	Humidity Error
eR	=	Radiation Error
eS	=	Seismic Error
eIR	=	Error due to current leakage through Insulation Resistance
MAR	=	Margin (included only if applicable)

11.1 Process Error (σ_{PE})

The switches sense Main Steam Line pressure via instrument tubing routed to the Instrument Racks. Tubing is routed in the Turbine Building (TB) from the process connection in the Steam Tunnel down to the switches, located in Instrument Racks 2251-1 (Unit 1) and 2-2252-1 (Unit 2) (References 5.6, 5.14.a and 5.14.b). Per Section 3.5, instrument tubing is static and the fill water temperature is assumed to be at ambient temperature. The process error will be evaluated based on the following sections of the tubing route:

Section 1 - Steam Tunnel. This section includes the route from the process connection to the zone penetration. Per References 5.6, 5.10.b, 5.14.a and 5.14.b, this corresponds to EQ Zone 25, which has a maximum temperature of 120°F. Minimum temperature in the TB is 65°F per Section 4.10. Elevation changes for each switch are summarized, based on references 5.9 and 5.11.

Instrument No.	Proc. Tap Elev.	Penetration Elev.	Delta h (Δh)
PS 1-0261-30A	627'-6"	620'-8"	82"
PS 1-0261-30B	627'-6"	620'-8"	82"
PS 1-0261-30C	627'-6"	620'-8"	82"
PS 1-0261-30D	627'-6"	620'-8"	82"
PS 2-0261-30A	627'-6"	621'-5"	73"
PS 2-0261-30B	627'-6"	621'-6"	72"
PS 2-0261-30C	627'-6"	621'-6"	72"
PS 2-0261-30D	627'-6"	621'-8"	70".

Section 2 - Instrument Racks 2251-1 and 2-2252-1– This section includes the route from the zone penetration to the switch. Per References 5.6 and 5.10.b, this corresponds to EQ Zone 26, which has a maximum temperature of 120°F. Minimum temperature in the TB is 65°F per Section 4.10. Elevation changes for each switch are summarized, based on references 5.9 and 5.11.

Instrument No.	Penetration Elev.	Mounting Elev.	Delta h (Δh)
PS 1-0261-30A	620'-8"	613'-10"	82"
PS 1-0261-30B	620'-8"	613'-10"	82"
PS 1-0261-30C	620'-8"	613'-10"	82"
PS 1-0261-30D	620'-8"	613'-10"	82"
PS 2-0261-30A	621'-5"	614"-4"	85"
PS 2-0261-30B	621'-6"	613'-8"	94"
PS 2-0261-30C	621'-6"	613'-8"	94"
PS 2-0261-30D	621'-8"	613'-8"	96"

Since both sections have the same temperature range, they are evaluated together. Based on the above, the maximum temperature range over which the instruments may be calibrated and operated is 65° to 120°F. Therefore, temperature may decrease or increase by as much as 55°F between calibration and operation.

$$\Delta T_{DEC} = (T_{OP\text{-}MIN} - T_{CAL\text{-}MAX}) = (65°F - 120°F) = -55°F$$

$$\Delta T_{INC} = (T_{OP\text{-}MAX} - T_{CAL\text{-}MIN}) = (120°F - 65°F) = 55°F$$

The change in fill water density is evaluated over these ranges to determine the worst-case magnitude of the process error.

Decreasing Temperature

Per Reference 5.18, density of water at 120°F is approximately 61.7132 lb/ft^3. Density at 65°F is not given directly, but can be approximated by interpolation between 60°F (62.371 lb/ft^3) and 70°F (62.305 lb/ft^3).

$$\rho\ @\ 65°F = (62.305\ lb/ft^3 + 62.371\ lb/ft^3)/2$$
$$= 62.338\ lb/ft^3$$

Process pressure (MSL pressure) has an impact on fluid density, but this affect is considered negligible for this evaluation. Based on the above tables, the maximum height through which this density change can be experienced is -166 inches (relative to the tap point). The effect of changes in water density on the process pressure at which the switch actuates (PE) is calculated for decreasing temperature (from 120° to 65°F) as follows:

$$PE_{DEC} = (\rho_{FINAL} - \rho_{INITIAL}) \times height$$
$$= (62.338\ lb/ft^3 - 61.7132\ lb/ft^3) \times (1\ ft^3/1728\ in^3) \times (-166\ in)$$
$$= -0.060021\ psig$$

Increasing Temperature

Similarly, the effect on the process pressure at which the switch actuates is calculated for increasing temperature (65° to 120°F) as follows:

$$PE_{INC} = (\rho_{FINAL} - \rho_{INITIAL}) \times height$$
$$= (61.7132\ lb/ft^3 - 62.338\ lb/ft^3) \times (1\ ft^3/1728\ in^3) \times (-166\ in)$$
$$= +0.060021\ psig$$

Even for the worst case, the magnitude of the bi-directional error (±0.060021 psig) is negligible compared to other error contributors. Therefore,

$$\sigma_{PE} = 0$$

11.2 Reference Accuracy (σ_{RA})

$$\sigma_{RA} = \text{Reference Accuracy}$$

Substituting values from Section 8.1 for a decreasing parameter:

$$\sigma_{RA} = \pm 0.5\%\ \text{of Adjustable Range}$$
$$= \pm 0.5\%(1173 - 50)\ psig$$
$$= \pm 5.615\ psig \qquad [2\sigma]$$

NOTE: Reference Accuracy will be established per the results of Reference 5.12. Historical drift from the referenced calculation will include this term, thus σ_{RA} will be forced to zero in the final loop accuracy computation.

11.3 Drift (σ_D)

Per Reference 5.20, a drift value of 1%/refueling cycle is assigned to this device. Since this is a default drift value, it is conservatively applied (i.e., even though the drift value is given in terms of "% span/refueling cycle," it is not reduced for a quarterly calibration).

$$\sigma_D = \pm 1\% \text{ span}$$
$$= \pm 1\% \text{ (1173 psig} - \text{50 psig)}$$
$$= \pm 11.23 \text{ psig} \qquad [2\sigma]$$

NOTE: Drift will be established per the results of Reference 5.12. Historical drift from the referenced calculation will include this term, thus σ_D will be forced to zero in the final loop accuracy computation.

11.4 Calibration Error (CAL)

The Calibration Error(CAL) is the sum of the Measurement & Test Equipment (MTE) and the Calibration Standard Error (STD). Hence, from NES-EIC-20.04, Eq. C8, (Ref. 5.2):

$$CAL = \pm[(RAMTE_{IN} + TEMTE_{IN})^2 + REMTE_{IN}^2 + STD_{IN}^2 + (RAMTE_{OUT} + TEMTE_{OUT})^2 + REMTE_{OUT}^2 + STD_{OUT}^2]^{1/2}$$

Where:		
	RAMTE	Reference Accuracy (MTE)
	TEMTE	Temperature Error (MTE)
	REMTE	Reading Error (Analog M&TE)
	IAMTE	Indication Accuracy (REMTE equivalent for Digital MTE)
	STD	Calibration Standard Error

This instrument loop consists of a pressure switch only, with a process analog input, and a digital output. This means that each of the terms: $RAMTE_{OUT}$, $TEMTE_{OUT}$, $REMTE_{OUT}$, and STD_{OUT} are equal to zero.

11.4.1 Measurement and Test Equipment Error (MTE)

The switches are calibrated by applying a test pressure to the switch while measuring the pressure with one of the pressure instruments listed in Section 9.0. The one with the greater uncertainty is used in the Calibration Error computation. A determination of the worst-case M&TE error is performed below.

11.4.1.1 Measurement and Test Equipment Error for the Heise CMM (0-1000 psig range) – MTE_1:

Per Section 8.2, the maximum temperature the switches may experience is 120°F. Per Section 4.10, the minimum temperature experienced by the switches is 65°F. Therefore, the worst-case temperature change is $\Delta T_1 = 120° - 73° = 47°F$. Per Reference 5.7, MTE error for a maximum zone temperature of 120°F with a ΔT of 47°F is:

$$MTE_{1(1\sigma)} = \pm 5.705480 \text{ psig} \qquad [1\sigma]$$

11.4.1.2 Measurement and Test Equipment Error for the Druck DPI-601 (0-1000 psig range) – MTE_2:

Per Reference 5.7:

$$MTE_{(1\sigma)} = \pm[(RA_{(1\sigma)} + IA_{(1\sigma)} + TE_{(1\sigma)})^2 + RES^2]^{1/2}$$

Where

RA = Reference accuracy
IA = Indication accuracy
TE = Temperature effect
RES = Resolution

From the data in Section 9.0,

$$RAMTE_2 = \pm 0.30\% \text{ Range} = (\pm 0.0030)(1000 - 0 \text{ psig}) = \pm 3.0 \text{ psig} \qquad [2\sigma]$$

$$IAMTE_2 = \pm 0.006\% \text{ Range} = (\pm 0.00006)(1000 - 0 \text{ psig}) = \pm 0.060 \text{ psig} \qquad [2\sigma]$$

Reference 5.7 evaluates the Druck temperature effect over a range of 32° to 104°F, referenced to 73°F. Attachment B states that the temperature effect is actually valid for temperatures up to 122°F. Per Section 8.2, the maximum temperature the switches may experience is 120°F. Per Section 4.10, the minimum temperature experienced by the switches is 65°F. Therefore, the worst-case temperature change is $\Delta T_2 = 120° - 73° = 47°F$.

Conservatively, evaluating the temperature effect at the upper limit of the current setpoint acceptance criteria (Section 10.0):

$$TEMTE_2 = \pm(0.006\% \text{ of reading/°F}) \times \Delta T_2 = \pm[(0.00006)(858 \text{ psig})/°F][47°F] = \pm 2.419560 \text{ psig} \qquad [2\sigma]$$

$$RESMTE_2 = 0.1 \text{ psig}$$

Converting to 1σ values:

$RAMTE_{2(1\sigma)}$ = (±3.0 psig) x 0.5
= ±1.5 psig [1σ]

$IAMTE_{2(1\sigma)}$ = (±0.060 psig) x 0.5
= ±0.030 psig [1σ]

$TEMTE_{2(1\sigma)}$ = (±2.419560 psig) x 0.5
= ±1.209780 psig [1σ]

Substituting and solving for MTE_2:

$$MTE_{2(1\sigma)} = \pm[(RAMTE_{2(1\sigma)} + IAMTE_{2(1\sigma)} + TEMTE_{2(1\sigma)})^2 + RESMTE_2^{\,2}]^{1/2}$$
$$= \pm[((1.5) + (0.030) + (1.209780))^2 + (0.1)^2]^{1/2} \text{ psig}$$
$$= \pm 2.741604 \text{ psig} \quad [1\sigma]$$

11.4.1.3 Calibration Standard Error, STD

The error due to calibration accuracy of calibration equipment standards is assumed to be negligible (Assumption 3.7). Therefore,

STD = 0 psig

11.4.2 Selection of CAL term

Examining MTE_1 and MTE_2 above, CAL is calculated based on MTE_1, the larger of the two MTE errors:

$$CAL = [(MTE_1)^2 + (STD)^2]^{1/2}$$
$$= [(5.705480 \text{ psig})^2 + (0)^2]^{1/2}$$
$$= \pm 5.705480 \text{ psig} \quad [1\sigma]$$

Converting to a 2σ value

$$= (\pm 5.705480 \text{ psig}) \times 2$$
$$= \pm 11.410960 \text{ psig} \quad [2\sigma]$$

NOTE: CAL will be established per the results of Reference 5.12. Historical drift from the referenced calculation will include this term, thus CAL will be forced to zero in the final loop accuracy computation.

11.5 Setting Tolerance, ST

Per Section 10.0, the Calibration Tolerance is ±4 psig, therefore:

$$ST = \pm 4 * 2 / 3 = \pm 2.666667 \text{ psig}$$

11.6 Input Error (σ_{IN})

The pressure switches are single devices. They sense Main Steam Line pressure directly and provide contact output upon reaching their setpoint. There is no input error associated with these switches. Therefore:

$$\sigma_{IN} = 0$$

11.7 Static Pressure Offset (eSP)

Static pressure errors do not apply to a pressure switch. Therefore,

$$eSP = 0$$

11.8 Pressure Error (eP)

The pressure switches sense Main Steam Line pressure directly. There is no error associated with changes in process pressure. Therefore:

$$eP = 0$$

11.9 Power Supply Effects (eV)

There is no power supply which may affect the accuracy specification for the pressure switch. Therefore,

$$eV = 0$$

11.10 Temperature Error (eT)

The Vendor's specification for the pressure switch gives the maximum recommended range of pressure media & ambient temperature as -65 to 165°F (Section 8.1). The normal operating ambient temperature at the switch is 65°F to 120°F (Sections 4.10 and 8.2). Therefore, per Assumption 3.5,

$$eT = 0$$

11.11 Humidity Error (eH)

There are no humidity errors described in the Vendor's specification for the pressure switch. These errors are assumed to be included in instrument reference accuracy or are negligible (Assumption 3.2). Therefore,

eH = 0

11.12 Radiation Error (eR)

There are no radiation errors described in the Vendor's specification for the pressure switch. These errors are assumed to be included in instrument drift related errors or are negligible (Assumption 3.4). Therefore,

eR = 0

11.13 Seismic Error (eS)

Seismic effects are not considered in this evaluation per Section 3.10. Therefore,

eS = 0

11.14 Insulation Resistance (eIR)

There is no insulation resistance effect for a pressure switch.

11.15 Margin (MAR)

See Section 12.5.1

12.0 SETPOINT ERROR ANALYSIS

Using the results from Reference 5.12, Section 7.1, the Historical Drift (D) is:

D = ±16.8 psig (115 Days),

And Equation 11.0 (this calculation Section 11.0):

$$Z = \pm[\sigma_{PE}^2 + \sigma_{RA}^2 + \sigma_D^2 + CAL^2 + ST^2 + \sigma_{IN}^2]^{1/2} \pm [eSP + eP + eV + eT + eH + eR + eS + eIR + MAR]$$

We find from Section 11.0 that the value of the random terms σ_{PE} and σ_{IN}, all bias terms ("eX") and MAR are zero. Therefore, the above equation becomes

$$Z = \pm[\sigma_{RA}^2 + \sigma_D^2 + CAL^2 + ST^2]^{1/2}$$

Since the historical drift (Reference 5.12, Section 7.1) is normally distributed and obtained from the measured results of a large number of surveillance tests, the 2σ value of the historical drift (D) includes the terms in the above equation which normally affect a calibration, i.e.:

(1) σ_{RA}, (2) σ_D, (3) CAL, (4) ST

We can therefore replace these terms with the historical drift term , D, as follows:.

$$Z = \pm[D^2]^{1/2}$$

Since D = 16.8 psig (2σ):

$$Z = \pm[16.8^2]^{1/2} \text{ psig}$$

$$= \pm 16.8 \text{ psig} \quad [2\sigma]$$

Where ±16.8 psig is the Total Random Error

Note that Total Random error consists only of historical drift (σ_{RA}, σ_D, CAL and ST). Per reference 5.13, these terms also define Drift Tolerance Interval (DTIc). Therefore,

$$DTIc = \pm 16.8 \text{ psig} \quad [2\sigma]$$

12.1 QCIS Head Correction

From Reference 5.3, Head Correction (h_{QCIS}) = 6 psig

12.2 Walkdown Head Correction

Reference 5.9 provides the following for determination of required head correction for Unit 1 switches:

Instrument	Mounting Elev.	Process Tap Elev.	Delta
PS 1-0261-30A	613'10"	627'06"	164"
PS 1-0261-30B	613'10"	627'06"	164"
PS 1-0261-30C	613'10"	627'06"	164"
PS 1-0261-30D	613'10"	627'06"	164"

Reference 5.11 provides the following for determination of required head correction for Unit 2 switches:

Instrument	Mounting Elev.	Process Tap Elev.	Delta
PS 2-0261-30A	614'04"	627'06"	158"
PS 2-0261-30B	613'08"	627'06"	166"
PS 2-0261-30C	613'08"	627'06"	166"
PS 2-0261-30D	613'08"	627'06"	166"

To determine the worst-case head correction, the minimum temperature in the area of the tube routing must be considered (lowest temperature, highest process density). Since both the process taps and switches are located in the Turbine Building, a minimum temperature of 65°F is used per Section 4.10.

Walkdown head correction (h_{WD}) is calculated as follows:

$$h_{WD} = (\text{delta h}) \times (\rho \text{ @ } 65°\text{F})$$

Per reference 5.18, density of water at 65°F is approximately 62.338 lb/ft^3.

Unit 1

$$\begin{aligned} h_{WD} &= (\text{delta h}) \times (\rho \text{ @ } 65°\text{F}) \\ &= (164 \text{ in}) \times (62.338 \text{ lb/ft}^3) \times (1 \text{ ft}^3/1728 \text{ in}^3) \\ &= 5.916338 \text{ psig} \end{aligned}$$

Note that the QCIS head correction of 6 psig (Section 12.1) is slightly greater, which is conservative for a decreasing limit. Therefore, a head correction of 6 psig is used.

Unit 2

The worst case head correction for Unit 2 is calculated for PS 2-0261-30B, 30C and 30D:

$$\begin{aligned} h_{WD} &= (\text{delta h}) \times (\rho \text{ @ } 65°\text{F}) \\ &= (166 \text{ in}) \times (62.338 \text{ lb/ft}^3) \times (1 \text{ ft}^3/1728 \text{ in}^3) \\ &= 5.988488 \text{ psig} \end{aligned}$$

Note that the QCIS head correction of 6 psig (Section 12.1) is slightly greater, which is conservative for a decreasing limit. Therefore, a head correction of 6 psig is used.

12.3 Calculation of AL with Head Correction (AL_C)

From Section 4.9, the Analytical Limit for Main Steam Line Low Pressure Isolation (not including head correction) is 785 psig.

$$AL_C = AL + \text{Head Correction}$$

As determined previously, the walkdown head correction (h_{WD}) equals the QCIS head correction (h_{QCIS}). Therefore, substituting the value for head correction given in Section 12.1:

$$AL_C = 785 \text{ psig} + 6 \text{ psig} = 791 \text{ psig}$$

12.4 Drift Tolerance Interval Determined from Vendor Specifications and Normal Methods (DTIv)

Per Reference 5.13, Drift Tolerance Interval (DTIv) is determined by combining Reference Accuracy, Drift, Setting Tolerance and Calibration Error. Based on this, the following random error values developed in Section 11.0 will be used in the development of DTIv (rounded to three decimal places):

Random Errors			
Reference Accuracy (σ_{RA})	±5.615 psig	[Section 11.2]	[2σ]
Calibration Error (CAL)	±11.411 psig	[Section 11.4]	[2σ]
Setting Tolerance (ST)	±2.667 psig	[Section 11.5]	[2σ]
Drift (σ_D)	±11.230 psig	[Section 11.3]	[2σ]

Per Reference 5.13, DTIv is calculated as:

$$DTIv = \pm [(\sigma_{RA})^2 + (CAL)^2 + (ST)^2 + (\sigma_D)^2]^{½}$$
$$= \pm [(5.615)^2 + (11.411)^2 + (2.667)^2 + (11.230)^2]^{1/2}$$
$$= \pm 17.175 \text{ psig} \quad [2\sigma]$$

12.5 Setpoint, Allowable Value, and Expanded Tolerance Determination for Improved Technical Specification / 24 Month Cycle Extension Project

12.5.1 Setpoint Determination

Since the DTIv developed in Section 12.4 is greater than DTIc, it is used in the determination of the Nominal Trip Setpoint as described in Section 2.1.

Per Reference 5.2, Calculated Setpoint (SPc) for a decreasing limit is calculated as follows:

$$SPc = AL + (Z + MAR)$$

Total error (Z) is shown in Section 12.0 to consist of the same terms that define drift tolerance interval (DTI). Therefore, DTIv can be substituted directly for total error (Z). As indicated in Section 11.15, additional margin is not required, since As Found and As Left data was analyzed in the determination of DTIc, which is enveloped by DTIv. However, because DTIc and DTIv are relatively close (16.8 psig and 17.175 psig, respectively), an additional margin of 0.5% of span is added to ensure adequate margin between AL and AV.

The following are therefore used in the development of SPc:

AL	= 791 psig (includes head correction)	[Section 12.4]
Z	= DTIv = 17.175 psig	[Section 12.4]
MAR	= 0.5% span	
	= 0.005 x (1173 psig – 50 psig)	[Section 8.1]
	= 5.615 psig	

Substituting:

SPc = AL + (Z + MAR)
= 791 psig + (17.175 psig + 5.615 psig)
= 813.790 psig (includes head correction)

A field calibration setpoint (SP_f) of 814 psig for this decreasing parameter is conservative and therefore acceptable.

12.5.2 Allowable Value (AV) Determination

Per References 5.2 and 5.13, AV for a decreasing setpoint is calculated as follows:

AV = SPc - (DTIc)

Where

SPc	= 813.790 psig (incl. head correction)	[Section 12.5.1]
DTIc	= 16.8 psig	[Section 12.0]

Therefore,

AV = 813.790 psig – 16.8 psig
= 796.990 psig
= 797 psig (rounded conservatively)

The terms included in the AV determination were treated in the same way as they were in the setpoint determination. Therefore, adequate margin exists between the Analytical Limit and the Allowable Value, and no check calculation is required.

12.5.3 Expanded Tolerance (ET) Determination

Per Reference 5.13, ET is calculated as follows:

ET $= \pm[0.7 \times (DTIc - ST)] + ST$
$= \pm[0.7 \times (16.8 \text{ psig} - 2.666667 \text{ psig})] + 2.666667 \text{ psig}$
$= \pm 12.560000 \text{ psig}$
$= \pm 12 \text{ psig}$ (rounded conservatively) [2σ]

13.0 SETPOINT ERROR ANALYSIS CONCLUSIONS

The results summarized below are determined based on a reduction in the Analytical Limit from 825 psig to 785 psig. A License Amendment is required prior to implementation of the revised setpoint requirements.

The results summarized below are applicable for normal operating and anticipated transient conditions when calibrated with the M&TE specified in Sections 4.7 & 4.8.

The calibration information used to support the results of this calculation is defined below. In addition, the calibration values and expanded tolerances are identified.

Calibration Setpoint / Allowable Value:

EPN	Parameter	Process Units	Head Corrected Units
PS 1(2)-0261-30A PS 1(2)-0261-30B PS 1(2)-0261-30C PS 1(2)-0261-30D	Analytical Limit	785 psig	791 psig
	Allowable Value	≥791 psig	≥797 psig
	Calculated Setpoint (nominal)	807.790psig	813.790 psig
	Field Calibration Setpoint (nominal)	808 psig	814 psig

Calibration Frequency, Setting Tolerances and Expanded Tolerances:

	Surveillance Interval	Setting Tolerance (3σ)	Expanded Tolerance (2σ)
Channel Calibration and Functional Test	Quarterly	±4 psig	±12 psig

Note that the Acceptance Criteria described in Section 2.0 of this calculation are satisfied:

- New field calibration setpoint (814 psig) is bounded by the calculated setpoint (813.790 psig, minimum)
- Expanded tolerance (±12 psig) is greater than the setting tolerance (±4 psig) and does not result in a violation of any limit (SP_f - ET ≥ AV)

Note: **An amendment to Quad Cities Technical Specifications to incorporate the specified Allowable Value is required prior to implementation of the Field Calibration Setpoint.**

Attachment A [signature] 1/31/03

April 21, 2000

Peter A. Price (Terran Technologies, Inc.)
for
Rick Sieprawski
Commonwealth Edison
22710 206th Ave. N.
Cordova, Il 61242

Carl Murphy
Barksdale, Inc.
P.O. Box 58843
Los Angeles, CA 90058

Carl,

Attached please find a Record of Conversation outlining our discussion of 3/2/2000. I am including this document in a calculation for the Quad Cities Nuclear Station and need to have your concurrence that the information is correct. I would appreciate it if you could review the document for accuracy and return it to the above address, with your confirmation or corrections/annotations.

Thank you very much for your cooperation in this manner.

[signature]

Peter A. Price

NED-I-EIC-0033 004
CALCULATION NO: ~~DCR990502~~ REV. ~~N/A~~
11/21/03

Attachment A

Record of Conversation

Date: March 2, 2000

From: Peter Price, Terran Technologies, Inc.
To: Carl Murphy, Barksdale Inc. (800-835-1060)

Subject: Barksdale Pressure Switches, B2T

I called Carl to clarify information on Barksdale B2T pressure switches. Specifically, the difference between model numbers B2T-A12SS and B2T-M12SS-TC. Carl stated the following:

Both are bourdon tube actuated switches (B2T).

The difference between the A12SS and M12SS is the DC rating of the contacts. The A12SS is not rated for 125 and 250 VDC. The M12SS is.

The "-TC" suffix designates that the switches have been cycled at temperature. This is a process performed primarily for the nuclear industry to help stabilize the tube.

The Reference Accuracy, Adjustable Range and Temperature Ratings are the same for the two models.

APPROVED AS ISSUED

Barksdale, Inc.
Carl Murphy
Carl Murphy,
Product Sales Specialist

May 1, 2000
Date

PEPP-E FORM

CALCULATION NO: ~~DCR990502~~ NED-I-EIC-0033 REV. ~~N/A~~ 004

1/31/03

Attachment B

Druck Incorporated

Druck

4 Dunham Drive
New Fairfield
CT 06812 USA

Tel: (203) 746-0400
Fax: (203) 746-2494
Telex: 643118

Message No. ______
Date: 11-Dec-98
No. of Pages: 1

To : Richard Siepewski
Company: Commonwealth Edison
Fax number: 309-654-2178 Tel: 309-654-2241 x3835
From: Steven W. Johnson
Subject: DPI 601 Operating Temperature Range
Copies: T. Zielinski, Simon Johnson

Richard,

With regards to our phone conversation, as previously stated to Commonwealth Edison, a thermal performance covers the extended range of 104 to 122°F is 0.006% rdg 1°F.

If you should need any other information, please call me.

Yours sincerely,

Steven W. Johnson
Applications Engineer

SWJ:be

PEPP-E FORM