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S&L Letter No. Q1479E
May 26, 1992
Project No. 8913-73

Commonwealth Edison Company
Quad Cities Station - Unit 2

Second-Level Undervoltage Relay
Setpoint QA Calculation, Revision 1

Mr. M. L. Reed
Electrical/I&C Design Superintendent
Nuclear Engineering Department
Commonwealth Edison Company
1400 Opus Place, Suite 400
Downers Grove, Illinois 60515

Dear Mr. Reed:

Enclosed is a copy of Design Input Transmittal (DIT) QC-EXT-0063-01 which transmits Sargent & Lundy Calculation 8913-73-19-4, Revision 1, dated May 20, 1992, entitled "Calculations for Second-Level Undervoltage Relay Setpoint."

The locations of the calculation purpose, methodology, assumptions, and any engineering judgements are referenced in the enclosed DIT.

As requested, the calculation follows the general guidelines contained in Commonwealth Edison Company (CECo) internal standards for instrument setpoint accuracy TID-E/I&C-20 and TID/I&C-10 in developing the degraded voltage relay setpoint. The scope of this calculation is to determine a degraded voltage relay setpoint based on a Post-LOCA Auxiliary System Voltage Analysis.

As we have discussed, a degraded voltage relay setpoint based on the results of Post-LOCA Steady-State Analysis can only be considered an interim setpoint. The setting does not address the voltage requirements associated with block-motor starting or evaluate possible motor tripping if bus motor voltage dip is low enough to delay motor acceleration.

The setpoints recommended in the calculation are based on minimum acceptable Post-LOCA 4160 V switchgear voltages of 3820 V at

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Bus 24-1. Based on the setpoint error determined in the calculation, the maximum voltage at the 4160-V safety-related switchgear required to reset the relay is about 3928 V or 94.4% of 4160 V. This means that a voltage dip during a motor start or other transient which results in the relay dropping out must recover above the reset point to avoid a spurious trip. Therefore, it is prudent to administratively monitor the voltage at the 4160-V buses as a precaution so that potential voltage concerns can be predicted and concerns can be predicted and corrected prior to actuation of the relay which can result in a unit trip.

If you have any questions, please contact me at (312)269-6246.

Yours very truly,

R. M. Schiavoni
Senior Electrical
Project Engineer

RMS:mco
In duplicate
Enclosure
qdqc2761.ep
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SARGENT & LUNDY ENGINEERS

DESIGN INFORMATION TRANSMITTAL

X	SAFETY-RELATED		NON-SAFETY-RELATED	DIT No. - QC-EXT-0063-01

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To M. L. Reed

CLIENT Commonwealth Edison Company

STATION Quad Cities UNIT(S) 2

PROJECT NO(S) 8913-73

SUBJECT Transmittal of Calculation 8913-73-19-4, Revision 1, Dated May 20, 1992, "Second Level Undervoltage Relay Setpoint."

MODIFICATION OR DESIGN CHANGE NUMBER(S) N/A

PREPARER (PLEASE PRINT NAME)	DIVISION	PREPARER'S SIGNATURE	ISSUE DATE
R. M. Schiavoni	EPED	[signature]	5/26/92

STATUS OF INFORMATION (This information is approved for use. Design information, approved for use, that contains assumptions or is preliminary or requires further verification (review) shall be so identified.)

This information is approved for use. Several assumptions used in the calculation listed below require verification.

This information is provided in accordance with the terms and conditions of the service agreement/contract between Sargent & Lundy (S&L) and its client governing the associated services. With respect to any third party use, S&L does not assume obligation to said third party as to the accuracy, completeness, usefulness, or noninfringing nature of such information.

IDENTIFICATION OF THE SPECIFIC DESIGN INFORMATION TRANSMITTED AND PURPOSE OF ISSUE (List any supporting documents attached to DIT by its title, revision and/or issue date, and total number of pages for each supporting document.)

This DIT transmits to Commonwealth Edison Company (CECo) the following calculation:

Calculation 8913-73-19-4, Revision 1, dated May 20, 1992, "Second Level Undervoltage Relay Setpoint."

The purpose, methodology, and assumptions can be found in the following calculation sections and pages:

Scope/Purpose: Section IV, Page 4
Methodology: Section VIII, Pages 11 and 12
Assumptions and Engineering Judgements: Section VI, Pages 8 and 9
Conclusions/Recommendations: Section X, Page 18

This DIT supersedes DIT No. QC-EXT-0063, issued April 21, 1992, which transmitted Revision 0 of this calculation. The changes made in Revision 1 of this calculation are identified in its Revision Summary.

SOURCE OF INFORMATION

Calc. No. 8913-73-19-4 | 1 5/20/92 (Rev. and/or date) | Report No. N/A | (Rev. and/or date)

Other

DISTRIBUTION See S&L Letter No. Q1479E, Dated May 26, 1992.

Form GQ-3.17.1 Rev. 2

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Project Quad Cities Unit 2, Division II	Reviewed by [signature] Date 5/20/92
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I. REVISION SUMMARY

Rev. 0, First Issue, Pages 1-20

Rev. 1, Pages 1-20

This calculation has been revised to include the latest information contained in new References R and S. Reference R defines a new higher minimum ambient temperature. Reference S defines a new range of temperature rise within the switchgear cubicle which is the relay environment. Consequently, the relay setpoints calculation (Section IX) and conclusions/recommendations (Section X) have been revised. Assumption A.3 in Section VI has been deleted because of the new information contained in Reference R. Other appropriate changes have been made in other parts of this caluclation. These changes are identified by a vertical line in the margin.

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II. METHOD OF REVIEW

QA CALCULATION REVIEW CHECKLIST
TYPE OF CALCULATION

☐ Hand-Prepared Design Calculation Only

☐ Computer-Aided Design Calculation Only

☐ Both hand-Prepared and Computer Aided Design Calculation

FOR HAND-PREPARED DESIGN CALC
(check the appropriate items)

☒ Detailed review of the original calculation.

☐ Review by an alternate, simplified or approximate method of calculation.

☐ Review of a representative sample of repetitive calculations.

☒ Review of the calculation against a similar calculation previously performed.

REVIEWED REV. 1 CHANGE ONLY.

FOR COMPUTER-AIDED DESIGN CALC
(check the appropriate items)

☐ A review to determine if the engineering design and analysis computer program(s) used have been validated and documented and that the calculation, regardless of the program used, contains all the necessary documentation for reconstruction at a later date. (MUST BE PERFORMED)

☐ A review to verify that the computer program is suitable to the problem being analyzed. (MUST BE PERFORMED)

☐ A review to determine if the input data as specified for program execution is consistent with the design input, correctly defines the problem for the computer program algorithm and is sufficiently accurate to produce results within any numerical limitation of the program. (MUST BE PERFORMED)

☐ A review to verify that the results obtained from the program are correct and within stated assumptions and limitations of the program and are consistent with the input. (MUST BE PERFORMED)

☐ Validation documentation for temporary changes to listed programs or developmental programs or unique single application programs shall be reviewed to assure that methods used adequately validate the program for the intended application. (WHERE APPLICABLE)

REVIEWER: [signature] DATE: 5-20-92

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III. TABLE OF CONTENTS

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IV. SCOPE / PURPOSE

The scope and purpose of this calculation is to determine a setpoint for the second-level undervoltage relays at Quad Cities Unit 2 Division II Bus 24-1 based on post LOCA voltage analysis. This setting will be reevaluated based on an expanded scope analysis of the auxiliary power system or a redesign of the second-level undervoltage relay scheme.

The setpoint will consider the setpoint error of the circuit that monitors the voltage at the 4.16 kV safety-related switchgear. The circuit consists of a GE type JVM-3, 4200-120 volt potential transformer (PT) (catalog number 643X94) and an ABB/ITE-27N undervoltage relay (catalog number 411T4375-L-HF-DP).

The calculation is essentially based on the approach adopted in a similar calculation for Dresden Unit 2 (Reference M) and addresses the following topics:

Instrument channel configuration,

Process range and Analytical Limit,

Loop element data,

Calibration instrument data,

Assumptions,

Scaling considerations (PT ratio),

Process errors,

Trip unit errors,

Calibration setpoint and Allowable Value.

V. INPUT DATA

A. Instrument Channel Configuration (per Reference A.1)

The ABB/ITE 27N undervoltage relay trip unit is fed from a 4200-120 volt PT. The 4200 volt side of the PT is connected to two phases of the 4160 volt source at the safety-related switchgear. The trip unit is connected to the 120 volt side of the PT. The trip unit is powered by a 125 volt dc source.

B. Loop Element Data (per Reference A.2, F, G, H, and P)

1. The PT is a GE, type JVM-3, catalog number 643X94, as per Assumption A.6. (See Ref. G).

Voltage ratio:	4200-120
Accuracy class:	0.3 W,X,M,Y
Frequency:	50 Hz, 60 Hz
Thermal Rating:	750 VA @ 30°C Ambient 500 VA @ 55°C Ambient
BIL:	60 kV

2. The trip unit is an ABB/ITE, type 27N undervoltage relay with a Harmonic Filter (catalog number 411T4375-L-HF-DP, Ref. A.2)

Setpoint Ranges

Pickup:	70 V - 110 V
Dropout:	70% - * 99.0% of Pickup
Dropout Delay:	1 - 10 sec.

* Note: Difference between pickup and dropout can be set as low as 0.5%.

Operating Ranges

Control Voltage:	38-58 Vdc (48 Vdc nominal) 100-140 Vdc (125 Vdc nom.)
Temperature:	-20 to +55°C (normal) -30 to +70°C (accident)
Seismic:	6g ZPA
Humidity:	0 to 100% no condensation (Reference O, Section 10.3)
Pressure:	Atmospheric, to 5000 ft
Radiation:	Gamma 100k rads over 40 yrs.

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V. INPUT DATA (cont.)

B. Loop Element Data (cont.)

Repeatability Tolerances

@ const temp & const control volt:	+/-0.1%
for volt. range 100 - 140 Vdc:	+/-0.1%
for temp. range +10 to +40°C:	+/-0.4%
0 to +55°C:	+/-0.75%
-20 to +70°C:	+/-1.50%

The 3 tolerances are cumulative and are considered to be 2(σ) values (see Assumption B.1 and Reference H).

For the tolerance over temperature range, the repeatability effect is linear over the range of 0 to +55°C, as indicated in References H and I.

C. Calibration Instrument Data (per References D and Q)

It is assumed that a Fluke 45 Digital Multimeter will be used for the calibration of the trip unit (see Assumption A.4).

Reference Accuracy:	+/-0.2% + 10 digits
Full Scale:	300 Vac, 5 digits
Minimum Gradation:	0.01 V

D. Calibration Procedure Data

The setting tolerance when setting the trip unit voltage is considered to be 0.2 V or about 0.182% for a setpoint near 110 V. (Refer to Assumption A.1)

V. INPUT DATA (cont.)

E. Station Data

The circuit for the process is located entirely in the Turbine Building in Environment Zone 35 per Reference A.2. The following are the conditions that the circuit will be subject to:

Normal Conditions

Control Voltage Range:	100-140Vdc (see Assumption A.2)
Temperature Range:	+18.33°C - +40°C (see Ref. R)
Humidity Range:	0 - 90%
Radiation Level:	<10k rads over 40 years

Accident Conditions

Control Voltage Range:	100-140Vdc (see Assumption A.2)
Temperature Range:	+18.33°C - +40°C (see Ref. R)
Humidity Range:	0 - 100% non-condensing

As noted in Reference S, the maximum actual temperature inside the cubicle where the relays are installed will be approximately 2.78°C higher than the ambient temperature outside the cubicle. The minimum actual temperature inside the cubicle where the cubicles are installed will be 0.39°C higher than the ambient temperature outside the cubicle. Therefore, the relays will experience temperatures in the range of 18.72°C to 42.78°C.

The relay has already been qualified for humidity variation, seismic events, radiation exposure, and pressure variation as discussed in References A.2, F, and O.

F. Allowable Value of Switchgear Voltage

Based on References E and L and Assumption A.7 the minimum voltage required at the 4160 V safety-related switchgear for adequate auxiliary system performance is :

3820.0 V at 4160 V at Switchgear 24-1 (Div II)

VI. ASSUMPTIONS

A. Assumptions requiring verification

1. The setting tolerance used for setting the trip unit voltage is assumed to be +/-0.2 V, which corresponds to about +/-0.182% for a setpoint expected to be near 110 V.

2. The dc control voltage for the undervoltage relays will be within the relay's acceptable range of 100-140 Vdc during both normal and accident conditions.

3. Deleted.

4. It is assumed that the voltmeter used for setting the relay is a Fluke 45 Digital Multimeter. It is also assumed this voltmeter has been set to a user selected reading rate of 5 (medium) readings per second.

5. It is assumed that the multimeter is calibrated to meet its technical accuracy specifications as identified in the Fluke 45 literature (Reference D). Furthermore, it is assumed that the relay is calibrated at a temperature that is within the range of 21 to 24°C. This assumption is necessary to limit the conservatism in the error due to relay temperature effect to a reasonable level.

6. It is assumed that the PTs on bus 24-1 are the same type and catalog number as the PTs on bus 21. Walkdown data for PTs on bus 21 is provided in Reference N.

VI. ASSUMPTIONS (cont.)

A. Assumptions requiring verification (cont.)

7. The DG HVAC supply fan and RHRS Emergency AHU 2B need not be considered in determining the minimum required 4.16 kV system voltage.

B. Assumptions not requiring verification

1. It is a general practice for vendors to provide device reference accuracy as a 2(σ) value. Therefore, all reference accuracy specifications, unless otherwise noted, are assumed to be 2(σ) values. Thus, the standard deviation, σ, of an instrument's error is one half of the reference accuracy provided by the vendor. (Ref. B, Exhibit B, Page 4 of 7.)

2. The error due to calibration standards is considered negligible.

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VII. ACCEPTANCE CRITERIA

The relay setpoint will be chosen such that the lowest possible voltage for relay operation, considering setpoint error, will be no lower than the Analytical Limit as identified in Section V.F of this calculation:

3820.0 V at 4160 V Switchgear 24-1 (Div II)

VIII. METHODOLOGY

The methodology for determining the setpoints is based on the methods in References B & C. The nomenclature for the relay setpoint terms, such as pickup, dropout, and reset is taken directly from the relay instruction bulletin (Reference P).

A. The error associated with the PT will be established. The error for the PT is classified as a non-random process error and will be based on the accuracy assigned to the PT by the manufacturer. It is not expected that the PT performance will be significantly affected by environmental factors. Therefore, no additional error for the PT will be introduced for environmental factors.

B. The error associated with the second-level undervoltage relay will be established. The following items will be considered in determining the setpoint error as a result of the relay:

   Reference accuracy (defined by the mfr as repeatability at constant temperature and constant control voltage)

   Calibration instrument error (defined by the mfr)

   Temperature effect (defined by the mfr as repeatability over temperature range)

   Control voltage effect (defined by the mfr as repeatability over the allowable dc control power range)

   Relay setting tolerance (see Assumption A.1)

   Reference accuracy, Calibration instrument error, and relay setting tolerance are classified as random errors, and will be combined by the "Square root of the sum of the squares"(SRSS) method.

   Temperature effect and control voltage effect are classified as non-random errors since their variation is linear and their effect can be predicted. (See References H and I)

VIII. METHODOLOGY (cont.)

The following items will be evaluated for their effect on the relays' functional capability:

Seismic error

Humidity error

Pressure error

Radiation error

Drift error

C. The errors identified above will be combined into total error by adding the total random error to the total non-random error (per Reference B, Exhibit F).

All random error values as published by the manufacturer are considered to be a $2^*(\sigma)$ value, or twice the standard deviation (refer to Assumption B.1). When the random errors are combined by the SRSS method, the σ values, or half of the published values, are used. The outcome of the SRSS method is then doubled in accordance with the methodology described in Ref. B, Exhibit F, Page 2 of 4.

All non-random error will be added together by straight addition.

D. The nominal dropout for the undervoltage relay will be determined by adding the total error to the Analytical Limits. No margin will be considered in this calculation since all applicable components in the circuit have been accurately represented.

IX. CALCULATION

A. The PT has a standard published error of +/- 0.3%. Experience has shown that the error is normally smaller than the standard published error. The operating voltage will be lower than the rated voltage of the PT. Therefore, the actual error will be lower than the published error at rated voltage. We expect that the burden on the PT is within the standard test burden of the PT. Therefore, the **maximum** error of +/- 0.3% will be considered in this calculation. PT testing would have to be performed to justify a smaller error. The error contributed by the PT is considered to be a process error since the PT is not a calibrated device. This is classified as a non-random error. (See Assumption A.6.)

B. The error introduced by the second-level undervoltage relay is developed below:

1. Reference accuracy (assumed to be a $2*\sigma$ value):

   Repeatability at constant temperature and constant control voltage is +/-0.1%

   Therefore, σ for reference accuracy is 0.05%

2. Calibration Instrument error (assumed $2*\sigma$ values):

   The reference accuracy at medium sampling rate of a 60 Hz voltage signal is +/-(0.2% of reading + 10 least significant digits). The linear resolution at medium sampling rate on the 300 V range is 0.01 V. Thus, each digit corresponds to 0.01 V. Therefore, the reference accuracy is +/-(0.2% of reading + 10*0.01 V).

   If the relay is set near 110V, then 10*0.01V or 0.1V is equivalent to about 0.091%.

   Thus, the $2*\sigma$ reference accuracy is 0.291%.

   Since the instrument has a digital readout, there is no reading error.

   Also, since the calibration instrument and the relay are calibrated within the allowable range as specified by the calibration instrument manufacturer, there is no temperature effect for the calibration instrument. (See Assumption A.5)

IX. CALCULATION (cont.)

Then the 2*σ calibration error is 0.291%, and σ for the calibration error is 0.146%

3. Temperature effect:

The temperature effect is published as +/-0.75%, and the absolute effect is 1.5% over the temperature range of 0 to +55°C as discussed in section V.B of this calculation. Per References H and I the relay operating voltage increases or decreases approximately at a rate of 0.0273%/°C over the 0 to +55°C temperature range.

The actual pickup and dropout voltages are lower than the setpoint values if the operating temperature is higher than the temperature at which the relay was calibrated.

Similarly, the pickup and dropout voltages are higher than the setpoint value if the operating temperature is lower than the calibration temperature.

Then, for a temperature range of +18.72 to +42.78°C and a relay calibration temperature range of 21 to 24°C (per Assumption A.5), the temperature effect is developed below:

Negative Temperature Effect:

In determining the error due to relay negative temperature effect, it will be considered that the relay is calibrated at a temperature of 24°C (see Assumption A.5). This will provide a conservative reference point from which the temperature effect for the relay can be incorporated into the determination of the maximum dropout of the relay. At 24°C, a larger portion of the error used in the calculation for relay temperature effect will be positive, which will provide a conservative nominal dropout.

Neg. Temp. effect = (24-18.72°C)*0.0273%/°C = 0.144%

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IX. CALCULATION (cont.)

Positive Temperature Effect:

In determining the error due to relay positive temperature effect, it will be considered that the relay is calibrated at a temperature of 21°C (see Assumption A.5). This will provide a conservative reference point from which the temperature effect for the relay can be incorporated into the determination of the nominal dropout of the relay. At 21°C rather than 24°C, a larger portion of the error used in the calculation for relay temperature effect will be negative, which will provide a conservative determination of the relay nominal dropout setpoint.

Pos. Temp. effect = (42.78-21°C)*0.0273%/°C = 0.595%

Thus, the temperature effect is -0.595%/+0.144% This is classified as a non-random error.

4. Control voltage effect is +/-0.1% over the dc control voltage range of 100-140 Vdc. This is classified as a non-random error. (See Ref. P).

5. The Relay setting tolerance is +/-0.182% (per Assumption A.1). This is a random error. Thus, σ for the setting tolerance is 0.091%.

6. By comparison of the acceptable relay conditions provided in Section V.B.2 with the expected station conditions provided in Section V.E, it is evident that no effect on functional capability is introduced as a result of pressure variation or humidity variation.

7. As discussed in Reference A.2, Section 2.7, no effect on functional capability of the relay is introduced as a result of a seismic event since the relay capability envelops the seismic requirement for the relay locations.

8. According to Reference H, no drift error is expected for the relay as long as the relay is calibrated at reasonable intervals.

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IX. CALCULATION (cont.)

C. The random and non-random errors determined above are now combined.

Negative Non-random error = 0.3% (from PT) + 0.595% (from relay temperature effect) + 0.1% (from relay control voltage effect).

Positive Non-random error = 0.3% (from PT) + 0.144% (from relay temperature effect) + 0.1% (from relay control voltage effect).

Negative Non-Random Error = 0.995%
Positive Non-Random Error = 0.544%

Random error is determined by the "Square-root of the Sum of the Squares" method. The random errors include relay reference accuracy, calibration instrument error, and relay setting tolerance.

$$Random\ error = \pm\sqrt{(0.05\%)^2 + (0.146\%)^2 + (0.091\%)^2} = \pm 0.179\%$$

Then the Total Error is calculated using:

Total = Non-Random + 2*Random

Total Negative Error(TNE)=(1.00%+2*0.18%)= 1.36%
Total Positive Error(TPE)=(0.54%+2*0.18%)= 0.90%

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IX. CALCULATION (cont.)

D. The nominal dropout setpoint is then calculated below:

4160 V Swgr 24-1 (Div. II)

Nominal Dropout(DO) = Allowable Limit(AL) + TNE (in % of DO)
= 3820/(1.0-0.0136)
= 3873 V

Nominal Relay Dropout Setpoint = 3873/35
= 110.65 V (rounded to nearest hundredth volt)

(Note : 35 is the PT ratio)

Nominal Pickup = 3873/0.995
= 3892 V

From the nominal dropout, the maximum dropout and pickup voltages can be determined:

Max. Dropout = Nominal Dropout + TPE (in % of DO)
= 3873 * (1.0 + 0.009)
= 3908 V

Max. Pickup = Max. Dropout / (dropout/pickup ratio)
= 3908.0 V / 0.995 = 3928 V

(The Max. Pickup is the relay Max. Reset Voltage)

X. CONCLUSIONS / RECOMMENDATIONS

Based on the methods described in References B & C and the assumptions in section VI., the following is the recommended setting for the Division II second-level undervoltage relay:

4160 V Swgr 24-1 (Div. II)

Nominal Dropout = 110.65 V

Set the Dropout/Pickup Ratio to the maximum published value of 99.5%, the pickup setpoint is calculated:

Nominal Pickup Setpoint = 110.65 V / 0.995 = 111.21 V

The delay setting for the relay was not analyzed in this calculation nor was it intended to be. Thus, the delay of the relay should be set to the same value as previously required per the Quad Cities Unit 2 Technical Specifications (Reference K), which is 7 seconds.

Please utilize the Instruction Bulletin I.B. 7.4.1.7-7, Issue D (Reference P) when setting the relay since the setpoints and setpoint terminology in this calculation are based on this instruction bulletin.

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XI. REFERENCES

A. DIT Number QC-EPED-0558-00, entitled "ITE-27N UV Relay and PT Technical Data (S/D Info.)", dated 5-14-92. The following is included in the DIT:

1. Quad Cities Unit 2 Drawings:

   a. 4E-2301, Sh. 3, Rev. X
   b. 4E-2334, Rev. R
   c. 4E-2346, Sheet 2, Rev. AE

2. Work Request Number MPC Nos. P04-1-91-105 and P04-2-91-105, entitled "Minor Plant Design Change Package for Commonwealth Edison Company, Quad Cities Unit 2, Replacement of Second-level Undervoltage Relays," dated 3-4-92.

3. Information on ITE-27N Relay

B. CECO document Number TID-E/I&C-10, Rev. 0, entitled "Procedure for Analysis of Instrument Channel Setpoint Error and Instrument Loop Accuracy", dated 12-01-91.

C. CECO document Number TID-E/I&C-20, Rev. 0, entitled "Basis for Analysis of Instrument Channel Setpoint Error and Instrument Loop Accuracy", dated 12-01-91.

D. Facsimile from S. Gaconis of CECO-NED to A. Runde of S&L-EAD dated 1-24-91, containing pages 58 and 59 of the 1992 Fluke/Phillips Test & Measurement Catalog.

E. S&L Calculation Number 8913-73-19-1, entitled "Calc. for Minimum Operating Voltage at 4.16 kV Bus 24-1 for Quad Cities 2/II Safety-related Continuous Loads," approved 4-15-92.

F. ABB document number RC-5[illegible]-A, entitled "Equipment Performance Specifications, 27N Undervoltage Relay."

G. Fax from GE dated 4-13-92, providing information on type JVM-3 Potential Transformers.

H. Memorandum of Telephone Conversation between S. Hoats of ABB and A. Runde of S&L concerning ITE-27N relay characteristics, dated 1-23-92.

SARGENT & LUNDY ENGINEERS	Calc. For Second-level Undervoltage Relay Setpoint		Calc. No. 8913-73-19-4
	X Safety-Related	Non-Safety-Related	Rev. 1 Date
			Page 20 of 20

Client Commonwealth Edison Company	Prepared by / Date
Project Quad Cities Unit 2, Division II	Reviewed by / Date
Proj. No. 8913-73 Equip. No.	Approved by / Date

XI. REFERENCES (cont.)

I. Memorandum of Telephone Conversation between C. Downs of ABB and H. Ashrafi of S&L concerning effect of temperature on the ITE-27N relays with Harmonic Filter Units, dated 3-30-92.

J. Deleted.

K. Quad Cities Unit 2 Technical Specification Number DPR-29, Amendment No. 114, Table 3.2-2. This reference indicates the second-level undervoltage relay time delay requirement.

L. Memorandum of Telephone Conversation between S. Gaconis of CECO and W.G. Bloethe of S&L regarding Unit 2/Division II ELMS Degraded Voltage Calculation, dated 4-1-92.

M. S&L Calculation Number 8982-13-19-6, Rev. 1, entitled "Second-level Undervoltage Relay Setpoint," for Dresden Unit 2," approved 1-29-92.

N. Fascimile from S. Witt to J. Wisniewski on PT walkdown data for Quad Cities, 4 kV bus 21, dated 4-3-92.

O. Main Line Engineering Associates (MLEA) Calculation No. MLEA 91-014 for Commonwealth Edison Company, entitled, "Environmental Qualification of Dresden Second Level Undervoltage System and Equipment for RWCU Line break Environmental Conditions," dated 1-23-92.

P. ABB Instruction Bulletin Number I.B. 7.4.1.7-7, Issue D for ITE-27N relays and others.

Q. Summary of Telephone Conversation between R. Gesinger of Fluke and A. K. S. Chaudhary of S&L concerning the error calculation of the Fluke 45 meter, dated 4-13-92.

R. DIT No. QC-EPED-0565-01, "Reactor Building Minimum Temperature," dated 5-13-92.

S. DIT No. BB-EPED-0178, "Undervoltage Relay Accuracy Calculation Input Data," dated 5-7-92. This DIT contains information regarding the actual temperature rise in the switchgear cubicle.